Critical Success Factors to the Inclusion of Climate Considerations in Dutch Road Planning

A Comparative Case Study

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Preface

I remember several years ago I saw the documentary: *An Inconvenient Truth*. At that time, 2006, the issues of global warming and climate change were of limited societal concern. We were all yet to understand the enormous impact climate change would have on our society. Now twelve years later the consequences of global warming are slowly showing. Constantly, weather records are chattered everywhere on the globe. The two month drought in Europe last year showed that in the short term climate change will impact us. The unavoidable impact of climate change on our life inspired me to search for a master thesis project that addressed this issue, which lead to the topic of this master thesis project.

In the last eight months this project has been a central part of my life. After some time I found out that my initial planning was not possible, this lead to the addition of several weeks to my planning, which caused some frustration about the slow pace of the project. Sometimes I felt like the Greek mythical being Sisyphus, pushing a large boulder up a mountain, only to see it crash down again some time later. Every now and then I thought I was nearing the finalisation of the project, and quickly realised I was not. However, now I am. The boulder now reached the top of the mountain, and will stay there. It is a tremendous feeling to have finished this thesis project. While it was an interesting new experience, I am glad that it is behind me. In time most likely only the good memories of this experience will stay with me. One of those good memories is that during this study and writing the thesis report I was helped and supported constantly. For that I owe several people some thanks.

First of all I would like to thank my graduation committee: my first supervisor Dr. Erik Louw for multiple feedback sessions during this project. I am thankful for his critical yet supportive feedback, his insightful comments and his quick adequate response to my emailed questions. Furthermore, I would like to thank Prof. Dr. Willem Korthals Altes and Dr. Jan Anne Annema for their honest and constructive criticism during the committee meetings.

I am thankful to Infram for giving me the opportunity to do my graduation project in cooperation with them. Especially, I would like to thank Bastiaan Kok, my supervisor at Infram. His unfaltering enthusiasm and constant ideas for my project were at times a much needed inspiration. His ability to address the practical use of the project findings, helped me to understand the potential of what I was doing.

Furthermore, I would like to thank my sisters for their constant support during the last months and putting up with me during family weekends, when I was preoccupied with this project. I would like to thank Janneke for the phone call on December 5th, when I had to finish my report for the green-light meeting and did not have any time to enjoy my birthday. I want to thank Corine for the postcard she sent me, that helped me overcome a low-point at the end of November.

Then I would like to thank my mother Geertrui Balkenende-de Leeuw, for supporting me not only during this thesis project but for the 21 years of my education. I am eternally grateful for her believe in my abilities, her ability to put things in perspective which help me realise the really important things in life and of course I would like to thank her for calling me out of bed every now and then.

There is still one person left to thank. Ingeborg, thank you for being there for me in the last eight months. During this time my preoccupation with this thesis project has often impacted our time together (negatively). I am grateful for your understanding, especially when it must have frustrating at times, for instance when earlier made plans were cancelled or postponed. Even so, you kept supporting me and your daily support has helped me through these months. Thank you for distracting me from my project when I needed it and thank you for making the cover page of this report.

Rick Balkenende
January 8th 2019, Delft

Executive summary

Introduction

As the evidence for anthropogenic climate change is piling up, and the effects are becoming more evident, the societal call for a solution increases. Climate change considerations must be embedded in every part of society. To reduce the impact of different parts of society on climate change the Dutch government indicated the road mobility sector as one of five main sectors that need to transit to a climate friendly system. The Ministerie van I&W initiated policies to include climate considerations in road planning, or Planuitwerkingsfase. Dutch road infrastructure projects must include climate considerations into their planning processes to limit the effect of a road on climate change. The central elements in climate considerations are climate mitigation, the reduction of CO_2, the cause of climate change, and climate adaptation, the adjustment of a system to withstand the impacts of climate change.

Inclusion of climate considerations in Dutch road planning is not yet achieved. The problem with introducing and considering climate issues and elements in road planning project is still experienced as troublesome. The current literature lacks research on this inclusion in road planning. Research in related fields, such as water infrastructure management, urban planning and spatial development to the inclusion of climate considerations and related sustainability aspects, establishes eighteen factors contributing to the successful inclusion of those aspects in the planning process. These factors can be approached as critical success factors (CSFs) as articulated by Rockart (1979). CSFs help to identify key areas of an organisation or business that need to be stimulated to achieve success.

The lack of specific research to the inclusion of climate considerations or specifically mitigation and adaptation in road planning creates a knowledge gap in the understanding of climate related transition in road planning. This lack of understanding is felt, as the sector is not able to successfully include climate considerations in the planning process. The findings in literature of related fields result in the identification of eighteen CSFs that potentially influence the road planning system in a similar manner during the inclusion of climate considerations. This thesis aims to identify CSFs that impact the inclusion of climate considerations in the planning process. To that end the following research question is formed:

Research Question: "What critical success factors in the planning process of Dutch MIRT road infrastructure projects affect the inclusion of climate considerations into the project scope?

Research approach

To answer this research question several methods are used. A literature study is used to identify CSFs in road planning and related spatial development and planning fields to the inclusion of climate and sustainability aspects. As touched upon in the introduction, these eighteen CSFs guide this research and create the possibility of embedding the empirical findings of this research in the literature. Furthermore, a literature and documents review of the Dutch road planning process is conducted.

This research uses a comparative case study approach to answer the main research question. Case studies are performed to three Dutch road infrastructure project, belonging to a national infrastructure programme called MIRT (Meerjarenprogramma Infrastructuur, Ruimte en Transport). Three case studies are conducted to Zuidasdok, RijnlandRoute and A16 Rotterdam.

The case studies are performed by analysing a set of twelve obligatory documents and other available spatial planning and tender documents. Furthermore, seven experts, different managers from the planning and tender side of the planning process, are interviewed.

Each case is analysed on seven climate mitigation or climate adaptation elements: *Sustainability & spatial development, Energy & CO_2, Materials & Waste, Water, Air quality, Market & Construction* and *Climate resilience*. The presence of different climate elements is analysed over time and results in a list of fifteen CSFs contributing to the successful inclusion of climate considerations.

Results

The three case studies result in the identification of many small positive and negative factors which are categorised into fifteen overarching CSFs. Table 1 shows the identified overarching factors and CSFs.

Figure 1: Fifteen CSFs that influence the inclusion of climate concerns, identified in Dutch road projects, Zuidasdok, RijnlandRoute and A16 Rotterdam.

1. Information and knowledge in decision-making	9. Early inclusion
2. Inclusion and clarity in project goal and scope	10. Availability of technology
3. Financial feasibility, financial incentives and budget	11. Participation and mind-set stakeholders
4. Participation and mind-set general public	12. Form and restrictions of design requirements
5. Perceptions, misconceptions and cognitive barriers	13. Market inclusion and incentives
6. Political decision-makers, political environment and policies	14. Type of contract
7. Laws and legal standards	15. Time
8. Form, mind-set and priorities of project organisation	

The CSFs and knowledge gained in this research help to establish how CSFs impact inclusion of climate considerations. This knowledge is used to construct a conceptual model of the system. The identified CSFs and the conceptual models help to establish five main problems with the current practice for inclusion of climate considerations in Dutch road planning. (1) The lack of early inclusion of climate considerations in the planning process is identified as main concern. Early inclusion attributes, when correctly embedded, to the inclusion of climate considerations in all the following parts of the project. It becomes an integral part of the planning project. During significant project decisions climate concerns are part of the trade-offs. Later inclusion is impeded by a lack of solution space since climate considerations were not part of earlier decisions. (2) The climate priorities of four main groups of actors: project organisation, political environment, stakeholders and general public are lacking. (3) Related to that are the mind-sets of decision-makers and cognitive problems of these groups. The mind-sets of main decision-makers and influencers are critical to include climate considerations. Currently common misconceptions on the effect of early inclusion of climate concerns obstruct successful inclusion. (4) Another problem is the establishment of climate goals and competition with other project goals and priorities. The (early) inclusion of climate considerations can only be successful when concerns are embedded in goals. Project goals are a requirement for integral inclusion. Currently, projects do not include climate considerations in early project goals, resulting in a lack of consideration of climate. (5). Even if climate concerns are part of the project scope, the concerns need to compete with other project goals (mobility, liveability). The other goals currently outweigh climate goals and as a result climate concerns lose to other priorities during the main project decisions.

Conclusion

Fifteen CSFs are identified in Dutch road projects for the inclusion of climate considerations. The research shows how mind-sets, a lack of knowledge, competing priorities and goals and the lack of climate project goals impact the creation of climate inclusive Dutch road network.

This thesis corroborates findings on CSFs in related disciplines for the field of road planning. The findings of this thesis help project organisations and political decision-makers to better understand the problems in the planning system that need to be overcome to create road project that include climate considerations. From the findings in this research three recommendations for future research are made. (1) Quantitative research to the different relations and impacts of CSFs to the inclusion of climate considerations. A large sample size to specific CSFs can help to strengthen confidence in the identified CSFs. (2) Research to the workings of early inclusion of climate considerations and the workings of establishing climate goals. With regard for both the political and project organisational processes in combination with stakeholders and general public. Research to these processes can shed more light on how to organise early planning projects to stimulate the inclusion of climate considerations. (3) Similar research in other spatial planning contexts, to generalise the findings.

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1. Introduction

1.1 Background

The earth is warming up, the atmosphere is heating up, the ice caps are melting, and desserts are growing. According to 99.94% of scientists the earth is currently warmer than it was 150 years ago as a result of human activity (Powell, 2017). Large scale emissions of CO_2 and GHG (Greenhouse gasses) trap infrared radiation, creating an increasing inflow of energy which results in a warming atmosphere (Kirk-Davidoff, 2017). In the last decades, due to increasing awareness, the need for change was voiced. In the early 2000's the response towards climate change had become intertwined with sustainable development (IPCC, 2001) as it was seen as an effective way to deal with climate issues (Swart, Robinson, & Cohen, 2003). Apart from that, political awareness grew and led to the Paris Agreement of 2015, signed by 195 Governments. Which actively calls for the need for sustainable development as means to solve climate change issues (UN, 2015, p. 6).

1.2 Climate Change in the Dutch Road Planning Context

The five largest sectors of Dutch society are stimulated to transit towards sustainable practices, as part of the Klimaatakkoord. The main goal is the reduction of CO_2 emissions (Ministerie van EZK, n.d.). The mobility sector is one of those sectors and needs to reduce its CO_2 emissions by 10.4 Megatons in 2030. In 2050 a net zero CO_2 emission is required (Ministerie van EZK, 2017).Dutch mobility issues are addressed with MIRT (Meerjarenprogramma Infrastructuur, Ruimte en Transport). The MIRT is a set of projects that deals with mobility issues and spatial development. Which is carried out by national, regional and local partners from both the public and private sectors. The cooperating parties focus on improving mobility and liveability in a sustainable manner (Ministerie van I&M, 2016).

In the last years the focus on sustainability and climate concerns in MIRT increased. MIRT-projects strive to include sustainability as an integral part of the project, meaning sustainable challenges and mobility issues become connected (Ministerie van I&M, 2016a). Two guiding documents were published to help achieve this: First the *Klimaatneutrale & Klimaatbestendige netwerken en projecten* (Ministerie van I&M, 2017) which provides ways to implement mitigation and adaptation measures in the different phases of the planning process. Second *Handreiking Verduurzaming MIRT* (Ministerie van I&W, 2017) which elaborates on different elements of sustainability within MIRT-projects: CO_2 & Energy, Circular economy, Sustainable mobility, Climate adaptation and Health. Mobility issues on land generally require the development of dry infrastructure or roads. New roads or the widening of existing roads is a generally used solution to congested road networks. New roads increase the flow of traffic and mobility. Sustainability is a challenge that must be addressed since MIRT requires the inclusion of sustainability in large road projects. A diversion from traditional solutions such as new asphalt might help to reach innovative sustainable solutions. Developing climate friendly roads is important. Solving mobility issues helps solve congestion and subsequently unnecessary emissions of CO_2. The current use of the Dutch road network is responsible for 21% of the total CO_2 emissions in the Netherlands in 2011. The clear majority of that, around two thirds, is emitted by cars and related infrastructure (PBL, 2012).

A reduction of the impact of Dutch mobility on climate change is an ambition in MIRT. According to consultants at Infram, in the current, it is unclear how to reduce the impact of road projects on climate change. As stated before MIRT stimulates sustainable development of roads as part of solutions to mobility issues. However, in many cases inclusion of the sustainable or climate aspect does not happen. Therefore, the sector can benefit from an increased understanding of the introduction of sustainable climate elements in the planning project. To that end it is necessary to understand what happens in planning phases of Dutch road projects. Meaning to have knowledge of the different areas of the planning processes that influence the inclusion of climate elements. That also means to know what areas must be stimulated, or what problems must be solved to successfully include climate aspects in the project. To that end this thesis aims to reach the following goal:

Practical Goal: *The identification of main problems and potential solutions in the inclusion of climate concerns in Dutch road planning.*

1.3 The Focus of This Study: Planuitwerkingsfase

Dutch road planning projects follow a set of phases as described by Ministerie van I&M (2016a) and RWS (2010). The different phases have specific characteristics that make them interesting for the inclusion of climate concerns. This research is focused on the Planuitwerkingsfase (planning phase).

The Planuitwerkingsfase is considered the middle phase of a Dutch road planning process. Two elements are vital in this phase: (1) The decision has been made to construct a road. (2) The location and characteristics of the road are addressed, designed and tested. The Planuitwerkingsfase results in a Tracébesluit (TB) a legally binding spatial planning decision that establishes the location and form of the road. The Planuitwerkingsfase is the main focus of this thesis since the problem addressed in this thesis is the lack of understanding of inclusion of climate aspects in road planning. That means a project must entail the planning and construction of a road. Secondly, this thesis includes climate concerns in road planning. The Planuitwerkingsfase revolves around elaborating the decision for a road and assessing the most optimal form and location of the road, given the spatial circumstances. The trade-offs made in that assessment and decision for place and form is considered an interesting place to include climate concerns. It is there that climate consideration can become part of the project.

The Verkenningsfase (exploration phase) precedes the Planuitwerkingsfase and leads to a decision in favour or against a road. This phase entails an exploration to potential solutions to the existing congestion problem. That means that the phase does not necessarily results in a decision for a road. The Verkenningsfase would be addressed if this research tried to establish how to include climate concerns in solving congestion problems. The subsequent phase to the Planuitwerkingsfase is the Realisatiefase (realisation phase). This phase is characterised by the translation of the TB of the Planuitwerkingsfase into a detailed road design. This provides possibilities for inclusion of climate concerns. However, the inclusion in this phase is limited by the preceding phase. Therefore, the impact of inclusion of climate concerns is smaller. The Realisatiefase would be addressed if the research focussed on translation of goals and ambitions into specific measures.

In the Netherlands, Rijkswaterstaat (RWS) is the responsible actor for infrastructure projects. RWS is the executive branch of the Ministerie van I&W. Most project teams consist of RWS employees and representatives of local actors. RWS is a large player in this road planning system. However, in this thesis the term, project organisation is used, to show where RWS is part of the system. When RWS is specifically named, the company is meant, not project organisations.

1.4 Scientific Context: Sustainability, Climate Change and Road Planning

The societal problem introduced in §1.1-§1.3 relates to a scientific problem. The scientific background of sustainable development and climate inclusion in road planning is explored through a literature review. The purpose is to identify the problems and knowledge gaps in existing literature.

§1.4.1 discusses sustainability and climate change in road planning. §1.4.2 explores and defines sustainability and climate aspects. §1.4.3 addresses the current understanding of sustainability and climate concerns in road planning, and the critical success factors related to the inclusion of climate concerns in road planning. In §1.5 the findings are discussed and used to create a research question.

1.4.1 Sustainability and Climate Change in Dutch Road Planning

It is unmistakable that the current strive for a sustainable world is rooted in the current unsustainability of the world. In the centre is climate change. With that perspective, sustainability is about slowing down climate change and dealing with its effects. This concept is known as mitigation and adaption and is a key element in MIRT (Ministerie van I&W, 2017). MIRT-projects need to limit the amount of CO_2 or GHG emissions and furthermore, address the effects of climate change. (NAS, 2016)

Elkington's (1997) triple bottom line or People, Planet, Profit (3Ps) breaks down sustainability into an ecological, social and economic part. The Dutch Omgevingswijzer operationalizes the 3Ps in twelve different aspects (themes) of sustainability. The Omgevingswijzer views sustainability as many different aspects that need to work together to create a sustainable design in ecological, social and economic terms. The 3Ps approach to sustainability broadens the sustainability concept and makes it not merely about inclusion of climate aspects, but many other spatial elements. By including these elements sustainability is no longer solely about climate considerations, but more about a comprehensive approach to optimise several spatial elements, to be more attentive to the spatial characteristics of an area, and consequently, increase the durability of a solution.

Sustainability can also be one of four interests in the spatial environment (Hooimeijer, Kroon, & Luttik, 2001). This operationalization of ecological sustainability shows that while sustainability can be supportive of the other three interests (economic, social and cultural), the interests are mostly in conflict with one another. While Hooimeijer et al. (2001) speak of conflict, the MIRT speaks of a Brede Blik or Broad view and of Meekoppelkansen, opportunities through integration of spatial qualities. The different spatial elements are potentially favourable to each other, creating opportunities for integral sustainable design. When there are many aspects of sustainability involved the overarching concept tends to become vague. What sustainability means in road planning projects is varied. Sometimes it is a combination of climate neutrality, with the focus on CO_2 reduction and several health and spatial quality concerns (Puodziukas, Svarpliene, & Braga, 2016).

Meijer, Adriaens, Linden, & Schik (2011) argue that flexibility in urban planning is an important part of success, as building sustainable and durable can be enhanced by flexibility. Busscher, Tillema, & Arts (2015) discuss the new programme-oriented planning approach in dealing with infrastructural planning and development in the Dutch context, of which the MIRT is a typical example. The programs in this emerging approach are more adaptive in reaching their goals. Furthermore, they are more interrelated, creating synergistic effects resulting in satisfying of objectives that go beyond the smaller infrastructural project. Turnheim, et al. (2015) argue that an integrated plan or integrated strategy, similar to the approach of Busscher et al. (2015) is key to reach a desired state of sustainability. This requires the organisation of dialogue between stakeholders, establishing shared concepts and creating operational bridging devices benefits the process (Turnheim, et al., 2015).

This section was about the form of sustainability and climate elements in Dutch road planning. The main findings indicate that sustainability is a broad concept related to 3Ps and addressed as such in most research and in MIRT. The climate element of sustainability is focussed on CO_2 reduction, but also health and spatial quality concerns play a part in sustainability. Lastly, dealing with sustainability is developing the area integrally, with the creation of benefits for multiple stakeholders. It can be concluded that addressing climate concerns in road planning is not approached in isolation but as part of sustainability. That makes climate concerns more depended on other spatial qualities. The literature on Dutch road planning does not discuss how to specifically address climate elements.

1.4.2 Sustainability and climate concerns defined

The previous section saw the use of sustainability and climate concerns in Dutch road planning. It concluded that climate concerns are addressed through sustainability. This section elaborates on the use of sustainability and climate concerns in general and in the field of road planning (not merely the Dutch situation). The aim of this section is to create an understanding of sustainability and climate concerns as used in this thesis. Furthermore, this section aims to identify possible knowledge gaps.

Sustainability

Sustainable development is the limitation of current development by the expected needs of tomorrow (Brundtland, 1987). Sustainability is a long-term view of development and a comprehensive world-view concerned with interconnections of people across space and time. According to IPCC (2001) satisfying present needs causes problems for future generation since current actions to satisfy the needs are causing environmental degradation. The processes concerned with sustainable development

are closely linked with the development of humanity, as argued by IPCC (2001). Through sustainable development, humanity grows as a whole. Regarding needs of all peoples now and in the future. The connection between sustainable development and humanity's place on earth means that sustainable development and planning practices focus on the generation of infrastructure in synergy with nature (Ghosh, 2017). According to (Kakoty, 2018, pp. 3216): *"The emphasis has always been the judicious use of natural capital and the reciprocity between humanity and nature"*. Sustainable development has become synonymous with addressing anthropogenic climate change. Sustainable development, thus the place of man in nature, has become an important part of climate policies. Climate change forms a significant driver for sustainable development (Swart et al. 2003).

As mentioned sustainable development is constructed from the People, Planet, Profit concept of Elkington (1997). Indicators concerned with rating sustainability measure performances in terms of these dimensions (Gibberd, 2017). In the end according to Ghosh (2017) sustainable development is about doing various activities to create environmentally responsive, economically feasible and socially inclusive places for communities.

Two things are concluded from this short section on the use of sustainability: (1) Climate is usually embedded in sustainability. (2) Sustainability is a broad term that usually consists of 3Ps explained by Elkington (1997). This shows that currently, climate measures and concerns require sustainable development, yet sustainable development is an extensive list of aspects and problems, and climate concerns are not necessarily a priority. The definition of Brundtland is considered more fitting as the intergenerational aspect resonates more with climate concerns, since the problem of climate change will strongly impact the chances of future generation to satisfy their needs.

The findings show that the view of sustainability is rooted in the intergenerational definition of Brundtland (1987) and the triple bottom line (3Ps) of Elkington (1997). As mentioned the use of sustainability within these two definitions does not necessarily mean climate concerns are included. It can be concluded that the concept of sustainability is too broad to be used to address climate concerns. Therefore, the focus of this research is narrowed to specific climate concerns. This does not mean sustainability is entirely excluded in this project. As it can provide some insight on the inclusion of climate concerns. It does mean that there is a prime focus on inclusion of climate aspects. It is also concluded that through this wide spread use of sustainability to address climate concerns, the literature on addressing climate concerns, is sparse.

Sustainability in road planning

Similar ideas are present in the context of road planning. Sustainability is about inclusion of all stakeholders and their interests. This connects to the triple bottom line as it focusses on including all social aspects into the decision-making process. The shift from 'now' to 'later' and from 'I' to 'We' stated by Arts (2007), reflects the generational interconnection as mentioned by Brundtland (1987). The inclusive character demands a shift in approach. Road planning should not merely aim at solving a mobility issue and constructing a new road, the approach should strive for integration of road planning with other spatial planning sectors (Heeres, Tillema, & Arts, 2012). This means that road infrastructure projects are aligned with development of the area. This includes the alignment of stakeholders' interests in the decision-making process (Heeres et al. 2012). Sustainability in road planning is about bridging the generations, inclusion of stakeholders and their interests and broadening road construction projects into area-oriented projects. According to Puodziukas et al. (2016) sustainable development serves three main purposes of sustainability: reduce or stabilize harmful impact on climate change, human health and biological diversity. In the case of road planning these three purposes ought to be strived for, while not limiting mobility of people or products.

Again, the strong connection of sustainability with 3Ps is observed. However, the inclusion of stakeholders and the change of approach to road planning are interesting findings. There must be a shift from addressing mobility to addressing mobility without impacting climate. The findings of Puodziukas et al. (2016) show that climate aspects in the form of reduction and stabilisation of climate

impacts can be part of sustainable development in road planning. The findings of this section strengthen the believe that the dominant approach to sustainability is the triple bottom line. However, the findings show that climate concerns, in some cases, are truly part of sustainable development. Furthermore, the importance of the connection with stakeholders, their interests and the broader project area to address climate issues is found.

Climate concerns: Climate Mitigation and Climate Adaptation

The reduction and stabilisation of climate impacts as mentioned by Puodziukas et al. (2016) is in line with the concepts of climate mitigation and climate adaptation. Climate mitigation involves taking measures to reduce the emissions of GHG in the atmosphere (NAS, 2016, p. 8). As a result, the amount of GHG in the atmosphere stagnates or decreases and limits warming off the earth and the consequent climate change. Climate adaptation takes climate change as a given fact and revolves around finding ways to adapt to changes in climate and weather. This means that during development, future climate conditions are considered. Climate adaptation and mitigation are strongly linked. More mitigation measures slow down the increase in global temperature and sea level rise. These measures than grant more time for adaptive measures (IPCC, 2001). Mitigation and adaptation are complementary measures that must be well aligned, since a lot of mitigation without adaptation would result in high impact of climate change. Adaptation without mitigation would be ineffective as well. No mitigation would mean the current emission of GHG continues, enhancing global warming and consequently climate change. Adaptation is purely dealing with symptoms of a larger problem.

Adaptation and mitigation measures together contribute to a large extent to sustainable development (IPCC, 2001). To achieve this, mitigation and adaptation measures must be addressed in climate policies. Swart et al. (2003) stress the importance of connecting the aforementioned climate policies to broader development policies. Broader development policies create ancillary benefits and opportunities. Alignment with other development objectives creates a more effective policy. The consideration of mitigation and adaptation and related sustainability aspects is tried in MIRT as well.

Climate Mitigation

Goals concerning mitigation have been included in the Paris Agreement. Article 4.2 states that parties must pursue domestic mitigation measures (UN, 2015). Measures concerning CO_2 and energy are often considered mitigation actions. Many concepts belonging to climate mitigation are addressed in the literature, e.g. advanced energy efficient technology, renewable energy technologies, and behavioural changes: lower energy consumption, low-emissions vehicles, modal split: limiting car use and urban design (Swart et al., 2003). Also, reduction of CO_2 and GHG, through sustainable design and material use, stimulating and facilitating sustainable use of infrastructure and compensatory measures (Ministerie van I&M, 2017). Mitigation is also present in the various sustainability concepts of the Omgevingswijzer for instance: Reduction energy demand, use of sustainable energy, circular economy, multi-dimensional use of space and solar and wind energy (Heeres et al., 2012.)

Mitigation policies consist of three target groups. Targets on emissions, atmospheric concentrations and temperature. That means that climate change is tackled by climate policies, climate policies set ambitions and targets, mitigation measures are taken to reach the targets. Björnberg (2013) calls these actions GHG abatement actions, the actions focus on achieving mitigation goals. The goals help to stimulate climate conscious behaviour. Climate mitigation is an essential part of climate concerns. As mentioned earlier the connection between climate change and CO_2 is definite. Addressing climate problems means addressing the root cause, CO_2. The identified concept of climate mitigation is used as the focus of this research. The literature review leads to the definition of this concept as follows:

Climate mitigation: *regulating actions in spatial development, based on mitigation and temperature targets, to reduce the amount of GHG being emitted into the atmosphere, and GHG concentrations in the atmosphere, to slow down and stop the increase in global temperature and climate change.*

Climate Adaptation

Climate adaptation depends highly on the economic, environmental and political elements. (Azhoni, Jude & Holman, 2018) Adaptation measures for example involve: Reducing coastal vulnerability, developing drought resistant areas, improving fresh water management, protecting vulnerable ecosystems, improving access to adequate food and water and health education.

Adaptation has been included in the Paris Agreement: Article 7.1 states that governments should aim at adaptation through enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change. Including adaptation must be done by sustainable development, and furthermore, governments must ensure that their country is ready to deal with an average temperature increase of 2℃(UN, 2015). Adaptation is seen as the key component of long-term response to climate change, in an effort to protect people, livelihoods and ecosystems (UN, 2015).

Dealing with the effects of climate change is part of MIRT. Changing climate will result in more flooding, more extreme weather and rainfall, heat and droughts. These phenomena result in 6 key problems (Ministerie van I&W, 2017). More heat stress, increasing malfunction of vital and vulnerable functions, frequent damage to harvests and damages to agriculture and horticulture sector, loss of biodiversity, health loss, labour loss and costs through possible increase in allergies and infections and cumulative effects. Adaptation is also present in the various sustainability concepts of the Omgevingswijzer and revolves mostly around water and soil issues. The Paris Agreement speaks of adaptive capacity as an important component of the adaptation strategy. The adaptive capacity is the ability of a country to address adaptations issues. The capacity depends on information available, technology, infrastructure, institutional mechanisms and economic resources. The concept shows that successful inclusion of climate adaptation, relies heavily on the organisational structures.

Similarly, to climate mitigation, climate adaptation is used in this project. The use of the concepts in this thesis creates a narrow scope, that can be efficiently analysed. However, the concepts are limited and do no account for the broader concepts related to climate issues. As such it addresses two distinct elements in isolations. The findings of Arts (2007) and Heeres et al. (2012) show that the connection of climate concerns with other project's interests are important in achieving a climate friendly project. Therefore, this research also accounts, to some extent, for the broader element of sustainability. The definition of climate adaptation is as follows:

Climate Adaptation: *regulating actions in spatial development to decrease society's vulnerability to the effects of climate change, by using society's adaptive capacity to strengthen resilience, adjust to potential damages and to respond to consequences of climate change.*

Climate mitigation and climate adaptation are the main focus of this thesis. Both concepts are a core element of the climate problem. Sustainability is mostly linked to 3Ps concept and considered too broad. Sustainability is addressed several times during this project, as there is a link between sustainability and addressing climate change. Climate mitigation and adaptation are used as an operationalisation of climate concerns or considerations.

This section discussed sustainability and climate mitigation and adaptation. Several main results are found. The use of sustainability or sustainable development is rooted in the intergenerational definition of Brundtland (1987) and the triple bottom line of Elkington (1997). Climate concerns can be part of these approaches, but it is not necessary. The two core elements of climate concerns are climate mitigation, reducing the cause of climate change and climate adaptation, dealing with the consequences of climate change. A lack of literature is noticed on the inclusion of climate mitigation and adaptation in road planning. From this section it is concluded that sustainability is too broad to effectively use in this thesis, mitigation and adaptation are more applicable, literature on inclusion of mitigation and adaptation is not found, suggesting a knowledge gap.

1.4.3 Limited Understanding of Success and Failure of Inclusion of Climate Concerns

Climate concerns must be implemented early in the planning process (Ministerie van I&W, 2017). To that end several tools have been created, e.g. Omgevingswijzer, Ambitieweb, DuboCalc and CO_2-Prestatieladder (RWS, 2010). With concepts such as Brede Blik, Meekoppelkansen and integrated plans it is vital that climate aspects are guaranteed in the whole planning process. How that is achieved remains unclear. Are there factors that can explain how climate elements are included?

According to Sola, Vilhelmson, & Larsson (2018) important is the need for cross-sectoral approach due to integrated nature of the plans, cutting through different administrative sectors and spatial scales. This calls for communication and collaboration and is essentially an organisational issue. Furthermore, the political and stakeholder unwillingness to switch from car-based solutions to other ways to solve mobility issues. Wu, Isaksson, & Antonson (2017) conclude that the institutional culture and political context contribute to the implementation of a holistic landscape view. A rising problem in holistic landscape approach is that the definition is widely disputed, which problematizes collaboration. Wu et al. (2017) propose implementing ways to improve commitment, stakeholder participation, conversations and learning processes.

Inclusion of climate mitigation and adaptation can become problematic when indicator frameworks (such as Omgevingswijzer etc.) are disconnected from actual planning according to Gibberd (2017). In practice the outcomes of indicator frameworks are not effectively used in decision-making process. In the Dutch context the different indicator tools are already integrated in the planning process. Nevertheless, successful inclusion of climate concerns is only sparsely obtained. Some reasons for failures or successes are linked to a lack of knowledge on how to align governing organisation and political and financial support as explained by Ghosh (2017). Furthermore, success or failure is due to initiatives of state government and local communities, the costs of certain technology and implementation time. A factor for failure is short-term goals, which are in direct conflict with the whole concept of sustainability and tackling climate issues. What Ghosh (2017) mentions is not unheard of in the Dutch context, short-term planning and a preference for asphalt as opposed to expensive innovations can frustrate sustainability concerns.

In §1.4.1 and §1.4.2 some factors are identified. There is a conflict of interests in integral area development (Hooimeijer et al. 2011) and there is lack of flexibility of the urban planning procedure (Meijer et al., 2011). Turnheim et al. (2015) speaks of the success of creating synergistic effects trough integration, which is agreed upon by Busscher et al. (2015). Furthermore, the Paris agreement attributes the success to information, technology, infrastructure, institutional elements and economic resources, as well as the overall organisational structures. As shown several disruptive elements and possible success themes are mentioned. Several documents give some indication of crucial factors of climate inclusion in road planning or other disciplines. The work of Malekpour, Brown, Haan, & Wong (2017) on disruptive elements in sustainable planning can help identify possible failure factors in the Dutch road planning context. In Dutch road planning some factors are already identified. For instance, during the Realisatiefase stakeholders are generally shielded of, while keeping stakeholders informed especially in complex implementations it is important as discussed by Verweij (2015). Leendertse, Langbroek, Arts, & Nijhuis (2016) agree with the importance of stakeholder involvement and state that integrating infrastructure and the surrounding area in planning and management is a challenge. Co-creation by private stakeholders and planning authorities is key to integral spatial development. However, interests differ and perspectives as well, making co-creation more difficult. In the case of the Blankenburgverbinding (MIRT project) a combined sustainable goal was reached with extensive design tables and counselling groups. Furthermore, climate solutions are sometimes too innovative. Current programmes disallow solutions with natural capital, underpinning the idea that ambitious sustainable ideas do currently not arrive at realisation due to barriers (Ruijs & Egmond, 2017). As a result, decision-makers focus on known robust solutions. In mobility issues, asphalt and more lanes are preferred to untested innovative ideas.

1.4.4 Knowledge Gap & Scientific Goal

§1.4 places the earlier discussed societal problem in a scientific context. This section discussed sustainability, sustainability in road planning, climate mitigation and adaptation and the limited understanding of the inclusion of climate mitigation and adaptation in road planning. In this section it is established that inclusion of climate concerns is currently approached through sustainability. It is concluded that these approaches are unsuccessful. A lack of understanding of inclusion of climate considerations in road planning is found. No literature is found that specifically addresses this issue. Scientifically speaking there is a substantial knowledge gap, there is no specific research to this societal problem. Since there is no research, there is no understanding. Kivilia et al. (2017) stresses the importance of more research to success and failure of sustainability issues in several types of project, as the need for sustainable development keeps increasing. The experienced barriers and enablers to inclusion of climate concerns are not scientifically addressed. The relevance of filling this knowledge gap is not only practical. It provides more information on climate transition processes in large infrastructure. In essence this problem is about the inclusion of a new project element that potentially conflicts with the main goal of the project. The inclusion of a climate element in any market or field conflicts with the current practices. Research to the workings of this phenomenon in road planning not only illuminates factors for success or failure in this specific field, but in the much broader field of spatial development, and even climate transition processes.

Scientific goal: *Improve the understanding of the workings of climate change induced transitions in road planning.*

This thesis explores the existence of enablers or barriers to the inclusion of climate concerns in road planning. The findings of this research create an understanding of the complex process of including climate elements in a specific spatial planning practice (road planning). This is achieved by establishing the existence of enablers and barriers in real world practice and gathers empirical evidence. This evidence shows which project elements impact the inclusion of climate considerations. This helps to improve the lack of knowledge on climate transition processes in road planning.

1.5 Research Question and Sub-questions

Enablers or disruptive factors can be approached as critical success factors (CSFs) as explained by Rockart (1979). CSF revolve around factors in an organisation that are essential to achieve a higher goal. This research tries to establish in what way climate adaptation and climate mitigation are included in road planning, specifically in the Dutch context. That means identifying key factors. CSFs can obstruct inclusion of climate concerns and by identifying them, the CSFs can be stimulated to reach climate inclusion in road planning. More on the theoretical implications of CSFs is discussed in chapter 3. This approach of CSFs is related to the earlier identified practical goal. CSFs are the areas of a project that either cause the main problems or possess potential solutions. By identifying CSFs in Dutch planning projects, possible barriers and enablers are discovered for the inclusion of climate concerns. The CSFs create a better understanding of the workings the transition process. The CSFs help to identify how different project elements impact each other to create either success and failure and are indications of how organisational elements impact the transition process. This thesis contributes to a societal problem. By identifying critical success factors, project teams and decision-makers can become better equipped to pursue inclusion of climate mitigation and adaptation in road planning. This thesis also contributes to scientific knowledge gaps, by checking and corroborating the sparse knowledge of factors found in different contexts and by introducing new factors found in the Dutch context. To fill that knowledge gap the following research question and sub-questions are used:

Research Question: "What critical success factors in the planning process of Dutch MIRT road infrastructure projects affect the inclusion of climate considerations into the project scope?

1. What part of the Planuitwerkingsfase needs to be focussed on?
This sub-question helps to identify which phases need to be analysed to obtain factors that contribute to the inclusion of climate concerns. What are the important phases, decisions, actors, researches and documents of the Planuitwerkingsfase and what happens to climate concerns in this phase? The findings of this sub-question are important input for the case studies, as it focusses during for the case studies. Chapter 4 answers this sub-question.

2. What critical success factors on inclusion of climate considerations are present in literature?
To assess CSFs in Dutch road planning it is useful to have a better understanding of CSFs in road planning, as it is found in existing literature. This helps to guide the analysis of the Dutch context, since it creates an understanding of what can potentially be found. It also helps to strengthen empirical findings by connecting them to existing literature. This question is answered in chapter 3.

3. What factors influence inclusion of climate considerations in Dutch road projects?
Finding factors that contribute to the inclusion of climate concerns is the central element in this thesis. This sub-question focusses on understanding how ideas that will lead to climate inclusive solutions are introduced and what factors contribute to that or disrupt that process. Furthermore, it tries to answer what factors help include climate in the decision-making and trade-offs.

The three sub-questions answer the main research question. However, the findings can be used to explore what can be done to facilitate the inclusion of climate concerns in road planning. The identified CSFs are important elements to create ways to improve future road infrastructure projects. Answering this question addresses how to facilitate success factors or discourage failure factors. To that end an additional research question is articulated:

Additional Research Question: "What can be done to facilitate the successful inclusion of climate concerns in Dutch road infrastructure projects?"

1.6 Report Outline

Figure 1.1 depicts a research flow diagram which represents the different elements of this thesis. As discussed, a main research question, three sub-questions and an additional research question are established. Chapter 2 discusses the research approach and different methods used in this thesis. The chapter discusses methods used to answer the different sub-questions. Which are answered in chapter 3-5. Chapter 2 also selects three cases and establishes an analytical framework. Chapter 3 answers sub-question 1. Central in this chapter is the Planuitwerkingsfase and its processes, documents and actors. This chapter results in a list of documents to be analysed during the case studies, an overview of the Planuitwerkingsfase which is necessary to understand the planning process and a set of actors which is used to decide who to interview during the case studies. Chapter 4 uses a literature study to establish which CSFs are present in literature, these findings provide guidance for the interviews of the case studies. Furthermore, it becomes possible to check whether empirically found factors correspond to findings of other in the literature. This chapter answer sub-question 2. The list of documents, overview of the planning process, list of actors and list of CSFs in literature are used in the case studies. Chapter 5 discusses these studies and discusses the main results. Chapter 5 results in a list of factors that are the answer to sub-question 3. The findings are elaborated on in chapter 6 where the results are synthesised, This results in fifteen CSFs. The CSF are discussed and are used in two conceptual models of the current system. Lastly, this chapter results in the main problems that occur during the inclusion of climate considerations in road planning. The findings form the answer to the main research question, which is also addressed in chapter 8 conclusion. Before the conclusion Chapter 7 uses the CSFs and conceptual model to elaborate on potential solutions. This chapter answers the Additional Research Question. Lastly, this thesis is concluded in chapter 8, were recommendations are given and the contribution of this project is reflected upon.

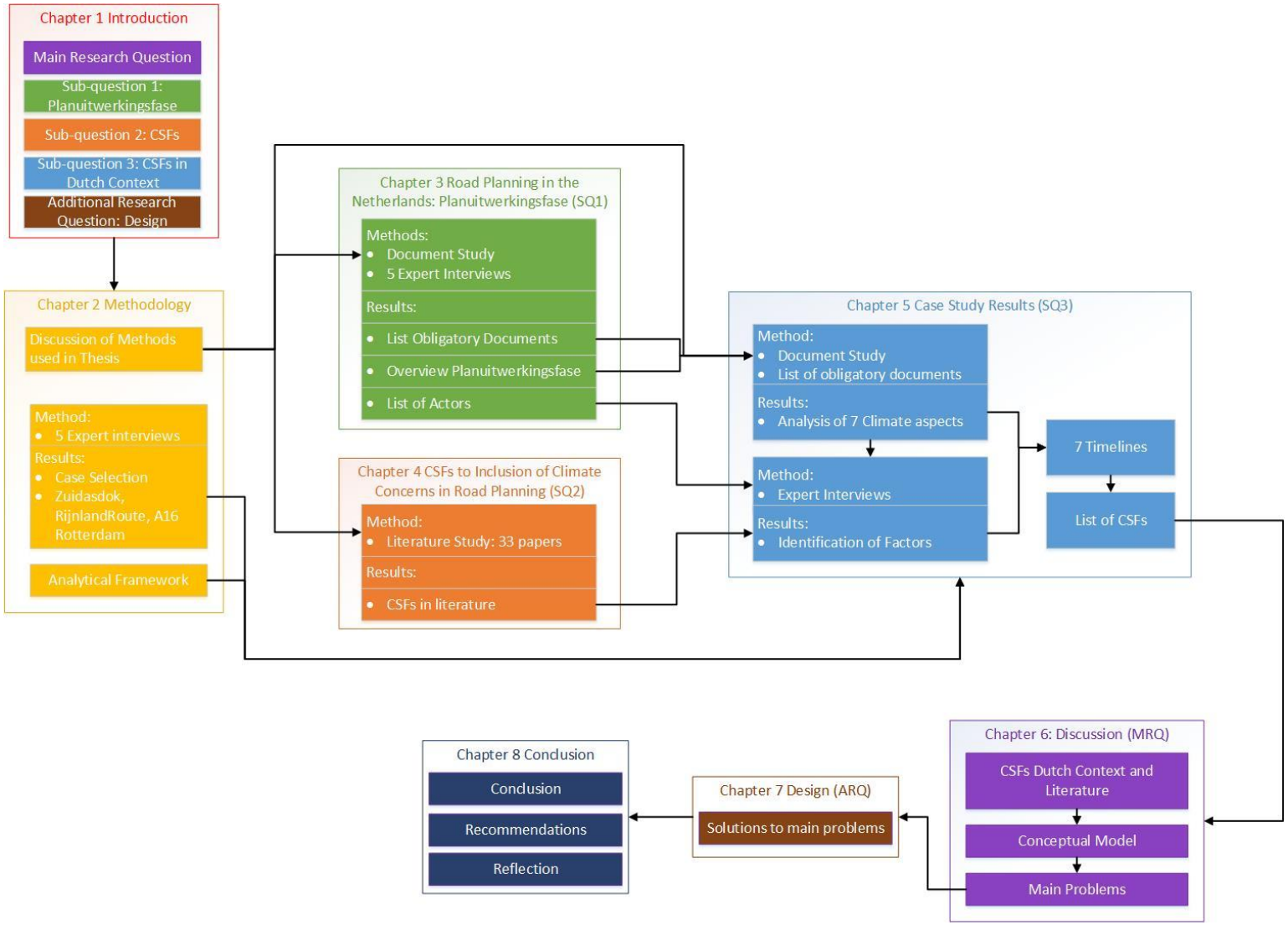

Figure 1.1: Research flow diagram of this thesis.

2. Research Design & Methodology

This chapter discusses the methods used in answering the main research question and sub-question 1-3. First this chapter discusses the main research approach; a comparative case study approach. This is followed by a discussion of the methods of data collection for the case studies. Essentially this is the method used to answer sub-question 3. However, to be able to answer sub-question 3 answers on sub-questions 1 and 2 are necessary. Therefore methods to answer these sub-questions are discussed, to be used in chapter 3 and 4. Furthermore the case studies are analysed, and an analytical framework is created. This framework is applied in the case studies of chapter 5. Lastly, since this thesis uses a case study approach a case selection method is discussed and carried out.

2.1 Comparative Case Study Approach

A case study approach is used to analyse in-depth a real-world phenomenon and subsequently deduce what is causing that phenomenon. Central in a case study approach is understanding what is happening and why it is happening (Harrison, Birks, Frankling, & Mills, 2017). Case studies have the tendency to explain or illuminate decisions made during a certain process in a specific situation (Yin, 2009). In this research the focus is on the illumination of decisions regarding inclusion of climate mitigation and adaptation in MIRT road projects. Therefore, the decision is made to use a case study approach. Currently, the literature on this topic is limited. When the amount of available knowledge is limited a case study can be used to explore what elements in the phenomenon are found that explain the phenomenon. The knowledge gap is considered large, therefore an in-depth explorative study such as a case study can help start filling some of that knowledge gap. Other research approaches are difficult to use when the current understanding and knowledge of the problem is low e.g. a quantitative statistical approach is not possible as there is no indication which CSFs or other variables to address in the study. This thesis uses an exploratory case study approach to identify which CSFs are important consequently, the results can be used in quantitative research.

Multiple case studies are performed in this project. Multiple case studies make comparison of results, policies and processes possible. A similar policy in a similar case might not always result in similar results. Comparing cases helps to identify and corroborate factors. Essentially three axes of comparison are possible, horizontal, meaning the workings of policies or processes on the same level or scale. Vertical, thus comparing phenomena on different scales and transversal, which focusses on comparing phenomena or policies across time (Bartlett & Vavrus, 2017).

The cases can be analysed first as individual cases, resulting in three cases that follow a normal case study approach. During the case selection the comparative characteristic must be considered. Horizontal comparison, means the comparison of similar size projects on the same phase, vertical means that small and larger projects are compared, and transversal means the comparison of projects that differ several years in time, for instance a project now compared to a project at the beginning of this decade. The decision is made to compare three cases that are similar in time and size, thus a horizontal comparison. As this thesis tries to illuminate the workings of large MIRT-project it is logical to discuss cases of the similar size. Furthermore, the cases are of similar timeframe since the focus on climate change of the last years would explain much of the difference between projects.

Information on the system is necessary for this analysis. Information can be gathered by studying existing documents and literature and by discussing the system and its problems with experts. The case selection and data selection are addressed in the next sections.

2.2 Data collection

In order to analyse the three cases, data on these cases is collected. Two methods are used for the collection of data, firstly a desk research document study. Secondly a number of interviews with project team members. This section discusses these two methods of data collection.

2.2.1 Document study

Documents related to the cases are retrieved through an extensive internet search. The websites of each case project are used as an important source of documents. Furthermore, documents are obtained through Infram. This document collecting method is relatively easy, as many project documents are publicly available online. There are some problems with this method. Especially the spatial planning documents are publicly available. The tender documents are not. Therefore, the document study contains more spatial planning documents. As the spatial planning documents are mostly focused on the location of the road it can be difficult to notice climate concerns. The tender procedure is more detailed with respect to the design. A lack of these documents can lead to the conclusion that there is no climate element in the project, while in fact these are present in the non-obtained tender documents.

Another problem is that documents, mostly reports, tell little of the extensive decision-making processes. By only analysing documents it is difficult to gain a full picture of the way different priorities played a part in the decisions working up to those documents. In this research part of that is solved by conducting expert interviews.

Lastly, there is quite a lot of documents publicly available. This can create an overload of documents in the analysis. Therefore, a set of obligatory documents is used. These documents, if found, must be analysed. This brings an extra advantage. The three cases are analysed on the same documents; therefore the cases can be compared more easily. The obligatory documents help focus the research on a set of main documents, that are essential in the planning process. These documents are identified by answering sub-question 1, and can be found in chapter 3, the method to create this list of obligatory documents is explained in §2.3. Obligatory documents do no exclude the use of other documents, however if the number of documents is large, a list of obligatory documents creates focus.

2.2.2 Interviews

Data is generated by doing expert interviews. After a document study of a case, expert interviews are conducted. The interviews are conducted to discuss findings from the document study, to fill in blank spaces and to gain new insights into the workings of the case. For this purpose semi-structured interviews are held. In the semi-structured interview a framework of themes helps to guide the conversation, yet it does not limit the conversation to a static set of questions (Wilson, 2014). On the one hand the expert must answer a series of questions on the existence of specific climate mitigation and adaptation aspects, on the other hand there must be some space to discuss other case elements.

Interviews are carried out with relevant actors as is established in chapter 3. The findings of the documents analysis are the source of information to structure part of the interview. The conversation is open to gain new insights and ideas from the interviewee. Interviews are preferably carried out face to face. Interviews are recorded, if the interviewee consents. The recorded interview is processed, and important parts are transcribed. A full transcript is not made. The interviews are held in Dutch, the transcripts are in English. That means that the audio material is not transcribed to Dutch. This is worth mentioning, as a result direct quotes are not used. Since the translation of a quote is no longer that same exact quote, as meanings can get lost in translation and interpretation. The transcripts of the interviews are emailed back to the experts in order to confirm that the interpretation of the author is in line with what is meant.

Appendix A includes a format for the interviews. The format has three parts. First the discussion of the project. Questions are voiced on specific climate mitigation and adaptation aspects in the project. Also the presence of more general form of sustainability is discussed. A typical question here is: In what manner did climate considerations get included in the project? Second, a discussion of the CSFs found in literature and discussed in chapter 4. The expert is questioned on the presence of the identified CSFs in the specific project and their impact on the inclusion of climate aspects. A typical question here is: Does [CSF] play a role in the inclusion of climate concerns in dealing with water? Or: Did energy and CO_2 play a part in this project, and what caused that? Last, a conclusive discussion of this thesis project and potential elements that were missed in the document study.

2.3 Methods for SQ1 and SQ2

As discussed in the previous sections, sub-question 1 and 2 need to be answered before starting the case studies. The answer of sub-question 1 provides insight in the Planuitwerkingsfase and helps to create a list of main documents and managers, to analyse and to interview. The answers to sub-question 2 provide guidance to the interviews, as the CSFs of the analysed literature are used as reference. This section discusses the main methods used to answer sub-question 1 and 2.

2.3.1 The Workings of the Planuitwerkingsfase (SQ1)

A documents study and interviews are used to answer sub-question 1. The goal of this sub-question is to create an overview of the Planuitwerkingsfase and to identify which documents must be analysed in the case studies and who can be interviewed.

A document study is carried out to identify the main processes and steps of the Planuitwerkingsfase. The whole planning process is described in RWS (2010), Ministerie van I&M (2016a) and RWS (2017). These documents help to understand the Planuitwerkingsfase as it is prescribed. However, description of processes does not always fully align with real-life practice. Furthermore, the document study can help establish the main actors and players in road projects.

Interviews are performed to gain a better understanding of the Planuitwerkingsfase. The interviews are used to check the description of the planning process. Furthermore, the interviews are used to gain a better understanding of missing or underdeveloped parts of the Planuitwerkingsfase in the documents. Semi-structured interviews are performed with experts from Infram as they are useful to discuss specific questions, while it creates enough space to discuss elements or aspects that are not part of the questions. Three things are central to these interviews, (1) Gain a better understanding of the Planuitwerkingsfase, (2) discuss possible cases for this research, (3) discuss the sustainability or climate aspects in those cases.

The interviews are conducted early in the research, just after the previously mentioned document study. The interviews are needed to get an early understanding of the planning process, and the results are input of later parts of the research, e.g. the interviews and document study result in a list of obligatory documents, to be used in the case studies. Furthermore, the interviews help to establish a list of projects, which are potential cases for the case studies.

The interviews are conducted face to face and are short half hour conversations. The conversations are not recorded. The interviewer writes down the main findings, which are used to construct a summary of the interview. During the interview questions are asked on the processes of the Planuitwerkingsfase, the involvement of actors, the place of sustainability and climate considerations and on possible cases for this thesis. It is also discussed if Infram has participated in the case project or whether contact with the project organisation is possible. The results of the interviews are used in case selection and the discussion of the Planuitwerkingsfase.

2.3.2 CSFs to the Inclusion of Climate Concerns in Road Planning (SQ 2)

A literature review is used to identify CSFs. The purpose of this identification is twofold: (1) The CSFs serve as guidance during the case studies. (2) The CSFs found in the literature can be corroborated in the real-life situation.

The literature study is carried out by using a list of keywords that are inserted in a series of online databases. As discussed literature on the inclusion of climate mitigation and adaptation in road planning is not available. Therefore the decision is made to use literature in related fields. Literature concerned with the implementation of various forms of sustainability or on achieving sustainable development in different spatial development and urban development areas are included. There are two reasons for this: Firstly, the amount of literature on the specific implementation of sustainability in road infrastructure, and more specific climate mitigation and climate adaptation is sparse. Secondly, factors that are relevant in other development sectors that strive for innovative change in development

projects, which show similarities with road infrastructure projects, can be relevant in road infrastructure projects as well.

The keywords: *Adaptation, Barriers, Climate, Disruptors, Enablers, Green infrastructure, Infrastructure, Mitigation, Motivators, Road* and *Sustainability* are inserted in five databases: Scopus, ScienceDirect, Web of science, Google scholar and Google. The Dutch counterparts of the key words are also used in google, to obtain documents that might use factors in the Dutch context.

Combinations of the different keywords are used to narrow down the number of papers. The first five pages of search results are analysed. Interesting papers are included. The abstracts or summaries of the papers are read and relevant papers, papers including some sort of factor, are kept. The relevant papers are submitted to in-depth analysis, were the full paper is read. The focus of this is to identify whether the documents contain factors either positive or negative in a context that is the same or at least similar to the context of this thesis. The remaining papers are analysed, and a list of factors is created. This list of factors can entail many factors, to create clarity the factors are grouped under overarching factors. Chapter 4 discusses the results of this literature review. The findings of chapter 4, the list of CSFs, is the answer to sub-question 2. These findings are input for the case studies.

2.4 Analytical Framework

The previous sections discussed how information and data related to the three sub-questions are retrieved. Sub-question 1, requires a document study and interviews. Sub-question 2 requires an extensive literature review and sub-question 3 requires a series of interviews and a document study related several project cases. Considering this is successful, the findings of the case studies need to be analysed. That analyses requires an analytical framework. This section discusses a framework for the analyses of different climate mitigation and adaptation aspect in Dutch road projects.

2.4.1 Case Overview

The first step is constructing an overview of the case which addresses the project and its goals. Furthermore, it addresses when each phase was started and was finished and when the major documents were delivered. Lastly, information on participants and stakeholders is gathered. This overview of the case follows the following tables. Table 2.1 shows the case overview table. This table contains the general information of the project. The overview table is accompanied by a timeline of events, table 2.2. These events are the starting and ending of phases, the deliverance of documents or presentation of final decisions. Another element of the overview tables is a table that explains where information is obtained. This is a list of documents, table 2.3 and interviews, table 2.4, with corresponding dates of the publication of the documents, and the dates of the interviews.

Table 2.1: Case overview table

Project name	*Name*
Project type	*Form of construction*
Location	*Province, Municipality*
Goals	*List of project goals*
Starting date	*Year*
Current phase	*Phase name*
Project stakeholders	*Provinces, municipalities, companies*
Project team	*List of members and affiliation*
Description	*Short description of the project*

Table 2.2: Case Timeline

Date	*Event*
Date	*Event 1*
Date	*Event 2*
…	...
Date	*Event n*

Table 2.3: List of used documents of the case, with date and source

Date	**Document**	**Published by**
Date	*Name document*	*Company A, Person A*
…	…	…

Table 2.4: List of interviews held about the case, with date, name of interviewee, company and role.

Date	**Name**	**Company**	**Role**
Date	*Name Person*	*Name Company*	*Role in project*
…	…	…	…

2.4.2 Sustainability, Mitigation and Adaptation Findings in Documents

The documents and interviews are analysed. Every slight form of sustainability or climate concerns is noted. It could be some articulated ambitions, a note, requirements, goals etc. as it proves that sustainability or climate concerns are part of the project. The findings are noted and subsequently included in a list of sustainable or climate aspects. Table 2.5 shows the concept for the document list.

Table 2.5: List of climate aspects found in case documents, with type of aspects and exact text

Aspect	Found in	Type	Exact text
…	*Document name*	*Goal, ambitions etc.*	*…*

Table 2.6: List of aspects found in case study belonging to overarching concept

Aspect	Type	Phase
…	…	…

2.4.3 Creation of Overarching Aspects

The identified climate or sustainability aspects are categorised into seven main overarching aspects. Each aspect in its overarching form is separately analysed in each case study. Table 2.6 shows the list of aspects belonging to an overarching aspect. These two tables are constructed for each overarching aspect in the case. The overarching aspects are as follows

Sustainability and Spatial development (split in Goals & Ambitions and Criteria)

Elements as 3Ps, liveability, sustainability etc. are part of this aspect. This aspect is not a typical climate aspect, as it is about the general form of sustainability. However, it is interesting to see if the inclusion of the concept of sustainability lead to more climate concerns or climate requirements. This helps determine if there are factors concerned with sustainability that limit or enable this inclusion. During the analysis of the different overarching aspects, this aspect is split in two parts, sustainability criteria and sustainability ambitions and goals. This is done to make analysis of both parts simpler.

Energy & CO_2

The production and consumption of energy is strongly related to CO_2 emissions. This is a typical form of climate mitigation. A road uses energy in its many traffic and safety systems. If a tunnel is part of the project the energy consumption becomes quite substantial, as 70% of RWS's energy consumption is attributed to Tunnels. Energy production related to the road project, as part of integral area development, is also part of this aspect. Measures to reduce CO_2 concentrations are part of this aspect.

Materials & Waste and Construction & Market

Materials such as concrete and asphalt, produce relatively high CO_2 emissions. Furthermore, scarce materials require difficult processes to obtain, resulting in increased CO_2 emissions. How waste is handled or reused impacts CO_2 emissions as well. Materials and waste are a form of climate mitigation. During the realisation of a project, climate concerns can limit the impact of construction on the environment. Choices on how to construct are usually delegated to the market. Contractors are challenged to implement climate mitigation or climate adaptation measures. Since materials and waste and construction and market are quite connected these aspects are analysed as one overarching aspect.

Water

Road project need to deal with water issues. As climate change continues, water issues become more problematic. More extreme weather, more precipitation, sea level rise and droughts. Including this into the project is a form of climate adaptation and is therefore included for analysis.

Air quality

The pollution of the air by GHG enhances the greenhouse effect. Improving the air quality is therefore part of climate mitigation. This aspect focussed on diminishing the amounts of NO_2 and PM_{10}, $PM_{2.5}$. Furthermore, dealing with air pollution can give some indication on how to address CO_2 emissions.

Climate Resilience

Climate resilience means being prepared for futures extreme weather. This is climate adaptation in its purest form. It is about the broader notion of adaptation. In road infrastructure project considering the future weather and impact on the road is important. Climate resilience is therefore part of the analysis.

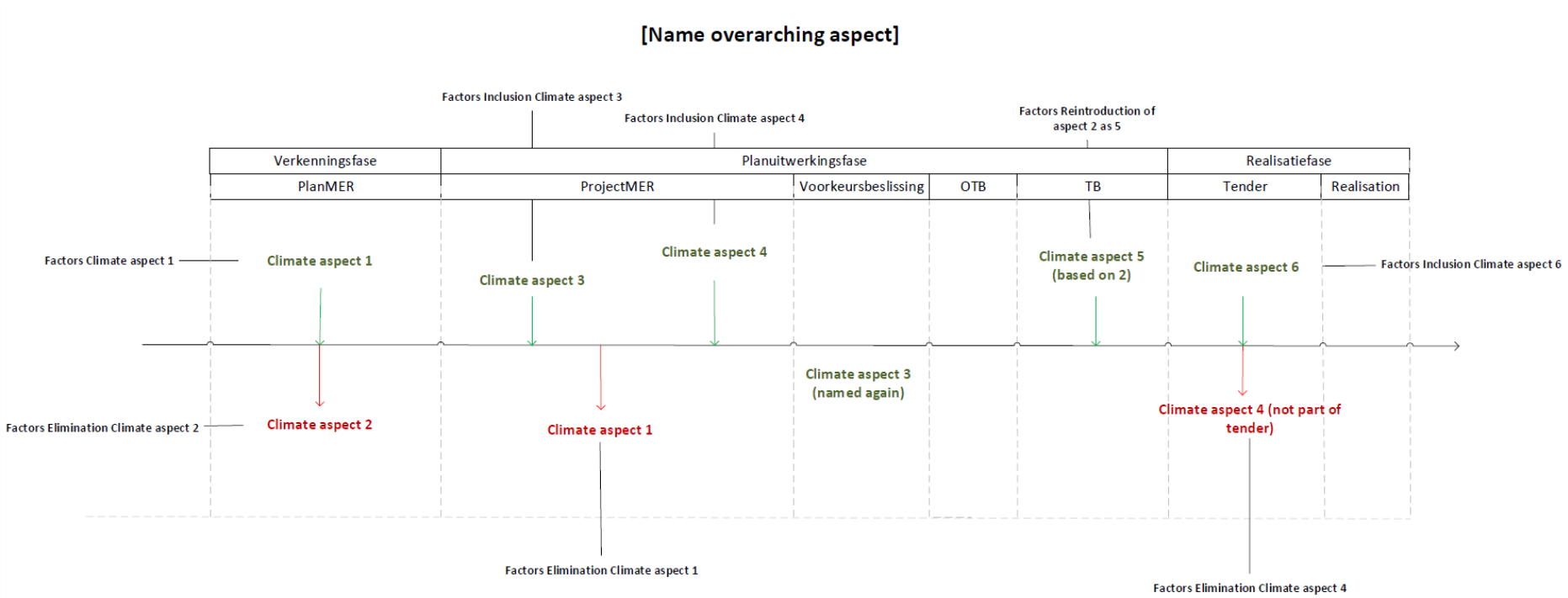

Figure 2.1: Concept of timeline for analysis of inclusion of overarching climate aspects in case studies. The timeline is divided in different phases corresponding to the phases of the planning project. The green aspects above the timeline with an arrow to the line depicts that these climate aspects are included in this phase of the project. These are detailed specific aspects, e.g. climate aspects 1 is a goal to reduce material use in this project.

The red aspects with red arrows under the line are the loss of climate aspects or strong negative remarks on climate aspects. Two examples of this, red climate aspect 1 in the ProjectMER leaves the line, maybe the decision is made that the goal to reduce material use is not achievable and so it is eliminated. Or the other example climate aspect 2 in the PlanMER could mean that the project organisation has stated that climate adaptation is not part of the project scope.

The green aspects below the timeline mean that an aspect that was introduced earlier is stated again, and thus remains part of the project.

Lastly, each included or eliminated aspect is given a set of factors that relate to the inclusion or elimination. This helps to identify what factors contribute to inclusion of climate adaptation or mitigation aspect and relates to the findings of chapter 4.

A last remark on the position of each aspect. An aspect located at the start of a phase is not necessarily introduced at the beginning of the phase. It only means that it is implemented earlier than other aspects in that phase.

2.4.4 Sustainability, Mitigation and Adaptation Findings in Interviews

Preferably, the interviews are performed after the document study as it helps to validate the findings of the document studies. The interviews have three main purposes: (1) Discuss the inclusion of climate aspects in the specific project, based on the experts' experience and documents study. (2) Discuss potential factors and reason for the (lack of) inclusion of climate concerns, assisted by identified factors from the literature. (3) Discuss and identify more potential problems or solutions. Appendix A includes the questionnaire used. The findings of each interview are put into table 2.7.

Table 2.7: List of climate aspects found in interviews with exact text and name interviewee

Said by	Aspect	Exact text
Expert	*...*	*...*

2.4.5 Analysis of Findings over Time

Both the results of documents and interviews are analysed. This is done by addressing an overarching concept over time. This creates a timeline of the aspect during the planning process. Through this, together with the results of the interviews factors can be identified. The analysis consists of a visual representation of the timeline and aspect over time, accompanied by text, which analyses and discusses aspects and underlying factors. That results in a list of factors. Figure 2.1 (previous page) shows an empty timeline for analysis of one overarching aspect in one case.

2.5 Case selection

A case study approach requires cases. This section explains in what way the decision for three case studies is made. The section includes a short description of the case selection process, the results of that process and finally the selection of cases. More information on the criteria and preferences for case selection and the main project on the shortlist is found in Appendix B.

2.5.1 Description Case Selection

A longlist of potential case studies is created by doing four interviews with five experts of the Dutch planning phase, table 2.8. The interviews are simple half hour conversations. These interviews are conducted with multiple aims. The main goal is to create a better understanding of the Planuitwerkingsfase and relates to chapter 3. However, an additional goal is to establish a longlist of projects. More on the interviews was discussed in §2.3.1. The interviews merely helped to identify names of interesting projects, more information on these cases is obtained from Rijksoverheid (2018). Short summaries of the interviews are found in Appendix C.

In this thesis, sometimes experts referenced. This is done by using (Ex.#). When for instance (ex.1) is used, it suggests that this was something said by expert 1, during the first expert interview.

Table 2.8: List of five experts of Infram interviewed for the creation of case longlist.

Expert	Expertise
Expert 1	Manager Planuitwerkingsfase
Expert 2	Manager Verkenningsfase & Planuitwerkingsfase
Expert 3	Manager Planuitwerkingsfase
Expert 4	Manager Planuitwerkingsfase
Expert 5	Manager Verkenningsfase & Planuitwerkingsfase

With the use of three criteria and four preferences the longlist, table 2.9, is assessed. The three criteria must be satisfied by a project in order to qualify for the case study. The four preferences must not necessarily be satisfied to qualify. The preferences are put in place to assess how convenient the choice for a project is. E.g. a project where contact with the project organisation is easy since Infram works on that project is preferred to a project were there is currently no contact. Table 2.10 includes the three criteria and preferences.

Table 2.9 Longlist potential case study projects, with number corresponding to experts.	
Calandbrug (2, 5)	Weg van de Toekomst (1, 2, 5)
RijnlandRoute (2, 5)	Ramspolbrug (1)
Zuidasdok (5)	Nieuwe sluis Terneuzen (3)
INNOVA58 (1, 5)	Beatrixsluis (4)
Afsluitdijk (1)	Dijkversterking Marken (4)
A6 (1,2)	A1 (1)
A16 Rotterdam	

Table 2.10: Criteria and Preferences for case selection	
Criteria	**Preferences**
Road project	Infram project
Realisation phase & TB	Easy contact
MIRT-project	Time of project
	Hint of Climate concerns

The project must be a road project as that is the focus of this study. It must currently be in the Realisatiefase (Realisation phase) with a published TB, that guarantees that the whole planning process is finished, and so the final result can be analysed. The project must be part of the MIRT, that guarantees a certain size, which makes comparing project easier, because it guarantees that the same phases and steps are used.

Preferably Infram participated in the project, this makes conducting interviews easier. Connected to that is easy contact with project participants. It is preferred that the project is not too dated, and that all projects are from a similar timeframe. This to limit the impact of the mind-set of a time on the inclusion of climate. Lastly, projects that are hinted, to include climate or sustainability in their project scope are preferred. More on these criteria and preferences can be found in Appendix B.

The next step is to score the different projects on the criteria and preferences. Five of the thirteen projects did not satisfy the *road* criterion and were immediately excluded. One project, Weg van de Toekomst, did not satisfy the *MIRT* criterion (Ex.1) and was also excluded. INNOVA58 while not fully satisfying the criterion: *Realisatiefase*, was not immediately excluded. this project posed some interesting new takes on sustainability and climate inclusion and is a Infram project (Ex.5). However, further consideration lead to the exclusion of the project. Table 2.11 shows the scoring of the projects, with the bottom group being immediately eliminated, the middle group being eliminated after reconsideration and the top group becoming the shortlist for case studies. A more in-depth explanation of this process and some background information on the top-8 project can be found in Appendix B.

Table 2.11: Scorecard with three groups of projects. Green means satisfying the criterion or preference, red is not satisfying the criterion or preference. Yellow means the project most likely does not satisfy the criterion or preference but is considered borderline case. The numbers in brackets (.) correspond to the comments of the experts.

	Criteria			**Preferences**			
Name project	**Road**	**Phase**	**MIRT**	**Infram**	**Contact**	**Time**	**Sustainable**
Zuidasdok	Yes	Realisatie	Yes	Yes	Yes	2013-2028	Yes (5)
RijnlandRoute	Yes	Finished	Yes	Yes	Yes	2011-2021	No (2)
A16 Rotterdam	Yes	Realisatie	Yes	No	Uncertain	2009-2024	Yes
A6	Yes	Realisatie	Yes	No	Uncertain (1,2)	2012-2023	Yes (2)
N50 Ramspolbrug	Yes	Finished	Yes	No	Uncertain (1)	2007-2013	Yes (1)
A1	Yes	Realisatie	Yes	No	Uncertain (1)	2015-2028	No (1)
INNOVA58	Yes	OTB 2018 (1)	Yes	Yes	Yes	2015-2024	Yes (5)
Weg van de Toekomst	Yes	Finished	No (1)	No	Uncertain (2)	2011-2013	Yes (2)
Afsluitdijk	No	Realisatie	Yes	Yes	Yes	2013-2022	Yes (1)
Calandbrug	No	Finished	Yes	Yes	Yes	2015-2021	No (2)
Nieuwe sluis Terneuzen	No	Realisatie	Yes	No (3)	Yes (3)	2012-2022	Yes (3)
Beatrixsluis	No	Realisatie	Yes	Yes	Yes	2011-2020	Yes (4)
Dijkversterking Marken	No	Planuitwerkingsfase	Yes	Yes	Yes	2016-2020	No (4)

2.5.2 Final List and Conclusive Notes

The final list of projects is:

- Zuidasdok
- Rijnlandroute
- A16 Rotterdam
- A6 Almere
- N50 Ramspolbrug
- A1

The first three projects: Zuidasdok, RijnlandRoute and A16 Rotterdam are chosen as case studies. These projects fit all the necessary criteria and most of the preferences. Three case studies are performed. Due to time and resource limitation three case studies is the maximum. Furthermore, three studies make it possible to cross-check finding between more cases. A6 Almere, N50 Ramspolbrug and A1 are possible back-ups.

2.6 Conclusion

This chapter is about the methods used in this research. A comparative case study approach is established as research approach. The case studies require document studies and interviews. For a successful case study, information on the Planuitwerkingsfase and CSFs in literature are necessary, meaning answers to the sub-question 1 and sub-question 2. This chapter discussed that with the use of a document study and interviews on the Planuitwerkingsfase, and a literature review on CSFs the needed information can be obtained. The results of those methods are discussed in chapter 3 and 4. This chapter furthermore saw the selection of three case studies, Zuidasdok, RijnlandRoute and A16 Rotterdam. Lastly this chapter discussed an analytical framework to be used in the case studies. The analytical framework is connected to the results of chapter 3 and 4. Since the findings in chapter 3 influence which documents are the focus of the case studies and which actors must be interviewed. The findings of chapter 4 are used during the interviews in the case studies.

3. Road planning in the Netherlands: Planuitwerkingsfase

The Planuitwerkingsfase is established as the main focus of this research, as mentioned in §1.3. The Planuitwerkingsfase must be understood well to be able to address what is causing or obstructing inclusion of climate mitigation and adaptation in this phase. This chapter elaborates on the different project phases of the Planuitwerkingsfase. As discussed in chapter 2, two methods are used to gain knowledge on the processes of the Planuitwerkingsfase, a document study and a series of interviews. The document study obtained three documents RWS (2010), Ministerie van I&M (2016a) and RWS (2017) that prescribe most of the Planuitwerkingsfase. Interviews were conducted as described in the previous chapter. These interviews are the same interviews that were used to create a longlist of cases for the case selection as discussed in §2.5. Table 3.1 shows the five experts and their expertise. Summaries of these interviews are found in Appendix C. The interviews are necessary to expand the knowledge on the Planuitwerkingsfase, beyond what is prescribed in the three identified documents.

Table 3.1: List of five experts of Infram interviewed on the Dutch planning process.

Expert	Expertise
Expert 1	Manager Planuitwerkingsfase
Expert 2	Manager Verkenningsfase & Planuitwerkingsfase
Expert 3	Manager Planuitwerkingsfase
Expert 4	Manager Planuitwerkingsfase
Expert 5	Manager Verkenningsfase & Planuitwerkingsfase

This chapter aims to do the following things: (1) Gain an understanding of the different phases of the Planuitwerkingsfase. (2) Discuss these phases and identify the main elements and decisions. (3) Establish a list of documents and decisions central to the Planuitwerkingsfase (4) construct a conceptual model of the planning process, to be used to analyse where CSFs influence the Planuitwerkingsfase. The conceptual model is also used to assess where stimulation of inclusion can happen. This chapter first describes the Planuitwerkingsfase as prescribed in policy documents and in discussed in the interviews. These findings are used to create a conceptual model. Connected to that key decisions, documents and actors are identified and discussed.

Why address this in this thesis? The Planuitwerkingsfase and the processes of that phase are the key focus of this study. By analysing and discussing this phase here, a foundation is created which helps to focus the case studies to the interesting decisions, processes and documents. Furthermore, the findings of this chapter create the possibility to relate identified CSFs and potential solutions to the planning process. In that way it is possible to address how and where CSFs work in the planning process. Linking the CSFs to the conceptual model of the planning process established in this chapter increases the use and understanding of the workings of CSFs.

3.1 Planuitwerkingsfase explained

The Planuitwerkingsfase consists of three phases (1) Startfase (Starting phase), (2) Beoordelingsfase (Assessment phase), (3) Afrondende fase (Concluding phase). The whole phase is connected to the preceding Verkenningsfase and the consecutive Realisatiefase. Figure 3.1 (next page) shows these main phases and the main document of each phase, based on the prescription in RWS (2017).

The Verkenningsfase explores solutions for congestion problems. The phase addresses if the congestion problem is large enough for action, and what form that action will take. Through a PlanMER (Environmental effect study) different alternatives are assessed, resulting in a Voorkeursalternatief (preferred alternative). That leads to a decision called Voorkeursbeslissing (Decision of preference) a document that includes the preferred form and place of the road (RWS, 2010).

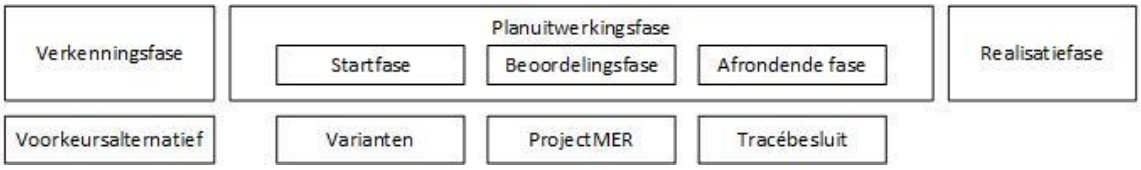

Figure 3.1: Visual representation of the planning process of the Planuitwerkingsfase. Simplification of system portrayed in RWS (2017, p.131) Left the first phase, Verkenningsfase, middle the Planuitwerkingsfase and the last phase on the right.

During the Startfase the variants to the preferred alternative are constructed. These are tested in the next phase. During the Beoordelingsfase the variants are assessed to their environmental impact. That leads to a ProjectMER. This ProjectMER discusses the best variant considering all the environmental criteria. The Afrondende fase revolves around checking the MER for procedural and content flaws. This phase results in a final spatial planning decision called the Tracébesluit (TB). Before the establishment of the TB a draft version called Ontwerp-Tracébesluit (OTB) is open for public criticism (RWS, 2017). During the end of this phase contact with the market is made, and a tender procedure is started. The procedure ends with a contractor who creates a design and realises the project in the Realisatiefase. The phase of design creation with contractors is the Contractfase (Contracting phase).

Essentially, there are two components to the Planuitwerkingsfase. Component A, a spatial planning procedure that results in a place and form of the solution and component B a tender procedure that results in a contractor who will design and built the project (Ex.1). Figure 3.2 visually represents the Planuitwerkingsfase with two components. The spatial planning component (A) strives to make the project possible and feasible within the spatial context of the area (Ex.1). Furthermore, this component is about establishing the main requirements of a solution by drawing up requirements based on the ambitions and system demands. The second component (B) is the tender procedure. This procedure entails establishing which contractor is hired to realise the project. This process also entails drawing up a design that meets the requirements put in place in the first part of the phase.

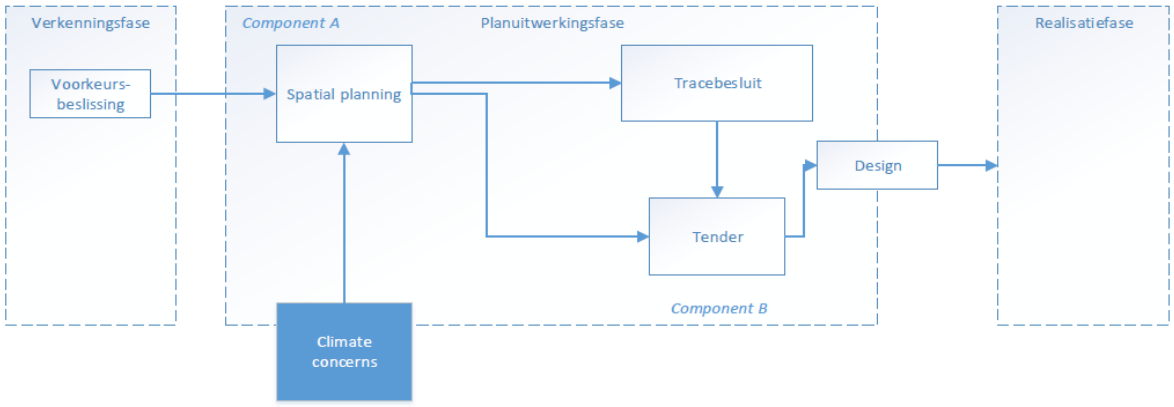

Figure 3.2: Schematic of two components of the Planuitwerkingsfase. The spatial planning component (A) and the Tender procedure component (B). The figure shows the inclusion of climate concerns in the spatial planning procedure.

3.2 Detailed planning process

This section builds on the findings of §3.1. The aim of this section is to discuss the Dutch road planning process. Central in this discussion is figure 3.3 (next page). This figure represents the simplified Planuitwerkingsfase. The figure includes three main aspects, the actors involved in the Planuitwerkingsfase, Component A: the spatial planning procedure and Component B: the tender procedure. This section introduces the main parts of the Planuitwerkingsfase and discusses their relevance in the inclusion of climate measures and their relevance in this research, as some of the elements are used during the case studies. E.g. the use of identified documents for an obligatory list of documents, to be searched for and analysed. And also the identification of players in the Planuitwerkingsfase, who are interviewed during the case studies.

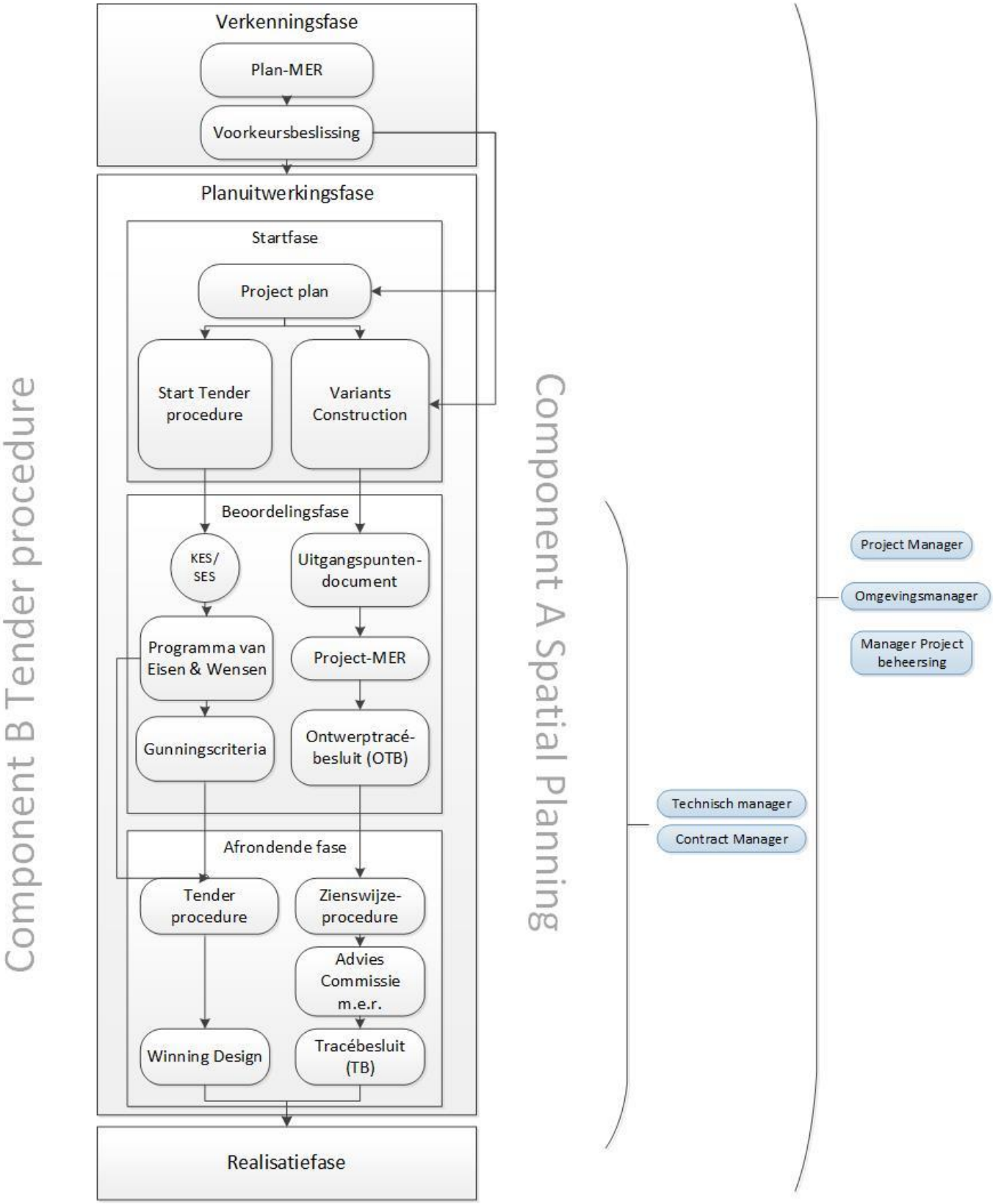

Figure 3.3: Simplified Planuitwerkingsfase, left component B Tender procedure, right component A spatial planning. The phases include the main documents, processes and decisions, deemed relevant in this thesis project. To the right are the identified managers and their sphere of influence.

3.2.1 IPM-Model: Actors

Project organisations of RWS are formed around the integral project management model consisting of five different managers that together manage all the aspects of a RWS projects or in this case MIRT-projects (RWS, n.d.; RWS, 2017). The separate roles are:

- Project manager: responsible for quality, support and alignment. Responsible for end result.
- Manager Projectbeheersing (project control): identify and manage risks.
- Omgevingsmanager (local environment): relation between stakeholders and local environment.
- Technisch manager (technical manager): responsible for input concerned with technical and organizational aspects.
- Contract manager: manage risks between project and market responsible for contracts.

The project manager focusses on guaranteeing certain qualities, alignment of goals and is responsible for the end result. The project manager has a central role in the project. His (or her) contribution in terms of climate consideration is substantial. A project manager with a climate mind-set is in the right position to reach climate goals. His say on the focus of the project and formation of goals carries weight (Ex.5). As such the project manager is potentially an important player in inclusion of climate considerations (Ex.4). While a project manager shows potential for inclusion of climate concerns, his prime goal is the successful completion of a road project. Therefore he is bounded by the mobility goals and by the political circumstances. Nonetheless the project manager has an interesting place and role in the system, he is an interesting person to discuss the problems of a project with (Ex.2). The project manager is therefore identified as a person of interest for interviews in the case studies.

The Manager Projectbeheersing is focussed on assessing and monitoring the risks surrounding the project. Climate concerns can be considered part of those risks. In that way the Manager Projectbeheersing is charged with monitoring climate threats and adjusting for those problems. A Manager Projectbeheersing who is concerned with climate problems can have impact on adjusting the project to favour climate mitigation and adaptation. As climate threats are real, it is possible that this happens. The influence of the Manager Projectbeheersing will be primarily on climate adaptation, as that deals with how to address and prepare for the risks and problems of climate change. The manager Projectbeheersing is identified as a person of interest for interview in the case studies, his knowledge on how to deal with risks in road planning can illuminate the inclusion of climate adaptation.

The Omgevingsmanager aligns the environment and project. When dealing with climate concerns through sustainability as discussed in §1.4.2. the Omgevingsmanager plays an important role (RWS, 2017). He must align the different priorities and sides of sustainability and deal with some of the problems with different priorities discussed by Samset & Volden (2016). The Omgevingsmanager has experience with creating shared visions and selling difficult aspects to the public and project organisation. In that way the Omgevingsmanager is capable of addressing inclusion of climate aspects (Ex.1). The knowledge on alignment and construction of goals is the reason to include the Omgevingsmanager in the interviews of the case study.

The Technisch manager has a smaller sphere of influence in the Planuitwerkingsfase than the previous three managers. The Technisch manager deals with the technical aspects of the design. He addresses what the road must look like, where it must be built and what technical requirements the road must satisfy. His task is focused on creating technical requirements for the road. A Technisch manager plays a role when climate concerns are included and need to be translated to the specifics of the road. It is there that the manager can play a role in achieving more climate aspect in the project. The Technisch manager is not a prime player in the inclusion of climate concerns. Therefore he is not the preferred expert for an interview. However, a Technisch manager is part of the planning process and therefore can be part of interviews in the case study.

The Contract manager is active in the tender procedure of the Planuitwerkingsfase. He helps translate goals and ambitions to design requirements, and is active in the tender with the market, and

the construction of contracts. Contract managers do not deal with the inclusion of climate in goals and scope of the project. Contract managers can translate those goals to requirements, and therefore play a vital part in the translation of climate concerns and consideration into project requirements used in the tender to the market (Ex.3). The contract manager is primarily focussed on the tender procedure (component B), whereas the other managers are more focussed on the spatial planning procedure (component A). As a result, uncovering more details on the place of climate concerns during this second component of the Planuitwerkingsfase is achieved by interviewing a contract manager.

This section discussed the five main managers in Dutch planning project. The Project manager, Manager Projectbeheersing and Omgevingsmanager can be instrumental in the inclusion of climate mitigation and adaptation into the project. The Technisch manager and Contract manager focus more on the translation of climate concerns, that are already included, into technical requirements and system requirements. The contract manager is the only manager primarily responsible for component B. All five actors are identified as persons to interview during the case studies.

3.2.2 Component A: The Spatial Planning Procedure

The spatial planning procedure is the main element of the Planuitwerkingsfase. As mentioned the procedure focuses on the place and form of the road. Central in this procedure is the assessment of different road variants. The process exists of ten elements deemed relevant in the scope of this research. These elements are relevant for two reasons: (1) The elements are the main parts of the procedure necessary to translate Voorkeursalternatief of the Verkenningsfase into a TB in the Planuitwerkingsfase. (2) These elements are considered relevant to consider during the case study, as the inclusion of climate concerns in these elements can be analysed. Furthermore, this is considered the right level of abstraction for the analysis. A higher level would result in vagueness on the specific parts of the process, and the impact of CSFs on the Planuitwerkingsfase. A lower level of abstraction would mean decision-making processes are considered in more detail, that is considered too detailed for this thesis. The elements of figure 3.2 are explained here:

MER: *Milieueffectrapport, report of environmental effect study.*
m.e.r.: *Milieueffectenrapportage: procedure of the environmental effect study, based on Wet Milieubeheer article 7 (Rijksoverheid, 2017).*

PlanMER

The PlanMER assesses the impact of different alternatives to the congestion problem on the local environment. The PlanMER is part of the Verkenningsfase (RWS, 2010). This study can include climate considerations (Ex.4). In that case the PlanMER shows the place of Climate considerations in the early planning project. The result of this study is a preferred alternative or the Voorkeursbeslissing. The PlanMER is an indicator of the inclusion of climate considerations in the early project.

Voorkeursbeslissing

The Voorkeursbeslissing is a political decision on the preferred alternative. The decision produces a clear and motivated choice for one solution. This choice needs to be sufficiently back-up by the PlanMER in order to be used in the ProjectMER (Ministerie van I&M, 2016a). The Voorkeursbeslissing discusses the actions and measures that can be excluded from future studies. Narrowing the scope of the next phase. Furthermore, it elaborates on the financial aspects of the project. The decision does not necessarily lead to a Planuitwerkingsfase (Ex.2). The Voorkeursbeslissing is an indicator of whether climate considerations were part of the PlanMER and early project considerations, and whether those considerations were deemed relevant enough to be included in the project.

Project plan

The project manager, local authorities and stakeholders draw up a project plan (RWS, 2017). The plan includes an outline of how to approach the different measures that will be taken in the

Planuitwerkingsfase. The activities are listed, and a project team is constituted. This forms the transition from Verkenningsfase to Planuitwerkingsfase. Notes on climate considerations could be drawn-up in this process, as ambitions of the previous phase are evaluated during this process (Ex.1). The project plan indicates if climate considerations of the Verkenningsfase get a place in the Planuitwerkingsfase. It can also be the case that climate concerns are implemented here, as the project manager local authorities and stakeholders create a plan for the future project. If climate concerns were not included in the Verkenningsfase, this is the first moment in the Planuitwerkingsfase were inclusion of climate considerations is possible.

Variants construction

The Voorkeursalternatief is further developed. This means different variants to the alternatives are made. These variants need to fulfil certain requirements (RWS, 2017). The decision for certain variants is politically motivated. This can either be from an ideology or through a social need. The focus of variants is to find a most optimal variant to the alternative. Variants must remain within the project scope and the sphere of influence of the project team and costs must be within the budget. The cost however may not be the only criterion since it would eliminate innovative ideas quickly. The decision for variants is politically driven, and can thus include climate, if that is a political concern.

That is an interesting note, as in the Voorkeursbeslissing the decision for certain variants is politically loaded. It is the project organisation that builds the variants, and in that way guides the focus of these variants. Including a climate related variant could help the decision-making to favour inclusion of climate aspects in the project (Ex.4). In order to achieve this, the project organisation will have to include climate considerations in variants, and the political decision-makers need to choose the climate variant as part of the assessment.

Uitgangspuntendocument

When a decision is made on the variants a decision must be made on the criteria to assess those variants. The criteria are drawn up by the project organisation, specifically the Omgevingsmanager and Technisch Manager (RWS, 2017). However, they are guided by the wishes of the public. After the decision for a set of variants a public announcement is made that an environmental effect study starts. local stakeholders and the public can comment on that announcement and propose the use of certain criteria or areas of interests. This need for public participation is enforced by Wet Milieubeheer article 7.2 (Rijksoverheid, 2017). The Uitgangspuntendocument includes the criteria and framework for the assessment of variants (RWS, 2017). Inclusion of climate concerns here means that climate criteria are part of the assessment. A ProjectMER will only include climate criteria if it is part of this document. Therefore it serves as indicator for inclusion of climate concerns in the MER. That means, that the project organisation wants to assess a solution on the merits for the climate. If that is the case, it suggests that a project organisation wants to address climate concerns during the road construction.

ProjectMER

During the assessment phase the effects are assessed, the assessment serves different goals. One of those goals is to limit the negative effects on the environment. Measures including prevention, integration, mitigation, adaptation and compensation are aspects that need to be addressed in the reporting (RWS, 2017). The ProjectMER is the key final document of the effects study. It describes all the effects of an alternative and its variants. It is a supporting document for the final project decision. The document can subsequently be used for the design. It identifies possible problems and can thus guide the requirements of a final design. The Project manager and Omgevingsmanager are concerned with this aspect of the project (RWS, 2017)

The ProjectMER ends with a MMA (Meest Milieuvriendelijke Alternatief) Environmental most friendly alternative. It is up to the political decision-makers to weigh the findings of this effect study.

Including climate concerns in the ProjectMER creates a situation where the variants are assessed for climate aspects (Ex.4). Consequently, climate concerns can be part of the trade-offs for a final decision

OTB, Advies commissie m.e.r. and TB

The final decision of a Planuitwerkingsfase is usually a TB. These decisions are legally binding decisions. The end of the assessment phase leads to OTB (RWS, 2017). Together with the MER the OTB is the most important decision or document of this phase. The legal requirements to an OTB are part of art. 10 of the Tracéwet. The OTB incorporates the findings of the MER and the problem analysis into a well-motivated decision for one variant. This decision contains requirements for the design and decisions on how and where the road is to be constructed. The MER itself is send to the Commissie m.e.r, an institute that assesses the execution of the m.e.r (RWS, 2017) The OTB is published and there is a possibility for public participation with the Zienswijzeprocedure. Advice of the commissie m.e.r. is given. The OTB is then changed to a TB, taking all advice and recommendation in to account.

Some interesting findings; the OTB is a political decision based on research of the project organisation in the ProjectMER. Since it is political, trade-offs are made, not just on the research of the MER, but also based on political views and forces in the political arena. The Omgevingsmanager and Project manager are the main actors in the creation of the OTB (RWS, 2017).

Relatively late in the planning process, the public is asked to comment on the proposed solution with the Zienswijzeprocedure. This shows the strong interrelations between project organisation, political environment, stakeholders and general public. A last remark on the relations between climate inclusion and the OTB and TB and the processes leading up to them. Including climate concerns in the OTB and TB, embeds climate concerns in the solution. However inclusion of climate aspects in this phase is relatively late. As it would not have been part of the ProjectMER, and thus the variants are not assessed on climate criteria (Ex.4). However, inclusion in the TB is possible through both project organisational, political or general public wishes (Ex.4). This is the case since the final decision is a political decision. If the political environment wants the inclusion of climate aspects, they can decide to include it. And through the Zienswijzeprocedure the general public can push for inclusion of climate concerns in the TB. The TB is a good indicator of whether climate concerns (adaptation or mitigation) have been part of the planning process.

3.2.3 Component B: The Tender Procedure

The tender procedure is the second component of the Planuitwerkingsfase, running parallel to the spatial planning procedure (Ex.1). This tender procedure follows the European directive 2014/24/EU on public procurement (European Parliament, 2014). In the Netherlands this directive has been translated into the Aanbestedingswet 2012 (Public Procurement Law), which requires large public projects outsource parts of the project to the private sector. Central in this component is the translation of project goals and wishes of different actors into design requirements (Ex.3). The requirements are consequently used in a tender between market parties. The most optimal design wins the tender. Subsequently, a contract is made with the contractor. These different parts of the tender procedure are included in this thesis for two reasons: (1) The parts are the main elements of the procedure and necessary to translate goals and wishes to useable requirements for the design to be used in the tender and contracting phase. (2) These parts are considered relevant to consider during the case study, as the inclusion of climate concerns in these elements can be analysed.

Start tender, KES/SES and PvE

After a decision has been made to cooperate with the market, the tender procedure is started (RWS, 2017). The tender procedure is a way to determine which private company will participate in the realisation of public works or services. These following criteria from the Aanbestedingswet provide the main decision framework.

4. Test whether the competitors satisfy the technical specifications, requirements and standards which have been established before the tender (Programma van Eisen en Wensen, PvE).
5. The assessment of competitors based on award criteria (Gunningscriteria).
6. Award decision is made and published.
7. Contract procedure between contracting authority and contractor.

First the ambitions, goals and technical restrictions of the spatial planning procedure are brought together to create a PvE (program of requirements). This is done with Klanteisenspecificatie (KES) or client requirements specification, and Systeemeisenspecificatie (SES) system requirement specification. The Contract manager is identified as playing a key role in this process (RWS, 2017).

KES – Klanteisenspecificatie – Client Requirement Specification
The requirements for a design are embedded in a PvE. The requirements are deviated from the problem analysis. Through a system engineering approach, functional requirements for the design are established. The establishment of requirements is done via Klanteneisenspecificatie (Ex.3). These requirements define what stakeholders expect of the solution. KES is derived from the system engineering concept of Stakeholder Requirements (StRS) (Faulconbridge & Ryan, 2014).

SES – Systeem Eisen Specificatie – System Requirements Specification (SyRS)
It is not merely stakeholders' wishes and needs that make up a program of requirements. The system needs to fulfil certain requirements in order to solve the problem. The StRS and SyRS are closely linked since. SES is the specification of system requirements based on the stakeholder and user requirements. System requirements further elaborate on stakeholder requirements. It is about the translation of stakeholder requirements to functional system requirements.

In most projects a PvE is created, through KES and SES. In the tender procedure the contracting authority can, based on its findings in the Verkenningsfase and Planuitwerkingsfase and the ambitions, construct a program of requirements. The contractors competing in the tender are than able to provide a design to satisfy the requirements. Not satisfying them can lead to exclusion. The program of wishes can be added. These wishes are not grounds for exclusion when not satisfied, however the authority can express its desire to have these elements included.

Gunningscriteria – Award Criteria
Awarding the project to a contractor is based on the award criteria. In the Netherlands these are based on the EMVI criteria (Economisch Meest Voordelige Inschrijving) or most economically advantageous tender. According to the Aanbestedingswet Article 2.114 three elements are vital in the decision for EMVI.

1. Best price-quality ratio
2. Lowest costs based on cost-effectiveness, like lifecycle-costs
3. Lowest price

Part 2 entails cost-effectiveness of the design over the whole life span. This part is closely linked to climate concerns. As the design is now chosen based on its costs over the whole lifecycle. This requires a long-term view which is needed for climate inclusive designs and guarantees that long-term climate design do not necessarily lose to short-term designs.

Contracting
After a contractor is chosen a process of discussing the design and creating contracts is started. These contracts discuss the design and specifications of the construction. Two types of contracts are used.

DBFM – Design, Built, Finance and Maintain

The contractor is responsible for both the design and construction of the road, as he is responsible for raising the financial investments necessary, the contractor is responsible for the maintenance of the road. More responsibilities and risks are allocated to the private company. As a result the contractor includes the maintenance issues into the design. This improves cost-efficiency and creates a shared interest, since the contractor does not get paid if the road cannot be utilised. (RWS, n.d.) An important difference with D&C contract is that in that case a product is bought. RWS essentially buys a road. With a DBFM contracts RWS buys a service, a road that can be used. RWS favours this form of contract over others since many responsibilities are handled by the private contractor (Verweij, 2015).

D&C – Design and Construct

The D&C contract focusses on design and construction. RWS develops a clear set of functional requirements for the design. The contractor provides a design and starts construction. These steps do not differ from the Design and Built step all that much. However, there is no incentive to think beyond the construction. A design that satisfies the requirements is realised, there ends the cooperation. However, in MIRT-project concerned with the Dutch main road network DBFM is chosen more often, due to the more comprehensive and integral approach. An advantage of D&C is that it uses standardised contracts for procurement of goods. This increases efficiency and decreases transaction costs. The standardised contracts are based on UAV-GC 2005. (RWS, n.d.)

3.3 Obligatory documents

So far, this chapter discussed the Dutch planning process with a focus on the Planuitwerkingsfase. The main processes and documents discussed are identified as key parts of this particular phase. As mentioned in §2.2.1 the document study of the case studies uses a list of obligatory documents. During the process of acquiring documents for the case study, the focus is on acquiring these 'obligatory' documents. If these are found, they are analysed. The list of obligatory documents helps to create focus on a specific set of documents, that have been identified as important in relation to inclusion of climate considerations in road planning. In this chapter the following list is identified:

Table 3.1: List of twelve obligatory documents or decision that are analysed in each case study. Left the document, right the reason to include that document

Document/Decision	Reason to include in analysis
PlanMER	Identify whether climate mitigation and adaptation were considered during the Verkenningsfase.
Voorkeursbeslissing	Identify if ambitions of climate mitigation and adaptation were present during Verkenningsfase.
Project-plan	Identify if ambitions climate mitigation and adaptation influenced the forming of the project team and planning approach.
Variants construction	Identify if climate mitigation and adaptation ambitions affected the forming of variants.
Uitgangspuntendocument	Identify whether climate mitigation and adaptation have gotten a place in the criteria for ProjectMER.
ProjectMER	Identify to assessment of the variant on climate mitigation and adaptation.
Programma van Eisen en Wensen	Identify if climate mitigation and adaptation where are considered in the requirements or wishes of the project.
Gunningscriteria	Identify if climate mitigation and adaptation played a role during the awarding of the tender.
OTB	Identify if climate mitigation and adaptation have become part of the OTB.
Advice Commissie m.e.r.	Identify whether the OTB was advised on more climate mitigation and adaptation inclusion.
Zienswijzeprocedure	Identify how the public has influenced decisions on if climate mitigation and adaptation.
TB	Identify if climate mitigation and adaptation are part of the final decision.

The PlanMER and Voorkeursbeslissing originate from the Verkenningsfase. Therefore these documents show whether climate considerations played a part during the early planning project. The Project-plan, Variant construction, Uitgangspuntendocument and ProjectMER are the key documents of the Planuitwerkingsfase and show if climate considerations played a part during variant construction and assessment.

The PvE shows if climate concerns are embedded in a set of clear requirements for the market. As PvE are more confidential, they are harder to obtain. The Gunningscriteria are the criteria used for the assessment of a design of the contractor. These criteria show whether climate consideration play a part during the decision for a final project design. It also shows if the planning process has led to the establishment of climate related criteria for the decision of a design, and thus indicates if the planning process has included climate considerations.

The OTB, Advies commissie m.e.r. and TB show if climate consideration were part of the final spatial planning decision, that indicates that climate concerns were part of the planning process.

The Zienswijzeprocedure shows the interest of the public in the inclusion of climate mitigation and adaptation in the road project.

3.4 Conclusion

This chapter discussed the road planning process in the Dutch context. The discussion of the different elements of the planning process leads to the identification of the main documents, processes and decisions of the planning process. It was established that the Dutch road planning process consists of two components a spatial planning component (A) and a tender procedure component (B). It is concluded that both components are relevant in the inclusion of climate considerations in Dutch road projects. Component A is about the specific place and form of the road, and the related studies and decisions. Inclusion of climate concerns in this part ensures climate as a consideration during decisions on the location and form of the road. Inclusion of climate concerns in component B, is focused on the creation of requirements and challenges to the private sector since private contractors design and built the road.

This chapter identified elements of the planning process that can be used in the analysis of case studies. A list of obligatory documents is created. This list is a guideline for the identification of useful documents during the case studies. Furthermore, five managers are identified. This knowledge is used in the search for project members that can be interviewed. The importance of the Project manager, the Omgevingsmanager and Contract manager is discussed during several of the five interviews held in relation to this part of the research.

This chapter saw the creation of a conceptual model of the Dutch road planning system. Based on the prescribed process and the findings of the interviews an overview of the system is created. This conceptual model is used in the later part of this thesis, to discuss where and how CSFs play a part in the planning process, and therefore helps to address sub-question 3 and consequently the main research question. Furthermore, this model is used to assess where solutions must impact the ‘system’ to be successful, this relates to answering the additional research question.

The findings of this chapter answer sub-question 1, as it has become clear what and where to focus on in the Planuitwerkingsfase during the case studies. The list of obligatory documents, identified managers and the conceptual model or overview of the planning process are a necessary input for the case studies. Moreover, the findings of the case studies, the identified CSFs, can be linked to the identified planning process or ‘system’, which results in a better understanding of the climate inclusion process and the problems or opportunities

4. Literature review: CSFs to inclusion of climate concerns in road planning

The purpose of this chapter is to identify critical success and failure factors of inclusion of climate concerns in road planning as it is available in scientific literature and documents. To that end a literature review is conducted, as was discussed in chapter 2. This chapter answers sub-question 2, what CSFs on inclusion of climate considerations are present in literature? This chapter starts by an elaboration of the theoretical concept of CSFs. Subsequently, the results of the literature review are shown and discussed. Lastly, several notes are made on the use and validity of the findings.

4.1 Critical Success Factors (CSFs)

Critical success factors (CSFs) was first described by Rockart (1979). The identification of CSFs helps executives and decision-makers to focus on those elements in their respective organisation that are critical in reaching their main goals. As Rockart (1979, pp. 86) states: *"CSFs are the few key areas where "things must go right" for businesses to flourish. If results in this area are not adequate, the organization's efforts for the period will be less than desired."*

The CSF approach of Rockart (1979) is focussed on businesses. Business can increase their success by addressing some areas in their field of influence that are key to their success. This means that these factors or elements are necessary for achieving the main business goal.
Boynton & Zmud (1984) elaborate on CSFs. Firstly, they establish that, since CSFs are vital for a business' success, constant attention must be given to those factors. The use of CSFs or the CSF method possesses both strengths and weaknesses. The use of CSFs support planning processes, creation of new information and insights that improve the competitive position of a business, creating a better understanding at higher levels and creating trust and promoting structured analysis processes for businesses (Boynton & Zmud, 1984). The method also possesses weaknesses, in large organisations with multi-level decision-making it becomes difficult to identify CSFs, CSFs must be more or less conceptually addressed and not in too much detail.

How does the concept of CSFs relate to road planning and this project? Firstly, a project organisation of a road project can be approached as a business. It has employees and works towards a goal, there are financial restrictions and incentives. The similarities between businesses as meant by Rockart (1979) and road planning as in the context of this thesis make it possible to use CSFs. What that means is that this research aims at finding critical factors in current road planning that are important to achieve inclusion of climate adaptation and mitigation. The weakness showed by Boynton & Zmud (1984) must be considered. MIRT road infrastructure project are billion-euro projects. The enormity of the project can make it difficult to identify CSFs. However, the decision-making process is quite centred around the project organisation and local or regional authorities. That limits the problems, since the number of levels of decision-making is limited, as a result the decision-makers are capable of overseeing to whole project and define areas which are vital for its success.

CSFs can be considered the means to fulfil the goals or strategy (Friesen & Johnson, 1995). In the case of road planning and climate concerns the successful inclusion of climate mitigation and adaptation is the goal. The CSFs are the means to achieve this.

Addressing CSFs in the scope of this project can rely on earlier findings in literature as is discussed in the following section. Those findings are specific for road planning and spatial development. However more general CSFs are available in literature. A literate review of Belassi & Tukel (1996) summarizes the main CSFs found for any business. Four main groups of CSFs are found: (1) Factors related to Project Manager and Team members, (2) Factors related to the Project, (3) Factors related to the organisation and (4) Factors related to the external environment. Belassi & Tukel (1996) explicitly name the political, economic, social, technological environments. What can be gained from this. four main conclusions are drawn:

- CSFs can be used to analyse road planning in Dutch context. Inclusion of climate concerns is the goal and CSFs are the means.
- An indicator for a CSF is that it is vital, if an identified factor is not vital to the success it is not considered a CSF.
- Identification of CSFs in large project can be difficult. This was deemed a limited problem since the decision-making process is centralised to project organisation and local and regional authorities.
- Several general CSFs, concerning project organisation and external environment are identified.

This section has illuminated the concept of CSFs. The use of this concept as discussed by Rockart (1979) and Boynton & Zmud (1984) revolves around identifying key or critical aspects of an organisation to achieve success. This can imply that all the identified factors must be addressed to create success. In some organisations this can be the case. However, it is questionable if that is the case in road planning and the inclusion of climate considerations. Perhaps stimulating one CSF can significantly influence inclusion of climate concerns. As such the stimulation of other CSFs is unnecessary. However, they could still be critical as the stimulation of other CSFs could also lead to success. Therefore this thesis uses CSFs more losely. CSFs are those elements of the road planning process that must be taken into account since those elements are the parts of the planning process that possess problems or opportunities. It is worth mentioning that a CSF can also be a barrier. A lack of consideration for a specific part of the planning process can create obstruction. Addressing these barriers could result in an increase of success. consequently, that part of the planning process is considered a CSF. Success depends on whether or not the barrier is addressed and overcome.

In short. The concept CSFs is used in this thesis to illuminate parts of the planning process that possess problems or opportunities, that if addressed could help constitute success. That does not mean all CSFs must be address to reach success.

4.2 Literature Study Results

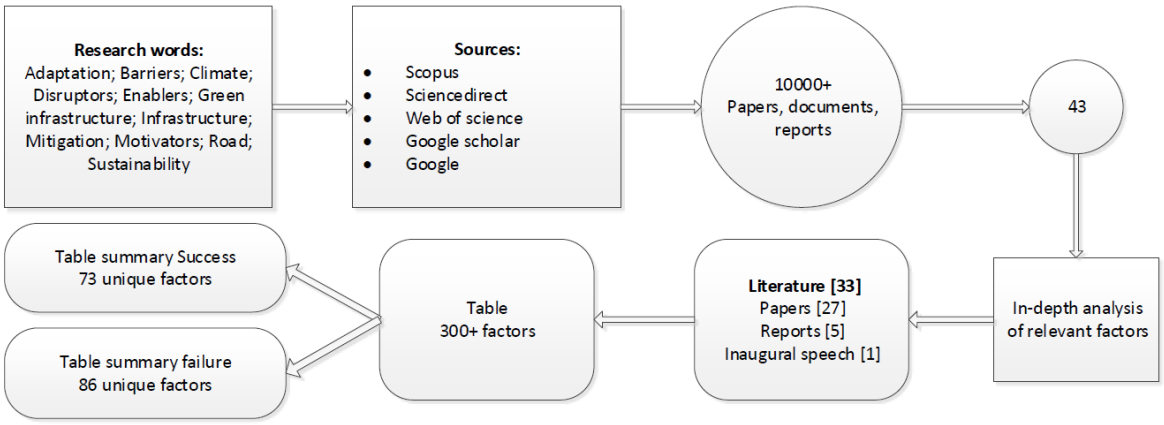

Figure 4.1: Visual representation of research method literature study success and failure factors.

As mentioned in chapter 2 the literature study is carried out by using a set of research words in large online literature databases. The words as seen in figure 4.1 were used in English in the scientific databases. Dutch counterparts of the research words were also used in Google, to obtain documents that might use factors in the Dutch context. With that first use of words and databases, thousands of papers were identified. Through a combination of more research words at once, the amount of papers dropped tremendously. The search is limited to the first five pages of titles. By analysing the titles, and if deemed interesting the abstract or summary, 43 papers and documents were identified. The papers were submitted to in-depth analysis. The focus of this was to identify whether the documents

contained factors either positive or negative in a context that is similar to the context of this thesis project. This analysis lead to two things. Firstly, the reduction of the number of documents to 33, of which 27 are scientific papers, 5 are reports and 1 is an inaugural speech. Secondly, around 300 instances were found were some sort of factor was identified. The 300 factors were used to make a table summary. Most factors were categorised under an overarching concept. Table 4.1 (next page) shows the sources used and the identified overarching CSFs. This creates an overview of the relative importance of some factors. Relative importance here means: the number of times a factor is discussed in the literature. It must be noted that, that is not always true. A CSF that is obscener could be one of the more critical factors. However, for this thesis the decision is made to focus on the factors that are discussed more often. A detailed list of the findings containing the specific factors, number of times a factor is found, and the expected impact is found in Appendix D.

18 overarching factors are identified. Almost half of the literature discusses the importance of information and knowledge in decision-making and the importance of clearly defined goal and scope, or inclusion of climate concerns in that scope. One third of the literature discusses financial feasibility, incentives and the budgets. Also the mind-set and participation of general public, perceptions, misconception and cognitive barriers, the mind-set of the political environment and policies and legal and institutional factors are discussed in one third of the literature. A quarter of the literature discusses the importance of early inclusion, the form and mind-set of project organisations and the availability of technology. In six instances the mind-set of stakeholders and governance and monitoring are discussed. The remaining factors are only discussed in five or less papers.

What to do with these results? Firstly, the goal of this chapter is to identify CSFs for the inclusion of climate concerns in development project. The factors act as guidance for this research, and this research checks whether these factors can be found in the Dutch road planning process. Some of these factors deserve more attentions, as they are observed more and there is a higher probability that they are relevant. The decision is made to elaborate on some of the factors that are deemed relevant for this thesis. The CSFs that are elaborated on are: Information and knowledge in decision-making, Inclusion and clarity in project goal and scope, Financial feasibility, incentives and budget, Participation and mind-set of general public and Stakeholders, Perceptions, misconceptions and cognitive barriers, Political decision-makers, environment and policies, Laws and legal standards and Form, mind-set and priorities of project organisation.

The observant reader will have noticed two discrepancies between the results of the table and this list. Firstly, institutional environment factors are not included. ‘The institutional context’ is a rather broad term that includes many different other elements e.g. legal, project organisational, governance etc. The literature mentions institutional context numerous times; however it remains a broad concept. More detailed factors within that institutional context are named but belong to some of the other factors. Secondly, the factors of general public and stakeholders are combined. The two factors share several elements and are related to one another. The general public is one stakeholder, and stakeholders will want the support of the public. therefore the findings are discussed together, this is for reading purposes only, the factors are used as separate factors.

Table 2.1: Findings of critical success factors of the inclusion of climate concerns, sustainability or innovations in road planning or other spatial development projects. The rows or Y-axis are the 33 pieces of literature used. The columns or X-axis are the 18 identified CSFs in short. The crosses (X) in the table represent that a factor is find in the paper. The bottom row shows how many times a factor is found.

	1. Information and knowledge in decision-making	2. Inclusion in and clarity of project goals and scope	3. Financial feasibility, financial incentives and budget	4. Participation and mind-set general public	5. Perceptions, misconceptions and cognitive barriers	6. Political decision-makers, political environment and policies	7. Laws and legal standards	8. Institutional Environment	9. Form, mind-set and priorities of project organisation	10. Early inclusion	11. Availability of technology	12. Participation and mind-set stakeholders	13. Governance and possibility monitoring	14. Socio-economic development	15. Form and restrictions of design requirements	16. Market inclusion and incentives	17. Change adaptation	18. Type of contract
Brundtland, 1987				X		X	X	X										
IPCC, 2001				X	X	X		X			X			X				
Swart, Robinson, & Cohen, 2003				X				X		X								
Arts, 2007		X	X			X	X		X	X		X	X			X		X
Heeres, Tillema, & Arts, 2012			X						X	X			X					
Lenferink, Tillema, & Arts, 2013	X				X				X	X					X			X
Shaw, Burch, Kristensen, Robinson, & Dale, 2014	X			X		X	X											
Sözüer & Spang, 2014				X			X		X								X	
Loon-Steensma., Schelfhout, & Vellinga, 2014			X															
Busscher, Tillema, & Arts, 2015		X	X			X		X			X	X					X	
van den Herik, 2015	X	X		X	X				X	X		X						
Matthews, Lo, & Byrne, 2015		X			X				X									
Turnheim, et al., 2015		X		X	X								X					
Arts, Hanekamp, Linssen, & Snippe, 2016			X											X	X			
NAS, 2016	X	X								X								
Rizzo, et al., 2016	X											X						
Samset & Volden, 2016	X	X	X		X	X			X								X	
Dhakal & Chevalier, 2017	X	X	X		X		X		X				X			X		
Kivila, Martinsuo, & Vuorinen, 2017		X		X			X					X	X					
Labonnote, Skaar, & Rüther, 2017		X									X				X			
Lah, 2017	X					X												
Malekpour, Brown, Haan, & Wong, 2017	X	X	X	X	X	X	X	X		X	X	X		X				
Niesten, Jolink, Jabbour, Chappin, & Lozano, 2017								X										
Ritzén & Sandström, 2017	X		X		X						X							
Ruijs & Egmond, 2017	X	X					X			X								
Azhoni, Jude, & Holman, 2018	X		X	X	X		X	X			X			X				
Biresselioglu, Nilsen, Demir, RØyrvik, & Koksvik, 2018	X	X		X	X	X		X			X					X		
Carroli, 2018		X						X			X							
Jesus & Mendonça, 2018			X					X						X				
Mees, Tijhuis, & Dieperink, 2018	X					X							X					
NAS, 2018	X			X		X	X											
Shealy, et al., 2018							X											
Studart & Gallaghar, 2018			X															
	15	14	12	12	11	11	11	10	8	8	8	6	6	5	3	3	3	2

4.2 Overview of CSFs in Literature

Table 4.2 is a short overview of the main CSFs identified. This section aims to illuminate some of the findings. The main findings and some of the sub-factors of each CSF are discussed, followed by an explanation of the relevance of that finding for this study. Lastly for each factor it is discussed whether the factor can be considered a critical factor. Aspect 10-18 are addressed together as they were not found often. That discussion shortly explains what that factor entails.

Table 4.2: List of main CSFs of inclusion of climate concerns or sustainability in development identified in the literature. In the top left corner the factor identified the most times is given followed by the next 17 factors in order of number of times found. A more extensive list of findings with sub-factors can be found in Appendix A.

1. Information and knowledge in decision-making	7. Laws and legal standards	13. Governance and possibility monitoring
2. Inclusion in and clarity of project goals and scope	8. Institutional environment	14. Socio-economic development
3. Financial feasibility, financial incentives and budget	9. Form, mind-set and priorities of project organisation	15. Form and restrictions of design requirements
4. Participation and mind-set general public	10. Early inclusion	16. Market inclusion and incentives
5. Perceptions, misconceptions and cognitive barriers	11. Availability of technology	17. Change adaptation
6. Political decision-makers, political environment and policies	12. Participation and mind-set stakeholders	18. Type of contract

4.2.1 Information and Knowledge in Decision-making

Information and knowledge play an important part in the inclusion of climate mitigation or adaptation, or other sustainable practices in development projects. Every decision and design made is based on information. It is information and knowledge on technical innovations that makes a project aware of climate friendly solutions. Furthermore it is knowledge that creates awareness of climate change in project organisations, politics and among the public (Lenferink et al. 2013; Sözüer & Spang, 2014; Van den Herik, 2015, Azhoni et al., 2018; Mees et al. 2018). A lack of information causes problems. Decisions become less well-informed, and sustainability or climate concerns do not get a place in the project (Ritzèn & Sandstorm, 2017; Ruijs & Egmond, 2017; Biresselioglu et al. 2018; Mees et al., 2018). Decisions that are made without proper information can create problems later in the development project, where a diversion of the course taken is more difficult. Helpful in creating information is the existence of networks of experts that can help the decision-makers (Lah, 2017). While a lack of information is troublesome, an overload of studies and research can slow down the development project (Arts J. , 2007; Sözüer & Spang, 2014). Decision-making can be difficult due to the vast amount of studies and information.

The importance of information has been established. During planning projects, decisions are based on available information. Information on climate change can help the inclusion of climate mitigation and adaptation in projects. Is that a critical factor? Considering what would happen in the complete absence of climate change information, it is. No information on climate change cannot create awareness and cannot guide decisions of project, therefore information is critical. Criticality of this factor is created to what would happen if it did not exist. The factor alone is not a certain solution to the problem of climate inclusion in road planning. However information is a precondition to success. Information is established as CSF, in theory. This thesis assesses if this factor is noticed and critical in the context of Dutch road planning and the inclusion of climate concerns.

4.2.2 Inclusion in and Clarity of Project Goal & Scope

Clearly formulated climate project goals impact the success of implementing sustainability (Shaw et al., 2014; Busscher et al., 2015; Van den Herik, 2015; Turnheim, et al., 2015; Kivila et al. 2017; Malekpour et al., 2017; Biresselioglu et al., 2018). Two parts are central in the success of projects goals and climate (1) A climate aspect and (2) a clear definition of that aspect. (Shaw et al. 2014; Van den Herik, 2015). Related to goals is early inclusion, which helps to make climate concerns integral part of the project (Kivila et al., 2017) and of the scope. A well-defined project scope is important since it establishes what is part of the project what not. (Busscher et al., 2015). Inclusion in the early project scope and goals is related to success. Currently those goals are either not present, or not clear enough (Labonnote et al., 2017; Carroli, 2018). Related to insufficient sustainability goals is the lack of realistic objectives (Samset & Volden, 2016). The objectives do not represent the purpose of the project in the real world. Consequently, articulating climate goals from those objectives is difficult.

The importance of a project climate goal and the inclusion of climate adaptation or mitigation in the project scope is established. Goals in road planning are mostly concerned with two things, solving

congestion and implementing a road in the existing spatial situation. A climate goal is necessary to shift the narrow view on these two elements to a third element, the creation of a road with regard for climate issues. Climate goals embed awareness of climate problems and possibly related ambitions into clear project objectives. This embeddedness ensures the inclusion of climate consideration in the project. Is this factor critical? A climate goal is potentially not critical; the lack of a goal does not make the chances of inclusion zero as for instance a lack of climate change awareness and knowledge would. However, in order to be successful through human actions it is important. The inclusion of climate concerns in goal and project scope create an integral project concern for climate change. For that reason this factor is considered a CSF, as it is an important means to achieve success.

4.2.3 Financial Feasibility, Financial Incentives and Budget

Financial factors are about the financial feasibility of projects, and how financial aspects can influence inclusion of climate measures in projects. This is strongly related to the budget drawn up in early planning phases. Financial uncertainty about return and profit of projects create problems. A project needs to be profitable (Ritzén & Sandström, 2017; Jesus & Mendonça, 2018). However, sustainable solutions are usually more expensive than traditional solutions. In order to be financially profitable, the climate related solution must be able to compete with conventional solutions since the budget is limited. This is addressed with financial incentives favouring climate related solutions (Dhakal & Chevalier, 2017; Malekpour et al., 2017). As noticed in the literature financial aspects of a project are of key importance. The financial feasibility limits the opportunities for decision-makers. As shown, the uncertainty and relative expensiveness of climate related solutions obstruct success. Financial feasibility creates tension between priorities. So in order to include climate mitigation and adaptation in road planning, it must be in line with the financial feasibility of that project. The Financial factor can be considered critical. The factor is instrumental in obstructing or opening up the inclusion of climate considerations. This corresponds with the findings of Belassi & Tukel (1996). A last remark, merely introducing large financial resources cannot solve underlying information and awareness problems

4.2.4 Participation and Mind-set of Stakeholders and General public

Support from the stakeholders can positively impact the effectiveness and efficiency of the project. (Swart et al. 2003; Lenferink et al., 2013; Sözüer & Spang, 2014; Rizzo, et al., 2016; Malekpour et al., 2017). Furthermore, it can help avoid hindrances along the way, since stakeholders and their needs are considered (Arts, 2007). A key factor that can lead to success in terms of stakeholder involvement is to include stakeholders early (Arts, 2007). A vision which is supported by most stakeholders can lead to successful sustainable development since hindrances are avoided and stakeholders are ready to participate in realising that vision. Just as stakeholders the general public plays a part. The general public is not necessarily involved in the project however, it is a large potential troublemaker. To that end it is important to create public support for the project. The public must understand why the project does what it does, how that will be achieved and how that will impact them. Furthermore, public support for the vision of the project is useful (Van den Herik, 2015; Malekpour et al., 2017). In short creating public support demands good communication, interaction and the alignment of project goals with local needs. This is essential as stakeholder and general public needs and wishes can be in conflict with climate goals.

Stakeholders and general public form the external environment of a project (Belassi & Tukel 1996). As such both groups of actors can obstruct parts of the project. With regard to inclusion of climate considerations this can work both ways. A public with a climate mind-set can influence decision-makers to aim for climate related solutions. However a general public with other priorities can pressure the projects decision-makers to deal with those elements and not climate concerns. The two groups possess a lot of obstruction power. The two factors can be considered critical to lead climate concerns into the project. This means that the public and stakeholders can pressure the

inclusion of climate considerations. The positive attitude of stakeholders and General public are of critical importance in the inclusion of climate concerns in road projects.

4.2.5 Perceptions, Misconceptions and Cognitive Barriers

This factor is about perceptions of people or groups towards inclusion of climate in road planning. Two important factors here are long-term thinking (Lenferink et al., 2013; Van den Herik, 2015; Dhakal & Chevalier, 2017; Malekpour et al., 2017; Biresselioglu et al., 2018) and no traditional asphalt-oriented solutions (Dhakal & Chevalier, 2017).

Furthermore, there is the perception of risks and uncertainty surrounding climate measures (Dhakal & Chevalier, 2017; Malekpour et al., 2017; Biresselioglu et al., 2018). Sustainable solutions are uncertain, and the risk are perceived as much higher. As result these solutions are hard to implement, decision-makers tend to rely on proven solutions. By choosing traditional non-sustainable solutions risks are averted and certainty is gained. This creates short-term thinking. Solutions that are quick fixes with little risks are preferred (Arts et al., 2016; Matthews, Lo, & Byrne, 2015).

The factor is strongly related to information. What people think and what is factual differ. Decision-makers in road planning mostly favour conventional solutions. That means that for instance climate adaptation and mitigation results cannot be reached as long as the misconception on risks, feasibility and favouring of short-term solutions exists. Changing the mind-set of decision-makers is of vital importance to translate information on climate change to useful project elements. As long as the mind-set and perspectives are against inclusion of climate concerns, no significant results can be reached. Therefore this factor is considered critical.

4.2.6 Political Decision-makers, Political Environment and Policies

A typical political factor is long-term climate policies (Brundtland, 1987; Dhakal & Chevalier, 2017; Lah, 2017; Biresselioglu et al., 2018). Steering to sustainable development is politically loaded and depends highly on the ruling political parties. The ideology of the sitting ruling parties is therefore relevant (Lah, 2017). Lack of urgency in the political context can impede inclusion of climate aspects (Arts, 2007; Ruijs & Egmond, 2017; Mees et al., 2018). Urgency, views and leadership are related to priorities. Is climate considered a priority or, does it often lose to other priorities (Malekpour et al., 2017; Mees et al., 2018). Climate unfriendly priorities and viewpoints are often founded in a lack of political environmental awareness (Biresselioglu et al., 2018). Merely providing information and data is not always the solution, since politicians sometimes overrule expert advice for other priorities which are grounded in their viewpoints and believes (Samset & Volden, 2016). The political context is important in achieving inclusion of climate concerns. More often than not through a lack of awareness, sense of urgency and through own viewpoints and priorities, sustainability measures are not priorities in the political field. The political factor relates to the main decision-makers in road planning. The project organisation can provide ideas, yet it is a political decision that chooses a solution. Therefore, the views and knowledge of the political arena is critical. Without the right political circumstance and guiding policy, successful inclusion of climate concerns becomes difficult. The decision of the political arena inescapable. Therefore the political and policy factor is considered a CSF corresponding with the findings of Belassi & Tukel (1996).

4.2.7 Laws and Legal Standards

Embedding climate consideration in legal frameworks can help enforce sustainable development (Shaw et al., 2014; Dhakal & Chevalier, 2017; Kivila et al., 2017; Malekpour, et al., 2017; Jesus & Mendonça, 2018). Environmental laws are important since legitimacy for sustainable actions can be derived from them (Brundtland, 1987; Shaw et al., 2014; NAS, 2018). Laws and other statutory provisions can help enforce implementation of climate concerns (Dhakal & Chevalier, 2017). The idea of legal factors is that legal concepts, laws or standards are put in place by the government to enforce certain climate goals. An interesting notion it is. However it assumes that the government wants this inclusion of climate. Several policy documents show that the national government is willing to address

this issue, however legal embeddedness is a rigorous step that will conflict with many societal priorities. It is questionable if legal standards are preferable. Road planning involves the weighing and trade-off of many priorities and interests. A legal obligation to inclusion of climate concerns seems useful. However it will most likely create more complexity in road planning. Without a legal basis inclusion of climate could be possible. Embeddedness of climate concerns in the law could stimulate further inclusion of climate concerns in road planning. Furthermore, other laws and legal requirements can impede inclusion of climate matters. As such this factor is considered a CSF.

4.2.8 Form, Mind-set and Priorities of Project organisation

The project organisation as executive party in road planning is of vital importance for everything that happens in the project. The composition of project teams, task allocation, number of team members, experience etc. influence the success of a project in reaching its goals (Heeres et al., 2012; Van den Herik, 2015). It are the project team members that work out ideas and address priorities and interests. That is where currently a problem is observed. Project sometimes do not prioritize climate concerns above other priorities. (Samset & Volden, 2016; Mees et al., 2018). As chapter 3 showed nothing in a planning project happens without the project organisation. Addressing climate concerns can be done through them. However that can be problematic. As it is the project organisation that will need to use the CSFs of this research to find ways to stimulate the inclusion of climate concerns. And project organisation is a considered a CSF itself. Project organisations that already want to address inclusion of climate concerns in their project can use this CSFs to assess the workings of their own organisation. In case that project organisations do not want to address climate consideration it is up to other parties e.g. Ministerie van I&W or RWS to stimulate them. Establishing the project organisation as CSFs can help to focus stimulating policies. The project organisation and its mind-set towards climate concerns is considered a critical success factor for the inclusion of climate concerns in road planning.

4.2.9 Other factors

The last sections discussed the CSFs found in literature that are considered most important. As mentioned the institutional context factors is left out. And stakeholders and general public are discussed in §2.4. What remains are eight factors, that are shortly discussed here.

Early inclusion factor is closely linked to the factor of inclusion and clarity of project goal and scope. By intertwining climate concerns with other project priorities, early in the process, the success of reaching them both is increased. The goal is to include all priorities and limit potential conflict.

Availability of technology closely relates to climate adaptation and mitigation. A lack of technical ways to tackle these issues can have a negative effect on the potential for climate measures in a project. This factor restricts what a project can do in technical terms.

The governance and possibility of monitoring factor is about how included climate aspects can be enforced and monitored during later stages of a planning project. This is only relevant when climate concerns are already included. And does not relate to inclusion of climate concerns, it does impact the willingness to use legal standards.

The socio-economic development factor is about the larger socio-economic climate. Economic downturn for instance strongly impacts the construction sector. However there is no influence of the project organisation on this factor. Therefore it is not a useful CSF.

Form and restrictions of design requirements is identified as a factor. The requirements for a design can restrict or enable inclusion of climate measures. This factor is more related to the realisation of climate measures than inclusion of climate concerns in the planning project.

Market inclusion and incentives is about how the climate concerns that are included are translated into challenges to the market. Furthermore, it is about how the market can help to create climate measures. This factor is more concerned with specific climate measures after the planning process than early inclusion of climate aspects in the planning process.

Change adaptation relates to the ability of a project to address changes in the circumstances along the way. In large road projects, spanning fifteen years this can help to include new goals and priorities

during the planning process. This factor could help the inclusion of climate concerns, as these concerns have been more of a relevant topic in the last years.

Lastly the type of contract used. The contract was only named twice in the literature. The contract factor can help embed wishes into contract requirements this happens during the late planning process. Contracts are instruments that can help to maintain a climate concern, it cannot create inclusion. Contracts were also considered important aspects of the planning process, in chapter 3.

4.2.10 Conceptual model

The identified CSFs are used to create a conceptual model of the relation between CSFs and the inclusion of climate mitigation and adaptation in road planning. Figure 4.2 shows this model.

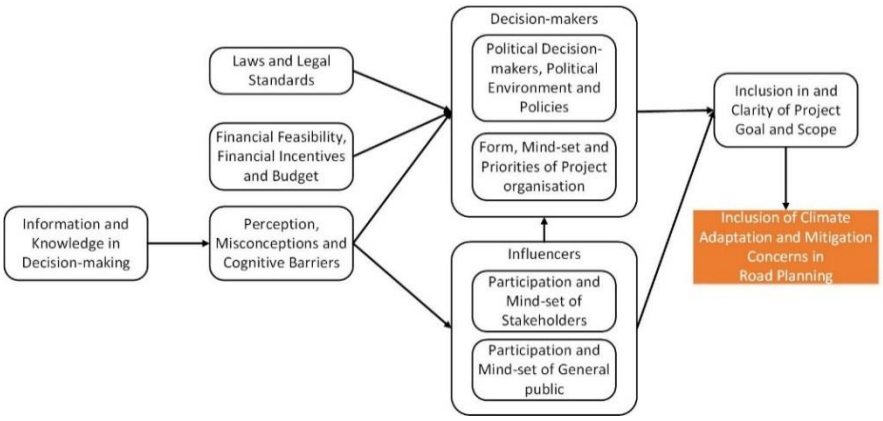

Figure 4.2: conceptual model of inclusion of climate mitigation and adaptation concerns in road infrastructure planning.

The impact of information on the process was discussed. Information helps to change people's perceptions and helps overcome misconceptions. The mind-set of decision-makers and influencers is important to include climate aspects. Furthermore, legal and financial factors impact the decisions of decision-makers. The decisions of these decision-makers create the goal and scope of the project. Inclusion of climate aspects in goals and scope mean that inclusion of climate adaptation and mitigation concerns in road planning are successful.

4.3 Conclusion

This chapter discussed the findings of a literature review to the existence of CSFs to inclusion of climate concerns in development projects. As seen the research helped identify eighteen main factors. Of those eighteen factors nine were explained and discussed in detail and were named critical success factors. The other nine factors could be critical success factors, however are not expected as such. This conclusion does two things, firstly, address the validity of the results and secondly, explain how these results are used in the context of this thesis.

The analysis of 33 documents lead to the list of CSFs. As there is a vast amount of literature, that can only be a small subset of what is available. Considering this, some of the factors will be overestimated and some will be underestimated. The number of papers discussing a factor was used as an indication for its importance. The assumption is made that this is the case. However there is no evidence to suggest that less reviewed factors are less important. However more papers on a factor do create reliability on the influence of that factor on the inclusion of climate.

The findings of this literature study serve two purposes. (1) The identified CSFs and other factors serve as guidance during the case studies. Knowing what factors look like, and in what forms they are present helps to identify the factors in the cases. (2) The identified CSFs can be checked in the cases. The literature shows the existence of these CSFs in different disciplines and to reach different goals. This research tries to establish if these CSFs are present in the Dutch road planning context, with the aim to include climate mitigation and adaptation. This chapter provides an answer to sub-question 2. The eighteen CSFs are used during the case studies.

5. Case Study Results

The methods described in chapter 2 are used on the three case studies, Zuidasdok, RijnlandRoute and A16 Rotterdam. This chapter discusses the main results of these three case studies. Each case study has resulted in an extensive list of factors influencing the inclusion of climate mitigation or climate adaptation. These factor tables are used to construct one table with all relevant factors. The factors are categorized into fifteen overarching factors. The fifteen factors, in various forms, are found in each case Table 5.1 shows the identified factors. The whole table with specific factors is found in Appendix E. This chapter discusses the main findings of each case. For each case study an overview table is given, the list of obligatory documents is revisited, and a short characterisation of that specific case is given. Followed by a discussion of the main findings of that case. That means that in some of the cases not all factors are discussed in detail. The results are structured along the lines of the earlier identified CSFs, however not limited to them. The main findings of these cases are combined in chapter 6.

Table 5.1: Main factors contributing or disrupting inclusion of climate mitigation and adaptation found in three case studies.

Perception, misconceptions and cognitive barriers	Political decision-makers, political environment and policies
Financial feasibility, financial incentives and budget	Form, mind-set and priorities of project organisation
Participation and mind-set of general public	Form and restrictions of design requirements
Inclusion in and clarity of project goals and scope	Participation and mind-set stakeholders
Information and knowledge in decision-making	Availability of technology
Early inclusion	Type of contract
Laws and legal standards	Time
Market inclusion and incentives	

5.1 Case 1: Zuidasdok

Zuidasdok is a large road and tunnel construction project in Amsterdam Zuid that limits congestion problems. The congested roads are relieved by rerouting the road through a set of tunnels and by broadening the roads altogether. Table 5.2 shows an overview of the main specifics of this project.

Table 5.2: Zuidasdok overview table

Project name	Zuidasdok
Project type	A10 Zuid is broadened, 1km of A10 Zuid is redirected through a tunnel.
Location	Amsterdam Zuid
Goals	Improvement of international prime location as integral part of Amsterdam. Optimally functioning transport and traffic network High quality public transport hub Sustainable integration of infrastructure, to improve the spatial quality and remove physical barriers.
Starting date	9-7-2012
Current phase	Realisatiefase
Expected final date	2028
Project owner	Gemeente Amsterdam, Rijkswaterstaat, ProRail
Project stakeholders	Ministerie van I&W, Stadsregio Amsterdam (Vervoerregio Amsterdam), Provincie Noord-Holland
Project team	RWS, ProRail, Gemeente Amsterdam, Consultants: IBZ Ingenieurs, Ingenieursbureau Oranjewoud, Infram
Description	Zuidasdok is a combination of spatial development, road infrastructure improvement and public transport improvement. The current A10 Zuid will be broadened, four to six lanes, and partly routed through a tunnel. Along with that the whole road infrastructure is redeveloped to decrease congestion and improve mobility and accessibility. Station Amsterdam Zuid can be extended to fit increasing passengers demand. The metro, tram and bus system are connected to the station. The spatial quality is improved by creating an integral green space, connecting different functions.

Table 5.3: Overview of obligatory documents used	
Documents	**Zuidasdok**
PlanMER	X
Voorkeursbeslissing	X
Project plan	
Variants construction	X
Uitgangspuntendocument	X
ProjectMER	X
PvE	
Gunningscriteria	
OTB	X
Advies Commissie m.e.r	X
Zienswijzeprocedure	X
TB	X

Table 5.4: Interviews held with experts on Zuidasdok	
Expert	**Role**
Expert 6	Team member contract management
Expert 7	Team member Planuitwerkingsfase

Nine of the obligatory documents are found and analysed. The project plan, PvE and Gunningscriteria are not identified in the document study, table 5.3. Two interviews are conducted. One with a team member of the contract management (Ex.6) and the other with a team member who was active during the Verkenningsfase and Planuitwerkingsfase of Zuidasdok (Ex.7), table 5.4. The document study and interviews lead to the identification of climate mitigation, adaptation and sustainability aspects in Zuidasdok. Furthermore, a set of factors are identified. Appendix F discusses the full analysis of this case and uses the analytical framework discussed in chapter 2. This Appendix also includes the full list of identified factors. Here the main factors and their place in Zuidasdok are discussed.

5.1.1 Characterisation of Zuidasdok

The project organisation considers Zuidasdok a sustainable project (Ex.6). A project where sustainability is a precondition to all decisions. Much of the sustainability is implicit, e.g. the congestion problem is solved, that reduces CO_2 emissions (Ex.6). The project does not explicitly address climate mitigation or adaptation or other climate issues. An energy inefficient tunnel is to be constructed. Zuidasdok did not make climate part of the project and does not address climate concerns as local energy production and climate resilience in water management. Zuidasdok does address climate in terms of materials and construction (Ministerie van I&M, 2015). Modular development and smart logistics during realisation are prime sustainability elements (Ex.6). In conclusion, the way climate aspects are included in Zuidasdok is limited (Ex.7).

5.1.2 Climate Concerns Not Part of Sustainability Goal

A sustainability goal in the early planning process of Zuidasdok is identified (Ministerie van I&M, 2012a). The goal entails: the sustainable integration of infrastructure. The sustainability goal is based on 3Ps and primarily focusses on improving liveability and economic attractiveness of the area. The climate aspect is limited. Surprisingly a climate focussed sustainability goal was dropped during the later Verkenningsfase (Ex.7). That has had its impact. Figure 5.1 (next page) shows this in action. This change from a climate focussed sustainability goal to an integration focussed sustainability goal creates a chain of problems. During the remainder of the Verkenningsfase and the early Planuitwerkingsfase there is a feeling that the project is quite sustainable, there are sustainable condition, awareness and mind-sets (Ministerie van I&M, 2012). However, it is a goal based around liveability and integration of the road. It is noticed, that climate aspect becomes a lower goal to the sustainability goal. That is seen in the trade-off to develop a large land tunnel. A tunnel is relatively climate unfriendly compared to a road on surface level. However it is considered sustainable in light of the used sustainability goal, and that strengthens the feeling that Zuidasdok is a sustainable project. Sustainability as used in the goals of Zuidasdok makes climate considerations inferior to other goals (Ex.7). It is worth noting that Zuidasdok is not capable of translating the sustainable mind-sets, climate change awareness and available sustainable project goals into requirements or measures (Ex.7). This is attributed to the vagueness of the goals through the whole planning process. Figure 5.1 shows that in the TB that vague goal is still named

What is the relevance of this? Zuidasdok uses a sustainability goal that is not focussed on climate issues. The importance of goals as CSF was established in §4.2.2. It shows how a sustainability goal

creates a sustainable mind-set, however a mind-set that is not focussed on climate. This misconception about the main part of sustainability can result in project considering themselves sustainable and dealing with climate issues, while in fact they do not address the issue full on. This must be nuanced, of course sustainability addresses climate problems, however the many aspects of sustainability cloud the importance of the climate aspect.

5.1.3 Financial Restrictions and Limited Budget

The problems of an insufficient goal related to climate mitigation or adaptation is enhanced by financial factors. It is noticed how a financial factor impacts the inclusion of the climate focussed sustainability goal in Zuidasdok, figure 5.1. As a project of €1.3 billion, the budget space for 'extra' measures is limited. Therefore the project focusses on its core elements, creating a solution to congestion (Ex.6,7). This connection between goals and financial factors works both ways. A financial factor makes it difficult to include climate goals, as it will impact the budget. Subsequently, including climate measures is difficult as there is no budget for it since the goals do not include climate considerations as part of the project scope. A reasoning observed in Zuidasdok is that climate measures are more expensive than conventional solutions, while this can be the case it does not have to be (Ex.7). If it is the case than the feeling that something is 'extra' is enhanced. Figure 5.2 is the timeline of CO_2 and energy in Zuidasdok. On the right at the start of the tender it is observed that no requirements and challenges on climate mitigation, in the form of sustainable energy production, are set. Climate mitigation measures are considered more expensive and there are no goals in place that aims to include climate mitigation in the project (Ex.7).

The observation that financial factors play a role in Zuidasdok is highly relevant. It shows how financial factors play a critical part in a road project for the inclusion or in this case mostly the obstruction of the inclusion of climate mitigation measures.

5.1.4 Political Decisions and MER

As discussed in chapter 3 several decisions in the planning process are politically loaded which creates problems. Take for example the inclusion of CO_2 and energy ambitions in Zuidasdok (figure 5.2). Local energy production is eliminated during the creation of ProjectMER (Ministerie van I&M, 2015). Other priorities of the political environment, influenced by the general public, are more important within the scope of this project. This relates to the previous two factors, the budget is limited, and climate mitigation measures are seen as 'extra' or unnecessary. It is not entirely the political views that create this elimination, it is also based on the MER. However it is observed that the MER is not always equipped to deal with climate mitigation and adaptation concerns. Since the prime focus is on the broader environment (Ex.7). Interestingly a climate related criterion for the MER was introduced through political pressure (Ministerie van I&M, 2014). This can also be observed in figure 5.1 where climate awareness is created by the ruling political party.

The importance of the political environment is observed in Zuidasdok. The ideology of large political parties or players can positively impact inclusion of climate mitigation and adaptation. However, the political process also entails the trade-off of many priorities and interests, where climate concerns can become less relevant and eliminated. This observation is in line with the findings on CSFs in chapter 4 and strengthens the confidence in the impact of political factors on inclusion of climate concerns.

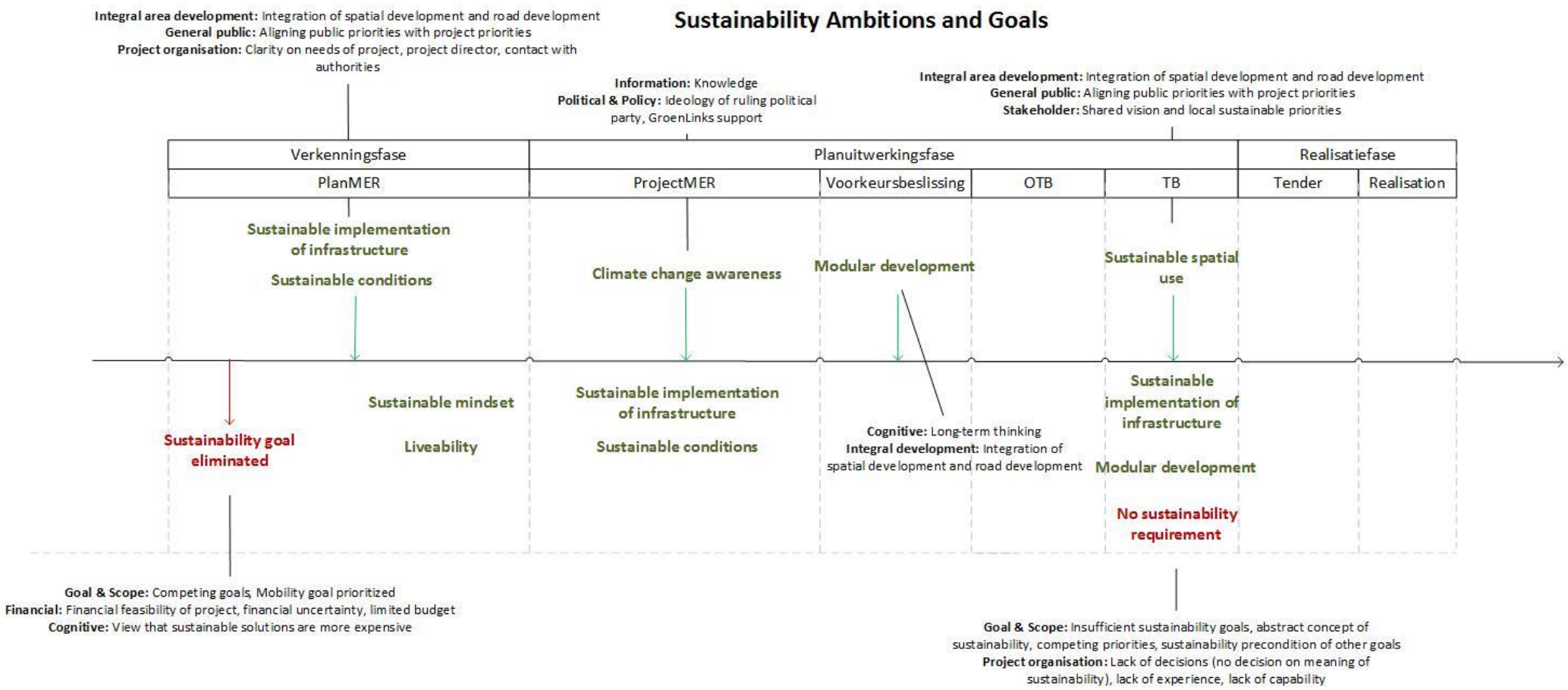

Figure: 5.1: Timeline of sustainability or climate goals in Zuidasdok, with in green aspects that are introduced and in red aspects that are eliminated.

5.1.5 Market inclusion as Best Practice and cognitive problems

Currently it has become common practice that the market deals with climate concerns (Ex.6). In Zuidasdok this is observed, figure 5.2 shows that for a long time, energy considerations are merely ambitions and vague goals. Consequently it is not included in the TB and during the tender reappears (Ministerie van I&M, 2016b). In itself using the creativity of the market to come up with climate measures should be stimulated. The problem lies at the inability to make climate aspects integrally part of the project. As a result the solution space of the contractor is limited. This relates to the earlier mentioned factor of goal and scope. Inclusion of climate aspects in the project goals enables the contractor to carry out climate measures within the scope of the project. Climate concerns are not an 'add-on'. Nonetheless this view is a deeply rooted cognitive problem in Zuidasdok (Ex.7).

Long-term thinking of the project organisation has led to a modular development approach to the project. Through that approach the project is capable to adjust to future changes and reserve room for future development (Ex.6). This is not explicitly related to climate adaptation or climate mitigation measures. However, it shows potential and shows that Zuidasdok attempts to include future development and scenarios into the project scope.

The cognitive barriers differ for adaptation and mitigation. Mitigation is about CO_2 reduction and mostly related to energy production. Including energy measures into the project scope is not considered necessary, as seen in figure 5.2. It is viewed as something that must be done outside of the project scope. The need for adaptation is much more relevant as the project location is between five polders, and changes in precipitation patterns and water levels will impact the project on the short term. As such it is not viewed as something to be done outside the project scope. It is an evident problem and should be addressed within the project and is tried in the ProjectMER (Ministerie van I&M, 2014). The observations on cognitive factors and market inclusion factors strengthen the confidence in the importance of these factors as CSFs. In chapter 4 the market was not deemed an important CSF. The criticality of this factor is questionable, as the market follows the wishes and requirements of the project organisation. However the market, as shown, can be a means to an end.

5.1.6 (Legal) Requirements

The use of requirements or targets that enforce inclusion of climate mitigation or adaptation is viewed negatively in Zuidasdok (Ex.6). Three problems are identified surrounding legal requirements. (1) Requirements increase complexity, since the project is no longer free to include aspects in a way that fits the project scope (Ex.7). (2) Requirements are used as maximum. The project takes the requirements as maximum those requirements become the goal to satisfy. That limits the actions to do more and go beyond requirements (Ex.7). (3) requirements require monitoring and monitoring of climate performance is complex and difficult (Ex.7). Legal factors play a dubious role. On one hand, legal requirements oblige inclusion of climate adaptation and mitigation, on the other hand legal requirements cause problems for the inclusion. Laws and legal requirements are considered a CSF in chapter 4. This observation shows that legal factors are a means to reach climate goals, yet also cause side-effects. This puts the CSF of chapter 4 in a new perspective and strengthens the confidence in the effect of legal requirements, however it also stresses the duality of legal requirements.

5.1.7 Human Drivers in the Project Organisation.

The importance of human drivers in the project organisation is observed (Ex.7). Figure 5.1 shows the importance of a project director interested in including climate elements. It immediately results in the inclusion of a sustainable project goal. Both figures also show the importance of political human drivers for sustainability or climate considerations. The right people in the right place can make world of difference. Human drivers are necessary to include climate goals. Especially in a large interconnected system as road planning with many different priorities and interests a project organisation and team members with a drive for inclusion of climate concerns can make a lot of difference. Their interest in climate concerns can improve the relative importance given to climate aspects and other project priorities. This observation corresponds with the CSF identified in chapter 4,

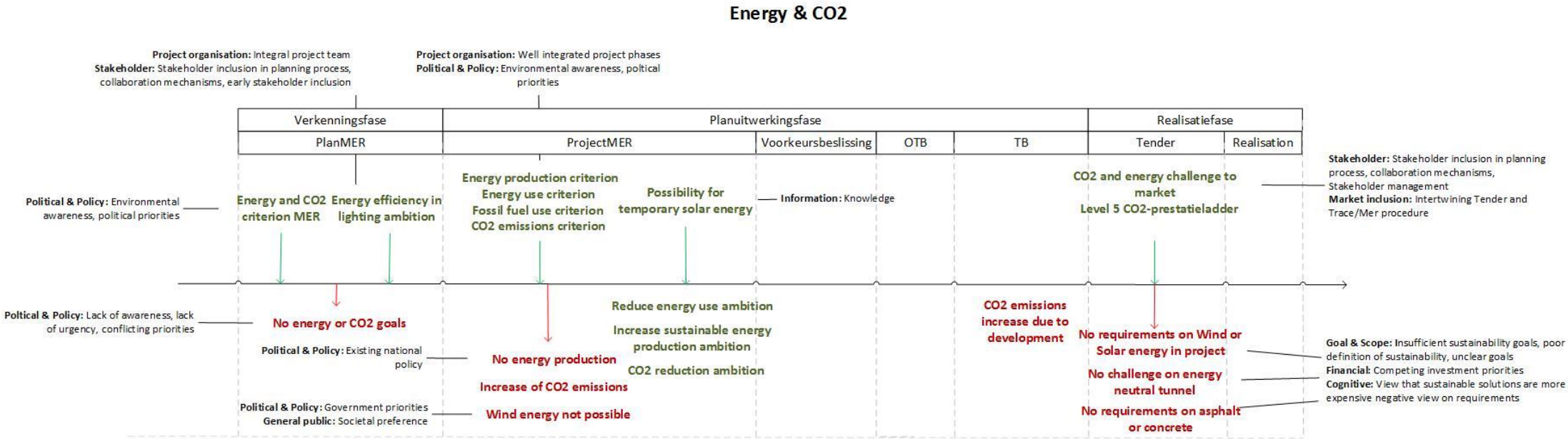

Figure 5.2: Timeline of Energy & CO_2 in Zuidasdok, with in green aspects that are introduced and in red aspects that are eliminated.

5.1.8 Availability of Technology and Technical Restrictions

It is observed in Zuidasdok that technical restrictions obstruct the inclusion of climate considerations. Projects need to overcome various spatial challenges. The availability of the right technology can prove instrumental in succeeding in that. In Zuidasdok the decision for a tunnel was the only technically possible option, satisfying the main interests surrounding the project. Climate mitigation measures are not taken. Wind energy is considered but unfeasible in a densely populated area. Solar energy can be implemented in the area but was not part the plans. Part of the reason is the lack of information on the availability of technology. Zuidasdok is restricted in its solutions by what is available.

5.1.9 Conclusion of Zuidasdok

The previous section discussed the eleven main CSFs found in the case study of Zuidasdok. Four other overarching factors are found, yet not discussed. These findings add to the knowledge on CSFs in road planning for the inclusion of climate mitigation and adaptation. Appendix F, as mentioned before, discusses all the findings related to this case study. That includes the full list of used documents, raw data of the document study, the transcripts of the interviews, all seven timelines (including the two used here) and the final factor table of this case study.

5.2 Case 2: RijnlandRoute

RijnlandRoute is a large road and tunnel construction project south of Leiden. The new RijnlandRoute is a connection between existing A44 and A4. Currently there is no east-west connection resulting in heavily congested N206 through Leiden. The new road is to be constructed south of Leiden through existing green structures. Table 5.5 shows an overview of the main specifics of this project.

Table 5.5: RijnlandRoute overview table

Project name	RijnlandRoute
Project type	A44 is redeveloped, broader roads. Development of crossroads at Ommedijk. A4 is redeveloped, broader roads. Development of crossroads at Hofvliet. Both roads are connected by N434 that is routed through a new 2,5 km tunnel
Location	Leiden
Goals	Significantly improve the east west connection for road traffic. Improve liveability in the region Holland Rijnland and connected municipalities. Creating possibilities for spatial-economic development in the region.
Starting date	10-12-2008
Current phase	Realisatiefase
Expected final date	2022
Project owner	Rijkswaterstaat
Project stakeholders	Gemeente Leiden, Provincie Zuid-Holland
BO-MIRT	Zuid-West Nederland
Project team	Rijkswaterstaat, Gemeente Leiden, other municipalities, Provincie Zuid-Holland, Tauw bv., ADVIN BV, Goudappel Coffeng, MTD Landschapsarchitecten, Infram
Description	The aim of RijnlandRoute is to broaden the A44 and A4 around Leiden and connect them with the N434 that is located in a tunnel. The connection and broadening must decrease congestion and improve the connection from east to west and west to east.

Eight of the obligatory documents are found and analysed. The project plan, PvE, variants construction and Gunningscriteria are not identified in the document study, table 5.6. One interview is conducted with three experts: a Technisch manager, a manager Planuitwerkingsfase and Contract manager, table 5.4. The document study and interviews lead to the identification of climate mitigation, adaptation and sustainability aspects in RijnlandRoute. Here the main factors and their place in RijnlandRoute are discussed.

Table 5.6: Overview of obligatory documents used	
Documents	**RijnlandRoute**
PlanMER	X
Voorkeursbeslissing	X
Project plan	
Variants construction	
Uitgangspuntendocument	X
ProjectMER	X
PvE	
Gunningscriteria	
OTB	X
Advies Commissie m.e.r	X
Zienswijzeprocedure	X
TB	X

Table 5.7: Interviews held with experts on RijnlandRoute	
Expert	**Role**
Expert 3	Technisch manager
Expert 4	Manager Planuitwerkingsfase
Expert 5	Contract Manager

5.2.1 Characterisation of RijnlandRoute

The project organisation of RijnlandRoute does consider the project a sustainable project (Ex.8). The focus of the project is creating a new road connection while not decreasing liveability. During the early planning phase climate and sustainability aspects are sparsely considered. However, through time the mind-set changes, in later project phases the focus shifts to including climate aspects. This results in a challenge for an energy efficient tunnel. While the project did little on inclusion of climate mitigation and adaptation in early phases it did succeed in inclusion in later phases. Climate adaptation is mostly done through the water standards of local water authorities. Climate related elements, such as energy production and climate resilience were not viewed as part of the project scope. The project is a typical example of a project that focusses on the road infrastructure, and where sustainability and climate concerns is not seen as a necessity. The project does include some climate aspects in later phases.

5.2.2 Information in Decision-making

A lack of making well-informed decisions, based on the findings of MER, is observed. Specifically the decision to a road south of Leiden instead of a road underneath Leiden is characteristic of a decision based on political preference instead of information. The road south of Leiden scored poorer on all sustainability related elements (not climate) than the road underneath Leiden. However two elements played an important part, the road underneath Leiden would take longer to be built as it needs to be drilled instead of a quicker cut and cover method south of Leiden. And it is more expensive, €2 billion compared to €1.5 billion (Provincie Zuid-Holland, 2012a). The financial aspect is considered more important than the sustainability aspects. Of course, financial indicators are also a form of information, one variant is more expensive than the others and the political decision-maker chooses a variant on the basis of those numbers. This shows that information on climate aspects can only be useful once the right amount of weight and consideration is given to it (Ex.9). This corresponds with the earlier considered idea that more information does not necessarily create better inclusion. It is about the importance given to information by decision-makers than the information itself. However more information can improve awareness of that decision-maker which can influence their priorities.

5.2.3 Lack of Climate Goals and Conflicting goals

A lack of a climate goal is observed in RijnlandRoute. Sustainability is present but focussed on liveability and not embedded in a goal. In RijnlandRoute a struggle between sustainability (liveability) and accessibility is noticed. The main road variant is routed through existing green areas south of Leiden, which conflicts with the general public's interests in liveability. Liveability is part of the project goals, and therefore a solution was constructed that solved congestion problems. The solution is a 2.5 km tunnel. The creation of the tunnel shows how goals enforce consideration of certain elements. The liveability issue is made equally important as the mobility goal. Consequently a solution is found that solves for both goals. What is also noticed is the lack of consideration for climate concerns. A tunnel is relatively climate unfriendly. However, the conflict between liveability and

climate does not happen since climate concerns are not part of the agenda (Ex9). This is present in figure 5.3 as well, as CO_2 is not part of project goals it is not part of the agenda, and there is no explicit conflict in later stages. That conflict does happen; however it is not noticed. There is no conflict, as climate concerns are not part of the considerations.

5.2.4 Early Inclusion

Closely related to project goals is early inclusion of climate adaptation or mitigation. Observed is that all experts agree on the positive effect of early inclusion. Mainly, because it influences goal creation, and makes climate concerns integral part of the project. Related to that is the size of the solution space, this will favour climate concerns, if these have been part of the project for longer (Ex.8). In RijnlandRoute it is observed that later inclusion of climate concerns and challenging them to the market was preferred (Ex.8). For example, figure 5.3 shows that the energy challenges are mostly located on the right side in the later phases. In earlier phases inclusion of energy concerns was low. As a result energy consumption and production were not considered during the decision for the location and form of the road (Provincie Zuid-Holland, 2012b). This was partly solved in RijnlandRoute by reserving some space in the TB for future development, and by making the TB flexible (Ex.10). Early inclusion helps create project goals, which consequently help to include climate aspects throughout the project. It impacts the solution space in later phases. Early inclusion of climate aspects is a precondition to climate goals, as it is needed to create goals, and guarantees the success of these goals.

5.2.5 Interests and Participation of the General Public

The general public stimulates the inclusion of a liveability goal in the project. High activity of the general public in the RijnlandRoute is observed. The public initiated an extra variant for the ProjectMER, a variant where the new road would be routed underneath Leiden, in a long tunnel. Eventually this was deemed too expensive by the political decision-maker. However the importance of liveability in the area was felt by the decision-makers and became an important aspect in RijnlandRoute. This public concern for liveability conflicted with climate concerns, as the public wanted a closed roof of the deepened road (Ex.9). This shows the strength of the public opinion in road planning. The public was able to guide the project to satisfy their needs, and the public even came up with a new design. That strength can prove useful to achieve inclusion of climate concerns.

5.2.6 Cognitive Barriers: Lack of Local Inclusion & Market as Best Practice

Figure 5.3 shows how clean energy production through wind turbines was not considered part of the project (Ex.8). Part of that is attributed to other priorities, the tunnel is built to satisfy liveability concerns and the project organisation did not want to build wind turbines in the green landscape (Ex.8). However there is also a cognitive problem. Within RWS there is a view that a project does not always have to include local energy production. Since energy production is realised in large wind mill parks and the energy produced there can be used in the project (Ex.8). That view strongly limits the inclusion of climate mitigation in the project scope. Another cognitive element is the view that the market should address climate concerns (Ex.10). This can be successful as seen in figure 5.3, energy challenges and the use of a DBM contract result in an energy efficient tunnel. However later included elements will have to deal with earlier made decision and a smaller solution space. Two main views impact the inclusion of climate mitigation and adaptation in RijnlandRoute. The views obstruct (early) inclusion in the planning process, as it is viewed that challenging the market is more efficient. This creates a limited consideration for climate concerns within the project scope.

5.2.7 Political Pressure and Lack of Policy

Extreme political pressure for a quick solution is observed in RijnlandRoute. The need for a quick solution makes including climate aspect difficult (Ex.9). This is enhanced by a ruling political party with primarily economic priorities (Ex.10). The local political environment limits the inclusion of climate concerns in RijnlandRoute. This is enhanced by a lack of policy. Policies trigger awareness

and oblige projects to start addressing certain issues (Ex.9). Apart from being a trigger, policies bring financial resources. The lack of political will, and policy negatively impacted RijnlandRoute in including climate mitigation and adaptation. The results are observed in the lack of climate goals, priorities and overall limited inclusion of climate considerations. Interestingly this changes in the later phases of RijnlandRoute. Figure 5.3, for instance shows how energy consumption becomes part of the consideration during the tender due to increases political awareness. The findings correspond with the CSF of political environment found in chapter 4.

5.2.8 (Legal) Requirements and Contract

Two forms of requirements are found in RijnlandRoute. First legal requirements, for example requirements on water management put in place by the local water authorities (Ex.9,10). Interestingly these requirements are based on weather and climate scenarios, created the KNMI. This shows how information strongly contributes to useful requirements. A negative aspect of these requirements is observed. Requirements can become the maximum, as there is only an incentive to satisfy the requirement which limits 'extra' measures (Ex.9). The other part of requirements are the requirements put in place by the project. The success of this is observed, EMVI criteria are successfully used and the combination with a DBM contract make it possible to include the contractor for a longer time (Ex.10). As seen in figure 5.3 several energy measures are achieved through the creation of challenges to and requirements of the market. RijnlandRoute shows the duality of requirements, on one hand they are useful to oblige inclusion of climate concerns and are quite successful. On the other hand there is fear of using them, as it creates limited solution space and a maximum to creativity. Requirements and legal elements are observed as critical factors in RijnlandRoute and corresponds to earlier findings.

5.2.9 Availability of Technology

RijnlandRoute shows some interesting new techniques to limit energy use and CO_2 emissions. With the use of sunlight of glass fibre the tunnel is lit. This ingenious new technique saves 17% of the energy consumption. This example shows how the availability of technical innovations strongly impacts the ability of projects to act upon climate concerns. It is observed that this technical factor is important in realising climate ambitions. Therefore it can be considered a CSF in successfully addressing climate concerns in road planning. It however does not immediately result in inclusion of climate concerns. It does however impact perceptions, since experience with the success of technical innovations can help change the view that climate inclusion is difficult and expensive.

5.2.10 Conclusion of RijnlandRoute

The previous discussion of the findings of RijnlandRoute helped to identify the twelve main factors found in the case study. Three other overarching factors are found as well but not discussed here. These findings add to the knowledge on CSFs in road planning for the inclusion of climate mitigation and adaptation. Appendix G discusses all the findings related to this case study. That includes the full list of used documents, raw data of the document study, the transcripts of the interviews, all seven timelines (including the one used here) and the final factor table of this case study.

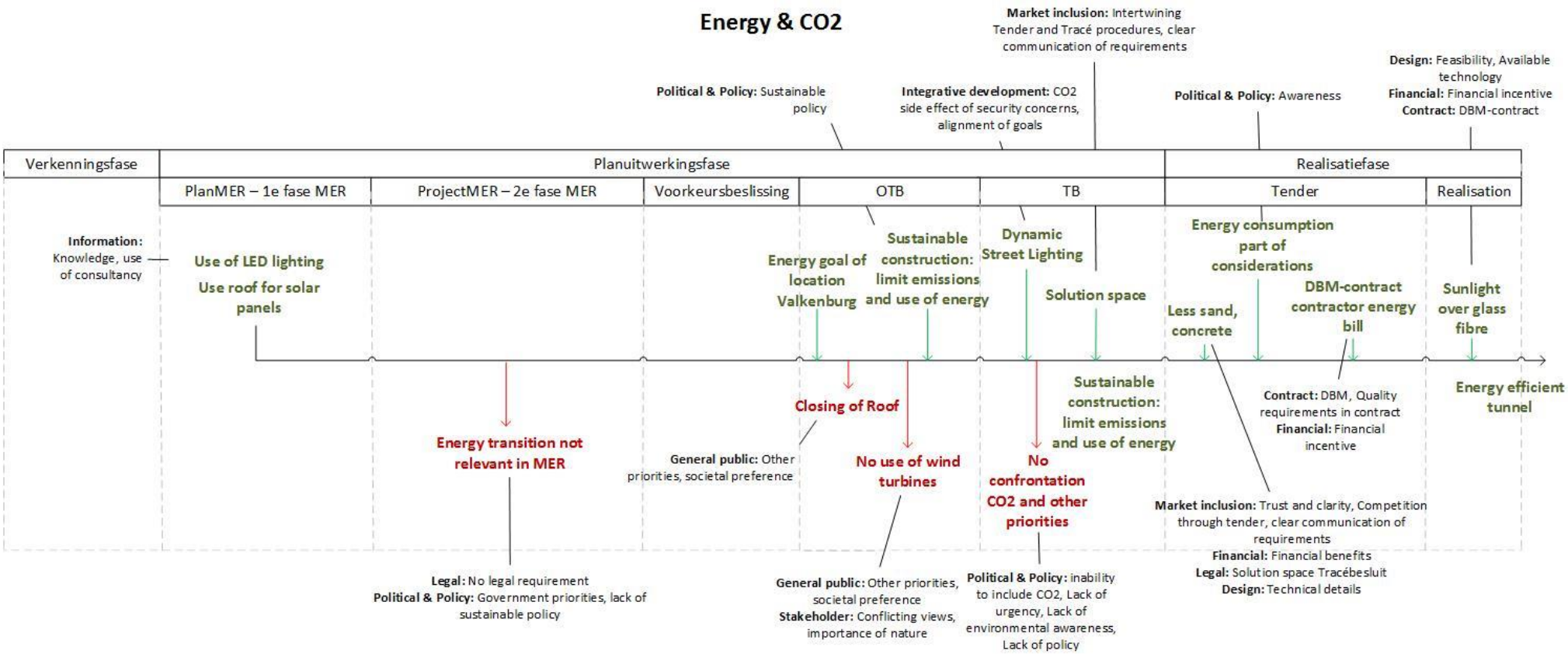

Figure 5.3: Timeline of Energy & CO_2 in RijnlandRoute, with in green aspects that are introduced and in red elements that are eliminated.

5.3 Case 3: A16 Rotterdam

A16 Rotterdam is a large road and tunnel construction project in Rotterdam. The extension of the A16 relieves the congestion at A13 and A20. The new road is to be constructed northwest of Rotterdam through existing green structures. Table 5.8 shows an overview of the main specifics of this project.

Table 5.8: Rotterdam A16 overview table

Project name	A16 Rotterdam
Project type	A16 is extended to connect A16 and A13 via a new road. The road is to be 2x2 and will be routed through a tunnel at Lage Bergse Bos
Location	Rotterdam
Goals	Reliable and acceptable travel times Good accessibility of Rotterdam-Centrum and the surrounding region Reduction of traffic on underlying road network Improvement of liveability around A13-A20
Starting date	1-11-2005
Current phase	Realisatiefase
Expected final date	2024
Project owner	Gemeente Rotterdam, Rijkswaterstaat
Project stakeholders	Gemeente Rotterdam, Gemeente Langsingerland, Deelgemeenten: Hillegersberg/Schiebroek, Prins Alexander, Overschie, Provincie Zuid-Holland, Recreatieschap Bergse Bos, ProRail, Hoogheemraadschap Schieland en Krimpenerwaard, Rotterdam Airport, MRDH, Hoogheemraadschap Delfland, De Groene Boog
BO-MIRT	Zuid-West Nederland
Project team	Rijkswaterstaat, de Groene Boog
Description	A16 Rotterdam is road infrastructure project. The project revolves around solving the congestion problems at Rotterdam, around the A20 and A13. The solution is an extension of the A16. The new road will be routed through the Lage Bergse Bos. The road consists of 2x2 lanes. In the region of the Lage Bergse Bos the road will be routed through tunnel. The tunnel is to be constructed with cut and cover method. The road essentially connects A16 with A13 without using the A20. As a result the congestion problems on A20 are solved. The tunnel will become an energy neutral tunnel.

Table 5.9: Overview of obligatory documents used in analysis A16 Rotterdam

Documents	**Rotterdam A16**
PlanMER	
Voorkeursbeslissing	
Project plan	
Variants construction	X
Uitgangspuntendocument	
ProjectMER	X
PvE	X
Gunningscriteria	
OTB	X
Advies Commissie m.e.r	
Zienswijzeprocedure	X
TB	X

Table 5.10: Interviews held with experts on A16 Rotterdam

Expert	**Role**
Expert 11	Manager Ruimtelijke kwaliteit
Expert 12	Contract manager

Seven of the obligatory documents are found and analysed. The PlanMER, Voorkeursbeslissing, Project plan, Uitgangspuntendocument, Gunningscriteria and Advies Commissie m.e.r. are not identified in the document study, table 5.9. Two interviews are conducted. An advisor spatial quality of the Planuitwerkingsfase and a Contract manager are interviewed. table 5.10. The document study and interviews lead to the identification of climate mitigation, adaptation and sustainability aspects in RijnlandRoute. Furthermore, a set of factors is identified. Here the main factors and their place in Zuidasdok are discussed.

5.3.1 Characterisation of A16 Rotterdam

A16 Rotterdam does not include climate concerns early on in the planning project (Ex.12). Sustainability is viewed as a lower goal, primarily related to liveability issues. However in the late planning phase more climate related elements are introduced. The ambitions document (Kansenboek) drawn up between public, stakeholders and project organisation helped to initiate the inclusion of more climate related elements (Ex.12; RWS, 2015). Currently a tunnel is being developed that will be energy neutral. Much of the late success is attributed to the connection between project and market.

5.3.2 Early inclusion and Climate Goals

It is observed that sustainability is part of the project as a lower goal, shown in figure 5.4. There is no climate element in that goal, it is mostly focused on the people and profit part of sustainability (Ex.11). Climate aspects are limitedly included during the planning process, as it is not part of a project goal. Interestingly the lack of use of climate aspects, meaning the Planet aspect of sustainability is noticed late in the planning project. Through the Kansenboek some gains are made with respect to climate measures (Ex.12). However, since climate considerations have not been part of the project the solution space is limited. The elements of the Kansenboek are mostly focussed on climate mitigation.

Again the importance of early inclusion and climate goals is observed. In A16 Rotterdam the inclusion of sustainability in the early project positively impacted liveability and other profit and people concerns of sustainability. From that can be concluded, that early inclusion of certain spatial qualities in project goals results in successfully including the quality into decision-making processes.

5.3.3 Strength of General public and Stakeholders

In A16 the importance of early inclusion of stakeholders is observed. The success of the ambitions document drawn up in the later project phases showed the potential of involving stakeholders and general public for inclusion of climate concerns (Ex.11). However, this was done relatively late in A16, early inclusion could have helped to make the ambitions integrally part of the road project. The power of stakeholders and general public should not be discarded. In public support lies a potential solution for climate inclusion in road project. If A16 showed one important thing it is that the lack of goals and early inclusion can partly be overcome by activity of stakeholders and general public. The importance of the general public and stakeholders is again established in A16 Rotterdam.

5.3.4 Cognitive barriers: Local vs National approach and Fear of Unfeasibility

An interesting finding in A16 Rotterdam is a certain mind-set related to local energy production. It is identified that there is a struggle within RWS between doing things sustainably and doing sustainable things (Ex.11). The first concept indicates that all projects are sustainable by themselves the other concept means that there are projects that have a sole purpose to be sustainable, in order to relieve pressure on other projects. What this means in road planning is that roads and tunnels are constructed without too much regard for climate and sustainability and for instance energy since energy is produced on a wind turbine park also created by RWS (Ex.11). The effect is that it relieves road projects from the responsibility to include climate mitigation and adaptation in the project scope.

Another insight gained from this case study was the view that a large and integral project are feared as these decreased financial feasibility (Ex.12). This results in small road projects, focussed on primarily the construction of the road and not the connection to other spatial qualities.

The cognitive barriers impacted A16 Rotterdam. Views on the best way to include climate concerns resulted in a lack of inclusion of climate concerns in the early planning process.

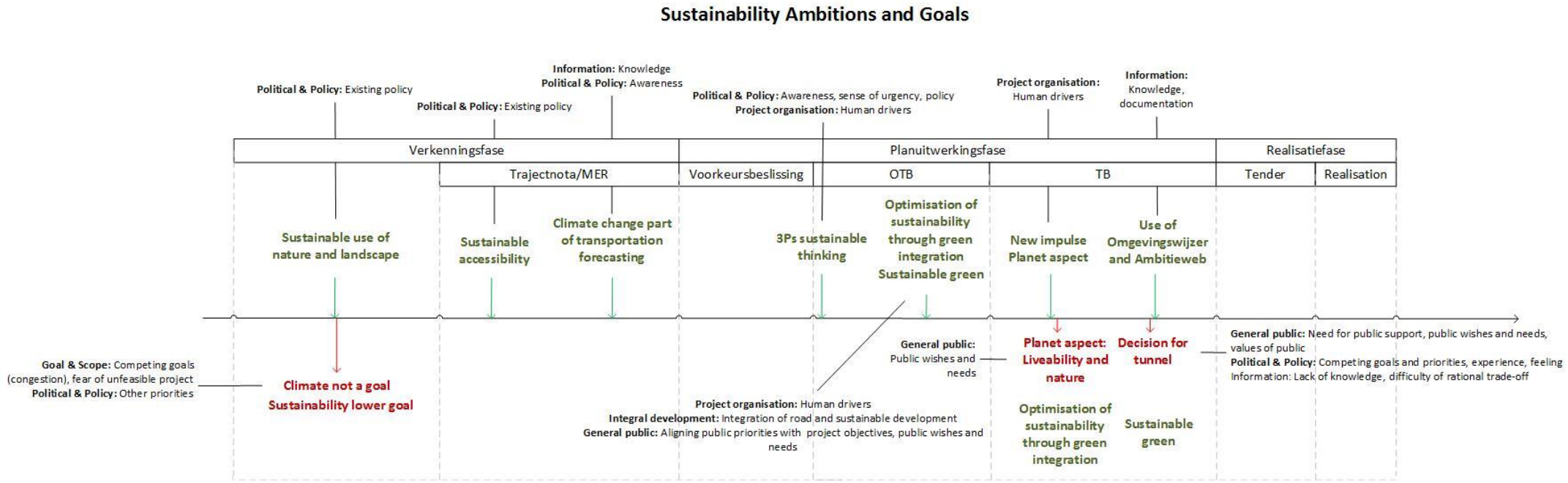

Figure 5.4: Timeline of sustainability goals and ambitions in A16 Rotterdam, with in green aspects that are introduced and in red elements that are eliminated.

5.3.5 Political Decision-makers

The difficulty in the decision-making process, with addressing all themes and interests is observed (Ex.12). The decision-making process is not a simple choice, as many aspects are involved in the trade-offs. Therefore political decisions do not merely rely on information, but also on experience and intuition on the part of the decision-maker (Ex.12). As this is the case it is important to create alignment of climate goals with the goals and interests of the decision-maker. In A16 Rotterdam certain parts of the construction are phased in such a way that some large new constructions are to be realised during elections for Provinciale Staten, as a result the political players can involve this project in their campaign, this creates ownership of the success of the project on the part of the politician.

These observations show how the political environment impacts the planning process, as it consists of the key decision-makers. Their interests in climate mitigation and adaptation are essential when the decision-making process is extensive, and many themes and interests are involved. The importance of the political climate was established in A16 and is line with earlier findings.

5.3.6 Market inclusion and Contract

Challenging the market is the main form of addressing climate issues in A16 Rotterdam. It is observed that this is done with success. A design for an energy neutral tunnel is created through the use of a sustainable EMVI criterion, a DBFM contract and by making the contractor responsible for the energy bill for 20 years (Ex.12). Part of this success is the relative flexibility of the TB. At the end of the planning process A16 Rotterdam improves its interest in climate measures. Part of that is attributed to the ambition document (Kansenboek) drawn up during this time. However it is a mind-set that initiated that ambitions document in the first place. The challenges to the market are not made in the form of requirements, to limit the creation of a maximum (Ex.11). Expert 12 explains that going beyond what is required is frowned upon within RWS, as it creates precedent for other projects (Ex.12). In A16 it was possible to go beyond the normal requirements due to extra financial resources of the province. Inclusion of the market and the use of contracts helps to make a project develop climate adaptation and mitigation measures. However, it does not help the inclusion itself. In theory, the market is able to help the inclusion of climate concerns. However most likely this will not happen since the market is included at the end of the planning process. The contract itself is only a tool to translate already included climate concerns into measures. The contract has been instrumental in achieving an energy neutral tunnel.

5.3.7 Human Drivers of the Project Organisation

In A16 Rotterdam the late inclusion of climate concerns can be attributed to human drivers. Several climate focussed team members influenced the late inclusions (Ex.11,12). This shows the importance of the right people with the right mind-set at the project organisational level as can be seen in figure 5.4 were human drivers, with the Kansenboek, help to give the Planet aspect of sustainability a new impulse in the late planning process. In A16 Rotterdam human drivers are considered critical for the inclusion of climate aspects.

5.3.8 Information, Awareness and MER

Two observations are made on the use of information in A16 Rotterdam. Firstly the awareness of the public caused the public to support more climate aspects in the project. Secondly, the difficulty of including climate aspects such as CO_2 in MER. The first finding rests on the assumption that more information creates more awareness, and awareness creates support and participation. In A16 the second part of that is noticed. The inability of MER to assess climate elements makes decision-making more difficult. In A16 Rotterdam CO_2 was not part of the MER (RWS West-Nederland-Zuid, 2014).

Information is an important aspect to create awareness and to help decision-making. These two parts are observed in A16 Rotterdam, and more confidence is gained on the criticality of information in including climate adaptation and mitigation in road planning.

5.3.9 Conclusion of A16 Rotterdam

The previous discussion of the findings of A16 Rotterdam helped to identify the ten main factors found in the case study. Five other overarching factors are found as well but not discussed here. These findings add to the knowledge on CSFs in road planning for the inclusion of climate mitigation and adaptation. The ten factors discussed here are considered critical in A16 Rotterdam. Appendix H, as mentioned before, discusses all the findings related to this case study. That includes the full list of used documents, raw data of the document study, the transcripts of the interviews, all seven timelines (including the one used here) and the final factor table of this case study.

5.4 The Importance of Time

The cases were selected based on a criterion, Realisatiefase. Meaning that the road project must be currently under construction or finished. As a result all three case studies are considered somewhat dated. Zuidasdok started at the beginning of this decade, and produced a TB in 2016, meaning the different spatial planning processes happened before that. RijnlandRoute finished the TB in 2013 but started around 2009 with the project. The Trajectnota of A16 Rotterdam commenced in 2009, with a TB in 2014. Most interviewed experts made remarks on this. The fact that road planning project approximately run fifteen years, enhance the problems with new upcoming perspectives (Ex.6,7). As Expert 9 explains, the timeframe of a project significantly influences the inclusion of climate considerations. For example RijnlandRoute did very little with regard to inclusion of climate concerns during the main part of the planning process. This can largely be attributed to the fact that climate concerns were not yet relevant during the time of the planning process. This is similar in Zuidasdok (Ex.6,7) and A16 Rotterdam (Ex.11,12)

This observation suggests that much of the success of including climate concerns is attributed to a change in mind-set and perspectives of people over time. Currently, society is more aware of climate change and its consequences. Consequently, there is more pressure and will to address these issues. It is however not as simple as leaving it be, suggesting a change in perspectives over time will resolve the current issues of including climate concerns in road planning. It is still necessary to actively address different aspects of the road planning process to increase success of current project with regard to inclusion of climate concerns. Nonetheless it is important to notice that at this moment policies, incentives and mind-sets are much more stimulating inclusion of climate concerns than it did five or ten years ago.

The observed phenomenon partly explains why all three cases have relatively little regard for climate concerns in the early planning project and much more in the later phase, during the tender procedure. The perspectives on climate change of the time, explain for a part the success of inclusion of climate concerns. While the impact of time and the perspectives over time is interesting it is questionable whether it is a useful CSF. The fact that over time the views on climate change have changed and continue to do so, do not necessarily help the inclusion of climate concerns in road projects. A project organisation cannot stimulate this factor. Project organisations and other relevant actors however can take this factor as a given. What that means is that the relevant actors must be aware that there is a change of views. Consequently, the project organisation must try to adjust the project to those changing views and connect the works of the project to those views and capitalise on the chances related to this change in mind-set.

Time and perspectives of the time is a CSF in the three case studies. It explains the success in terms of inclusion of climate considerations. It is however a difficult to use CSFs for project organisations. It can be considered but cannot be actively stimulated.

5.5 Conclusion

The main results of the three case studies are discussed in this chapter. Table 5.11 contains the main identified CSFs of the three case studies. These factors correspond to the findings of chapter 4.

Table 5.11: Empirical findings case studies, corresponding to the findings of CSFs in literature.

Literature	Zuidasdok	RijnlandRoute	A16 Rotterdam
1. Information and knowledge in decision-making	X	X	X
2. Inclusion and clarity in project goal and scope	X	X	X
3. Financial feasibility, financial incentives and budget	X	X	
4. Participation and mind-set general public		X	X
5. Perceptions, misconceptions and cognitive barriers	X	X	X
6. Political decision-makers, political environment and policies	X	X	X
7. Laws and legal standards	X	X	
8. Institutional environment			
9. Form, mind-set and priorities of project organisation	X		X
10. Early inclusion	X	X	X
11. Availability of technology	X	X	
12. Participation and mind-set stakeholders		X	X
13. Governance and possibility monitoring			
14. Socio-economic development			
15. Form and restrictions of design requirements	X	X	
16. Market inclusion and incentives	X		X
17. Change adaptation			
18. Type of contract		X	X
19.	Time	Time	Time

Fifteen CSFs are identified in the case studies. The CSFs in red are not identified in the case studies. Of the fifteen factors five are discussed for all cases. The other factors are only discussed in a subset of the cases. In some instances a factor is present in a case, but not on such as scale that it is worth discussing it. For instance the general public will have had some influence in Zuidasdok. However, it was only seen in the public participation procedure and did not clearly result in tangible changes. Therefore it is not included as a CSF of Zuidasdok. Similarly financial aspects will have played a role in A16 Rotterdam, however it was not discussed or found to be a significant element during the case studies. nonetheless financial restrictions and the budget impact the financial feasibility of A16 Rotterdam and consequently the project. This is applicable to several of the factors.

Table 5.11 shows the main findings of this chapter. It can be concluded that these fifteen factors influenced the inclusion of climate considerations in each of these road projects. The findings correspond with earlier findings in literature. In the next chapter, the fifteen CSFs are connected to the planning process as discussed in chapter 3. This chapter discusses the workings of the CSFs and the main problems identified in Dutch road planning. The fifteen CSFs are the answer to sub-question 3.

CSFs can be different for addressing climate mitigation and climate adaptation. It is for instance noticed that climate adaptation is much more viewed as a necessity, as it relates to water management, which is a rather important part of spatial development in the Netherlands. Climate mitigation however is much more difficult to include, as it is not always clear to the projects organisations, why it is necessary and that it is part of their scope as well.

Before starting the next chapter a last remark must be made on the used documents of the case studies. The observant reader might have noticed that not all documents were found and analysed. Two remarks on that: (1) Of all projects the main spatial planning documents were read, the tender documents were harder to obtain. This is not a problem as the interviews with experts from the Contract fase provided more insight in the tender procedure. (2) In two cases, the structure of the case projects did not follow the current planning structure of PlanMER, Voorkeursbeslissing, ProjectMER etc. RijnlandRoute used a 1e fase and 2e fase MER which is comparable with the PlanMER and ProjectMER. A16 Rotterdam used a Trajectnota/MER which is a combination of the two MERs.

6. Discussion

In the previous chapter fifteen factors are identified in three Dutch road project. The value of these findings is increased by comparing them between cases and to literature. The comparison between cases can increase the confidence in the importance of the factors in Dutch road planning. The comparison to existing literature on both development projects and CSFs embeds the findings in existing literature, increasing the confidence in the importance of the factors. This chapter discusses the fifteen identified factors. In chapter 2 eighteen factors are identified. Four factors are missing the reason for this is explained in this chapter. Furthermore, an extra factor is identified: 'time', this factor is explained in chapter 5, and is not explained again in this chapter. The CSFs are used to construct two conceptual models of the planning system and the factors, that shows how the factors influences the system and how inclusion of climate aspects, mitigation and adaptation are achieved. Furthermore, this chapter uses the findings to establish the main problems in the current system.

6.1 Critical Success Factors in Dutch Road Project and Literature

To identify if the factor is a CSF, it important to understand what constitutes a CSF. This was discussed in chapter 4. (1) A CSF is either a factor that is in the sphere of influence of the specific organisation that is critical to reach part of the success, or (2) it is a critical issue that needs to be addressed or monitored. With that in mind it is not necessary that a critical factor is explicitly in the sphere of influence of the project organisation. However, it is worth discussing whether it is in the project organisational sphere of influence. Partly as this project is carried out with consultancy firm Infram, whose perspective is one of a project organisational nature. Partly, because it helps to think who could impact the factor if the project organisation is not able to. That can help work towards a solution to the problem of inclusion of climate adaptation and mitigation in Dutch road planning. Not all CSFs need to be addressed to reach success. A subset of factors can create success. Furthermore, CSFs implies it are all factors creating success. However CSFs can also be barriers.

Figure 6.1: Comparison of factors in literature and Dutch road planning

	Literature	Empirical (Dutch context)
1.	Information and knowledge in decision-making	X
2.	Inclusion and clarity in project goal and scope	X
3.	Financial feasibility, financial incentives and budget	X
4.	Participation and mind-set general public	X
5.	Perceptions, misconceptions and cognitive barriers	X
6.	Political decision-makers, political environment and policies	X
7.	Laws and legal standards	X
8.	Institutional environment	
9.	Form, mind-set and priorities of project organisation	X
10.	Early inclusion	X
11.	Availability of technology	X
12.	Participation and mind-set stakeholders	X
13.	Governance and possibility monitoring	
14.	Socio-economic development	
15.	Form and restrictions of design requirements	X
16.	Market inclusion and incentives	X
17.	Change adaptation	
18.	Type of contract	X
19.		Time

6.1.1 Information and knowledge in decision-making

The factor information and knowledge in decision-making is found in all three case studies. Information is observed as factor in decision-making processes, related to the MER and important in establishing climate change awareness. The influence of information to create climate change awareness is established in the literature (Lenferink et al. 2013; Sözüer & Spang, 2014; van den Herik, 2015, Azhoni et al., 2018; Mees et al. 2018). As is the importance of information to include climate

concerns in decision-making (Ritzèn & Sandstorm, 2017; Ruijs & Egmond, 2017; Biresselioglu et al. 2018; Mees et al., 2018). The specific problems with MER are observed in at least two of the three cases (Ex.7,9). Information forms an important precondition for many project organisations and decision-makers. Information is needed to help with decision-making to address inclusion of climate mitigation and adaptation in road projects. Inclusion of climate concerns becomes difficult without proper information. Is it necessary to have information, or can climate concerns be included in another way? It is possible to push or oblige inclusion with policy or legal instruments. However, both are not in the sphere of influence of project organisations or local politicians. It is a higher level of government that could create laws and policies to push decision-makers to include climate considerations in local or regional road projects. It is also questionable if local politics and project organisations are able to address their own climate change awareness, as one needs to be aware to focus on climate change information to become aware. Nonetheless it is clear that information is a critical part of including climate concerns and using those concerns in decision-making. The findings relate to existing literature and therefore information and knowledge are considered a CSF in road planning. This CSF impacts most of the Dutch project, but is primarily of importance during the Startfase, as the goals and scope are established and during the decision-making, were the ProjectMER is used to create an OTB (Ex.9).

6.1.2 Inclusion in and clarity of project goals and scope

Factors concerned with goal and scope of a projects are found in all three case studies. Broadly supported project climate goals are necessary for success (Ex.7,12). Central is the embeddedness of climate concerns. A problem is identified in the use of broad sustainability goals. The People aspect is prioritised above the Planet aspects. The view that goal and scope factors are important is shared in the scientific community (Shaw et al., 2014; Busscher et al., 2015; van den Herik, 2015; Turnheim, et al., 2015; Kivila et al. 2017; Malekpour et al., 2017; Biresselioglu et al., 2018). The criticality of the inclusion of climate concerns in goals and scope, and the clarity of that scope for the inclusion is questionable. The factor does not help the inclusion of climate concerns. The factor only embeds an already included element as integral part of the project. However in the process of developing project goals climate concerns can be included. Goals and scope factors are not critical for the inclusion of climate mitigation and adaptation in the project. However the success of keeping climate concerns within the project does rely on clear climate project goals. The creation of goals is within the sphere of influence of the project organisation. The goal and scope factor is considered a CSF, not for the specific inclusion of climate concerns, but for embedding an included aspect in the whole project. Goals are established in the early Planuitwerkingsfase, or earlier in the Verkenningsfase (which are reviewed in the Planuitwerkingsfase). This CSF therefore impacts the Startfase of a planning project.

6.1.3 Financial feasibility, financial incentives and budget

The financial feasibility, financial incentives and the budget are found to be relevant factors in all three cases, yet not discussed for A16 Rotterdam, as discussed in chapter 5. Financial factors strongly limit the possibilities for inclusion of climate and problematizes decision-making. The financial factor creates tension between actors and their priorities, as not everything can be done within the limited budget (Ex.8). This is a problem when climate measures, mostly innovations, need to be included. The risks and uncertainties of climate measures are perceived as higher than conventional solutions. Consequently, the costs are perceived as higher (Ex.7). This finding is in line with the findings of Ritzén & Sandström (2017) and Jesus & Mendonça (2018). The criticality of financial factors is not special in the context of road planning or spatial development and correspond with the more general CSFs in project organisations as explained by Belassi & Tukel (1996). The financial feasibility, incentives and budget as a factor is considered a CSF since the lack of addressing this factor will result in a project that do not have the budget for inclusion of climate concerns. Two remarks on this: Firstly, it is up to a project organisation to do this, to make climate concerns part of the project and budget. Secondly, the political environment can improve on this by making more financial resources available.

Furthermore, financial incentives can be used to achieve inclusion of climate concerns, either into the spatial planning process or the tender. The precondition here is that projects organisations and political environment truly want to address the inclusion of climate elements in the project. The financial CSF impacts the trade-offs during the construction of a OTB, as it is there that tension between financial considerations and other priorities becomes evident.

6.1.4 Participation and mind-set general public

The importance of the participation and mind-sets of the general public is especially explained in RijnlandRoute and A16 Rotterdam. In these cases the support of the public and their participation is vital to get sustainability concerns into RijnlandRoute and climate ambitions into A16 Rotterdam (Ex.8,12). The participation of the public stimulates decision-makers to include the aspects favoured by the public. That means when the public is aware of climate change, it has the ability to stimulate decision-makers and project organisation to address climate concerns. It works both ways, as the lack of support, or the support for other spatial qualities obstructs inclusion of climate concerns, as was noticed with the conflict between liveability and climate in all cases. The creation of tunnels satisfies the public's liveability concerns, yet conflicts with climate concerns (Ex.7,8,11). This finding corresponds with earlier findings of van den Herik (2015) and Malekpour et al. (2017) and belongs to the external environment as discussed by Belassi & Tukel (1996). The influence of a project organisation or the political environment on the support of the general public is not as strong as on other CSFs. The public has its own will and that can make it difficult. However, including the public in decision-making processes, through public participation tools and processes can help create public support for the priorities of a project organisation. That works on the assumption that the project organisation is aware of climate problems and wants to deal with those. Focussing on public participation can also help to identify opportunities for addressing climate concerns. Local and especially higher levels of government can try to create public awareness of climate change and the relation between climate change and local road projects. The public has a large potential for obstruction. This is not merely the case in road planning but corresponds with more general organisational CSFs. The mind-set of the general public is relevant during goal construction in the Startfase. Public participation is relevant during the Zienswijzeprocedure in the Afrondende fase. This factor also relates to the work of the Omgevingsmanager, as it is about the inclusion of the general public and their priorities.

6.1.5 Perceptions, misconceptions and cognitive barriers

In all cases the perceptions of climate change, misconceptions on how to address climate change and cognitive barriers are identified as playing a role in inclusion of climate concerns. A specific cognitive problem is for instance the view that climate measures are 'extra' and best addressed in later phases and on a national scale (Ex.6,7,8,11,12). Misconceptions obstruct the inclusion of climate concerns, either mitigation or adaptation, as the project organisation or decision-makers are mistaken in what best path to take. The specific findings in the case studies are new and were not found in literature. The cognitive factor was discussed in several studies (Lenferink et al., 2013; van den Herik, 2015; Dhakal & Chevalier, 2017; Malekpour et al., 2017). Cognitive barriers are critical as they obstruct any form of inclusion due to a view or believe in the workings of the system or best practices. The factor can be influenced by information, and it is up to the project organisation, or their mother company RWS to address this. However, this can be difficult as much of the cognitive problems are observed within their ranks. The political environment can have a positive impact on informing RWS and project organisations on their cognitive flaws. Cognitive factors are considered a CSF in road planning, and currently obstruct inclusion of climate concerns. The factor impacts the inclusion of climate considerations in the early Startfase and impacts the inclusion in the later tender procedure.

6.1.6 Political decision-makers, political environment and policies

The role of political decision-makers, the form of the political environment and policies, either climate or other is identified as important. Most substantial decisions in road projects are taken by local, regional or national authorities. The research shows that the impact of the political ideology of decision-makers and their main priorities is high (Ex.6,8). E.G, Zuidasdok saw a short-lived sustainable uplift when a Groenlinks councilman was responsible for the project. And RijnlandRoute was limited by VVD representatives in the Gedeputeerde Staten. The political environment pushes constantly on the project organisations to include their politically loaded interests. The pressure in itself is not a problem, if the pressure was about inclusion of climate consideration, more stimulation would be good. However a lack of awareness on climate change on the part of the political environment obstructs inclusion of climate concerns. The problems are found in literature as well Arts J. (2007), Ruijs & Egmond (2017), Mees et al. (2018) discuss the problems with a lack of a sense of urgency on the part of the authorities. The importance of policy is also stressed, policy guides inclusion as it is a trigger to show that something is important, and it creates financial resources (Ex.9).

The political decision-maker, the environment and policies are CSFs. The main project decisions are made by politicians. The political environment however is difficult to influence by the project organisation, yet not impossible. A16 for instance shows how aligning project elements with the views of politicians can help create a broader political support for certain measures (Ex.12). The identification of Political environment and policy as a CSF is rooted in general CSF literature of Boynton & Zmud (1984), and applicable to road planning and the inclusion of climate concerns. These CSFs are relevant in the Startfase during the construction of goals and ambitions. The connection with the political environment is related to the tasks of the project manager.

6.1.7 Laws and legal standards

Legal factors are found in all three cases. Legal requirements are given to the project organisation by an authority via the law e.g. water requirements are given by water authorities in both RijnlandRoute and A16 Rotterdam (Ex.10,12). Two main problems with legal requirements are identified, (1) legal requirements increase complexity of projects and (2) legal requirements or standards are used as the maximum, satisfying the standard is enough, going beyond them is not necessary (Ex.11,12). The embeddedness of climate concerns in law is found in literature (Shaw et al., 2014; Dhakal & Chevalier, 2017; Kivila et al., 2017; Malekpour, et al., 2017; Jesus & Mendonça, 2018). The success of legal requirements is questionable (Ex.6). Interestingly the success of climate targets is advocated by Björnberg (2013). Of course requirements such as GHG abatement targets (Björnberg, 2013) oblige inclusion, however it creates adverse effects. The legal framework is a usable tool to enforce inclusion of any aspect into projects. However, it is questionable if this is the best way. Radical laws create obstruction and problematizes the inclusion of climate even more, as the support falters. It is also questionable if legal enforcement will happen, as it assumes that a national government is willing to do it. The project organisations of road projects are influenced by the existing legal framework. The legal framework and embeddedness of climate concerns in the law are considered a CSF. However, a CSF that is not influenced by project organisations.

6.1.8 Form, mind-set and priorities of project organisation

It is quite interesting to see that project organisations do not include climate considerations in the early project and then after increased awareness are able to include quite some climate elements. This shows the strength and possibilities of project organisations in including climate concerns. The project organisation is found to be a prime CSF in any organisation (Boynton & Zmud, 1984). The importance of the project organisation and its form and people are discussed by Heeres et al. (2012), Van den Herik (2015). Addressing this CSFs by the organisation itself can be difficult. An organisation must be aware of climate concerns to address its own actions. However assuming there is awareness among the organisation, then it is possible to capitalize on that by having the right form of organisation and the

right people in place. As the research shows that only a handful drivers of climate concerns can achieve a lot. The project organisation can also be influenced by RWS and the political environment, to be better able to address climate concerns. The research shows the importance of the right project organisation and is therefore considered a CSF. The project organisation is relevant in all parts of the planning process. It is the executive power behind every part of the Planuitwerkingsfase.

6.1.9 Early inclusion

Each case showed the importance of including climate concerns as integral part of the project via early inclusion (Ex.7,8,12). This entails that inclusion of climate concerns in the early planning process and consequent embeddedness of the climate concerns in project goals creates a project were climate considerations are integrally part of the scope. As a result every decision is rooted in that goal. This intertwines different project priorities with climate concerns early in the development project as was discussed by Swart et al. (2003), Heeres et al. (2012), Lenferink et al. (2013) Busscher et al., (2015).

This integral development approach and early inclusion are considered critical to optimise success. As road projects are quite path-dependent, early inclusion creates or reserves enough space for climate measures in later phases. This CSF is influenced by the project organisation. The project organisation is dependent on the political environment to strive for early inclusion since the political priorities might conflict with the inclusion of climate concerns. This CSF is part of the Startfase.

6.1.10 Availability of technology

Project organisations that want to include climate measures are bounded by what techniques are available. Furthermore, technical elements in the final decision, the TB, restrict the contractor in its creativity, as the solution must satisfy the technical requirements. Technical barriers are identified by Labonnote et al. (2017) and in more general terms by Boynton & Zmud, (1984). It is difficult to assess the criticality of this factor. It is clear that it can obstruct the success of a project in later project phases. However, the inclusion of climate mitigation and adaptation of the project is not impeded by technical restrictions. It problematizes already included elements. It is questionable if technical factor is considered a CSF. It is an important factor in the late tender phase, and thus impacts the success of the project. Furthermore, the existence of technology and the experience with climate related technology might influence the awareness and decisions of project organisations. This CSF is relevant in the tasks of the contract manager.

6.1.11 Participation and mind-set stakeholders

The inclusion of stakeholders, similarly to the general public, can have large effect on a projects' drive to include climate considerations. This is found in all three case studies, and especially in A16 Rotterdam, were late discussions with stakeholders led to the creation of an ambition document (Kansenboek), and consequently late inclusion of climate concerns (Ex.12). The importance of stakeholders for the successful inclusion of sustainability or climate concerns is discussed by Swart et al. (2003), Lenferink et al. (2013), Sözüer & Spang (2014), Rizzo, et al. (2016) Malekpour et al. (2017). The stakeholders can be a large supporters or opponents, depending on the awareness of the climate problem (Ex.11). Project organisations can address this CSF by including the stakeholders early on, and by creating shared visions. Stakeholders are considered a CSF as their ability to disrupt projects must be noted and should be considered by project organisations. Stakeholders are relevant during the Startfase as interests are included in goals.

6.1.12 Form and restrictions of design requirements

Requirements of the project organisation to the market create problems with, the creation of a maximum, the difficulty with monitoring performance and increasing complexity and financial feasibility (Ex.7). The factor of form and restrictions of design requirements closely corresponds with the design factors as discussed by Dhakal & Chevalier (2017). Since it is about how requirements of the organisation impact the design. While it influences how the climate concerns are translated into a

design, it does not influence inclusion directly. Similarly to the technology factor it merely impacts the already included climate consideration. It is important for a project organisation to note the difficulties with requirements. However the factor does not help to include climate aspects in the project. Can it still be considered a CSF? So far, this thesis has used to concept CSFs in a broad sense. A factor in the planning process that possibly has a substantial impact on inclusion of climate concerns or the preservation of concerns are considered CSFs. Here the design requirements play a substantial part in preserving climate concerns in the later parts of the planning process, therefore it can be considered a CSF. Requirements are relevant in the late tender phase and are a task of the Contract manager.

6.1.13 Market inclusion and incentives

The inclusion of the market is found in all cases. This is logical, as most projects outsource the development of the design and realisation to the private sector (in cooperation with RWS). Interestingly a lot of the current climate measures are attributed to the contractors. The common view is to address climate mitigation and adaptation in later project phases, as the creativity and experience of the market can be put to good use (Ex.6,8,12). As mentioned that problematizes the early inclusion and embeddedness of climate consideration in the spatial planning procedure. The importance of the market was noted by Biresselioglu et al. (2018). An active market strategy can only be successful if the problems the market will face in later phases are considered earlier in the process. Is market inclusion a critical factor? The inclusion of the market is as the case studies show, quite successful. However, the market mostly only translates the project ideas to measures. It is mostly the case that the market helps to include climate considerations, as it is for the most part only following earlier decisions. This is partly the case, as A16 Rotterdam showed, the contractor is able to introduce climate considerations, partly helped by the ambitions document of the late planning phase. Therefore, market inclusion is considered a CSF of inclusion of climate concerns.

6.1.14 Type of contract

The contract between market and project organisation is relevant to ensure preservation of included climate concerns. The three studied cases all used a different contract: Zuidasdok, a D&C contract, RijnlandRoute a DBM contract and A16 Rotterdam used a DBFM contract. The main differences are seen between D&C and DB(F)M. The two types of contract are discussed earlier in §3.2.2. By using a DB(F)M contract RWS buys a service, the road is designed, build and can be used. The contractor is responsible for all these things. In the case of a D&C contract RWS buys a road, which is built. The case studies show that there are two upsides of using a DB(F)M contract. Firstly, the contractor becomes responsible for the road, for a longer amount of time. Consequently, it is in the contractor's interest to deliver a durable, and easy to maintain road. Secondly, it is possible to add financial incentives to introduce climate measures into the design. Both A16 Rotterdam and RijnlandRoute are excellent examples of this. Both projects used a financial incentive to achieve energy neutral or efficient tunnels. By making the contractor responsible for the energy bill, the contractors became more committed to limit energy consumption. The DB(F)M contracts seem to favour inclusion of climate concerns and are instrumental in achieving climate measures. Interestingly Zuidasdok, with a D&C contract, is not able to achieve climate mitigation or adaptation measures. DB(F)M contracts show to be successful in including climate concerns, and incentivising climate measures of the contractor. The type of contract is considered a CSFs.

6.1.15 Missing factors

Four factors are not found in the case studies. (1) Institutional environment; as mentioned several other factors belong the institutional factor. Therefore, it is not used, as smaller factors already clearly belong to other overarching factors. (2) Governance is not identified. As with institutional, elements that can be considered part of governance can also be categorized in other factors e.g. the monitoring of performances could be considered part of governance, however it is used in the requirements factors. (3) Economy; as the socio-economic development is a large force in the development sector, it

is relevant for road planning as well. The cases all were already in progress during the start or the aftermath of the global financial crisis of 2008. It was however not identified as a factor on climate inclusions. Furthermore, it is the mind-set of that time that influenced the lack of inclusion. Interestingly the mind-set of the time compared to the climate focussed mind-set of the last years has a tremendous influence on inclusion of climate concerns. (4) Change adaptation; the way a project can adjust to risks and new developments is not identified as a relevant factor in the case studies. Two reasons can constitute this, first it is not there, and it is limitedly relevant or second, there was too little focus on this factor, as a result it was limitedly discussed in interviews. However it was named only a few times in the literature, strengthening the believe that it is of limited relevance.

A final remark on the missing factors. It becomes clear that much of the missing factors can be attributed to the categorisation of findings. In the end it is arbitrary which factor goes were. This is especially the case with institutional factors. Furthermore, these factors are limitedly or not observed and are therefore considered not relevant in the Dutch context.

6.2 Discussion and Conceptual Model

The CSFs can be used to create a conceptual model showing how the CSFs influence the planning process to achieve inclusion of climate concerns. Figure 6.1 (next page) is the visual representation of how spatial qualities are included in the road planning system. Following Hooimeijer et al. (2001) climate concerns can be approached as spatial quality, making it possible to address this system in more general terms.

On the right the available information and knowledge impacts the perceptions, misconceptions and cognitive barriers of actors towards climate mitigation and adaptation. Laws and legal standards oblige inclusion of several spatial quality concerns, for instance climate concerns. These three factors impact the decision-makers, which are the project organisation and political environment. These three factors are noticed to change over time, due to the increasing understanding of climate change in the last decade information, perceptions and laws change. Most likely changing perceptions have some influence on changing laws.

Consequently, the decision is made by decision-makers. Their decisions are bounded by the legal framework and depend on their own views and those of the public and stakeholders; the influencers. Through decision-making processes and participation instruments spatial qualities are included and become part of the project. If that happens in the early planning project the early inclusion factor is positive, and integral development is possible. Consequently those ambitions are used to create goals. The goals are created in the Startfase and influences the following parts of the project phases.

In the spatial planning component (A) the spatial quality becomes part of the variants, and MER and consequently the decision for the place and form of the road, in the OTB. Here the financial feasibility, incentives and budgets are relevant. Budgets are based on project goals and therefore financial resources are reserved if project goals exist. The OTB is translated to TB and there is a final project decision in including the spatial quality.

In the tender procedure the spatial quality is part of the creation of PvE and Gunningscriteria. These are the requirements to be used in assessment in the tender procedure. During the tender procedure the market is included. The inclusion of the market can help to translate ambitions concerning a spatial quality to measures. Different incentives can be used to stimulate the market to do this, for instance through EMVI and contracts. The type of contract is relevant, as a DB(F)M contract will most likely favour the inclusion of climate elements.

Lastly, there is the availability of technology. This factor impacts the tender procedure. The contractor can only be successful in including climate measures, if the necessary technology is available, to satisfy the wishes of the project. Furthermore the knowledge on the availability of technology in early project phases impacts the early mind-sets. As the project is aware of what is possible and what the (financial) risks of that technology are. In that wat the availability of technology plays a role much earlier in the planning process.

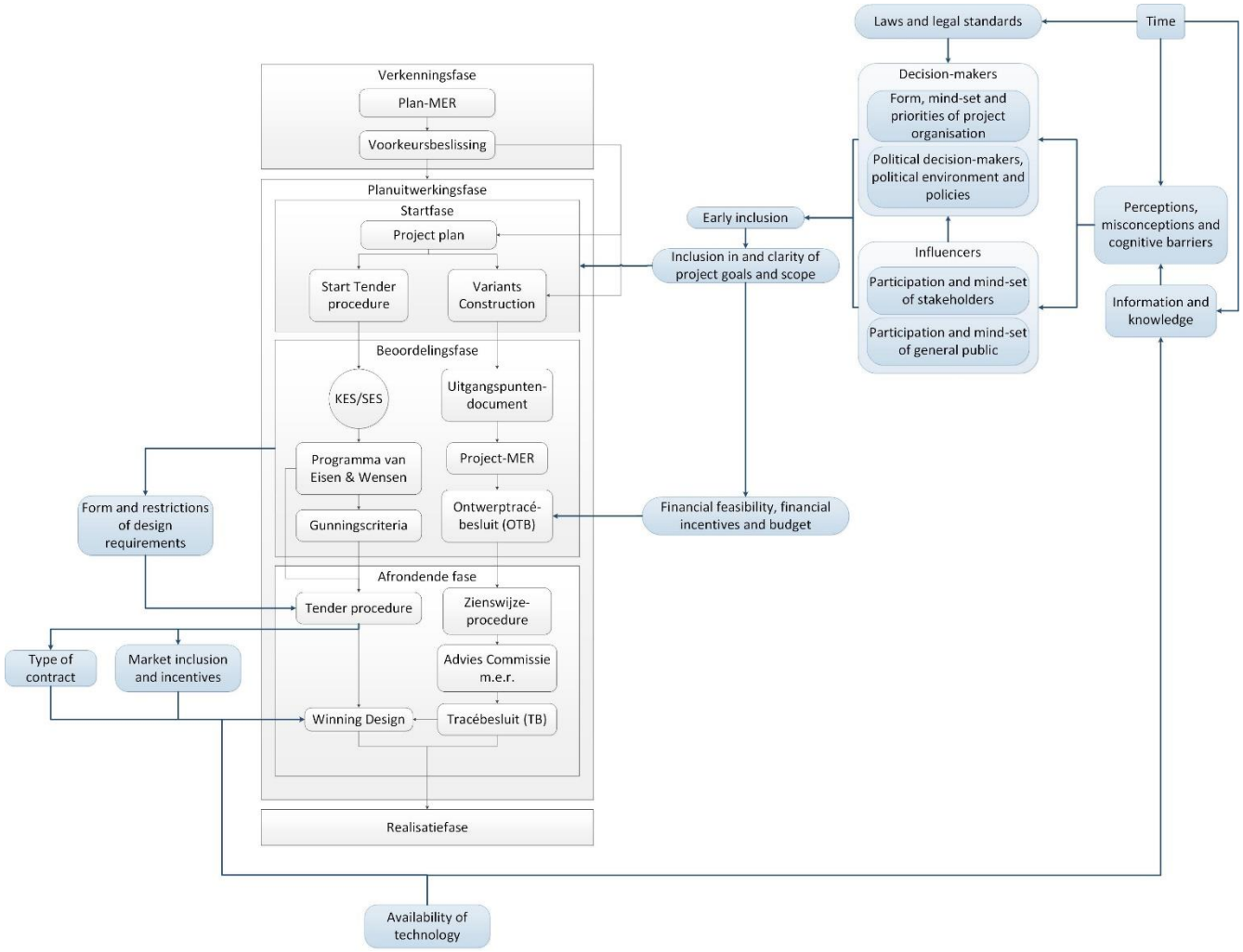

Figure 6.1: Impact of CSFs on Dutch road planning system. With on the right the factors impacting the inclusion of spatial qualities. On the left the four factors that show the translation of goals on spatial qualities into measures and design.

Figure 6.1 shows the impact of CSFs on the planning process. The figure is a simplification of reality. Some connections are therefore left out e.g. the general public factor, also impacts the Zienswijzeprocedure. However what this figure does, is show which relations between CSFs are relevant for the inclusion of climate adaptation and mitigation or other spatial qualities into the early project scope. The lack of early inclusion of climate concerns is found to be an important problem in current practice. Early inclusion of climate concerns establishes it as an integral and important part of the project, resulting in positive chain of events.

The chain of events is depicted in figure 6.2. This model is an abstraction of a detailed conceptual model, including all the different factors identified in this thesis project. This complete model is included in Appendix I. Figure 6.2 corresponds with figure 6.1 and explains how inclusion of climate concerns can be achieved. The figure shows elements in the system a bit differently.

1. The left part of the figure corresponds with the CSFs explained in figure 6.1. The factors are operationalised to aim at the inclusion of climate concerns.
2. The block: *early inclusion of climate concerns*, is the result of that process and corresponds with the early inclusion factor.
3. Cognitive hindrances are not in figure 6.1 but explains that during this early inclusion other cognitive hindrances play are role. It is in fact torn apart from the climate mind-set.
4. The climate goal, means that a climate goal is included and corresponds with the Startfase of the planning process.
5. The involvement of climate in trade-off and decision-making, combines the processes of MER towards TB.
6. The right part of the figure shows how the market and contractors are influenced and show how the earlier climate concerns become part of the design. This corresponds to the later part of the Planuitwerkingsfase and the Contractfase

What is the relevance of this model. The model is a translation of CSFs into a system of interconnected parts that represents the real-world system, and how climate concerns are introduced there. With the use of this model, and the full model of appendix I, a list of five main problems is identified. These problems are addressed in chapter 7 and revolve around the question: how to stimulate inclusion of climate mitigation and adaptation in the Dutch road network.

6.3 Main problems

If the chain of reactions in figure 6.2 is followed five main problems are observed.

1. Information, awareness and mind-set

Much of the inclusion of climate concerns starts with information. The current mind-set is not sufficient to spark initiative to include climate concerns in road planning. An underlying reason is the focus of project organisations, and RWS, on building a road. All other things are extra. Gradually, RWS is increasing its sustainability perspective in projects, however as observed sustainability does not equal climate concerns. As such there is an observed problem in the current mind-set and awareness of critical actors. This problem is perceived by Experts 7,8,9,11 and 12.

2. Actors and Priorities

Another problem is the tension between the actors and their priorities. The many different interests of the four main groups of actors, makes it difficult to come to a shared understanding and vision on climate concerns. Since other interests are prioritised above climate concerns it becomes difficult to keep these early notions of climate problems in the project. This problem is perceived by Experts 6,7,9,11 and 12

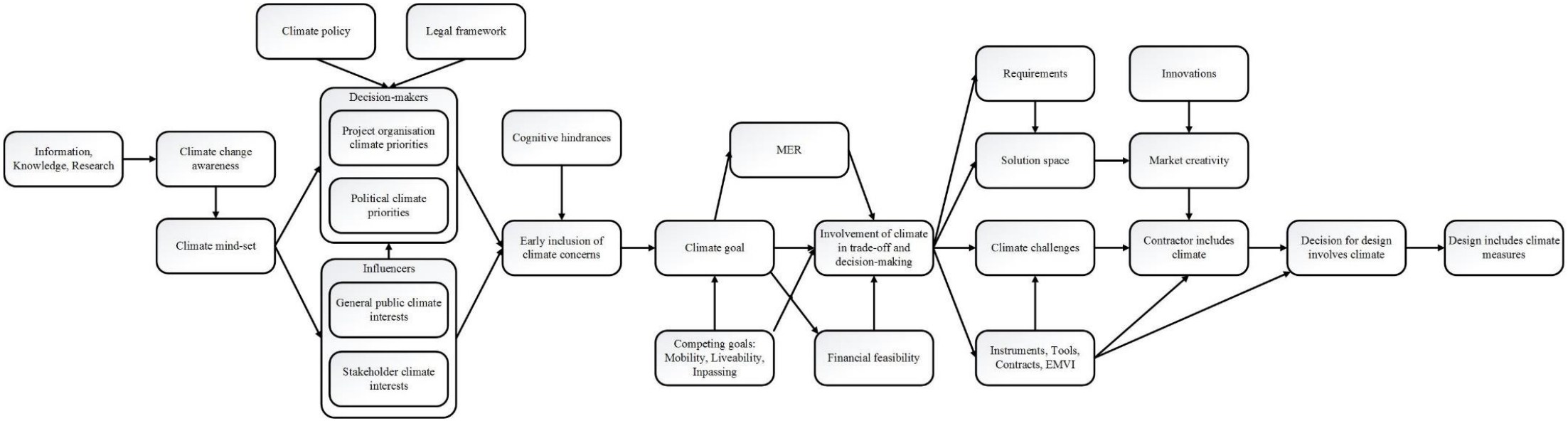

Figure 6.2: Abstraction of conceptual model, with left the information inflow into main project actors. Middle the early inclusion and creation of project goal corresponding to early Planuitwerkingsfase, followed by trade-offs in the decision-making process corresponding to the creation of TB. To the right the workings of the market and creation of a project design, corresponding with late Planuitwerkingsfase and Contractfase.

3. Early inclusion and Climate goal

The early inclusion itself is a challenge, depending on the actors, information, laws and policy. These early included notions are preferably translated to goals. Another problem can be identified. The creation of project goals depends on the priorities of all involved. It also depends on the relative importance of priorities. Weights are given to different aspects. The weight given to climate interests is currently lower than the mobility goal, and potentially other goals. The consequence is an uneven level playing field between the goals. This problem is perceived by experts 6,7,8,9 and 12

4. Continuous conflict between priorities

The priorities conflict again in the consequent trade-off a decision-making process. Here priorities on mobility and liveability can come in stark conflict with inclusion of climate aspects. Part of that tension is related to spatial circumstances and part is created by limited financial resources. The process is partly influenced by the MER. The MER increases information, to make a well-informed decision, yet the MER is currently not capable of properly addressing climate elements. That problematizes trade-offs further. The problems are perceived by Experts 6,7,8,9,10,11 and 12

5. Market and Solution space

The translation of climate concerns and introduction of concerns in the later phases is troubled by a limited solution space, as result of earlier decisions. The contractor is limited in his creativity by financial aspects and the TB. This problem is perceived by Experts 6,7,10,11 and 12.

6.4 Conclusion

This chapter discussed the fifteen CSFs as identified in the case studies. The fifteen CSFs and the knowledge on the Dutch planning process resulted two conceptual models. The first model shows the influence of the CSFs on the planning process. The second model is more an overview of the five different parts of inclusion of climate considerations and is an abstraction of a much larger more comprehensive model with many smaller and more specific factors. This model uses the CSFs of the first model and translates those into factors that are specific for climate considerations. With this model, and with the obtained knowledge on CSFs a set of five main problems is identified. The five problems are currently obstructing the inclusion of climate considerations in road projects. The five problems correspond to the fifteen CSFs, as they are problems in the different project areas that relate to one or more CSFs. From this chapter it can be concluded that fifteen CSFs influence the inclusion of climate considerations in road planning. Furthermore, it is concluded that five main problems in the areas of these CSFs currently obstruct success. The two conceptual models, the fifteen CSFs and the five problems are revisited in chapter 7. The focus of that chapter is to discuss solution of the five identified problems.

Chapter 6 answered the main research question. Fifteen CSFs can be identified in Dutch road planning. The workings of those factors as discussed in chapter 6 answer the main research question. Chapter 7, discusses the solutions to the five main problems and therefore answers the additional research question.

A last remark on the findings of this chapter. The conceptual models, while insightful, are models, and are ultimately wrong. The models simplify relations between factors with one arrow. That neglects some of the underlying assumptions and problems of these connections. Furthermore, this thesis observed the factors, but did not specifically research the relations between factors. However, in many cases it was difficult to merely observe a factor, the relationship with other factors is also observed. Therefore the relations are based on the findings. The models are used to compile a list of five main problems in inclusion of climate concerns, mitigation or adaptation, in Dutch road planning.

7. Design

A design is developed to overcome the five main problems and to improve the inclusion of climate mitigation and adaptation in road planning. This ‘design’ is not a list of several solutions and suggestions. The design uses a systems perspective to the problem. That means that the planning process and the identified CSFs are viewed as a system. The design proposes solutions to the problems in that system. The design answers three main elements: Where must an intervention take place? Who must intervene? And what is that intervention? This chapter uses the findings of the road planning process of chapter 3 and the CSFs of chapter 5 and 6.

7.1 Information, awareness and mind-set

Currently, the climate inclusive mind-set of project organisations and political players is limited. Decisions, mind-sets and priorities depend on climate change awareness. As figure 7.1 shows, information and knowledge are necessary for awareness of climate change and the related mind-set. Since information and knowledge help to change perceptions, limit misconceptions and overcome cognitive barriers. E.g. more knowledge on the expenses of climate measures would decrease the misconceptions that climate measures are more expensive than conventional measures (Ex.6). Figure 7.1 is a subset of the conceptual model. This model explains the impact of CSFs on the planning process. In this conceptual model the availability of technology and time impact knowledge. Increasing experience with climate related technology can for instance limit the misconception that climate measures are relatively expensive. The ‘time’ CSF is discussed as relevant, since in the last decade perceptions on climate change shifted. However it is already discussed that while time explains some of the inclusion of climate concerns, it is not a useful CSFs.

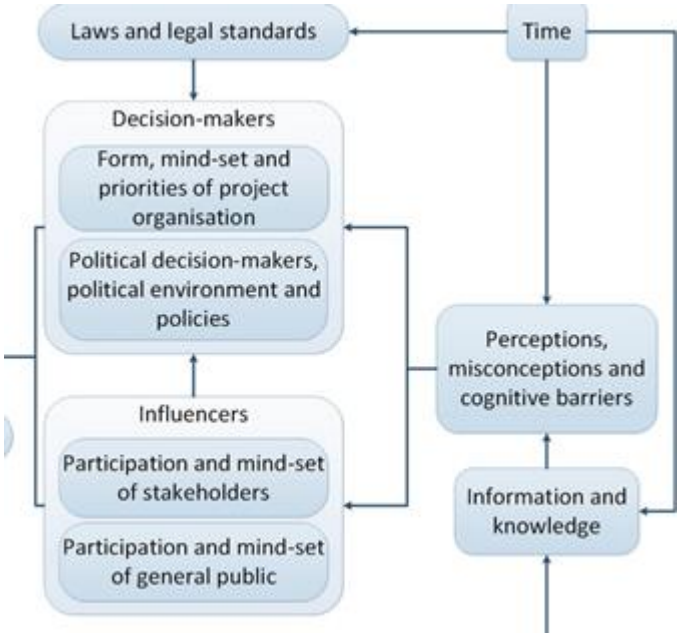

Figure 7.1: CSFs information and knowledge, and Perceptions, misconceptions and cognitive barriers and their impact on other CSFs, subset of conceptual model 1.

It is interesting to consider where to intervene. Considering the perceptions and related awareness of climate change and the importance of early inclusion, stimulation of the aforementioned perceptions must happen in early project phases. That means during the translation of Verkenningsfase to Planuitwerkingsfase. The so called Startfase. As discussed in §3.2.2 a project plan is constructed in that phase. The Project plan includes ambitions of the project and translates the outcomes of the Verkenningsfase to activities and goals for the Planuitwerkingsfase. It is during this phase that a

stimulation of perceptions and awareness, through information and knowledge can improve the inclusion of climate concerns.

Who must stimulate information and knowledge and tackle perceptions and misconceptions during this phase? As discussed in §3.2.2 the project plan is drawn up by the Project manager and local authorities and stakeholders. Three groups of actors can tackle the information problem:

(1) The project organisation. As stated the project manager is responsible for the project plan, and it is therefore befitting for him to improve the availability of information during the process of drawing up the project plan. Two problems are related to having the project manager stimulate the inflow of necessary information. Firstly, it assumes the project manager is willing to stimulate the inclusion of climate concerns, and therefore wants to stimulate information provision. This can prove problematic, as established in §3.2.1 the project manager is first and foremost responsible for the construction of a road, it is not necessarily in his interest to include climate concerns. Secondly, it assumes the political environment and stakeholders are willing to use the information and knowledge to change their views.

(2) During the Startfase the authorities (politicians) play their part. As local and regional policy makers it is their responsibility to address climate inclusion in regional projects. Through climate policy these authorities can steer the project organisations. This assumes the authorities' perceptions favour inclusion of climate concerns. Policy in this case must be focussed on supplying information to project organisations. Relevant authorities are for the municipalities: College van B&W, and in the Province: Gedeputeerde Staten.

(3) Actors outside of the described system can improve the available information and knowledge necessary in the project. For instance RWS can increase the amount of knowledge and help distribute that knowledge over the project. Furthermore, the central government, in the form of Ministerie van I&W must improve the availability of information, through campaigns. Think for instance of SIRE campaigns, these are not merely focussed on the perception within road projects but increase a better understanding of climate change among the public, which can have a positive influence on political decision-makers and project team members.

What can actors do to solve the lack of information and knowledge during the Startfase of the Planuitwerkingsfase. The project manager can improve the availability of information on the importance and possibilities regarding climate measures during the construction of the project plan. Local authorities can improve local and regional policies to improve information and knowledge, as expert 8 explained, policies tend to put focus on specific project elements. RWS and Ministerie van I&W can put in place policies as well and start campaigns to increase the awareness of climate change in society.

There is a difference in the approach to mitigation and adaptation. Adaptation is much more relevant for road projects since the consequences of climate change will impact the constructions. Therefore, climate adaptation is intertwined with information on water requirements and safety research on constructions. The constructions must be able to withstand extreme weather. Therefore the views of project organisations and authorities must change to use more extreme climate scenarios. With mitigation it is more the question whether climate mitigation must be part of a road project. Information must show the importance of mitigation in road projects. The perceptions of project organisation and authorities must change in such a way that they see it as imperative to include climate mitigation in road projects.

7.2 Actors and Priorities

Actors and their priorities and interests are shown in figure 7.1 as well. The conceptual model shows two groups. The decision-makers and influencers. In the decision-makers the form, mind-set and priorities of the project organisation and the political decision-makers, political environment and

policies play a role. The influencers are the general public and stakeholders. Their mind-set and degree of participation are relevant. These actors play a role in decisions on ambitions, goals and activities of the project. These decisions are made in the Startfase. As mentioned in the previous section their perceptions etc. depend on information and knowledge. Currently the mind-sets of actors are insufficiently focussed on inclusion of climate concerns. If it are perceptions and mind-sets, fuelled by misconceptions and limited information the solutions of the previous section can help overcome this problem. However, other elements related to the actors can create problems for including climate concerns. Perhaps there is some sort of positive attitude in the project organisation, yet the form and structure of the organisation does not help. For example there is no manager solely responsible for climate concerns (Ex.11,12). Or the perceptions of political decision-makers are positive, yet the political environment is not, obstructing the inclusion of climate concerns. Maybe there is a lack of climate policies that provide structure for project. The influencers can be obstructed in their participation if the public participation processes are limited. For example, the Zienswijzeprocedure happens only late in the Planuitwerkingsfase.

The problems with actors and their priorities, and the inability to properly address them is also part of the Startfase. It is important to intervene during construction of a project plan and variant construction. From a project organisational standpoint solving problems with actors and interests is a job for the Omgevingsmanager. The Omgevingsmanager is tasked with the alignment of different priorities and the inclusion of stakeholders. Through stakeholder management the Omgevingsmanager is capable of doing that. The alignment of priorities is currently done by using specific tools: Omgevingswijzer and Ambitieweb, during this early project phase.

Other actors within the project scope can have a positive effect. The local political decision-makers can put in place climate policies. In that way climate concerns are established as a priority. Furthermore, local and regional political decision-makers can put in place laws and legal standards to oblige inclusion of climate concerns. This is shown in figure 7.1 as well.

Legal standards and laws can be instituted on a national scale as well. Inclusion of climate concerns in the MER by a change of the Wet Milieubeheer, obliges inclusion of climate concerns. It is the national government and Ministerie van I&W that are responsible for this. lastly RWS can form project organisations that are explicitly in favour of including climate elements. As Expert 12 explained, it is up to RWS to include climate concerns during the construction of project teams and by doing so ensuring that several players of that organisation fight for climate concerns.

There is a difference in the way climate mitigation and adaptation are to be approached. Most likely climate adaptation, especially in relation to water management is already part of the project, and part of priorities of stakeholders, for instance Hoogheemraadschap or Waterschap. Increased focus on climate adaptation is merely the enhancement of a priority that already exists. In the case of climate mitigation it is different. The priorities of actors on climate mitigation, e.g. the reduction of energy production is a priority that is not yet part of a road project. Therefore, whoever stimulates climate mitigation must stimulate the inclusion itself, and not the prioritisation of an already existent interest.

7.3 Early inclusion and climate goal

The inclusion of climate concerns into the project must be done early on, to maximise results. The CSFs and actors discussed in the previous two sections lead up to this. Inclusion during the Startfase, means establishing climate concerns as integral aspect of the road project. To establish climate as integral aspect it is important to include climate as a project goal. The process of goal creation is closely related to the previous sections, as it is a tangle of priorities, interests, goals and ambitions. And it is up to the project organisation to guide the process to create project goals. One of the problems here is the relative importance of other goals. Especially, mobility and liveability goals tend to conflict with climate concerns, something that was noticed in all three case studies. Where

liveability was prioritised, resulting in land tunnels. Figure 7.2 shows how the outcomes of the process of decision-makers and influencers results into project goals at the Startfase of the Planuitwerkingsfase.

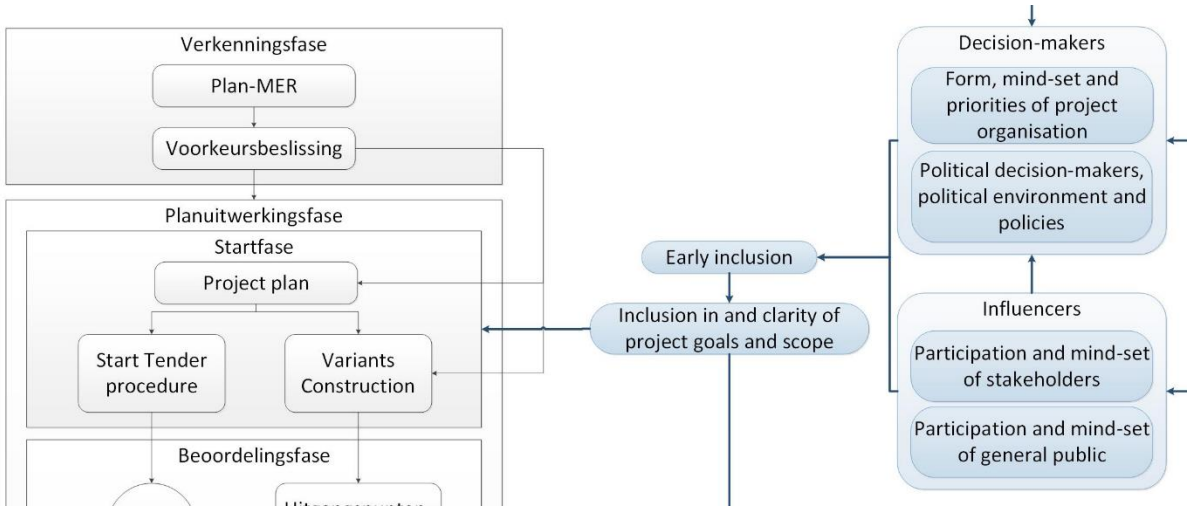

Figure 7.2: Impact of decision-makers and influencers on early inclusion of climate concerns, and creation of climate goals in the Startfase of the Planuitwerkingsfase.

In order to achieve inclusion of climate considerations in goals it is important to influence the goal creation process. Part of that is already explained and depends on influencing the different actors.

From a project organisational view it is clear that the process of goal creation is a task of the Omgevingsmanager. The Omgevingsmanager deals with the different actors and their priorities, and actively works towards a set of project goals and ambitions. Tools such as Omgevingswijzer and Ambitieweb are used during this process. While the process itself is a task of the Omgevingsmanager the decision on goals and ambitions, embedded in the Project plan, is made by the Project manager together with local authorities and stakeholders. Both the Omgevingsmanager and Project manager must take climate concerns into account during the creation of goals. As mentioned the local authorities and stakeholders are relevant in the creation of project climate goals. If climate is one of their priorities it will come up during goal creation process. If these actors are willing to prioritise climate concerns above other spatial qualities, the project organisation will be more inclined to include climate concerns. Lastly, outside of the project organisation, RWS can try to establish the inclusion of climate goals in projects. They will have to change their current focus on effective road development towards a more climate inclusive road construction focus.

The inclusion of climate concerns in climate goals is different for mitigation and adaptation. As mentioned earlier adaptation is much better intertwined with various project priorities such as water. However, through that, climate adaptation can become an implicit element, and not a clear explicit goal. Climate mitigation is usually not a goal in road projects, as it is not viewed as something that should be done in road planning. However as for instance A16 Rotterdam shows, climate mitigation through energy reduction is possible in road projects.

7.4 Continuous conflict between priorities

Once climate concerns are part of the project scope and embedded into the project goals, the planning process still entail several steps towards a TB. Figure 7.3 shows this process. Interestingly, there is still a struggle between different goals and priorities. During the ProjectMER, the different variants are tested. Considering climate inclusion was successful in the Startfase, the ProjectMER includes variants and criteria related to climate mitigation and adaptation. However, the decision for a location and form

of the road is made in the TB. The weight given to the findings of the MER might be low. Other priorities related to political ideology or public preference can outweigh climate concerns. Ultimately there is a trade-off between many different concerns. Project organisations fall back on experience and intuition, and the project goals to make the trade-off. More difficulties arise when trade-offs involve conflicts between project goals. Furthermore problems arise due to financial restrictions. The financial feasibility of a project comes under pressure when the scope is extended. The budget is based on the early project goals, and therefore early inclusion is instrumental in reserving enough space in the budget for climate measures.

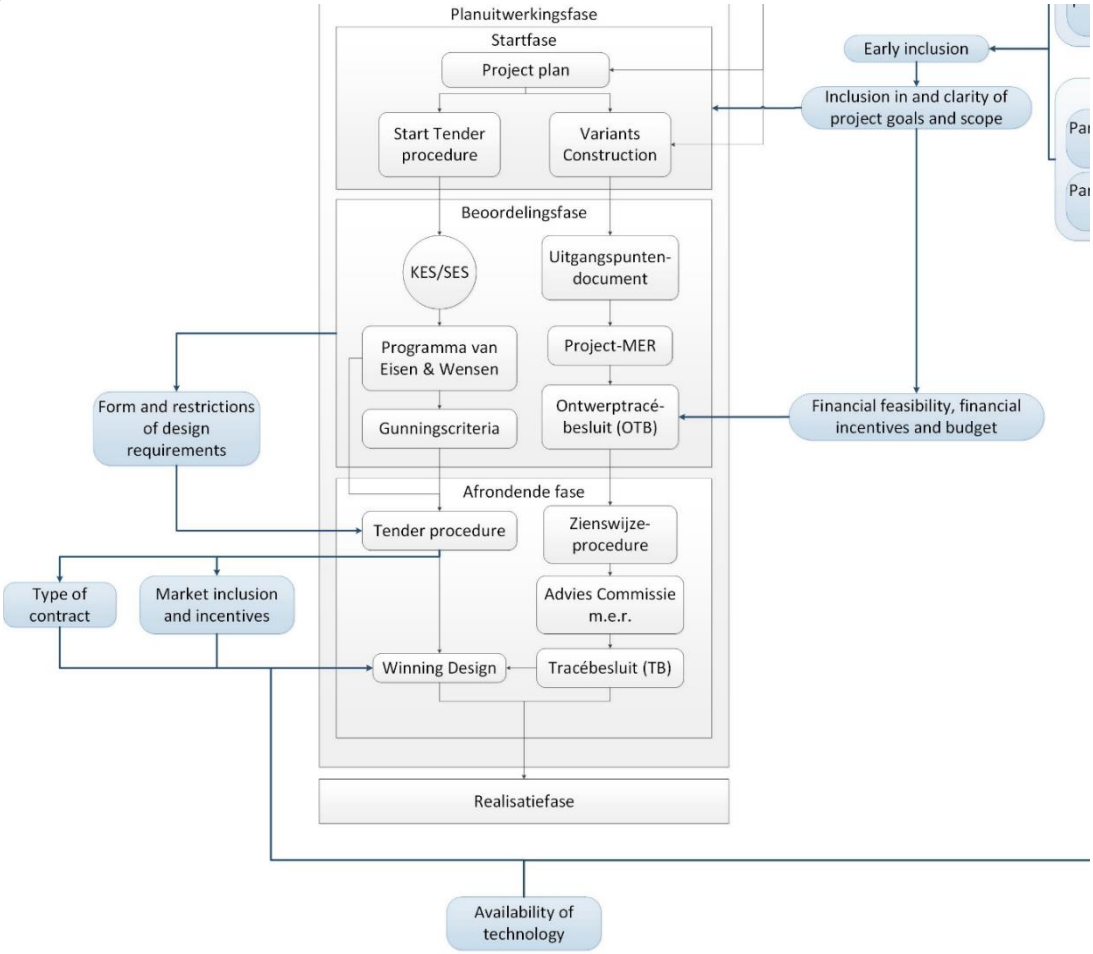

Figure 7.3: Subset of conceptual model, with the in the centre the Planuitwerkingsfase, on the right the CSFs influencing early inclusion and on the right CSFs influencing the tender component of the Planuitwerkingsfase.

To solve some of these problems it is necessary to intervene in two parts of the system. First during the construction of the Uitgangspuntendocument, this document contains the criteria for the effects study. To maximise the effective inclusion of climate concerns, climate criteria must be part of the effect study. This increases the chance that climate aspects are included in the decision for a form a location of the road. Furthermore, intervention can take place during the decision-making process around the OTB and in less extent the TB (the TB mostly follows the decisions of the OTB).

In the project organisation it is the Omgevingsmanager that mainly deals with the ProjectMER. The Uitgangspuntendocument is based on the priorities of project and stakeholders and is established by Omgevingsmanager. The Uitgangspuntendocument is drawn up by the project manager, in cooperation with Omgevingsmanager. Furthermore, the project organisation decides on a location and form of the road which is based on the findings of the ProjectMER and must be agreed upon by the

authorities. It is here that the form of the project organisation is important. There is a need for team members that can prioritise climate goals and ambitions over other goals.

Outside of the project organisation it is the political environment that influences the process. The TB is a decision made by the local and national authorities and their wishes in inclusion of climate concerns carries weight. From a national authority viewpoint legal requirement can be made to include climate aspects in the MER, which gives it a place and weight during the decision-making. Lastly the public can voice their interest during the Zienswijzeprocedure. It is there that climate concerns can still be included. As is seen in A16 Rotterdam, de late construction of the Kansenboek has led to inclusion of climate related measures, not in the TB itself but in the tender procedure.

The earlier considered difference between climate adaptation and mitigation is relevant here as well. The importance of climate adaptation is much more intertwined with road development than mitigation. It is logical to include the effect of weather on road constructions into the planning project. However, mitigation measures such as energy production is much less related to road projects. Therefore, even if these aspects are part of the early planning project, it does not carry much weight.

7.5 Market and solution space

On the left part of the conceptual model the tender procedure is shown. Following the early inclusion of climate aspects in the project plan, the tender procedure establishes system and client requirements for the final design. This happens through the KES and SES processes. The outcomes of these processes depend highly on the wishes of stakeholders. The PvE is the outcome and is used by the contractors to construct a design. The decision for a design is based on the EMVI-criteria, which can include climate aspects. The PvE creates requirements to the design. The form matters, as seen in the case studies there are strict requirements, but also challenges through which extra points can be scored. The type of contract is considered relevant, a DB(F)M contract is favoured over D&C. Furthermore, the availability of technology limits the potential climate measures.

But what are the problems? The result of the spatial planning procedure, the TB, forms the framework for the final design. Technical and spatial restrictions limit the solutions space of contractors. Currently, it is best practice to introduce climate elements late in the project during the Contractfase. Consequently, the chances of including climate measures are limited. The project organisation is able to put in climate challenges. These challenges try to stimulate the contractor to include extra elements, in this case climate measures. Most of that depends on the DBFM contract, EMVI criteria and other tools. And that works, the market is challenged and comes up with new solutions, that have included climate measures.

Late inclusion is the last solution if all other attempts to include climate concerns failed. The success depends on the contractor. It is interesting to notice that currently project organisations favour late inclusion. As it pushes the responsibility to the contractor. It is much easier to put a financial incentive in for the contractor, than to include it in the heavily pressured early project stages.

Ideally, the intervention takes place early in the process, as the previous sections mentioned early inclusion makes climate concerns integrally part of the project. The project organisation must be aware of the importance of early inclusion. Furthermore, the project organisation must consider the solution space of the contractor earlier in the process (Arts, 2007). This is a job for the Omgevingsmanager and Contract manager, who together must include the problems of contractors during the early Planuitwerkingsfase. That would mean the technical difficulties perceived by contractors get a central place during the ProjectMER and the construction of the TB.

Currently, the tender takes place after the decision for a TB. This results in both advantages and disadvantages. An advantage is the clarity for the contractors, the TB has clear technical rules that must be followed. A disadvantage is the restriction to the creativity of the contractors, especially when it comes to inclusion of climate measures. This last element is strengthened by financial restrictions.

Two system changes might help solving these issues. Firstly, the contractor could be chosen and included earlier in the spatial planning process. This increase the considerations for their problems, and must be guided by Omgevingsmanager, Contract manager and the Technisch manager. The Technisch manager is tasked with the technical elements of the road, something that is closely related to the challenges of contractors and the technical restrictions of the TB. Secondly. The TB could be made more flexible, to give contractors more space to come up with solutions, that also address the climate concerns. A flexible TB is also in line with the findings of Meijer et al. (2011).

The problem of limited solution space for contractors is slightly different for climate mitigation and adaptation measures. Climate mitigation is an 'add-on' to a project. If the TB does not explicitly reserve space for energy production, it is difficult to realise. However the contractor is able to address climate mitigation in material use and construction logistics, as these are not elements of the TB. Climate adaptation is embedded in the concept of road planning. Therefore it will, to some extent, be part of the TB. However the rules of the TB will form the maximum for climate adaptation in the project and there is limited space for the contractor to make adjustments.

7.6 Conclusion

This chapter set out to find ways to overcome the five main problems found in the planning process and identified CSFs. The system approach used led to several main findings. (1) There is a large role for the project organisation for the creation of much needed information and awareness to change perceptions and limit misconceptions. Misconceptions which obstruct (early) inclusion of climate concerns. The project manager is identified as main player. Local authorities share the responsibility to increase information on climate change, RWS is responsible for stimulating early inclusion and addressing widespread misconceptions. (2) The Omgevingsmanager is responsible during the inclusion of stakeholders and their priorities. The Omgevingsmanager must include climate concerns as well and align the wishes of different stakeholders with climate concerns. (3) Early climate concerns are more successful when embedded in climate project goals. The Omgevingsmanager and Project manager are instrumental in achieving this. The role of the political decision-makers and legal framework is identified as important as well. (4) The Project manager and Omgevingsmanager are responsible for inclusion of climate concerns during the ProjectMER and construction of TB. Especially, during the conflict between different project goals. (5) The problems with the limited solution space for the contractors during the tender procedure can be solved, by earlier inclusion of contractors by Omgevingsmanager and Contract manager. Furthermore a more flexible TB can limit obstruction of the creativity of the market. It is concluded that the inclusion of climate concerns must be done early in the planning project. The project organisation has the responsibility for that inclusion, especially the project manager and Omgevingsmanager. RWS must change its policy of late inclusion, to a policy focussed on earlier inclusion.

Furthermore, a slight difference between climate mitigation and adaptation is observed. Adaptation is closely related to some of the activities of road projects, especially soil and water elements and weather resistance of constructions. As such, climate adaptation is mostly an adjustment of already included elements. Climate mitigation is not naturally part of a road project. Therefore it must be brought into the project scope altogether. Lastly, the importance of climate mitigation in road projects is unclear. Solving this starts with making information on the importance of climate mitigation available early in the planning process.

8. Conclusions, Contributions, Reflection and Recommendations

This chapter discusses the final conclusion of this thesis. The conclusions are started with a short recap of the reason for this thesis project, followed by the main findings and the answer to the main research question. After this section the scientific and practical contributions of this research are discussed. The project is reflected upon and from the conclusions, contributions and reflection a set of recommendations for future research is discussed.

8.1 Conclusion

Man-made climate change has been established as the biggest challenge of today's world. This calls for the consideration of the impact of every part of society on the world's climate. The Dutch government has initiated a transition to a climate friendly and climate adaptive future. The Dutch mobility sector is one of five main sectors stimulated to reduce its CO_2 emissions and to adapt to future climate circumstances. This transition has been troublesome. The road planning sectors has been struggling with including climate considerations into the planning process. Interestingly, several policy documents and guiding documents have been introduced in recent years. The policies have not had the desired effect and the inclusion of climate concerns has been relatively unsuccessful. A societal wish for a better understanding of inclusion of climate concerns in development project has been voiced. Currently, the solution to inclusion of climate considerations in road planning projects cannot be answered by scientific findings. A lack of scientific sources on this inclusion in road planning causes uncertainty of the workings of road planning projects and the inclusion of climate considerations. The available scientific sources on different transitions in spatial development projects is insufficient to help understand this current problem. There is a limited understanding of critical success factors (CSFs) of inclusion of climate considerations in road infrastructure projects. CSFs make it possible for project organisations to address their main problems and issues.

In this research a case study approach is used to identify CSFs in road infrastructure projects to fill the mentioned knowledge gap. Three case studies to Dutch road infrastructure projects Zuidasdok, RijnlandRoute and A16 Rotterdam are conducted to identify CSFs in the workings of the Planuitwerkingsfase (planning phase) and the inclusion of climate elements in that phase. Climate considerations are focussed on climate mitigation and climate adaptation which are the two core elements of addressing climate issues. Two methods are used in the case studies, a document study and a series of interviews with different managers of the case studies. Figure 8.1 shows the main findings of this thesis. It shows fifteen CSFs that have influenced the three cases in the inclusion of climate mitigation and adaptation

Figure 8.1: Fifteen CSFs that influence the inclusion of climate concerns, identified in Dutch road projects, Zuidasdok, RijnlandRoute and A16 Rotterdam.

1. Information and knowledge in decision-making
2. Inclusion and clarity in project goal and scope
3. Financial feasibility, financial incentives and budget
4. Participation and mind-set general public
5. Perceptions, misconceptions and cognitive barriers
6. Political decision-makers, political environment and policies
7. Laws and legal standards
8. Form, mind-set and priorities of project organisation
9. Early inclusion
10. Availability of technology
11. Participation and mind-set stakeholders
12. Form and restrictions of design requirements
13. Market inclusion and incentives
14. Type of contract
15. Time

The importance of availability of information on climate change and its consequences and the perceptions and misconceptions of relevant project actors is considered the root of most problems. CSFs 1 and 5 revolve around this problem. Misconceptions at the project organisational level cause a lack of inclusion during the early planning process. These findings are in line with Lenferink et al. (2013) Sözüer & Spang (2014), Azhoni et al. (2018) and Mees et al. (2018). It is concluded that the

lack of information on the importance of inclusion of climate concerns in the early planning process, and the existence of misconceptions on for example the advantages of late inclusion of climate concerns, and financial problems of climate measures currently obstruct successful inclusion.

Furthermore, the importance of the four main actors is found. The political decision-makers and project organisation make the main decisions, and are established as CSFs 6 and 8, however the general public and stakeholders influence these decisions as well, CSFs 4 and 11. The importance of these actors, and the related CSFs to these actors are in line with much of the identified literature. For instance Malekpour et al. (2017) and; Mees et al. (2018). discussed that a lack of climate information leads to unsustainable political priorities. Interestingly, it is there that much of the problems occur. Conflicts between actors and their priorities obstruct inclusion of climate priorities during the (early) planning project. Furthermore, the importance of legal standards and requirements for the inclusion of climate concerns is identified which is in line with the findings of Shaw et al. (2014), Dhakal & Chevalier (2017), Kivila et al. (2017) Malekpour, et al. (2017) and Jesus & Mendonça, (2018).

These previous two findings, with the relevant CSFs all relate to the early inclusion of climate concerns. A central theme during the case studies is the importance of early inclusion and creating climate project goals. Climate must become embedded as an integral part of a road planning project. CSFs 2 and 9 relate to this. Several of the interviewed experts (6,7,8,9,12) agree with this notion. The case studies show that problems related to early inclusion were seen in each project and result in sub-optimal inclusion of climate concerns. The importance of early inclusion and the establishment of climate as part of a project goal is in line with the findings of Kivila et al. (2017) and is more broadly shared in the existing literature.

More problems are identified in planning process. The early project goals and ambitions guide the effect study (MER) and result in a final decision, Tracébesluit (TB). Interestingly, a conflict between project goals and priorities is observed during these final project decisions. RijnlandRoute for instance shows how financial concern can outweigh the liveability concerns, which results in a decision for a road south of Leiden through green areas, instead of an underground tunnel through Leiden. The cases show how a continuous struggle between priorities happens during the spatial planning procedure of the Planuitwerkingsfase.

This thesis also identifies several CSFs in the tender procedure part of the Planuitwerkingsfase. Design requirements are created in the planning process. Consequently, the market is included, and the requirements are given to the contractor, eventually a contract is made. The research shows that contractors are limited by the TB, as a consequence of late inclusion of contractors. The creativity of private parties, especially when it comes to climate measures, is limited by the earlier decisions. The research also shows that DB(F)M contracts are relatively successful to D&C contracts since contractors are responsible for a project for a longer amount of time. Contractors are restricted by limitation to the availability of technology. It is concluded that the current best practice of late inclusion of climate concerns, struggles due restrictions of earlier decisions. However, it is also concluded that contractors are instrumental in reaching success in terms of climate inclusion.

This research set out to answer the following research question:

“What critical success factors in the planning process of Dutch MIRT road infrastructure projects affect the inclusion of climate considerations into the project?

The fifteen CSFs of table 8.1 have been identified as CSFs and are the answer to this question. The confidence in the findings is high due to the similarities of the findings and existing CSFs in literature in other development disciplines.

8.2 Contributions

8.2.1 Scientific

This research connects the concept of CSFs in spatial development projects for the inclusion of various spatial qualities to the inclusion of climate considerations in road planning. Currently, there is no existing research that identifies CSFs for the inclusion of climate considerations in road planning. This thesis strengthens the confidence in the earlier findings in spatial development. The similarities between different spatial development disciplines and the similarities in addressing different spatial qualities is an interesting observation. It suggests that since the different disciplines are similar the approach to problems is similar. E.g. the findings of Azhoni et al. (2017) on climate adaptation in water management in the Dutch context are similar to the findings of this study. In short, this research made the following scientific contributions:

- New research to the inclusion of climate considerations in road planning.
- Add to the knowledge on CSFs in spatial development projects for the inclusion of different spatial qualities.
- Corroborate the earlier findings on CSFs in spatial development project for the inclusion of different spatial qualities.

In the beginning of this thesis a scientific goal was articulated:

Scientific goal: *Improve the understanding of the workings of climate change induced transitions in road planning.*

From a scientific perspective this thesis contributes by establishing how CSFs obstruct the successful transition process in road planning. Two remarks on the scientific contribution. Firstly, the lack of scientific knowledge on climate related transition processes in road planning and inclusion of climate aspects is the main knowledge gap this thesis tries to fill. That makes it hard to embed this scientific contribution in a wider scientific context, as there is of yet not much written on it. Secondly, this thesis has always had a more of a practical use, as currently project organisations and consultancies are unable to address inclusion of climate concerns in road projects.

8.2.2 Practical

This thesis project sets out to address the practical issues of inclusion of sustainability in Dutch infrastructure. Consultancy firm Infram observed the current struggles with the transition of different infrastructures towards a sustainable situation. The uncertainty on what practices are successful, or where to act to reach success were the prime reason to start looking into the problem of this project. This thesis contributes to society and more precise to the Dutch road planning sector in various ways:

- The findings are a clear reminder of the many struggles project organisations deal with. Many of the problems are known but have never been joined together to create and extensive overview of the problems.
- This research identified CSFs to be used by project organisations. CSFs are areas of interest for the management of a company or in this case a project organisation. This research helps project organisation to know what to focus on, what to do, and what not to do in the inclusion of climate considerations.
- This research found the importance of early inclusion of climate considerations and identified the problems with current best practice to include climate considerations in later project phases.

A practical goal was articulated:

Practical Goal: *The identification of main problems and potential solutions in the inclusion of climate concerns in Dutch road planning.*

The practical goal is specifically focussed on the Dutch situation. The scientific goal focusses on the field of road planning overall. The list of CSFs, understanding of the system of CSFs and planning process and five main problems, especially the importance of earlier conclusion shows the main problems and solutions of the current system. The discussion of chapter 7, illuminates the importance of the project organisation, project managers and Omgevingsmanager to address climate concerns in road projects.

8.3 Reflection

The findings of this research are observations made in case studies. The number of cases, three, are limited so are the number of expert interviews, seven. As such it is difficult to generalise the findings. Which is also a result of the used research approach. Interestingly the findings strongly relate to the existing literature in related fields. Therefore, the confidence in the findings increases. The limited number of expert interviews is a weakness in this research. As the results are based on conversation with only seven experts. As a result some of the findings could be more opinions than facts. Due to the limited number of experts it is difficult to compare opinions on a larger basis.

Another identified problem is the level of abstraction. The focus of the thesis is on the main processes, CSFs and actors. As a result it takes these elements as one homogenous element. For example the political environment is named. This is the level of abstraction which works in this thesis project. However there are many detailed processes happening in that political environment, with many different actors. The workings of the political process are not discussed. As a result the understanding of the current problem and system is limited to the higher level of abstraction.

This research focussed on the problems with inclusion of climate considerations in road infrastructure planning. Under the current circumstances this is an interesting research topic, as there is a need to make different parts of society climate friendly. However what is the use of this research if circumstances change. These findings help to improve climate consideration in the near future ‘tomorrow’, however what is the use in the day after tomorrow. What if in ten years all cars run on electricity. The road infrastructure itself is only a small part of the climate impact of the mobility sector. As a result, in the situation the traffic itself does not harm the world’s climate, it is questionable if this need for especially climate mitigation is still there. What if CO_2 retrieval techniques become more successful and the world is capable of cleaning the air effectively. Would it than be necessary to address CO_2 in the construction roads and tunnels. Or perhaps in an even further future when there has been a modal shift to new forms of mobility, e.g. the hyperloop. In these cases the interests in road networks and the climate mitigation aspect of these networks will drop. Interestingly, this will be different for climate adaptation, is necessary, since it is inevitable that the world’s climate will keep changing to some extent. However, as the IPCC (2001) explained, a lot of climate mitigation measures will strongly minimise the future need for climate adaptation.

Even though that might be the case this thesis is more than just inclusion of climate considerations in road projects. In essence it is about including a spatial quality into a spatial development process. This new spatial quality potentially conflicts with reaching the main goal of that project. The findings of this research therefore go beyond road and climate. And the current problems in the processes and CSFs are interesting findings useful in many other spatial issues.

This research used slightly dated case studies. Since TBs were needed for the analysis of cases, projects needed to be under construction to be eligible for selection. Consequently, all three cases

conducted their Planuitwerkingsfase at the start of this decade. During that time climate concerns were not a clear societal problem. As a result inclusion of climate concerns is very limited in the early planning projects of the case studies. The CSFs time is related to this. As a result this thesis project cannot discuss the impact of contemporary tools, policies, legal framework and instruments to the inclusion of climate concerns. This is a weakness in this research.

A last remark on climate adaptation and climate mitigation. During this research these terms were used to approximate what climate consideration entail. As a result a narrow scope is taken on climate issues. As current practice uses sustainability much more. It would have been interesting to view this problem in the broader sustainable perspective. This would have put the emphasis more on integral area development. The importance of this notion is discussed by Puodziukas et al. (2016). In this thesis the problem of conflicting priorities is brushed off with relative easiness, and it is suggested that climate problems should just be prioritised above other elements. It must be noted that this is easy to say but is simply not possible in reality. The different priorities and interests are there for a reason. The conflict of interests is touched upon in this thesis, and was discussed with Expert 12, however it remains an underdeveloped theme in this thesis.

8.4 Recommendations

8.4.1 Recommendations for future research

Currently, there is a limited understanding of the way climate concerns, mitigation and adaptation, become part of road planning. In three cases fifteen CSFs are identified. Furthermore, the importance of early inclusion is identified. Both findings can benefit from more research. The reflection discussed the limited confidence in the findings due to a limited set of interviews. To assess whether the findings of this research are broadly recognized a quantitative study can be performed. The goal must be to analyse one or a small sub-set of the identified CSFs. A larger sample size can help identify if the CSFs are broadly observed or based on isolated instances and opinions. Upscaling the research increases confidence in the CSFs as the findings are based on more experts,

- Quantitative research to the different CSFs, with a larger sample size to statistically analyse the views on inclusion of climate consideration. E.g. conducting surveys to project organisations, checking whether problems and CSFs are more broadly observed.

This research identified early inclusion and goal creation as main issues in the current system. The importance of early inclusion and the embeddedness of goals relates to the literature. However the literature and this research do not address the workings of early inclusion and goal creation This relates to the problems with the level of abstraction as discussed in the reflection.. Therefore, additional research on the workings of early inclusion, and what is necessary to achieve early inclusion is considered an important addition to current knowledge. Therefore, the following research is recommended:

- Research to the workings of early inclusion and goal creation. Understanding how early concerns become embedded and guaranteed in the project goals.
- An analysis of the results of early goal creation workshops between project stakeholders and actors. E.g. an ex-post evaluation of collaboration tools such as Omgevingswijzer.

The time element, as mentioned is a weakness of this study. Therefore it is recommended to analyse the success of current instruments and policies. A comparative case study analysis of current projects can help determine if the CSFs are currently stimulated, and if that achieves success. In this study it is better to focus on the Startfase of the Planuitwerkingsfase, since that makes it possible to analyse current projects.

- A series of case studies to current projects, to analyse the success of current policies and tools to address (early) inclusion of climate concerns.

Lastly, this thesis discusses CSFs for road planning in the Dutch context. As a result the CSFs are closely related to the Dutch planning system. It is interesting to see whether CSFs are also observed in other countries in another context. Such a comparison can illuminate whether it is the CSFs themselves that obstruct or enable inclusion of climate concerns, or whether it is the structure of the planning process that explain the problems. This research has some practical applications as well, as both contexts can learn from each other's successes and failures.

- Comparative research with other spatial planning contexts

8.4.2 Practical recommendations

As mentioned this thesis has a strong practical component, as it was produced in cooperation with consultancy firm Infram. Therefore, it is interesting to give several practical recommendations.

Early inclusion of climate concerns and embeddedness of these concerns in project goals are considered important elements to reach success, both are extensively discussed in this thesis. An underlying element is the importance of information to change perceptions and eradicate misconceptions. The provision of necessary information during the early planning process is a responsibility of the project organisation, to be precise that of the project manager. It is important to tackle the current perception that late inclusion of climate considerations is best practice. This is a taks for RWS. Currently, it is RWS that pursues quick and efficient mobility solutions. RWS favours late inclusion since climate ambition. Based on this research the following is recommended:

- The project organisation, especially the project manager, must address early climate inclusion.
- A change at RWS in the way project organisations are stimulated to address climate concerns earlier.
- The Omgevingsmanager should aim to include climate concerns in project goals.

8.5 Link Thesis Project and Master Programme.

The thesis connects to the master programme CoSEM with the specialisation Built environment and Spatial development in the several ways. Firstly, there is a multi-actor multi-level system involved since the Dutch planning system involves both political, project organisational, public and stakeholder actors. Secondly, the system can be perceived as a complex system, were different actors with different priorities and wishes are in a constant struggle to achieve a, for them, optimal solution. This complexity is enhanced by the different political levels involved. And the technical nature of the project. That is the third part, this thesis deals with road projects, the development of roads has a strong technical component. Also, the inclusion of climate concerns results in technical climate measures for the project. This transition process is part of the complexity of the aforementioned system and related to availability of technology. So far, the relation of the thesis to the complex system component of CoSEM. The thesis also relates to the engineering and management component since this thesis elaborates on ways to solve the current problems experienced in road planning. Finally, the thesis relates to the Built environment and Spatial development specialisation in that it focusses on road planning and development, which strongly related and overlaps with spatial planning and development.

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Appendix A – Interviews Case Studies

Interviews with project team member and managers in the project organisation are part of the case studies. This appendix includes the questionnaire used during the semi-structured interviews. This appendix is about the questionnaire used and not about the specific interviews. These are included in later appendices.

Questionnaire:

Naam:
Datum:
Tijd:
Locatie:
Project:

Vragenlijst Case interview
Introductie

Korte uitleg onderzoek: ik onderzoek op wat voor manier duurzaamheid een plek krijgt in wegenbouwprojecten. Duurzaamheid betekent, klimaat adaptatie en klimaat mitigatie. Ik focus op de Planuitwerkingsfase, met het idee, er komt een weg hoe wordt die weg duurzaam. Hoe heeft klimaat adaptatie en mitigatie een plek gekregen in het project? Dus van voorkeursbesluit tot Tracébesluit. Ik neem daarbij de planologische procedures in ogenschouw en ook kijk ik naar de aanbestedingsprocedure. Echter niet volledig. Ik laat de echte aanbesteding buiten beschouwing. Op die manier neem ik dus niet mee wat een aannemer nu precies doet. Wel kijk ik hoe de projectorganisatie duurzaamheid planologisch en via systeemvereisten in de aanbesteding meeneemt. Uiteindelijk ben ik op zoek naar onderliggende factoren. Aan de hand van een literatuuronderzoek heb ik een lijst aan succes factoren (enablers) en faal factoren (disruptors) geïdentificeerd. Via case studies, naar drie Nederlandse wegenbouwprojecten probeer ik te achterhalen of die factoren daar ook invloed hebben gehad. De case studies doe ik met behulp van project documenten en interviews. Met de documenten kan worden vastgesteld of duurzaamheidsaspecten aanwezig zijn in het project. Met de interviews wordt bepaald welke factoren daar aan ten grondslag hebben gelegen.

Research Question: "What critical success factors in the planning process of Dutch MIRT road infrastructure projects affect the inclusion of climate considerations into the project scope?

Interview

Dit interview wordt gehouden met [Naam], [Functie] bij [Bedrijf], en actief in [Project]

Aspecten - [Project]

1. Bij welke onderdelen van [Project] ben je actief (geweest)?
2. Welke duurzaamheidsaspecten kent [Project] (algemeen)?
3. Wat voor duurzaamheidsaspecten met betrekking tot klimaat mitigatie en adaptatie kent [Project]?
4. In relatie tot de vorige vraag, welke hoe zijn de volgende 7 aspecten meegenomen in [Project]?
    a. Energie en CO_2
    b. Materialen en afval
    c. Water
    d. Luchtkwaliteit
    e. Constructie en markt
    f. Klimaatbestendigheidsaspecten

5. Heb je het idee dat klimaat en duurzaamheidsaspecten een belangrijke positie hebben in [Project]?
6. Wat zijn manieren waarop klimaat en duurzaamheidsaspecten het project binnen zijn gekomen?
7. Zijn er onderweg ook aspecten, ambities of doelen met betrekking tot duurzaamheid en klimaat verloren gegaan?
8. Hoe wordt duurzaamheid meegenomen in de aanbestedingsprocedure?
9. De vroege fases van dit project zijn mogelijk gedateerd:
    a. Wat heeft dat voor invloed op hoe duurzaamheid en klimaat zijn meegenomen in de Planuitwerkingsfase?
    b. Hoe is dat verandert, hoe is dat nu?

Factoren – [Project]

10. Wat voor factoren hebben invloed op inclusie van klimaat en duurzaamheid in wegenbouwprojecten en [Project]?
11. Zoals ik zei heb ik via een literatuurstudie factoren geïdentificeerd. Het lijkt mij interessant om te kijken of die invloed hebben gehad op [Project].
    a. Factoren die ik wil doornemen (Factoren lijst)
        i. Wel of niet relevant (speelden zij een rol?)
        ii. Bij welk duurzaamheidsaspect
            1. Algemene duurzaamheidszaken
            2. Energie en CO_2
            3. Materialen en afval
            4. Water
            5. Luchtkwaliteit
            6. Constructie en markt
            7. Klimaatadaptatie
12. Zijn er nou ook nog factoren die niet in zo relevant waren in [Project], maar waar u van denkt dat die mogelijk belangrijk kunnen zijn?
13. Wat kan los van deze factoren nog invloed hebben op de implementatie van duurzaamheid en de inclusie van klimaat zaken?

Vervolgstappen

14. Zijn er nog zaken die niet besproken zijn die mogelijk nog interessant zijn voor mijn onderzoek?
15. Welke mensen die aan [Project] hebben gewerkt zijn volgens u mogelijk interessant om mee te spreken in het kader van mijn onderzoek?

Appendix B – Selection Case Studies

The case studies are carried out to three road infrastructure projects. The decision on which projects to include is made through the use of a set of selection criteria. This appendix includes extra information on the criteria and preferences used and eight potential cases. The scorecard used in chapter 2 resulting in a list of cases is the result of combining, criteria, preferences and knowledge on the cases.

1. Criteria and Preferences Case Selection

The case selection process uses criteria and preferences. The criteria are necessary to decide whether a project is suitable as a case study for this project. The criteria are split between two groups. First the real criteria, these form requirements for a project. If the project does not satisfy these criteria it cannot be part of this project since it does not comply with fundamental aspects of the case studies. The preferences are soft criteria that are preferably met. However cases are not immediately eliminated on the basis of these preferences. The preferences help to rate the projects. Due to limited resources only three projects are used.

1.1 Criterion 1: Road project

This thesis project focusses on road infrastructure development. The project must entail road infrastructure to be fit to be a case study in this thesis. Generally this will mean a project where the mobility issues are tackled by the construction of a new road, or the broadening or renewal of existing roads. Roads through tunnels or over bridges can also be included. A project that does not comply with this criterion does not fit the scope of this project and shall not be used a case study.

1.2 Criterion 2: Realisation phase and Tracébesluit.

In MIRT-project it is possible to speak of a road infrastructure project after the Voorkeursbeslissing, as the decision to construct a road has been made. Furthermore, it is only possible to say something about the success of inclusion if the final design and decisions have been made. During the realisation phase the design constructed between project and contractor is realised. The TB must be established. It is therefore necessary that a project has surpassed the processes of constructing design and TB. Therefore the second criterion states that a project must have a TB and must at least have started the realisation of the project.

1.3 Criterion 3: MIRT-project

To be able to compare the different case studies projects must be of a similar size. To that end criterion 3 expresses the need for MIRT-projects. MIRT-projects are all large infrastructure projects, financially backed by the government and carried out primarily by RWS and large contractors. As a result MIRT-projects are similar in size. A comparison between these projects can therefore be made in a fair manner. A small local road construction project might be an interesting project, however too different in scope and size to be able to compare it to the large MIRT-projects. Furthermore MIRT-projects follow similar steps and procedure, as a result the decision-making processes are comparable.

1.4 Preference 1: Infram project

The projects in which Infram participated preferred to others. The participation of Infram has several advantages. Firstly, the Infram advisors that worked on the project can prove an easy and quick source of information. Secondly, Infram will have documents and notes available on the project. Thirdly, the Infram advisors will have had contact with other project team members and potentially several managers. These contacts are useful in contacting people for interviews. The participation of Infram in the project is a preference.

1.5 Preference 2: Easy contact

If Infram has worked on a project easy contact with other team members and managers is possible. If not, it is still possible that Infram advisor have contacts that worked on a specific project. These contacts can be used as well. Being able to make quick contact with experts is a great advantage and thus the second preference. No easy contact, will drain time and resources, however contacting someone 'cold' is still a possibility.

1.6 Preference 3: Time of project

The third preference is related to the time a project was carried out. It is preferred that a project has been carried out in the last couple of years. There are several reasons for this. Firstly, information will be better available. On top of that, the interviews can be more successful since the experts must recall something that happened not so long ago. Secondly, if a project happened in the near past it will have followed rules and regulations similar to today's. The circumstances of those projects are the circumstances of current and future projects. That make them better suitable than project that happened a decade ago under very different legal, economical and institutional circumstances. Thirdly the focus on sustainability. Dealing with sustainability is something that came up only a few years ago. Older projects have limited forms of sustainability, as it was not a hot topic. Why not make this a criterion? It might be the case that an older project, for instance a project from around the early 2010s is suitable for this project and has hints of sustainable development on them. In that case it must be possible to not adhere to this preference and go with an older yet suitable project.

1.7 Preference 4: Hint of sustainability

It is preferred that a project has had some sustainability considerations. A project where no small piece of sustainability can be distinguished will be difficult to analyse and might not give the most interesting insights. No sustainability consideration can still be interesting, as the question arises: why not? Moreover, if such a project is compared with a very similar but more successful project in terms of sustainability it could result in interesting new insight, in the reason for failure or success.

2 Best scoring cases

A list of eight possible cases is obtained by using the criteria and preferences. This section gives background on these cases and are an addition to the case selection of chapter 2.

2.1 Zuidasdok

Zuidasdok satisfies all the predetermined criteria. It entails the construction of roads and the strengthening of the main road network, it is currently in the realisation. The project is a MIRT project. Apart from the criteria it is the only project that satisfies the preferences. Zuidasdok is a project in which Infram is currently participating. This will mean that contact with project team and different managers is possible. This also means that information either through documents or people is available. The project started in 2013 and will be fully finished around 2028. However currently a TB is already in place and realisation has started. Hints that the project focusses on sustainability and has sustainable ambitions are found. Zuidasdok satisfies all criteria and preferences and can be considered a good fit for a case study.

2.2 RijnlandRoute

RijnlandRoute is a project that deals with the construction of a new road. It is currently in the realisation phase and is a MIRT project. Infram participated in the project giving it all the advantages discussed before. The project started in 2014 and is set to be finished in 2021. The only setback of this project is the lack of a sustainable element. According to Expert 2 the project did not consider sustainability an important element or quality for the project. Even so, the project does fit the criteria and satisfies other preferences. Understanding why it was not possible to implement sustainability in

this project is interesting, especially considering it was started in a similar time as Zuidasdok, were sustainability was an important topic. RijnlandRoute is considered a good fit for this project.

2.3 A16 Rotterdam

The A16 Rotterdam satisfies all the criteria. It is a road project, of MIRT and it is in realisation. A16 is not a project were Infram participated in. Therefore it is uncertain if contact can be made with the relevant actors. The project started in 2005, with the Trajectnota in 2009. From then there was a decision to construct a road. The project is to be realised in 2024. The A16 has some interesting sustainability or climate aspects. A tunnel is to be constructed, that tunnel will be energy neutral.

2.4 A6 Almere

The A6 Almere project also satisfies all the criteria. It is a road project, of the MIRT and is currently being realised. The problem with A6 arises at the preferences. The A6 project was not a project that Infram participated in. Therefore it is uncertain if contact can be made with relevant actors.
The A6 project was started in 2012 and is currently being constructed, the timeframe is therefore adhering to the preferences. The A6 is an interesting project since sustainability has played a role. A solar field was connected to the construction of the road making it energy neutral. The A6 Almere project is a good option for a case study. If contact can be made via Infram.

2.5 N50 Ramspolbrug

The N50 Ramspolbrug belongs to the main road network. N50 is a MIRT project. The project satisfies the criteria. The trouble with the project starts with the preferences. N50 Ramspolbrug was not a Infram project, contacting experts more difficult. Enhancing that problem is the time it was carried out. The project started in 2007 and was finished in 2013 making it an older project. The decision of the Verkenningsfase and Planuitwerkingsfase were made a decade ago, under very different circumstances. Why include this project? The project has interesting sustainability aspects. It was delivered and works fully energy neutral. Considering that was done a decade ago, the project might have some interesting insight in how to achieve this.

2.6 A1 Amsterdam

The A1 project is a road MIRT project that is currently being realised, it satisfies all the criteria. Infram however, did not participate in the project. It is uncertain if contact can be made with relevant actors. The time frame it is constructed does adhere to the preference. It was started a few years back and will be realized in the coming years. The project was a failure in terms of sustainability. This makes it an interesting project. Sustainability was and issue during the early phases of the project, yet very little was done with it. The A1 could provide interesting insights in why current projects have difficulty to incorporate sustainability, and why they fail.

2.7 INNOVA58

INNOVA58 is project that satisfies all criteria but one and all preferences. It is a large road MIRT projects. Infram is participating in the project and has contacts with relevant actors. The project is ground-breaking in its approach to sustainability and is currently being developed. The only issue is the current advancement of the project. The project is working on its OTB. This means that no clear design and final decision is available. This makes it hard to see how sustainability during the process has led to a decision or design. While INNOVA58 can, for the aforementioned reason, not serve as a case study during this thesis project, it is a noteworthy project, that could serve as an interesting case study in future studies to successful inclusion of sustainability and climate concerns.

2.8 Weg van de Toekomst

The Weg van de Toekomst is a road project that was finished in 2013. The project implemented various forms of sustainability to create an environmental friendly and sustainable road. While this sounds promising the project has some problems. Firstly it is not a MIRT-project. It was local project for a regional road. As a result it is much smaller in size than other projects on this list. Another reason this project might not fit this thesis project is that Infram did not participate in the project and contacting actors might be difficult. Furthermore the project was finished in 2013 making it an older project. Weg van de Toekomst could be an interesting case study, however, it does not satisfy all criteria. Furthermore, contacting relevant actors might be an issue. As a result this project will not be used as a case study in this thesis project.

Appendix C – Summaries of Interviews Expert 1-5

This appendix includes five short summaries of the interview held with regard to the case selection of cases as discussed in §2.5 and the discussion of the Planuitwerkingsfase of chapter 3. Three things are central to these interviews, (1) Gain a better understanding of the Planuitwerkingsfase, (2) discuss possible cases for this research, (3) discuss the sustainability or climate aspects in those cases. Table C.1 shows the five experts and their expertise:

Table C.1: List of five experts interviewed for the creation of case longlist.

Expert	Expertise
Expert 1	Manager Planuitwerkingsfase
Expert 2	Manager Verkenningsfase & Planuitwerkingsfase
Expert 3	Manager Planuitwerkingsfase
Expert 4	Manager Planuitwerkingsfase
Expert 5	Manager Verkenningsfase & Planuitwerkingsfase

Expert 1: Manager Planuitwerkingsfase

The expert has participated in INNOVA58 and Afsluitdijk. Both projects are discussed. INNOVA58 possesses a lot of sustainability and climate considerations. The project is currently in the Planuitwerkingsfase. The Afsluitdijk project is in the Realisatiefase. The project included sustainability and climate concerns. This is shown in the goal for energy efficient pumps. The Afsluitdijk project is a wet infrastructure project. The Omgevingsmanager of Afsluitdijk can be contacted. The A6 Almere project is also discussed. Contact with the Omgevingsmanager is potentially possible through Infram. A1 is named as a project that fails in including climate and sustainable elements. The Omgevingsmanager can be contacted. Furthermore, the Weg van de Toekomst is an option as it included climate concerns successfully. This project is not a MIRT-project but a smaller regional road project. Ramspolbrug is named, this is a project that succeeded in being energy neutral. Infram did not participate in this project.

The Voorkeursbesluit includes several themes, climate and sustainability can be such a theme. Furthermore, the project plan can include certain goals such as stimulating circular economy, or energy neutrality. The decisions at the start of the project influences the scope and consequently work through in the TB. A lot of these decisions influence the Tender and the contractor, as they form a framework. Tools such as DuboCalc are used here.

The Planuitwerkingsfase has two parts, a spatial planning part and a tender procedure. Sustainability goals are used in the contract, meaning during the tender. However these goals are based on the decisions of the spatial planning procedure.

Expert 2 Manager Verkenningsfase & Planuitwerkingsfase

A6 Almere is a project where climate concerns have been included successfully, contact is uncertain, a Infram employee worked on the project, however it is uncertain if contact with the current project organisation is possible. RijnlandRoute is a project that can be analysed. However, it is a relatively old project, during the planning process sustainability and climate concerns were not a hot topic.

Current projects have little potential for sustainability or climate measures as the Voorkeursalternatief does not address sustainability. RijnlandRoute is such a project, it could have included climate considerations in the contract phase. Another project is Calandbrug, the Verkenningsfase was done in 2014, but still there is little regard for sustainability.

What is noticed, is that most projects keep pushing climate related decisions to the end of the planning process. As a result the design does not account for these concerns. That is because it is much easier to make requirements for the contractors to be climate friendly, than to address the concerns

within the planning phase. If climate concerns are not included in the early planning process it becomes difficult to create true sustainable roads. An example of a project that was successful in doing this is the Weg van de Toekomst, contact with the Project manager can potentially be made.

Expert 3 Manager Planuitwerkingsfase

Nieuwe Sluis Terneuzen is an interesting project, the sluices will be energy neutral, through the use of the difference in water level. Contact with the project organisation can be made, however it is a wet infrastructure project. Sustainability is always a difficult and broad concept. The Omgevingswijzer is used in some projects to create clarity. Projects that take clear decisions on sustainability or climate elements in early phases have generally more positive results. This however is not as simple as just including it in early project phases, as the process of translation early ambitions to real project elements is difficult. In the end the ambitions must be translated to requirements in the contract. This happens through system engineering, and KES. This translation is bounded by the TB. During the Verkenningsfase, especially the PlanMER many themes and topics are discussed, sustainability and climate concerns are among those. What happens there can have substantial impact of whether climate and sustainability are part of the Planuitwerkingsfase. If so these need to become embedded in the TB at the end of the Planuitwerkingsfase. Climate concerns are a matter of interest. Take for instance climate scenarios, if they are problematic slightly less extreme scenarios can be used. In the end it is a trade-off to invest in climate measures related materials and energy or to address other project elements. Usually sustainability loses to financial considerations and short-term thinking. This is related to a lack of understanding of the consequences on the long run.

Expert 4 Planuitwerkingsfase

Problems with sustainability and inclusion of climate concerns is that it is difficult to decide which alternative is better. It is comparing apples with oranges. An interesting case is Dijkversterking Marken, where a smaller and larger dike are the options. One is more climate friendly as it is smaller so uses less materials. The other is climate friendly since it is bigger and better equipped for future storms. The question is, which of the two options is better? In the end success depends on human drivers. The Beatrixsluis is an interesting case since financial incentives and a climate inclusive mind-set of the contractor lead to a CO_2 neutral sluice. Afsluitdijk also does things with energy neutrality, however this was not intended by RWS and is more the result of stakeholder interest.

During the Planuitwerkingsfase decisions are made on the size and place of the road. These are key decisions that impact the actions of other player, contractors, down the road. However, currently climate concerns are not part of those decisions. This can be achieved by including sustainability and climate concerns in the MER. This happens occasionally but is not mandatory.

Expert 5: Manager Verkenningsfase & Planuitwerkingsfase.

No specific interview is held with expert 5. This expert is the external supervisor in this project. Because of that several conversations were held with this expert, with regard to this project. The following cases are discussed with this expert: Calandbrug, RijnlandRoute, Zuidasdok, INNOVA58, and Weg van de Toekomst.

Appendix D – Literature Study to Factors

This appendix contains the excerpt of the literature study to factors on the inclusion of climate and or sustainability in road projects. This appendix contains a table summary of the findings. Here each factor is elaborated on. The literature study to factors serves as guidance for the case studies of this project. Primarily, the main findings are important as they are used during the case studies. The text in this appendix serves as an extra explanation of some of the identified factors and explains where the factors were found. The factors are divided in success a failure factors. First the success factors are discussed followed by the failure factors.

Table D.1: Table summary of all factors found in literature, with an indication of positive or negative factors and the number of times a factor was found.

Early inclusion		**#**
Integration sustainable and spatial development	+	4
Integration of spatial development and road development	+	4
Co-benefits creation through development integration	+	4
Integration sustainable development and community	+	1
Inclusion and clarity in project goal and scope		
Clear sustainability project goals	+	11
Well defined spatial quality aspects	+	2
Inclusion of sustainability in (early) plans	+	2
Well defined project scope	+	1
Unstable scope demarcation and problem definition	-	3
Lack of realistic objectives	-	1
Discrepancy in goals over phases	-	1
Including non-quantitative goals in decision-making	-	1
Form, mind-set and priorities of project organisation		
Integral project teams	+	3
Clear and thoughtful allocation of tasks (right people)	+	3
Responsible team (member) for spatial quality	+	1
Adequate project planning	+	3
Experience	+	3
Planning cannot address changing technologies	-	3
Limited resources	-	3
Lack of and changing priorities	-	2

Financial feasibility, financial incentives and budget		**#**
Financial incentives	+	3
Financial resources	+	3
Return of Investment	+	2
Financial aspects	+	1
Financial benefits	+	1
Dedicated budget	+	1
Shared budgets	+	1
Shared resources	+	1
Uncertain estimation of quality aspects	-	3
Lack of data on cost and performance	-	2
Emergence of competing investment priorities	-	1
Financial barriers	-	1
Market inclusion and incentives		
Clear communication of (sustainability) requirements	+	3
Early inclusion	+	1
Competition through tender	+	2
Trust and clarity	+	2
Intertwining Tender and Trace/Mer procedures	+	1
Type of contract		
PPP	+	3
DBFM	+	1
Quality requirements in contract	+	1

Institutional environment		**#**
Institutional environment	+/-	7
Traditional solutions; pro-grey mind-set	-	4
Path dependency	-	3
Laws and legal standards		
Environmental standards, codes and guidelines	+	8
Environmental law	+	4
Statutory provisions that enforce implementation	+	1
Regulations	+	1
Slow formal procedures	-	5
Outdated laws (inadequate for innovations)	-	3
Broad regulations	-	1
Legal procurement restrictions	-	1
Numerous technical rules and regulations	-	1
Changing jurisprudence	-	1
Lack of enforcement of the	-	1
Political decision-makers, political environment and policies		
Long-term sustainable policies	+	6
Ideology of ruling political parties	+	1
Lack of urgency	-	3
Changing political views	-	2
Change of government/leadership	-	1
Change of government priorities	-	2

Form, mind-set and priorities of project organisation (2)			**Participation and mind-set of stakeholders**			**Political decision-makers, political environment and policies (2)**		
Poorly integrated stages	-	2	Stakeholder management	+	2	Political horse-trading between competing parties	-	
Lack of decisions	-	1	Collaboration mechanisms	+	2	Political circumstances	-	2
Inefficient use of resources	-	1	Creation of additional value	+	2	Lack of environmental awareness	-	1
Changing project teams	-	1	Shared vision and local sustainable priorities	+	2	Expert advice overruled by political preferences	-	1
Information and knowledge in decision-making			Tools that converge visions and priorities	+	2	**Policy factors**		
Knowledge	+	5	linkage of project and stakeholder environment	+	1	Misaligned incentives	-	2
Documentation	+	2	Early stakeholder inclusion	+	1	Unclear policy agendas	-	1
Epistemic communities	+	1	Critical stakeholder relationship	+	1	**Governance and possibility for monitoring**		
Scattered, limited and missing knowledge	-	4	Conflict resolution	+	1	Front-end governance	+	1
Research overload	-	2	Embeddedness of vision in development agenda	+	1	Control mechanisms	+	1
Change adaptation			Appealing vision	+	1	Performance indicators	+	1
Risk management	+	4	Many stakeholders	-	2	Diffused responsibilities	-	4
Address dynamics of interrelated systems	+	2	Interdependencies	-	2	Lack of coordination	-	1
Change management	+	1	New actors involved have to deal with closed agreements	-	1	Fragmented governance	-	1
Form and restrictions of design requirements			Complex contracts	-	1	Lack of business culture	-	1
Design requirements	+	6	**Participation and mind-set of general public**			Contested perspectives on governance	-	1
Technical details	+	1	Public awareness	+	8	Pro-grey arrangements	-	1
Feasibility	+	1	Education of the public	+	2	Lack of quality control	-	1
Requirements under changing conditions	-	1	Public support (for vision)	+	2	**Perceptions, misconceptions and long-term thinking**		
Unclear requirements	-	1	Local participation	+	3	Long-term thinking	+	7
Scrutinizing of alternative concepts	-	1	Good communication of problem, vision and benefits	+	2	No traditional asphalt-oriented solutions	+	1
Availability of technology			Aligning public priorities with project objectives	+	1	Perception of risks and uncertainty	-	3
Available Technology	+	1	Good public image	+	1	Risk aversion	-	2
Technical barriers	-	2	Building trust in authorities	+	1	Perception of sustainability	-	1
Technological infancy of innovative sustainable solutions	-	2	(changing) societal preference	-	1	Lack of trust	-	1
Technical restrictions	-	1	Demand for short-term solutions	-	1	Behavioural barriers	-	1
Socio-economic development			Demand for traditional solutions	-	1	Cognitive barriers	-	1
Long-term economic conditions	+	2						
Socio-Economic Development	+	2						
Economic barriers	-	1						
Market imperfections	-	1						

1. Success factors

1.1 Information and knowledge in decision-making success factors

Knowledge is important in many aspects of development projects. In this case knowledge on technical aspects and innovation regarding sustainable measures are essential. Furthermore, knowledge on best practices and organisations are important. Knowledge can also be important to create awareness of the problem of climate change and creating public support (Lenferink et al., 2013; Sözüer & Spang, 2014; Van den Herik, 2015; Azhoni et al., 2018; Mees et al., 2018). Important in knowledge is in-depth documentation of projects. Documentation creates the information for future projects (NAS, 2016; Rizzo, et al., 2016). The existence of networks of experts is found to be helpful (Lah, 2017).

1.2 Inclusion and clarity in project goal and scope success factors

Clearly formulated project goals concerning sustainability impact the success of implementing sustainability. A goal or target guides development, since the development must strive to reach the goals (Shaw et al., 2014; Busscher et al., 2015; Van den Herik, 2015; Turnheim, et al., 2015; NAS, 2016; Kivila et al., 2017; Malekpour et al., 2017; Biresselioglu et al., 2018).

Related to that is the definition of these goals. Broadly speaking this means the definition of quality aspects, sustainability is than part of spatial quality. Clearly defining what quality aspects are necessary helps form clear sustainable project goals (Shaw et al., 2014; Van den Herik, 2015). To make sure that goals on sustainability are formulated and are considered in the whole planning process it is important to deal with this concept early on. Early inclusion of sustainability helps put in place a framework that guides the project in terms of sustainability (Van den Herik, 2015; Kivila et al., 2017). A well-defined project scope establishes what is part of the project what not. What quality aspects need to be considered and what different areas of development is related to the project. Is it merely building a road, or is there a connection with other spatial programs, and how does that affect sustainability goals and opportunities (Busscher et al., 2015).

1.3 Financial feasibility, financial incentives and budget success factors

Financial success factors are about the financial feasibility of projects. Financial incentives, through government policies, are factors that affect implementation of sustainability. Plainly speaking, if sustainable solutions are financially competitive with traditional solutions, they are used much more (Dhakal & Chevalier, 2017; Malekpour et al., 2017). Other elements are the height of return of investment (Shaw et al., 2014), financial benefits (Van den Herik, 2015), the availability of economic resources (Azhoni et al., 2018) and clear and dedicated budgets (Busscher et al., 2015). All these elements are about making sustainable solutions profitable and competitive with traditional solutions. Factors concerning shared budgets and shared resources revolve around the combination of resources through cooperation of different stakeholders, either private or public. A combination of companies and authorities are better suited to tackle the problem in a sustainable matter than different companies on their own (Heeres et al., 2012).

1.4 Participation and mind-set of general public success factors

The general public is not necessarily involved in the project however, it is a large potential troublemaker. Therefore it is important to create public support for the project. The public must understand why the project does what it does, how that will be achieved and how that will impact them. Public awareness is essential in this. Awareness of the goals of the development project and the reasons for including sustainability in the project (Brundtland, 1987; Shaw et al., 2014; Dhakal & Chevalier, 2017; Azhoni et al., 2018; Biresselioglu et al., 2018; Jesus & Mendonça, 2018; NAS, 2018; Mees et al., 2018). Awareness can be achieved through education of the general public (Dhakal & Chevalier, 2017; Malekpour et al., 2017).

Furthermore, public support for the vision used in the project is useful, it shows that the public understands and supports what is being done in the project (van den Herik, 2015); Malekpour et al., 2017). Participation can be a factor in achieving public support (Lenferink et al., 2013; Biresselioglu, et al., 2018; Jesus & Mendonça, 2018). Creating public support demands good communication, interaction and the alignment of project goals with local needs (Shaw et al., 2014; Van den Herik, 2015; Malekpour et al., 2017). Finally, in order gain the support of the general public, it is important to have a good public image and to be trustworthy to the public (Kivila et al., 2017; Biresselioglu et al., 2018). The public must be certain that the development carried out in the project are not impeding their interests, and that the project takes their wishes and needs into account

1.5 Perceptions, misconceptions and cognitive success factors

These factors are about ideas of people or groups. Two important factors here are long-term thinking (Lenferink et al., 2013; Van den Herik, 2015; Dhakal & Chevalier, 2017; Malekpour et al., 2017; Biresselioglu et al., 2018) and no traditional asphalt-oriented solutions (Dhakal & Chevalier, 2017). Long-term thinking is essential in sustainable development projects. Sustainable options are mostly less financially feasible and profitable as opposed to traditional solutions, at least on the short-term. Short term demand for quick fixes puts pressure on development projects to choose for the traditional solution. Through long-term thinking and considering the full life-cycle of the project the sustainable solution will mostly be more attractive.

1.6 Political decision-makers, political environment and policies success factors

Long-term sustainable policies are identified as a factor (Brundtland, 1987; NAS, 2016; Dhakal & Chevalier, 2017; Lah, 2017; Biresselioglu et al., 2018; NAS, 2018). This means that it is important to have policies in place that have long-term goals. Policy might disrupt development process, as the rules are constantly changing. Sustainable policies, and the drive to develop sustainably is largely a political choice. Steering to sustainable development is politically loaded and depends highly on the ruling political parties. Where green and left-wing parties are usually more inclined to think about the environment than right wing, conservatives. The ideology of the sitting ruling parties is therefore extremely relevant (Lah, 2017).

1.7 Laws and legal standards success factors

Three legal success factors are identified. Firstly, (national) environmental standards, codes and guidelines. Embedding sustainability in legal frameworks can help enforce sustainable development (Shaw et al., 2014; Dhakal & Chevalier, 2017; Kivila et al., 2017; Malekpour et al., 2017; Jesus & Mendonça, 2018). Environmental laws are important as legitimacy for sustainable actions can be derived from them (Brundtland, 1987; Shaw et al., 2014; NAS, 2018). Laws and other statutory provisions can help enforce implementation (Dhakal & Chevalier, 2017) as well as regulations (Kivila et al., 2017). The idea of legal success factors is that legal concepts, laws or standards are put in place by the government to enforce certain sustainability goals.

1.8 Institutional environment success factors

The literature explicitly names the institutional context as a key success factor (Brundtland, 1987; Niesten et al., 2017; Azhoni et al., 2018). The institutional context is an overarching concept which entail laws, rules, social constructs, policies, regulation etc. Many of these concepts are discussed as separate types of factors.

1.9 Form, mind-set and priorities of project organisation success factors

There are several success factors related to the project organisation. Firstly, an integral project team, meaning the project team consists of people of different expertise and oversees the whole project planning process, creating continuity, inclusion and integration of development project and goals. The

project teams might change, with new members coming in and others leaving, however some sort of continuity is important, to prevent changing views on sustainability goals (Lenferink et al., 2013; Van den Herik, 2015; NAS, 2016). Secondly, a clear allocation of tasks. Responsibilities are distributed in the right manner, with the right people at the right place. One supporter of sustainable action at the right spot can greatly influence the successful implementation of sustainability (Heeres et al., 2012; Van den Herik, 2015). In the allocation of responsibilities it is important to make a specific person or group responsible for spatial quality, sustainability or climate. Through clarity in planning it becomes clear what the responsibilities are, and who can best perform them (Van den Herik, 2015; Malekpour et al., 2017). Experience with development projects and the implementation of sustainability is an important project organisation factor. As was said earlier, one person with a lot of drive for sustainable solutions can be a key factor. Project members with relevant experience in the implementation of sustainability can have a positive effect as well, since they know what the best practices are and what must be avoided (Van den Herik, 2015).

1.10 Early inclusion success factors

Sustainable development should be an integral part of spatial development. The implementation of sustainable concepts is helped when the need for sustainability is embedded in the whole development project. (Brundtland, 1987; Swart et al., 2003; Heeres et al., 2012; NAS, 2016) Integration of spatial development and road infrastructure planning can also have positive effects. Since it beneficial for development to not focus on one small area and one specific problem, but to broaden the scope of the development. Spatial development becomes intertwined with road infrastructure development. The road is then not constructed merely to improve the road network but to solve mobility issues and improve other qualities (Brundtland, 1987; Swart et al., 2003; Heeres et al., 2012; Shaw et al., 2014).

Integral development approach opens up opportunities to implement sustainable elements in both spatial development and infrastructure, creating linked measures and improving the usefulness, meaning possibilities for the creation of co-benefits (Swart et al., 2003; Heeres et al., 2012; Shaw, et al., 2014; Matthews et al., 2015). This can also partly increase feasibility of the project and local support. Thus the existence of co-benefits through integration of different development projects can open up possibilities to implement sustainable measures. Essential for integral development, is early inclusion of certain spatial qualities.

1.11 Participation and mind-set of stakeholders success factors

Stakeholders must be included in the planning process (Swart et al., 2003; Arts, 2007); Heeres et al, 2012; Lenferink et al., 2013; Sözüer & Spang, 2014; Rizzo, et al., 2016; Kivila et al., 2017; Malekpour et al., 2017). Support from the stakeholders can positively impact the effectiveness and efficiency of the project. Furthermore, it can help avoid hindrances along the way, since stakeholders and their needs are considered (Arts, 2007). This can be achieved through stakeholder management (Sözüer & Spang, 2014), collaboration mechanisms (Lenferink et al., 2013; Malekpour et al., 2017) and through the linkage of project and stakeholder environment (Heeres et al., 2012). The needs of the local stakeholders become intertwined with the goals of the development project.

A key factor that can lead to success in terms of stakeholder involvement is to include stakeholders early (Arts, 2007). Another factor is the assurance of critical stakeholder relationships (Busscher et al., 2015).

A vision which is supported by most stakeholders can lead to successful sustainable development since hindrances are avoided and stakeholders are ready to participate in realising that vision. Several tools and instruments guide these processes (think of Omgevingswijzer) (Heeres et al., 2012). Furthermore it is important to have ways to resolve conflicts along the way (Malekpour et al., 2017) and to embed the vision into a broader development agenda Malekpour et al. (2017).

1.12 Governance and possibility for monitoring success factors

Three success factors are related to the way the projects are governed. Front-end governance (Heeres et al., 2012), control mechanisms and performance indicators (Kivila et al., 2017). Through control mechanisms the project is able to make sure that the ideas at the start are correctly used in the following phases. Through performance indicators the project is able to monitor if the project is performing in accordance with the targets and goals that were established at the beginning.

1.13 Socio-economic development success factors

Favourable long term-economic conditions and socio-economic development can be an important success factors. These two factors are large forces working on many aspects in society. In tough economic times development is hard, resources are hard to come by and project are difficult to finance. A society with a strong economy, and high socio-economic standards can afford to invest in sustainable solutions (IPCC, 2001; Arts et al., 2016).

1.14 Form and restrictions of design requirements success factors

Clear requirements on what a design should look like are necessary to get a desired solution. Requirements are derived from system engineering, through the analysis of stakeholder wishes and system requirements. Requirements on sustainability aspects can positively influence the implementation of sustainable elements (Arts, 2007; Shaw et al., 2014, Busscher et al., 2015 Van den Herik, 2015; Shealy, et al., 2018). Furthermore, the designs must be worked out in enough technical detail, and they must be feasible. This is important since the design will be realised, if the design is clearly formulated realisation will be able to work according to the design. The design is based on requirements and thus the realisation will also be in line with requirements. If the requirements involve sustainability, sustainability is thus also achieved (Loon-Steensma et al., 2014; Busscher et al., 2015).

1.15 Availability of technology success factors

If the availability of technology is limited, the design will still follow traditional solutions and it will be difficult to meet the sustainability requirements. Available sustainable technologies are necessary, to be able to construct sustainable designs (Azhoni et al., 2018).

1.16 Market inclusion and incentives success factors

The market can, in some cases, through competition, innovation and creativity be more productive and effective than public companies and agencies. Creating designs and the realisation is already done by private companies. Clear communication of requirements for the solution is required (Arts, 2007; Van den Herik, 2015; Malekpour et al., 2017). Furthermore, it is important to include the market early on, in that way public objectives become intertwined with the goals of the private companies (Arts, 2007). This can also strengthen trust between the two sides, which can positively affect the outcome of the project (Biresselioglu et al., 2018); Van den Herik, 2015). With the tender procedure competition is created between private companies, which can help find the most optimal design (Arts, 2007). The tender and spatial planning procedure should be intertwined so that design specifications are tested in ProjectMER and embedded in TB (Arts, 2007).

1.17 Change adaptation success factors

Changing circumstances can have a negative effect on development projects. Roads become more expensive, through an increase in resource costs. Or risks become larger because of changing weather conditions. The existence of risk management in a project has a positive effect on these problems. Goals can still be reached, even if circumstances changed since risks were considered beforehand, and knowledge on how to deal with changes is available (Sözüer & Spang, 2014; Busscher et al., 2015). A project team that acknowledges and addresses the dynamics of the system has a positive impact on the project and increases sustainability of the project (Busscher et al., 2015)

1.18 Type of contract success factors

Public-Private Partnership strengthens the project in that it is broader in expertise and has larger resources. Moreover, the private companies usually are more inclined to work towards innovative solutions and be overall more creative (Arts, 2007; Lenferink et al., 2013; Niesten et al., 2017). The use of DBFM contracts helps ensure that designs are realised by the same contractor. DBFM helps to ensure that a contractor thinks long-term as they are responsible for both design, financing, building and maintaining the road, sustainability aspects become very attractive in such instances (Arts, 2007). Through contracting an obligation regarding quality aspects or sustainability aspects can be created (Van den Herik, 2015).

2. Failure factors

2.1 Information and knowledge in decision-making failure factors

Difficulties can arise through scattered, limited and missing knowledge. Consequently well-informed decisions on organisation, goals, design, sustainability, innovative solutions etc. are difficult to make (Ritzén & Sandström, 2017; Ruijs & Egmond, 2017; Biresselioglu et al., 2018; Mees et al., 2018). Decisions are made without proper information, this can cause large problems later in the development project, as it becomes much more difficult to change direction. While a lack of information is troublesome, an overload causes problems as well. An overload of studies and research can slow down the development project (Arts, 2007; Sözüer & Spang, 2014). Decision-making can be difficult due to the vast amount of studies and information. Information is necessary to make well-informed decisions; however the priorities must be right, otherwise it can lead to a situation where there is a lot of research, and little action.

2.2 Inclusion and clarity in project goal and scope failure factors

One barrier in successful development project is an unstable scope demarcation and problem definition (Arts, 2007; Busscher et al., 2015; Samset & Volden, 2016). When the problem is not defined properly, and the scope is unclear or changes over time it becomes difficult to find effective solutions. As a result development processes become slow and ineffective.

Furthermore, the problem lies at the articulation of sustainability goals. The goals are either not present, or not clear enough, to be able to work towards them (Van den Herik, 2015; Labonnote, Skaar, & Rüther, 2017; Carroli, 2018). Related to insufficient sustainability goals is the lack of realistic objectives (Samset & Volden, 2016). The objectives do not represent the purpose of the project in the real world. As a consequence articulating sustainability goals from those objectives can be difficult. Goals that are formed in the early phases of development projects might change during the project. The danger of that is that sustainability goals are weakened, and a lack of sustainable development occurs Labonnote et al., (2017). Furthermore, changing goals creates unstable development processes, which lead to slow and chaotic development processes.

2.3 Financial feasibility, financial incentives and budget failure factors

Five specific financial failure factors are found. Firstly, the uncertainty in estimation of quality aspects. Quality aspects, such as sustainability, are difficult to define in monetary terms (Arts, 2007; Van den Herik, 2015; Ritzén & Sandström, 2017). As a consequence it is hard to compare such aspects with other aspects in development. Furthermore, it is unclear what they bring to a design or project, in monetary terms. Financial uncertainty about return and profit of project creates problems as well as project needs to be profitable (Ritzén & Sandström, 2017; Jesus & Mendonça, 2018). However, sustainable solutions are usually more expensive than traditional solutions. Furthermore, there is a certain degree of uncertainty to these new solutions, which makes the choice for traditional solutions easier. On top of that the focus is mostly on short-term financing over long-term sustainable finance (Studart & Gallaghar, 2018). The third identified factor is a lack of resources (Arts, 2007;

Dhakal & Chevalier, 2017; Jesus & Mendonça, 2018). A lack of financial resources will pressure the use of cheap solutions, which does not align well with sustainable solutions. Uncertainty can be diminished by having information on costs and performance (Dhakal & Chevalier, 2017; Ruijs & Egmond, 2017). A lack thereof will result in financial uncertainty, which will impact decision-making. The fifth factor is the competing investment priorities. Financial resources are limited, Sustainable priorities might not be able to compete with other priorities (Malekpour et al., 2017).

2.4 Participation and mind-set general public failure factors

The participation of the general public is important to reach broadly supported solutions. Three factors disrupt this process. Firstly the lack of information and awareness (Biresselioglu et al., 2018), secondly, the lack of acceptance among the public (Sözüer & Spang, 2014) and lastly the lack of public engagement (Dhakal & Chevalier, 2017). These three factors are related. Through public engagement information and awareness can be increased and through that the chances of acceptance by the general public increase. A lack of information and a lack of engagement of the public can result in little public support and potentially public protest. Societal preferences might conflict with sustainable solutions (Malekpour et al., 2017). Furthermore, the demand for short-term solutions and quick fixes can impede long-term sustainable thinking (Malekpour et al., 2017). This is related to the demand for traditional solutions (Malekpour et al., 2017).

2.5 Perceptions, misconceptions and cognitive barriers failure factors

One failure factor is the perception of risk and uncertainty (Dhakal & Chevalier, 2017; Malekpour et al., 2017; Biresselioglu et al., 2018). Sustainable solutions are more uncertain, and the risk are perceived as higher than conventional solutions. As result these solutions are hard to implement, decision-makers tend to rely on proven solutions. (By choosing traditional non-sustainable solutions risks are averted and certainty is gained Ritzén & Sandström, 2017; Dhakal & Chevalier, 2017). This creates short-term thinking. Solutions that are quick fixes with little risks are preferred (Arts et al., 2016; Malekpour et al., 2017). Innovation, which are mostly more sustainable, cannot compete with such solution due to risks and uncertainties surrounding these solutions. These factors will usually result in demonstrated traditional solutions (Matthews et al., 2015). Other cognitive problems arise with the perception of sustainability. To many stakeholders and decision-makers it is unclear what sustainability entails, and how climate aspects are a part of that (Ritzén & Sandström, 2017). These problems could be solved by mutual trust between different parties. However, a lack of trust creates tension between decision-makers and stakeholders, which could lead to lack of support for certain solutions (Biresselioglu et al., 2018).

2.6 Political decision-makers, political environment and policies failure factors

Lack of urgency in the political context can impede sustainable development (Arts, 2007; Ruijs & Egmond, 2017; Mees et al., 2018). This results in a lack of laws, regulations, policies, incentives etc. Apart from a sense of urgency success and failure depend highly on political views and the current leadership (Arts, 2007; Sözüer & Spang, 2014; Malekpour et al., 2017). Changes in political views and leadership or government can have both positive and negative effects on development projects. Urgency, views and leadership are also related to priorities. Is sustainability a priority or, does it often lose to other priorities (Malekpour et al., 2017; Mees et al., 2018). The literature further discusses how sustainability can be used in political horse-trading (Samset & Volden, 2016). Where different political parties throw out priorities and values in order to achieve other priorities. Unsustainable priorities and viewpoints are often founded in a lack of political environmental awareness (Biresselioglu et al., 2018). Merely providing information and data is not always the solution, since politicians sometimes overrule expert advice for other priorities which are grounded in their viewpoints and believes (Samset & Volden, 2016). The political context is extremely important in

achieving sustainable development. More often than not through a lack of awareness, sense of urgency and through own viewpoints and priorities, sustainability measures are not priorities in the political field. Policy failure factors entail, misaligned incentives. The incentives to stimulate sustainable development do not align well with the goals, and are therefore ineffective (Samset & Volden, 2016; Jesus & Mendonça, 2018). Another policy failure factor are unclear policy agendas (Matthews et al., 2015). It is unclear what the policy entails, which makes it difficult to use it or work according to it.

2.7 Laws and legal failure factors

Slow formal procedures can be regarded as a problem in development projects (Arts, 2007; Sözüer & Spang, 2014; Malekpour et al., 2017; Ruijs & Egmond, 2017; Azhoni et al., 2018). The procedures can stall projects, furthermore, these procedures can be incompatible with innovative solutions. As the procedures are formed around traditional solution, they are often incapable of addressing new solutions. Another legal factor is the lack of sustainability standards. Sustainability standards can oblige to use certain techniques, or to achieve certain targets. Through more standards the government could enforce their ideas on sustainability (Arts, 2007; Dhakal & Chevalier, 2017; Jesus & Mendonça, 2018). Connected to these legal standards are laws. Outdated laws can obstruct sustainable development when they are not capable of addressing innovations (Lenferink et al., 2013; Ruijs & Egmond, 2017; Azhoni et al., 2018). Broad regulations are a failure factor (Biresselioglu et al., 2018). Broad regulations are not capable of addressing specific sustainability needs. Through broad regulations it remains unclear what is expected and leading to minimum implementation. There are numerous technical rules and regulations, narrowing the solution space (Sözüer & Spang, 2014). The project can further be influenced by changing jurisprudence. (Arts, 2007).

2.8 Institutional environment failure factors

Part of the institutional context is the focus on traditional solutions, the so called pro-grey mind-set that prevents innovative sustainable solutions to be introduced in road infrastructure planning processes (Swart et al., 2003; Arts, 2007; Matthews et al., 2015; Dhakal & Chevalier, 2017). Much of that is related to path dependency (Shaw et al., 2014; Matthews et al., 2015; Samset & Volden, 2016). Road infrastructure as solution for mobility issues, with fossil-fuelled cars is a path that we are currently on. Changing the path to electric vehicles, and no-asphalt solutions is difficult.

2.9 Form, mind-set and priorities project organisation failure factors

The planning process cannot always address changing technologies. As a result the project does not consider certain sustainable innovation and choose older less sustainable techniques (Matthews et al., 2015; Ruijs & Egmond, 2017; Carroli, 2018). A lack of resources makes it difficult to find, choose and pay for innovations that can solve the problem at hand (Arts, 2007; Dhakal & Chevalier, 2017; Azhoni et al., 2018). An added factor is the inefficient use of resources. Resources are thus limited in themselves, but are inefficiently used as well (IPCC, 2001). Furthermore, project sometimes do not prioritize sustainability and climate concerns above others, or the priorities tend to change along the way (Samset & Volden, 2016; Mees et al., 2018). Other priorities are used as the main framework to decide on designs and sustainability is pushed back. Along with a lack of priorities a lack of experience is also troublesome (Arts, 2007; Sözüer & Spang, 2014). Experience in project teams can help avoid simple issues and improve the use of best practices. The different project phases must be aligned in order to make sure that goals and ideas in the early phases are carried on in later phases. When integration is failing, certain priorities or goals might be pushed out and do not make it to the end of the project. Ineffective task allocation can lead to uncertainty on responsibilities and the wrong person in the wrong place (Lenferink et al., 2013; Sözüer & Spang, 2014; Ritzén & Sandström, 2017). Development projects and sustainability implementation are strongly influenced by the people participating in them. Political pressure to perform quickly is an underlying problem. This will usually

lead to traditional solutions with little regard for sustainability concerns. These uncertainties are increased by changing project teams. Project teams will have different configuration over the whole project. An issue that can result from that is the lack of continuity of views, goals etc. (Arts, 2007).

2.10 Availability of technology failure factors

Two times technical barriers are named as disruptors of implementation of sustainability (IPCC, 2001; Labonnote et al., 2017). One of these barriers is the technological infancy of innovative sustainable solutions (Malekpour et al., 2017; Ruijs & Egmond, 2017). Sustainable innovations are usually too new. They have not always been tested, there is little experience with them and they cannot easily be implemented. As a result the focus goes to traditional solutions. Another failure factor is technical restrictions. Restrictions on current technologies can impede successful implementation (Biresselioglu et al., 2018).

2.11 Participation and mind-set of stakeholders failure factors

Development projects usually contain many stakeholders, different level authorities, consultancies, contractors, local groups etc. As a result decision-making is complex (Arts, 2007; Sözüer & Spang, 2014). This is further enhanced by the multiple interdependencies between the stakeholders with each other and with the outside world. In order to succeed support of stakeholders is necessary. When there are many stakeholders getting support from the majority can be difficult (Lenferink et al., 2013; Busscher et al., 2015). Implementation of sustainability might be hindered by stakeholders who feel resources should be allocated to other priorities. These conflicting views can disrupt the planning process (Matthews et al., 2015). Other problems might arise when new actors start to participate in the project. New actors, potentially critical stakeholders, will have to follow goals and rules put in place in the start of the project or established in contracts. This can create friction, if the views of these new stakeholders differ from the views of the early participants (Lenferink et al., 2013). The contracts themselves create problems as well. The contracts are usually very detailed, extensive and complex (Lenferink et al., 2013). If sustainability is to be implemented in contracts a very clear up-front definition of sustainability and sustainable aspects is necessary. This can be difficult in early development processes, were a broad idea of and goals of sustainability are known, however the specifics are not. Many of these problems can be avoided through good stakeholder management.

2.12 Governance and possibility monitoring failure factors

Diffused responsibilities are identified (Brundtland, 1987; Sözüer & Spang, 2014; Dhakal & Chevalier, 2017; Ritzén & Sandström, 2017). If responsibilities become dispersed it becomes unclear who should work on what. If no one feels responsible due to shared responsibility no goals are reached. Coordination can help avoid such responsibility problems. A lack of coordination will lead to problems as it is unclear who does what, and how goals and targets are enforced (Dhakal & Chevalier, 2017). Also fragmented governance, where it is unclear how the system is governed and who is governing is can have its influence on the successfulness of development projects (Dhakal & Chevalier, 2017). Other factors that are named are, a lack of business culture (Arts, 2007), contested perspectives on governance (Turnheim, et al., 2015) and pro-grey arrangements (Dhakal & Chevalier, 2017). Governance is also about monitoring performances and interfering if needed. A lack of quality control (Arts, 2007) and a lack of performance measuring can have negative effects.

2.13 Socio-economic development failure factors

Economic barriers are discussed in the literature (IPCC, 2001). Specific barriers are economic downturn, market imperfections and a lack of economic incentive. Economic downturn is part of large economic forces. Economic downturn will have its impact on development, contractors will find themselves in financial troubles, resources are hard to come by and project are stalled (Malekpour et

al., 2017). Decisions are made to cut parts of the project, visionary aspects such as sustainability measures are most likely removed or diminished.

2.14 Form and restrictions of design requirements failure factors

Factors concerned with the design can also have a negative impact on development projects and implementation of sustainability. Firstly, a lack of design standards can make it difficult to make a design that satisfies the goals of a project (Dhakal & Chevalier, 2017). A lack of standards might also be a problem in the choice for a design. Designs can be too different to compare properly. Standards and requirements for designs are problematic in changing conditions. During the long development process new findings might provide the need for changes in the existing design, which could interfere with the requirements of the project (Labonnote et al., 2017). Requirements can also be unclear, in such a case it is difficult to understand what is expected of a design, and the realised project could very well not satisfy the project (sustainability) goals (Arts, 2007).

2.15 Change adaptation failure factors

Dealing with changing situations is essential during long development projects. The project must be able to adapt to changes in their environment. This is not always the case. In the literature two factors were identify that disrupt proper adaptation to changing circumstances. The first factor is a lack of risk management (Arts, 2007; Mees et al., 2018). With risk management the project team can assess what the risks are of the solutions under changing circumstances. By doing this a project is prepared to deal with these changes. Due to a lack of risk management a project is not capable of adapting to these changes since the changes were not considered during the earlier phases. What will change is not always clear, however that circumstances will change can be expected. This is due to long handling times and a very complex and dynamic environment (Arts, 2007).

Appendix E – Factors, CSFs and Conceptual Model

This appendix shows the main factors found in the three cases. and the conceptual model constructed.

Table E.1: Overview of all identified factors, with Z for Zuidasdok, R for RijnlandRoute, A for A16 Rotterdam. Blue factors are corroborating findings in literature, green factors are new findings not identified in literature. + indicates a positive impact on climate inclusion, - a negative an +/- both.

1. Information and knowledge in decision-making			Knowledge and information (drive mind-set)	Z	+	Connection project director with other parties	Z	+
Knowledge on climate change	ZA	+	Evidence of the problem	Z	+	Formal advisor or coordinator Climate	A	+
Knowledge on available technologies	R	+	Climate focussed mind-set of the time (last decade)	A	+	**9. Early inclusion**		
Availability information on climate change	R	+	Perspective of doing things sustainably	A	+	Integration of spatial, sustainable and road development	ZA	+
Knowledge on positive consequences of early inclusion	Z	+	Modular development	Z	+	Alignment of climate ambitions with competing ambitions	R	+
Proper problem analysis	A	+	Perspective of doing sustainable things	A	+/-	Prospect of co-benefits	R	+
KNMI, other research groups	RA	+	View that certain topics are best addressed later	ZRA	-	**10. Availability of technology**		
Use of knowledge and information in decision-making	ZR	+	National approach to certain aspects is preferred to local	R	-	Availability technology	Z	+
Use of MER in decision-making	R	+	Sustainable solutions viewed as riskier	R	-	Knowledge on technology	R	+
Relative importance project goals and results studies	R	-	Fear of large integral but unfeasible project	A	-	Stringent technical rules in TB	ZA	-
Relative importance political preference and results studies	R	-	View that going beyond requirements undesirable	A	-	Spatial restrictions	Z	-
Incapability of MER to study certain aspects	ZA	-	**6. Political decision-makers, political environment and policies**			**11. Participation and mind-set of stakeholders**		
2. Inclusion and clarity of project goals and scope			Political climate priorities	Z	+	Shared sustainable visions between stakeholders	RA	+
Clarity of climate goals and ambitions	Z	+	Political climate pressure	R	+	Early inclusion of stakeholder	ZA	+
Climate focussed sustainability goal	ZRA	+	Climate awareness	ZRA	+	Stakeholder management	A	+
Early inclusion of climate concerns or goal	ZRA	+	Sense of urgency of climate change	ZRA	+	Collaboration mechanisms to help alignment of goals	Z	+
Explicitness on climate concerns in early project	Z	+	Political player focussed on climate	ZA	+	Alignment of needs and interests by project director	Z	+
Involvement of climate in trade-offs and decision-making (agenda)	ZR	+	Political appeal of climate measures	A	+	Stakeholder awareness of climate change	A	+
Alignment of climate goals with project goals	Z	+	Alignment of climate measures and concerns with political activities	ZA	+	Number of stakeholders	A	-
Use of sustainability instruments Ladder van Verdaas, Ambitieweb, Omgevingswijzer, DuboCalc	RA	+	Climate on political agenda	RA	+	**12. Form and restrictions of design requirements**		
Conflict climate concerns and main (mobility) goal	ZRA	-	Experience in decision-making	A	+	Goals results in specific targets	Z	+
Prioritisation of main (mobility) goal above climate concerns	Z	-	Intuition in decision-making	A	+	Requirements based on research	RA	+

Conflict climate concerns and other priorities: inpassing, liveability, health	ZR A	-	Rational decision-making	A	+	Use of climate EMVI criterion	RA	+
Conflict project's scope and project's feasibility	A	-	Availability of information in decision-making	A	+	Possibility of getting extra points for going beyond requirements in tender	A	+
Climate measures side-effect of reaching other goals	Z	-	Long term policy on materials, energy & CO_2 (Duurzaam Bouwen)	ZR	+	Inclusion of climate in water requirements water authorities	RA	+
Path dependency of early (political) decisions, limitation of solution space	ZR A	-	Long term policy on climate adaptation (Randstad Urgent, NMP 4, Deltaprogramma 5)	RA	+	Targets/requirements are maximum	ZR	-
3. Financial feasibility, financial incentives and budget			National policy water includes climate (NMP 4)	ZR	+	Scaring of the market	Z	-
Financial incentives	A	+	National policy on air quality (NSL)	RA	+	Limitation of solution space	Z	-
Financial certainty innovations	Z	+	Regional or municipal sustainable policy	ZA	+	Monitoring difficulty	Z	-
Prospect of financial benefits	Z	+	Specificness of policy	Z	+	**13. Market inclusion and incentives**		
Budget follows early project goals	R	+/-	Ideology of ruling party	Z	+/-	Competition	Z	+
Trade-off between financial benefits of sustainable/conventional measure	R	+/-	Political priorities guide MER	R	+/-	Intertwining planning process and tender	Z	+
Limited budget	ZR	+/-	Political pressure for quick solution	R	-	Flexibility TB	ZR A	+
Conflict financial feasibility and climate concerns	Z	-	Shirking responsibilities	ZR	-	Facilitate innovation power of market	A	+
Conflict public wishes and budget	R	-	Multiple themes trade-offs in decision-making	A	-	Trust	ZR	+
Sustainable solution viewed as more expensive as conventional solution	Z	-	Conflict of competing policy and climate policy	R	-	Communication	R	+
4. Participation and mind-set of general public			**7. Laws and legal standards**			Market's creativity	ZR A	+
Public support	RA	+	Speed of procedures	Z	+	Climate challenges to market	ZA	+
Public awareness	RA	+	Legal requirement to include climate in MER	ZR A	+	Use of Climate EMVI-criterion	A	+
Alignment climate project goals and public wishes	A	+	Applicability assessment framework on innovations and new scenarios	ZA	+	Use of assessment instruments: CO2-prestatieladder, DuBoCalc	ZA	+
Creation of ambition document (Kansenboek)	A	+	**8. Form, mind-set and priorities of project organisation**			Financial incentive (pay energy bill)	RA	+
Agreements	A	+	Human drivers of climate mitigation and adaptation	ZR A	+	Inclusion of local challenges (local energy production)	A	+
Public participation	RA	+/-	Project team members climate mind-set	A	+	Disregard of contractor's challenges, in early planning process	R	-
Conflict societal preference and climate measures	R	-	Climate awareness	Z	+	Climate concerns addressed in realisation phase	Z	-
Public pressure for quick solution	R	-	Sense of urgency of climate change	Z	+	Shirking responsibilities	Z	-
5. Perceptions, misconceptions and cognitive barriers			Experience with dealing with climate concerns	ZA	+	Symbolic use of CO2-prestatieladder	Z	-
Long-term thinking	Z	+	Creativity of project organisation	R	+	**14. Type of contract**		
Climate focussed mind-set	Z	+	Knowledge of and experience with instruments	A	+	DB(F)M contract	RA	+

Appendix F – Case Study Zuidasdok

1. Description of Zuidasdok

On 9 July 2012 Gemeente Amsterdam, Ministerie van I&M, Stadsregio Amsterdam and Provincie Noord-Holland agreed to continue with the development of Zuidasdok (Ministerie van I&M, Gemeente Amsterdam, Stadsregio Amsterdam, Provincie Noord-Holland, 2012). In the previous years the parties had worked on the Verkenningsfase towards a Voorkeursbeslissing, in the form of a Structuurvisie. Zuidasdok is a project focussed on redeveloping the Zuid-as of Amsterdam. The Zuid-as is a large business centre, that is accessible by train via station Zuid-as and by road via A10 Zuid. The traffic situation on A10 Zuid had worsened over the years. The road was heavily congested, and projections showed an increase of users for the coming years. The I/C-ratio is around 1 and will keep increasing until 2030. The result: structural traffic jams which cause noise and air pollution and accessibility problems (Brinks, 2012). The road system needed change, to ensure a constant traffic flow. The train station and availability of other public transport needed an upgrade as well. The current train station was too small to accommodate a growing user demand. An increase to 95000-130000 travellers a day is expected due to new connections, Hanzelijn and Noord-Zuidlijn and increasing economic activity in the area (Brinks, 2012). Improving public transport can also relieve some pressure on the congested A10 Zuid. In the Verkenningsfase four goals were articulated (Artz & Heijning, 2012):

- Improvement of international prime location as integral part of Amsterdam.
- Optimally functioning transport and traffic network
- High quality public transport hub
- Sustainable integration of infrastructure to improve spatial quality and remove physical barriers.

The Voorkeursbeslissing entails two relevant development measures (Artz & Heijning, 2012):

- Increasing the capacity and rerouting the A10 Zuid from De Nieuwe Meer until Amstel. Part of the road will be situated underground in a tunnel.
- Sustainable embeddedness of road infrastructure by situating it underground in the Zuid-as area. This will create space for a public transport terminal and will reconnect Zuid-as increasing spatial quality.

According to the Voorkeursbeslissing the A10 Zuid needed the following changes (Brinks, 2012):

- Realisation of 4 driving lanes on both sides, with 100km/h speed limit.
- Realisation of 2 parallel roads for local traffic, with 80km/h speed limit.
- Rerouting the road through a 1 km long tunnel under Station Zuid-as.
- Noise reduction, especially around the tunnel exists.

With these goals the Planuitwerkingsfase was started. Between 2012 and 2015 all the necessary steps towards a TB were taken. The ProjectMER analysed the effects of broadening of the A10-zuid and rerouting it through a tunnel. It came to two main conclusions (Ministerie van I&M, 2015): Variant A10 PRB S109 is the most robust variant. In this variant there is a two-lane road parallel to the A10 at the location of city route S109. This is an add-on to the basic variant where there is a two-lane parallel road at S108. For the tunnel three variants were constructed, which scored fairly similar on the criteria. As a result not one is shown to be the absolute best. Variants were: basic variant, where the tunnels are constructed in wet, 3 to 5 meters of surrounding buildings that have a risk of damage due to construction. Variant: Tunnel-Ba-dr which uses the Wanden-dak method, construction is in dry. The third variant was a wet variant as well, however 10 meters from surrounding buildings. The ProjectMER lead to a OTB in 2015. The document was open for public participation in the Zienswijzeprocedure. Around this time the project was issued to the market by opening of the tender. Parallel to the urban planning process a PvE was constructed through system engineering. In 2016 the TB along was adopted. The TB named the following main measures:

- Broadening of A10 Zuid, new network of main and parallel roads. At station Amsterdam Zuid a tunnel of 1km north and 1.1 km south. The main and parallel roads are located in separate tunnels.
- Traffic nodes at the Nieuwe Meer and Amstel will be altered to fit the new broader A10 Zuid.
- The A10 Zuid will be up to 5 lanes broad at certain points. The parallel roads 2.
- The Tracébesluit establishes which roads and other construction are to be made or altered.

The TB was altered in 2016 and 2017, the change was about noise reduction. In 2017 the Tender was won by ZuidPlus, a coalition of Fluor, Heijmans and Hochtief. Currently the project is in the Realisatiefase. Table F.1 shows a timeline of Zuidasdok from deliverance of the Plan-MER and subsequent Structuurvisie till the decision on the tender and final amendment to the TB.

Table F.1: Timeline of Zuidasdok

Date	Event
8-2-2012	Plan-MER
8-2-2012	Ontwerp Voorkeursbeslissing - structuurvisie
8-3-2012	Start public participation
18-4-2012	End public participation
9-7-2012	Decision to start Planuitwerkingsfase
16-8-2012	Voorkeursbeslissing - structuurvisie
29-8-2012	Adopting Structuurvisie
12-12-2013	Ambitiedocument Zuidasdok
1-3-2014	Advies Reikwijdte en Detailniveau
1-3-2015	Project-MER
11-3-2015	Ontwerp Tracébesluit
12-3-2015	Zienswijzeprocedure, OTB, Ontwerp Bestemmingsplan, ProjectMER
22-4-2015	End Zienswijzeprocedure OTB, Ontwerp Bestemmingsplan, ProjectMER
30-4-2015	Issue project to Market
1-3-2016	Tracébesluit
14-3-2016	Bestemmingsplan
11-5-2016	Adopting Tracébesluit
10-11-2016	First amendment Tracébesluit
22-2-2017	Decision Tender, ZuidPlus: Fluor, Heijmans, Hochtief
15-8-2017	Second amendment Tracébesluit

2. List of Documents Analysed

Table F.2: Overview of use documents in Zuidasdok case study, documents with publication date, Title, Type and author.

Date	Document	Title	Type	Author
1-12-2011	PlanMER	Bijlage III Luchtkwaliteitsonderzoek tbv planMER Zuidasdok Amsterdam	Report	DHV B.V.
7-2-2012	PlanMER	Bijlage I Integrale verkeer-en vervoersanalyse Zuidasdok	Report	Reinier Brinks
7-2-2012	PlanMER	Bijlage II Nadere groen-blauwe thema's	Report	Projectorganisatie Zuidasdok
8-2-2012	PlanMER	ZuidasDok - Milieueffectenrapportage (planMER)	Report	Advies- en ingenieursbureau Oranjewoud, drs. T. Artz, dr. Ir. L.T. Runia
8-2-2012	Voorkeurs beslissing	Structuurvisie ZuidasDok - Ontwerp	Report (draft)	Ingenieursbureau Oranjewoud, drs. T Artz, drs. J. van de Heijning
10-2-2012	Voorkeurs beslissing	Structuurvisie Zuidasdok, Officiele bekendmaking structuurvisie Tweede Kamer	Letter/Announcement	De minister van Infrastructuur en Milieu, M.H. Schultz van Haegen
28-2-2012	Voorkeurs beslissing	Kosten-Batenanalyse ZuidasDok	Report	Projectorganisatie ZuidasDok
8-3-2012	Voorkeurs beslissing	Kennisgeving Ontwerp Structuurvisie en Milieueffectenrapport ZuidasDok	Public Announcement	Rijksoverheid
9-7-2012	Voorkeurs beslissing	Bestuursovereenkomst Zuidasdok	Contract	Ministerie van Infrastructuur en Milieu, Gemeente Amsterdam, Stadsregio Amsterdam, Provincie Noord-Holland
3-7-212	PlanMER	ZuidasDok - Aanvulling planMER	Report	Ingenieursbureau Oranjewoud, drs. T Artz
16-8-20	Voorkeurs beslissing	Structuurvisie ZuidasDok	Report	Ingenieursbureau Oranjewoud, drs. T Artz, drs. J. van de Heijning
29-8-2012	Voorkeurs beslissing	Vaststelling Structuurvisie ZuidasDok en planMER	Public Announcement	Rijksoverheid
12-12-2013	Ambitiedocument	Ambitiedocument Zuidasdok	Report	Projectbureau ZuidasDok
1-3-2014	Variants	ProjectMER Zuidasdok - Advies Reikwijdte en Detailniveau - Samenvatting	Report	IBZ ingenieursbureau Zuidasdok

1-3-2014	Zienswijze procedure	Nota van Beantwoording - Zienswijzen op de kennisgeving projectMER Zuidasdok	Report	Projectorganisatie ZuidasDok
1-3-2015	Variants	Trechteringsdocument: Verantwoording over de selectie van Basisalternatief en varianten in MER Zuidasdok	Report	IBZ ingenieursbureau Zuidasdok
1-3-2015	Project-MER	Milieueffectenrapport Zuidasdok	Report	IBZ ingenieursbureau Zuidasdok
1-3-2015	Project-MER	Deelrapport luchtkwaliteit Zuidasdok	Report	IBZ ingenieursbureau Zuidasdok
1-3-2015	Project-MER	Deelrapport duurzaamheid en klimaat Zuidasdok	Report	IBZ ingenieursbureau Zuidasdok
1-3-2015	Project-MER	Deelrapport water Zuidasdok	Report	IBZ ingenieursbureau Zuidasdok
1-3-2015	Project-MER	Deelrapport bodem Zuidasdok	Report	IBZ ingenieursbureau Zuidasdok
1-3-2015	Project-MER	Deelrapport landschap, cultuurhistorie en ruimtelijke kwaliteit Zuidasdok	Report	IBZ ingenieursbureau Zuidasdok
1-3-2015	Project-MER	Deelrapport natuur en ecologie Zuidasdok	Report	IBZ ingenieursbureau Zuidasdok
11-3-2015	OTB	Terinzagelegging ontwerptracébesluit, ontwerpbestemmingsplan, MER Zuidasdok Amsterdam	Public Announcement	Gemeente Amsterdam
30-4-2015	Tender	Toelichting op het project Zuidasdok - De scope en de omgeving	Report	Projectorganisatie ZuidasDok
30-4-2015	Tender	Visie van opdrachtgever op project Zuidasdok - Projectdoelstellingen en kritische succesfactoren	Report	Projectorganisatie ZuidasDok
30-4-2015	Tender	Selectiedocument	Report	Rijkswaterstaat
30-4-2015	Tender	Aankondiging van een opdracht	Public Announcement	Rijkswaterstaat
27-5-2015	Tender	Nota van inlichtingen Aanmeldingsfase	Public Announcement	Rijkswaterstaat, ir. J.M. Versteegen
28-5-2015	Project-MER	ProjectMER Zuidasdok - Toetsingsadvies over het milieueffectrapport	Report	Commissie voor de milieueffectrapportage
1-3-2016	TB	Landschapsplan - toelichting op Tracébesluit	Report	IBZ ingenieursbureau Zuidasdok
1-3-2016	TB	Passende beoordeling - toelichting op Tracébesluit	Report	IBZ ingenieursbureau Zuidasdok
1-3-2016	TB	Nota van Beantwoording - Zienswijzen op OTB, ontwerpbestemmingsplan en MER Zuidasdok	Report	Gemeente Amsterdam, Ministerie van Infrastructuur en Milieu
1-3-2016	TB	Tracébesluit Zuidasdok - Deel II Kaartbladen	Report	Ministerie van Infrastructuur en Milieu
1-3-2016	TB	Tracébesluit Zuidasdok - Deel III Toelichting	Report	Ministerie van Infrastructuur en Milieu
1-3-2016	TB	Tracébesluit Zuidasdok - Deel I Besluit	Report	Ministerie van Infrastructuur en Milieu
1-3-2016	TB	Rapportage actualisatie milieu-informatie	Report	IBZ ingenieursbureau Zuidasdok
14-3-2016	Bestemmingsplan	Bestemmingsplan Zuidasdok Regels	Report	Gemeente Amsterdam
14-3-2016	Bestemmingsplan	Bestemmingsplan Zuidasdok Toelichting	Report	Gemeente Amsterdam
13-4-2016	Bestemmingsplan	Voordracht voor de raadsvergadering - Vaststellen van het bestemmingsplan Zuidasdok	Public Announcement	Gemeente Amsterdam
22-4-2016	Bestemmingsplan	Raadsbesluit - Vaststellen van het bestemmingsplan Zuidasdok	Public Announcement	Gemeente Amsterdam
11-5-2016	Zienswijze procedure	Kennisgeving - Vaststelling Tracébesluit Zuidasdok	Public Announcement	Ministerie van Infrastructuur en Milieu, Gemeente Amsterdam
11-5-2016	TB	Kennisgeving vaststelling Tracébesluit	Public Announcement	Ministerie van Infrastructuur en Milieu, Gemeente Amsterdam
1-11-2016	TB	Tracébesluit Zuidasdok (wijziging 2016) toelichting	Report	Ministerie van Infrastructuur en Milieu
1-11-2016	TB	Tracébesluit Zuidasdok (wijziging 2016) - Deel I Besluit	Report	Ministerie van Infrastructuur en Milieu
10-11-2016	TB	Bekendmaking besluit tot wijziging van het Tracébesluit Zuidasdok	Public Announcement	Ministerie van Infrastructuur en Milieu, Gemeente Amsterdam
22-2-2017	Tender	Aankondiging van een gegunde opdracht resultaten van de aanbestedingsprocedure	Public Announcement	Rijkswaterstaat
1-8-2017	TB	Nadere onderbouwing verkeersveiligheid - Toelichting wijzigingstracébesluit 2017	Report	IBZ ingenieursbureau Zuidasdok
1-8-2017	TB	Tracebesluit Zuidasdok (wijziging 2017)	Map	Rijkswaterstaat
1-8-2017	TB	Tracébesluit Zuidasdok (wijziging 2017) - Deel I Besluit	Report	Ministerie van Infrastructuur en Milieu
15-8-2017	TB	Besluit tot wijziging van het Tracébesluit Zuidasdok, Ministerie van Infrastructuur en Milieu	Public Announcement	Projectorganisatie ZuidasDok

3. Description of Analysis Process and Findings of Documents

The documents were read, and sustainability aspects identified. These aspects come in many forms. It can be ambitions, goals, criteria of MER, results on criteria, notes, targets, suggestions, requirements, answers to questions and policy. From that list of aspect seven overarching aspects were found. These seven aspects were tested on applicability for this research. The test was done to identify if the aspect could be considered climate mitigation, climate adaptation or either. All seven overarching aspects fitted at least one definition see. Table F.3 shows the legend of table F.4 which shows the aspects that were identified.

Table F.3: Legend and seven overarching aspects

Sustainability and spatial development
Energy and CO2
Materials and Waste
Water
Air Quality
Construction and Market
Climate resilience

Table F.4: Climate aspects found in documents, with colouring of seven overarching aspects.

Aspect	Found in	Type
Sustainable implementation of infrastructure	PlanMER Hoofdocument (pp. 9)	Ambition
Sustainability as part of effect study criterion	PlanMER Hoofdocument (pp. 20)	Assessment Criterion
Sub-criterion: spatial possibilities	PlanMER Hoofdocument (pp. 20)	Assessment Criterion
Sub-criterion: Energy and CO_2 in spatial planning	PlanMER Hoofdocument (pp. 20)	Assessment Criterion
Sub-criterion: liveability	PlanMER Hoofdocument (pp. 20)	Assessment Criterion
Water as part of effect study criterion	PlanMER Hoofdocument (pp. 20)	Assessment Criterion
Sub-criterion: Rainwater	PlanMER Hoofdocument (pp. 20)	Assessment Criterion
Sub-criterion: Surface water	PlanMER Hoofdocument (pp. 20)	Assessment Criterion
Sub-criterion: Water security	PlanMER Hoofdocument (pp. 20)	Assessment Criterion
Air quality as part of effect study criterion	PlanMER Hoofdocument (pp. 20., pp. 72)	Assessment Criterion
Sub-criterion: effect on concentrations NO_2	PlanMER Hoofdocument (pp. 20)	Assessment Criterion
Sub-criterion: effect on concentrations PM_{10}	PlanMER Hoofdocument (pp. 20)	Assessment Criterion
NO_2 does not exceed norms	PlanMER Hoofdocument (pp. 22)	Score on criterion
Improving air quality	PlanMER Hoofdocument (pp. 22)	Score on criterion
Zuidasdok is overall a sustainable project	PlanMER Hoofdocument (pp. 23)	Score on criterion
Spatial opportunities improve	PlanMER Hoofdocument (pp. 23)	Score on criterion
liveability improves	PlanMER Hoofdocument (pp. 23)	Score on criterion
Water storage important issue	PlanMER Hoofdocument (pp. 24)	Score on criterion
Sustainability not an issue during alternative selection	PlanMER Hoofdocument (pp. 39)	Selection criterion
Water storage needs to be addressed in later phases	PlanMER Hoofdocument (pp. 147)	Ambition
Water security needs to be addressed in later phases	PlanMER Hoofdocument (pp. 147)	Ambition
People, Planet, Profit	PlanMER Hoofdocument (pp. 152)	Note
Integral development	PlanMER Hoofdocument (pp. 154)	Note
Climate and Water	PlanMER Hoofdocument (pp. 154)	Ambition
Materials and Waste	PlanMER Hoofdocument (pp. 154)	Ambition
liveability	PlanMER Hoofdocument (pp. 154)	Ambition
Energy and CO_2	PlanMER Hoofdocument (pp. 155)	Ambition
Air quality satisfy legal norms	PlanMER Bijlage III (pp. 4)	Note
Air quality Environmental Act (Wet Milieubeheer)	PlanMER Bijlage III (pp. 4)	Targets
Sustainable implementation of infrastructure	Ontwerp Structuurvisie (pp.12)	Goal
Liveability	Officiele bekendmaking structuurvisie (pp.3)	Goal
Environmental concerns	Kennisgeving Ontwerp structuurvisie Zienswijze	Note
Sustainable implementation of infrastructure	Structuurvisie (pp.13)	Goal
Sustainable implementation of infrastructure	Ambitiedocument (pp.5)	Ambition
Water storage	Ambitiedocument (pp.19)	Ambition
Tree planting	Ambitiedocument (pp. 23)	Ambition
Saving energy	Ambitiedocument (pp. 24)	Ambition
Use of ZOAB	Ambitiedocument (pp. 27)	Ambition
Robust water system	Ambitiedocument (pp. 36)	Ambition
Sustainable conditions	Ambitiedocument (pp. 58)	Ambition
Sustainable implementation of infrastructure	Advies Reikwijdte en detailniveau ProjectMER (pp.2)	Goal
Climate and energy	Advies Reikwijdte en detailniveau ProjectMER (pp.2)	Assessment framework
Air quality	Project-MER hoofddocument (pp.20)	Criterion
Climate and energy	Project-MER hoofddocument (pp.22)	Score on criterion
Energy use and sustainable energy production	Project-MER hoofddocument (pp.173)	Criterion
Fossil energy use, sustainable produced energy used in the project	Project-MER hoofddocument (pp.173)	sub-criterion
CO_2 emissions	Project-MER hoofddocument (pp.173)	Criterion
Reduction CO_2 emissions due to modal shift	Project-MER hoofddocument (pp.173)	sub-criterion
Climate adaptation	Project-MER hoofddocument (pp.173)	Criterion
Water storage and drain capacity	Project-MER hoofddocument (pp.173)	sub-criterion
Communication and energy networks	Project-MER hoofddocument (pp.173)	sub-criterion
Resource use	Project-MER hoofddocument (pp.176)	note
Waste	Project-MER hoofddocument (pp.176)	note

Energy production	Project-MER hoofddocument (pp.177)	Score on criterion
Climate adaptation not part of study	Project-MER hoofddocument (pp.177)	Score on criterion
Water storage possible storage areas	Project-MER hoofddocument (pp.178)	Suggestions
Flood damage, protection of functions	Project-MER hoofddocument (pp.178)	Suggestions
Water storage on and in buildings	Project-MER hoofddocument (pp.178)	Suggestions
Water storage on roofs	Project-MER hoofddocument (pp.178)	Suggestions
Water storage through use of vegetation	Project-MER hoofddocument (pp.178)	Suggestions
Water drainage through steeper walls	Project-MER hoofddocument (pp.178)	Suggestions
Extreme weather alarm system	Project-MER hoofddocument (pp.178)	Suggestions
Slippery tunnel slopes roof protection	Project-MER hoofddocument (pp.178)	Suggestions
Slippery tunnel slopes heated asphalt	Project-MER hoofddocument (pp.178)	Suggestions
Water rerouting in development area	Project-MER hoofddocument (pp.179)	Suggestions
Waste disposal	Project-MER hoofddocument (pp.179)	Suggestions
Energy production, wind and solar energy	Project-MER hoofddocument (pp.179)	Suggestions
Climate change, dry periods, extreme weather, increasing amount of damage	Project-MER hoofddocument (pp.181)	Note
Heat stress and drying out	Project-MER hoofddocument (pp.181)	Note
Construction, transport of resources	Project-MER hoofddocument (pp.235)	Ambition
Construction, environmental hindrances	Project-MER hoofddocument (pp.235)	Criteria
CO_2 emission	Project-MER hoofddocument (pp.253)	Score on criterion
Involving sustainability in view contractor about transport and waste	Project-MER hoofddocument (pp.265)	Requirement
Sustainability (CO_2 reduction) in contract	Project-MER hoofddocument (pp.268)	Goal
Sustainability and climate	Project-MER hoofddocument (pp.275)	Score on criterion
Sustainable energy production	Project-MER bijlage Duurzaamheid en Klimaat (pp.23)	Ambition
Energy use reduction	Project-MER bijlage Duurzaamheid en Klimaat (pp.24)	Ambition
CO_2 emissions	Project-MER bijlage Duurzaamheid en Klimaat (pp.24)	Ambition
Climate and Energy	Project-MER bijlage Duurzaamheid en Klimaat (pp.24)	Ambition
Reduce the use of rare resources	Project-MER bijlage Duurzaamheid en Klimaat (pp.24)	Ambition
Clean energy production	Project-MER bijlage Duurzaamheid en Klimaat (pp.24)	Ambition
Water security, risk limitation and damage limitation. Adjusting to precipitation of 50mm/hour	Project-MER bijlage Duurzaamheid en Klimaat (pp.24)	Ambition
Reduce CO_2 emissions	Project-MER bijlage Duurzaamheid en Klimaat (pp.24)	Goal
Reduce CO_2 emissions	Project-MER bijlage Duurzaamheid en Klimaat (pp.25)	Goal
Reduce energy use and increase sustainable sources.	Project-MER bijlage Duurzaamheid en Klimaat (pp.25)	Goal
Energy use and sustainable production	Project-MER bijlage Duurzaamheid en Klimaat (pp.29)	Assessment Criterion
CO_2 Emission	Project-MER bijlage Duurzaamheid en Klimaat (pp.29)	Assessment Criterion
Water storage and drainage with regard for climate change	Project-MER bijlage Duurzaamheid en Klimaat (pp.29)	Assessment Criterion
Changing climate and precipitation patterns.	Project-MER bijlage Duurzaamheid en Klimaat (pp.69)	Note
Climate change, dry periods, extreme weather, increasing amount of damage	Project-MER bijlage Cultuur en Ruimtelijke kwaliteit(pp.48)	Note
Sustainable conditions	Project-MER bijlage water (pp.49)	Ambition
Spatial quality over time	Project-MER bijlage water (pp.30)	Note
Sustainability	Selectiedocument bijlage I De scope en de Omgeving(pp.6)	Ambition
Sustainable implementation of infrastructure	Selectiedocument bijlage II Visie van opdrachtgever (pp.4)	Goal
Sustainability	Nota van beantwoording (pp.106)	Answer
Sustainability	Nota van beantwoording (pp.111)	Answer
Sustainable implementation of infrastructure	Tracébesluit toelichting (pp.15)	Goal
Sustainability	Tracébesluit toelichting (pp.18)	Result
Increase in CO_2 emissions due to development	Tracébesluit toelichting (pp.19)	Result
Sustainable development	Tracébesluit toelichting (pp.36)	Policy
Air quality, not impeding	Tracébesluit toelichting (pp.53)	Score on criterion
Sustainable water use, protection of sources	Tracébesluit toelichting (pp.93)	Policy
Mitigation and compensation demand for contractor	Tracébesluit toelichting (pp.101)	Requirement
Climate measures, precipitation does not impede traffic	Tracébesluit toelichting (pp.101)	Score on criterion
Involving sustainability in view contractor about transport and waste	Tracébesluit toelichting (pp.105)	Requirement
Level 5 CO_2 Prestatieladder	Rapportage actualisatie milieu-informatie (pp. 72)	Requirement
Climate adaptation, increased protection of roads	Rapportage actualisatie milieu-informatie (pp. 72)	Requirement
Sustainability	Bestemmingsplan (pp.24)	Ambition
Climate proof, Flood security, clean water, space for renewable energy	Bestemmingsplan (pp.40)	Ambition
Sustainable spatial use	Bestemmingsplan (pp.40)	Interest/Ambition
Sustainable development	Bestemmingsplan (pp.42)	Requirements
Sustainability and climate	Bestemmingsplan (pp.118)	Note
Tunnel	Bestemmingsplan (pp.118)	Note
Energy and CO_2	Bestemmingsplan (pp.118)	Note

4. Description of Analysis Process and Findings of Interviews

Table F.6 and Table F.7 are the transcripts of two interviews with the experts of table F.5. Below table F.7 the main findings are elaborated on, which forms the basis of the findings used in the main text.

Table F.5: Interviews Zuidasdok, with name, date and project role

Date	Name	Project role
24-9-2018	Expert 6	Contract management
4-9-2018	Expert 7	General Planning process

Table F.6: Interview Expert 6, 24-8-2018, 16:00, Maarn, Zuidasdok

Interviewer	Which parts of Zuidasdok have you participated in?
Expert 6	I worked on the contract management. I was responsible for the tender. I helped translate the Voorkeursalternatief into requirements. In the Planuitwerkingsfase it is checked what requirements need to be satisfied by the design of a contractor. The project has a Design and Construct contract, this means that with requirements the framework is created and a contractor or the market must develop a design and a plan for construction that adheres to those requirements.
Interviewer	KES is a way to do that?
Expert 6	Yes, through KES the requirements of the client, in this case Rijkswaterstaat, ProRail and the Municipality of Amsterdam, are listed. These requirements are used to create system requirements, through system engineering. The result is a PvE. This is than given to the market.
Interviewer	In short it is Klanteisen-Systeem Eisen-Vraagspecificatie
Expert 6	Exactly, you can find more on this in the *Leidraad system engineering*
Interviewer	How is sustainability embedded in Zuidasdok?
Expert 6	Yes that is included, in various ways. However it may sometimes be very implicit. For instance the project entailed a couple of ambitions: for instance a sustainable integration (duurzame inpassing). That means the following: there are a couple of bottlenecks in that region, for instance the A10-Zuid. That road is very congested and results in large unnecessary CO_2 emissions. Resolving that is a form of sustainability. The main goal of doing that will be resolving a congested road, a smaller goal is dealing with CO_2 emissions. Another way is boosting public transport in the area, to decrease pressure on the road network. This in addition with making space for bicycle through paths and a better connection with public transport and other infrastructure such as bicycle parking spaces. Another measure is including future development in the design. Meaning the measures now must not obstruct and leave room for measures in later years. It is a modular development; future development will not require demolition of current development. Another sustainable feature is the logistics of development. Contractors were challenged to think of ways to optimize construction. For instance, using a sort of logistic hub, which diminishes the number of rides of one truck through the project area. Think of transport lines (transportbanden) instead of truck rides. In light of climate adaptation, the water storage and water security are important issues in the area.
Interviewer	With respect to clean energy, have energy requirements been introduced?
Expert 6	There were no requirements on energy. So no requirements on using solar power or combining a solar project or wind project with the construction of the tunnel. No explicit requirements were made on that part. There are requirements on effective maintenance, yet that is much more implicit. Even though it is implicit, perhaps it is more effective than explicit goals since it targets causes rather than symptoms.
Interviewer:	So sustainability is not always the main goal, yet there are sustainable connotations.
Expert 6	Yes, however it is imperative that solutions are sustainable, so it has an important place. But there are not explicit targets concerning CO_2 or energy etc. it is questionable if that is necessary.
Interviewer	Yes to that point. In this case the main goals were sustainable and were non-conflicting. However, sometimes these goals could be in conflict if there are no targets or requirements sustainability concerns might lose to other goals.
Expert 6	Yes that could be the case. This has to do with the KES process. It was not made very explicit to include sustainable solutions, with targets or specific goals. However, sustainability concerns were made, and the need to think sustainable was present. Focusing on solutions that are more structural, that focus on resolving causes, is in my opinion more useful than mere targets or goals.
Expert 6	On climate adaptation, and mitigation, we have put in place green requirements. Meaning trees, vegetation and the use of other green, nature elements.
Interviewer	I have found different factors, failure and success factor in literature. I would like to discuss some of these with you to see if these factors have played a part in Zuidasdok. The first is scope en goal factors. Project with a clear scope have large change of success
Expert 6	Yes, in Zuidasdok it was always clear what the goals were. Clear goals and ambitions on spatial quality were formulated. A clear set of requirements on spatial quality were formulated. These were put in place early on creating clear. That scope explains what will be done and what not. Things were added though, the three large companies asked additional measures that were smoothly introduced in the existing framework or scope. In other projects unclearness on what the goals is and what the scope is lead to failure.
Interviewer	Another factor is project organisation, which is more about how project organisation and project teams perform
Expert 6	the IPM-model is used. In Zuidasdok for every of the three mother organisation a specific representative was appointed. This representative focussed on introducing interests of the organisation in the project. It was very clear what each organisation wanted. Such an organisation is important and was used.
Expert 6	This is also closely related to the governance structure, Zuidasdok had a project director that was able to discuss the wishes of local authorities with these authorities. The project director than focussed on analysing the ideas and coming up with clear studies to make well informed decisions. The director further spoke with the three main organisations and used their input in the project.
Interviewer	Cognitive, meaning long-term thinking
Expert 6	Also important, modular development and of course it is a project is finished in 2028
Interviewer	How about legal factors?
Expert 6	Very simple, we need to comply with the law. However, sometimes it is interesting to do more than the law requires. These elements are important in Tracébesluit etc.

Interviewer	Design factors?
Expert 6	We tried to challenge contractors to use materials and resources that can be considered sustainable. This is related to maintenance and lifespan.
Interviewer	Most factors have been already touched upon in the interview. How about KES documents and PvE how accessible are those?
Expert 6	Rather difficult to access. A very specific question on the PvE can be answered, but the full PvE is confidential.
Interviewer	Are there specific people in the organisation that I could interview
Expert 6	I know most about tender and KES.
Expert 6	A last point on the project. It does not present itself as a sustainable project. Yet under each decision lies a sustainable mindset or at least a notion that sustainability is important.

Table F.6: Interview expert 7, 4-9-2018, 12:00, Maarn, Zuidasdok

Interviewer:	I study how sustainability, to be precise climate mitigation and climate adaptation, is implemented during the Planuitwerkingsfase of Dutch road infrastructure projects. I analyse the urban planning process, and part of the tender procedure.
Expert 7:	The PvE of the tender procedure could be accessible, I will have a look. How have you defined climate mitigation?
Interviewer:	I defined it as taking measures to limit or decrease the causes of climate change, thus primarily the decrease of the concentrations of CO_2 and focus on energy.
Expert 7:	CO_2 and energy have not been implemented in the goals of Zuidasdok. As a result no real measures have been taken on this aspect. In the tender procedure the market was challenged to include CO_2 and energy in the design. However no clear targets or requirements were set. No standards or goals were articulated. This happens in more parts of Zuidasdok, sustainability is a very unclear and abstract concept, that is not made explicit. For long the question was asked, what sustainability meant, and this was never really answered. As a result not a lot is done with sustainability, and no true climate mitigation and climate adaptation measures are introduced. Sustainability is not a real goal in itself and is only a precondition of reaching other goals.
Interviewer:	That was something I talked about with Expert 6, there is sustainability in Zuidasdok, however it is quite implicit. Many goals and measure have some sustainability in it, however, it never seems to be the main objective.
Expert 7:	Interestingly, during the Verkenningsfase sustainability was, for quite some time, a sixth goal of the project. However, it did not survive, this was a political choice. The focus was on solving the mobility issue at hand. Furthermore, the project entails a development project of 1.3 billion euros. The enormous project did therefore not qualify for extra measures concerned with sustainability. the main focus was to deliver the much-needed road solution, in a financially responsible manner. Sustainable measures are often viewed as costly and lose to the financial considerations.
Expert 7:	As I said sustainability becomes a precondition, it is great if it is incorporated by a contractor but not a reason to eliminate the contractor who does not incorporate it. Contractors are still challenged, for instance, to think of ways to make realisation/construction as environmentally friendly as possible. Smart logistics can help with that, so different transport hubs in the development area. These logistics do not primarily serve climate consideration. The road system may not be obstructed during construction. The existing system may not be halted by development, smart logistics can help with that too.
Expert 7:	However, it is interesting to see that almost no challenges or targets have been set on climate mitigation and climate adaptation. Take for instance a tunnel. Tunnels are large energy consumers, as they need a lot of energy to keep lights and ventilation working properly. Challenging or obliging energy neutral tunnels could be a good form of climate mitigation. However, currently the project does not focus on that. Moreover, no new targets or standards on which asphalt or concrete needs to be used were specified. These elements contribute quite a lot to the CO_2 emissions, opportunities in terms of climate mitigation can be found, however, not much is done with it.
Interviewer:	What about climate adaptation? I read a lot about water storage and water security, how is that incorporated.
Expert 7:	The water system in the area is part of 5 polders. As a result it is quite a challenge to rearrange the water system, especially while constructing a tunnel. The main objective was to keep feet dry and keep the system running during development. The focus therefore is not so much on climate adaptation and more on keeping the system running. The future climate, with more extreme weather has not been used in the Planuitwerkingsfase. Thus, climate adaptation did not get an important place, and did not lead to targets or measures.
Expert 7:	The project is built modular. This means that it leaves space for future development. By doing this the chances that the current constructions are demolished in the future to make room for new construction is limited. Modular development is a form of climate mitigation and climate adaptation.
Expert 7:	Not incorporating sustainability, climate mitigation or climate adaptation in these processes is not always caused by unwillingness. It can also be the case that the project organisation is not able to incorporate it. In Zuidasdok there is some idea of sustainability, however it is very abstract and was difficult to specify. Furthermore, it can also be the case that something is specified, however the current rules are not built for certain forms of innovation. Local civil servant might not be able to give out necessary permits since the innovations do not fit the rules. In these cases what is very important is that there needs to be just one driver on the right spot. Take for instance Zuidasdok, the councilman in Amsterdam who was responsible for Zuidasdok, was of the GroenLinks party, a leftish green party who are very concerned with the environment. As a result there was a lot of political support for green innovation and incorporating sustainability, this one person was an important driving force to make Zuidasdok more sustainable. Even so the amount of sustainability was low, have you read the urban planning document? What did you think of them?
Interviewer:	Yes, in my opinion there was very little sustainability. In some cases climate adaptation or climate mitigation was named, and sometimes sustainability, but it is never more than a remark or a result that did not lead to a measure or requirement
Expert 7:	Indeed it was quite little. Sustainability is sometimes noted and for instance in MER it is considered. However, it does not lead to specific targets, requirements or measures. The MER compares different variants of roads, and all these variants are similar in CO_2 emissions. In some cases the urban planning documents state that findings need to be addressed in the final design, by the contractor. This mostly means that it challenges contractors to think of solutions. The considering of sustainability aspects in MER and other documents is in some cases obligatory, this can lead to documents containing these aspects, yet nothing is done with them.
Interviewer:	There is no legal framework, no standards and in Zuidasdok no targets are articulated with respect to CO_2, energy or climate adaptation. Why not include such aspects and oblige a contractor to incorporate it?

Expert 7:	The reason for that is twofold. First of all, it is hard to specify goals and targets. As mentioned earlier, how to use sustainability was not always clear in Zuidasdok. Than working towards specific targets is even harder. Moreover it is difficult to monitor these targets. If a performance is asked, it must be checked whether the contractor does perform that way and reaches the target. This in itself requires ways to monitor. That leads to complications, sometimes it is not yet possible to monitor since the techniques do not exists. Or it is a method that is disputed, as a result a contractor could fight a negative performance review by addressing the method. It is not as simple as it seems. Secondly, the sustainability targets will most likely result in more measures and an increase of costs. As a result the projects financial feasibility is decreasing. Contractors might not want to get involved if the profit margins are too low. A result can be that no one wants to develop the project. An extra note however, is that involving sustainability does not necessarily lead to higher costs. There are some requirements or notes made in the PvE, for instance during the construction the project must have CO_2 Prestatieladder level 5. That is a requirement and seems a real target, however it is a target that is easily reached, and is therefore not really a challenge.
Expert 7:	It was noticeable during the project Verkenningsfase and Planuitwerkingsfase that sustainability had a central place. There was a sustainable mindset, however as mentioned before translating that in actual measures or requirements, specific aspects were hard. Sustainability was introduced as the fourth goal, however that was more about spatial quality and not so much climate mitigation or climate adaptation. The sustainable mindset exists, but it was more a precondition than an actual goal. The goal was and is to resolve traffic, mobility and accessibility issues and that must be done with regard for sustainability. In that sense it sustainability consideration will not be able to guide development as much as for instance financial considerations. However, sustainability consideration might sometimes be key aspect in just tipping the scales in favour of one measure or design as opposed to another. In that sense the importance of sustainability is growing.
Expert 7:	Extremely important in successfully incorporating sustainability is having 1 main actor who is a driver of sustainability. In Zuidasdok the GroenLinks councilman was important. The project organisation is important in that sense, and it would be interesting to take that into account during the formation of a project organisation.
Interviewer:	I have found different success and failure factors for incorporating climate mitigation and climate adaption in development project in the literature. Some of these factors have been discussed already. I would like to discuss some more, to identify which factors have played an important role in Zuidasdok and the implementation of climate mitigation and climate adaptation. The first is Scope and Goal factors
Expert 7:	As we have seen there was no real goal on sustainability, and thus no explicit sustainability ambitions. As result it is much harder to use do something with sustainability since it is not embedded in a central project goal.
Interviewer:	Project organisation factors
Expert 7:	The project organisation will focus on reaching the goals. These goals form the framework to work in. In Zuidasdok sustainability goals were not existing, and it was hard for the project organisation to introduce sustainability along the way. The 1.3 billion euro project needed to reach the goals, working for something that does not help reach the goals is not very productive. A couple of strong drivers for sustainability can help.
Interviewer:	Market factors
Expert 7:	In the tender and specifically the PvE, requirements on sustainability were introduced and on climate mitigation and climate adaptation. However, these requirements are vague and as mentioned before the market must not be scared off by targets.
Interviewer:	knowledge factors
Expert 7:	A lack of knowledge on techniques and methods to monitor performance can disrupt the process.
Interviewer:	Cognitive factors
Expert 7:	Long-term thinking is noticeable, the sustainable mindset is present and through modular development something is being done with it. However, the project tries to solve mobility issues, and as a result traditional solutions are used. The immensity of the project results in a continued focus on solving mobility issues and keeping the project financially feasible, sustainability becomes a mere precondition.
Interviewer:	Political and Policy factors
Expert 7:	Many decisions are political decisions. A decision is made on what needs to be done were and how, based on the findings of the Planuitwerkingsfase. A GroenLinks councilman and Groenlinks as the main party in the municipal council helps, but in the end, it is a political decision. Additionally, that decision will be part of existing policy from different (levels of) governments.
Interviewer:	Legal factors
Expert 7:	There are no legal climate mitigation or climate adaptation requirements in the Netherlands, as for instance in England. It is questionable if these are necessary, on one hand they oblige to think sustainable, on the other hand it can lead to slow procedure and can result in difficulty to find contractors. Older legislation based on older technologies and solutions might obstruct innovation.
Interviewer:	Governance factors
Expert 7:	Monitoring of performance can be hard, as the methods or techniques might not be available or disputable.
Interviewer:	Design factors
Expert 7:	The articulation of specific (technical) requirements for the system, the to be delivered objects, and the processes of construction works, is difficult. Clear requirements might help the design, and clear requirements are taken up into the PvE, however they need to compete with the requirements concerned with the main focus of the project. Zuidasdok is about solving traffic flow issues and mobility issues. Requirements on that have more priority than sustainability requirements.
Interviewer:	Technical factors
Expert 7:	Technologies are not always available, or do not fit current legal systems.
Interviewer:	Financial factors
Expert 7:	There is competition between different priorities. Financial aspects are mostly more important than sustainability. There is a lack of financial incentives to work sustainable. As a result Zuidasdok, while having a sustainable mindset, did not centre around it and focussed on reaching mobility goals.

5. Analysis of Zuidasdok

The analysis of Zuidasdok is based on the findings in interviews and documents. With those findings timelines are constructed. This section includes the seven constructed timelines. And their explanation. These analyses are the basis for the findings discussed in chapter 5 of the main text. The seven overarching aspects and timelines are discussed in this section.

5.1 Sustainability Criteria

In the Verkenningsfase environmental aspects are introduced as part of the MER which is legally required (Wm, art. 7). Criteria on sustainability, spatial possibilities and liveability are included. The PlanMER states that Zuidasdok can be considered a sustainable project. Sustainability itself was not a consideration in the selection of alternatives. Zuidasdok includes a goal on sustainable implementation but lacks a specific sustainability goal. This causes the lack of inclusion of climate in alternative selection. The aspect is not able to compete with other goals. A solution on mobility is more relevant in the project. Therefore the alternatives and its selection revolve around mobility. Well defined sustainable project goals are necessary to achieve sustainable solutions.
The variants score positive on this the sustainability criterion of ProjectMER. Sustainability is part of the OTB and TB. This inclusion is mostly driven by the project organisation. By a project director, and several team members interested in sustainability and Groenlinks councilman, the sustainable mind-set was slightly induced in the project. they helped to put sustainability into the consideration and increase climate awareness. Human drivers have proven to be important elements in introducing sustainability as criteria or part of the considerations. While that is promising, in the TB sustainability requirements are not articulated. This is due to the competition with other goals and interests. This competition is a returning problem. The project wants to incorporate sustainability however, the main goals are not to be disrupted. This relates to the early planning phase, were no sustainability goals were set. Furthermore, Zuidasdok focusses on more structural solutions than setting requirements. Instead of articulating obligatory requirements, Zuidasdok focusses on challenging the market to come up with certain sustainable solutions. In their view this is more optimal, as it leaves room for the creativity of the market and helps to construct more sustainable solutions. During the tender and contract phase no climate mitigation or adaptation targets are set. Firstly, this is the consequence of a lack of sustainability goals in earlier phases. Secondly, target require monitoring. It is difficult to monitor and score the performance of a project. There is a financial factor as well, the targets will ultimately result in more project costs, as extra measures are needed. In a project of €1.3 billion, extra costs are viewed as undesirable. Connected to this is the (incorrect) idea that sustainable solutions are generally more expensive.

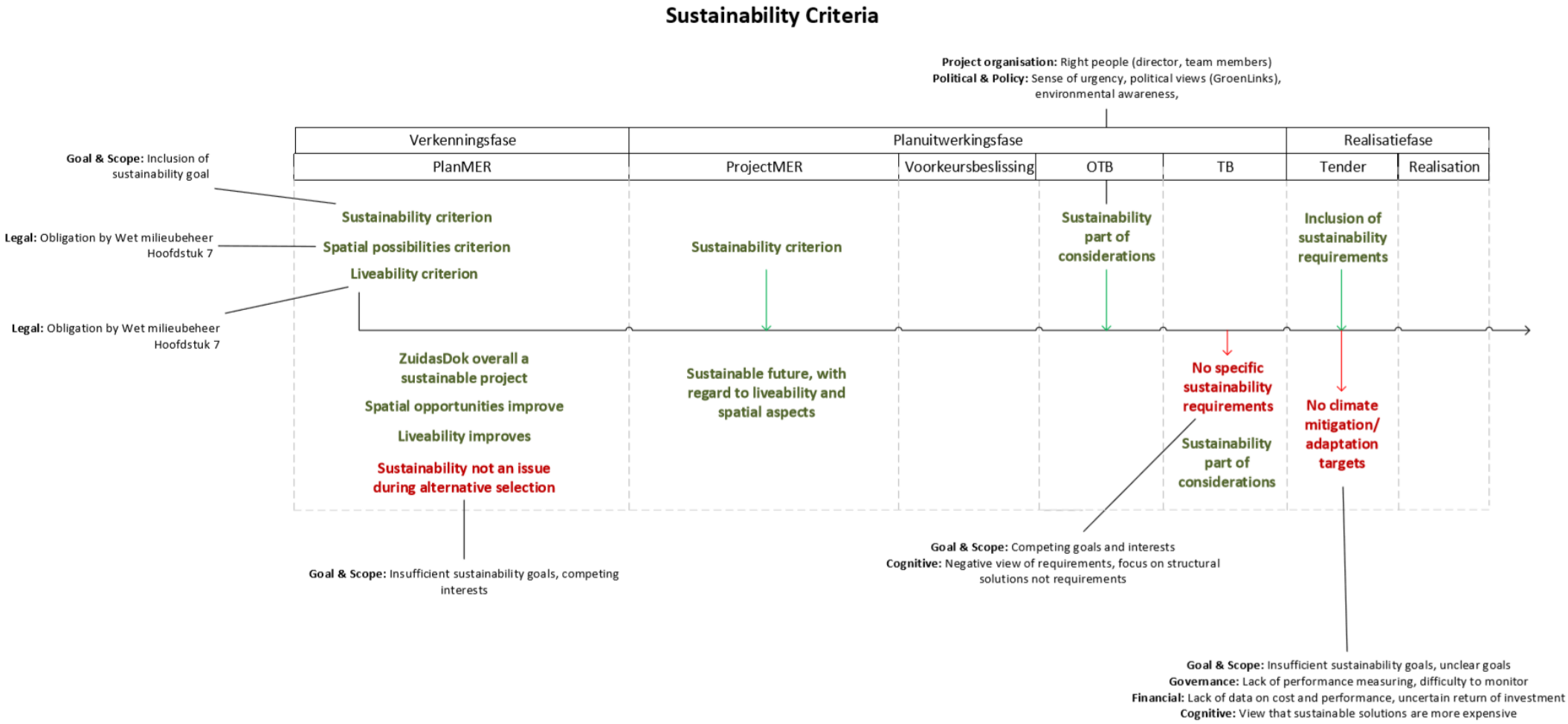

Figure F.1: Timeline of Sustainability Criteria in Zuidasdok

5.2 Sustainability and Spatial development – Sustainability Ambitions and Goals

A separate sustainability goal is eliminated during the Verkenningsfase. The mobility goal is prioritized above sustainability. The goals could potentially co-exist however, there is another factor involved. The financial factor drives the project to decide on priority of goals. The limited budget, financial feasibility and financial uncertainty surrounding sustainable solutions favour the mobility goal. Solving mobility issues is the main concern of the project. Even though a standalone goal on sustainability is not articulated a goal on sustainable integration of road infrastructure is. Several reasons exist to include this. Firstly, there is a drive for integral area development. Integration of spatial sustainable development and road development can create co-benefits and increase the quality of the project more than in the case of loose standalone measures and projects. Furthermore, it aligns public and stakeholder needs with the project goals. In aligning needs of stakeholders and project the project director plays a key part. A thoughtful organisation helps including sustainability in a project. The connection between project director and local authorities is important in exchanging demands, needs and wishes. It becomes clear that there is an implicit sustainable mind-set in the Verkenningsfase of Zuidasdok. The sustainability which is included focusses primarily on liveability and spatial concerns. Climate considerations become more explicitly part of the project in the Ambitiedocument. The document speaks on sustainable basic conditions, which focus on water compensation and a robust water structure.

Awareness of climate change and its consequences, dry periods, extreme weather, increasing amount of damage are articulated in the ProjectMER. Two reasons are found for this. Firstly, there is an increasing amount of knowledge on these issues. Secondly, the current ruling political party is a leftish party concerned with the environment. The notions of sustainable implementation of infrastructure and sustainable basic conditions remain part of Zuidasdok. The Voorkeursalternatief also includes sustainability explicitly in the form of modular development. The idea that the project reserves space for future constructions, which limits the need for demolition in the future. The emergence of modular development can be attributed to long-term thinking and thinking beyond the project scope. Furthermore, it is driven by the idea that optimal use of space and budget requires integral development. Where road and spatial development are intertwined.

The OTB and TB still include the need for a sustainable implementation of infrastructure and use of modular development. No requirements are set on sustainability. Several reasons exist for this. Firstly, it is difficult to base requirements on goals, as there are no sustainability goals. The transition from abstract mind-set to requirements is not made. Sustainability is not a goal in its own right, and thus becomes a part of other goals, it is a precondition to other goals. While that is the case, it does not compete with the other project goals. A lack of decisions on the meaning of the mind-set, a lack of experience and a lack of capabilities result in a general lack of inclusion of sustainability in Zuidasdok.

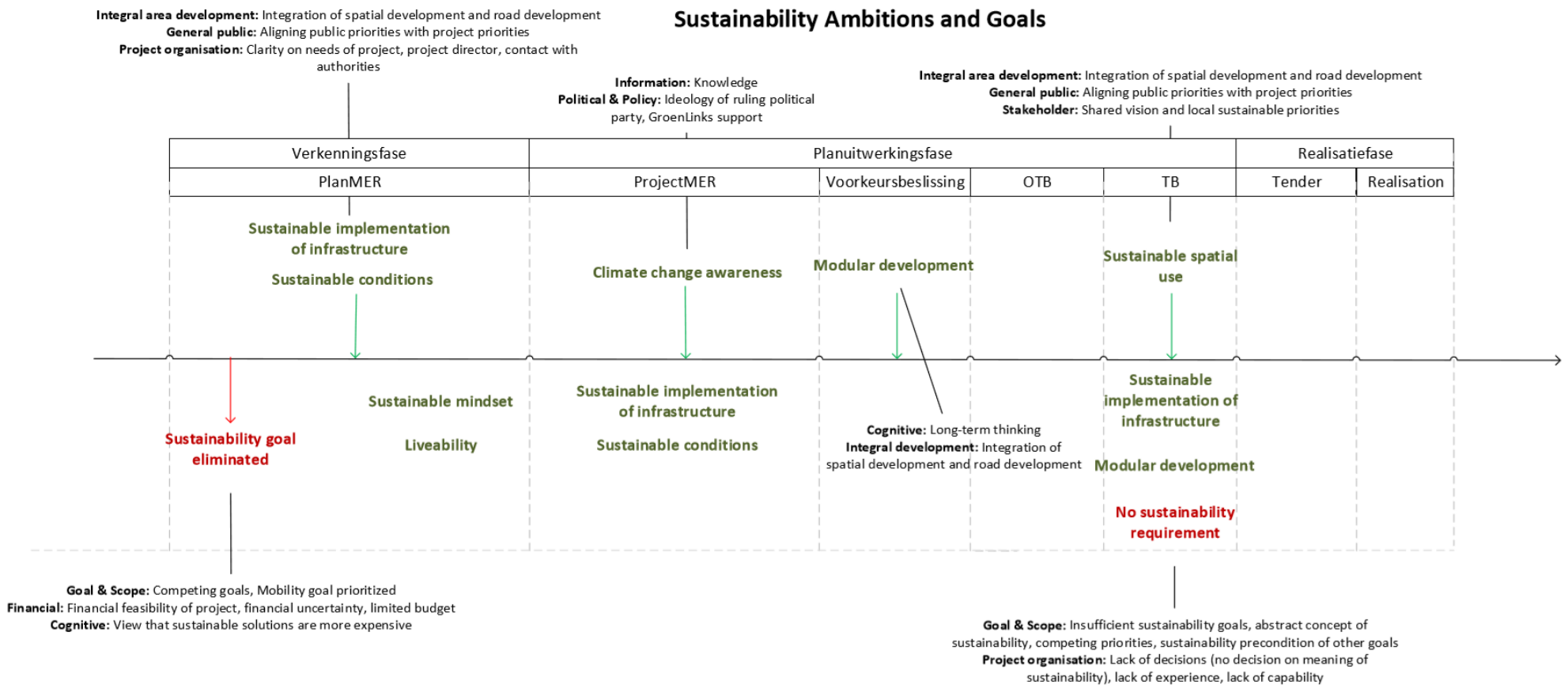

Figure F.2: Timeline of Sustainability Ambitions and Goals

5.3 Energy & CO_2

Energy and CO_2 reduction goals are not specified in Zuidasdok. Due to a lack of political awareness, urgency and conflicting priorities solving congestion is prioritised. While this is the case the Verkenningsfase and PlanMER do include energy and CO_2 as criterion of the MER. However, energy and CO_2 are considered not important enough to be embedded in a project goal. Ideas for the inclusion of energy efficient lighting is proposed in the Ambitiedocument. This is achieved by including stakeholders early in the planning process, and by using collaboration mechanisms

The criterion on energy as included in the PlanMER is also present in the ProjectMER through well integrated project phases, and a political drive for inclusion. Energy production, energy use, fossil fuel use and CO_2 emissions are part of the assessment framework. Several relevant results can be found. Firstly, no energy production is to be part of Zuidasdok. National policy on sustainable purchasing of energy deems it unnecessary to produce energy within the project scope. Furthermore, wind turbines are not possible in the area. The spatial characteristics do not allow it, and it will conflict with the societal preferences. There is a possibility for temporary solar panels on top of the tunnel. This is still a theoretical option at this point in the project and is merely suggested since the information and knowledge on it are in place. A second result is the increase of CO_2 emissions. In the area, mostly attributed to increasing amount of traffic using the area. Thirdly, ambitions to reduce energy use, increase sustainable energy production and CO_2 reduction are articulated. These abstract concepts are made more explicit e.g. a reduction of CO_2 emissions of 75% compared to 1990 in 2040 and 40% in 2025. The TB only states the negative impact of development on the CO_2 emissions. These ambitions are left for the market to act on.

In the tender and subsequent contract phase CO_2 and energy are articulated as a challenge for the market. By setting a level 5 CO_2-prestatieladder requirements the market is challenged to think of ways to limit CO_2 emissions. This challenge is a result of the earlier considerations of CO_2 and energy. It is also about the inclusion of stakeholders in earlier processes, during the creation of the Ambitiedocument, to make this possible collaboration mechanisms and stakeholder management are necessary. While it is a good to challenge via the CO_2-Prestatieladder, the challenge is relatively easily met, as most project are already complying with this standard. In this phase no requirements on wind or solar energy, energy neutral tunnel or asphalt and concrete are set. As seen before wind energy was difficult to produce, however some potential for solar energy was indicated. Energy and the tunnel are not addressed, tunnels require a lot of energy and thus it would seem logical to limit the energy use of the biggest consumer, especially considering the considerations of energy and CO_2 in earlier stages. A similar problem is noticeable with asphalt and concrete, both materials are large CO_2 emitters, and should be part of the considerations. What are the underlying reasons for this. Firstly, there are no clear goals on these aspects, as seen earlier goals on energy and CO_2 are not articulated, and that makes it difficult in later considerations and decisions. Other priorities do have explicit goals and are better embedded in the project and will win any conflict related to CO_2 and energy. Why is it a conflict at all? That is the result of financial factors, a limited budget and competing investment priorities require a decision. That combined with the view that sustainable solutions are more expensive than conventional result in a lack of measures, targets and challenges on the topic of CO_2 and energy.

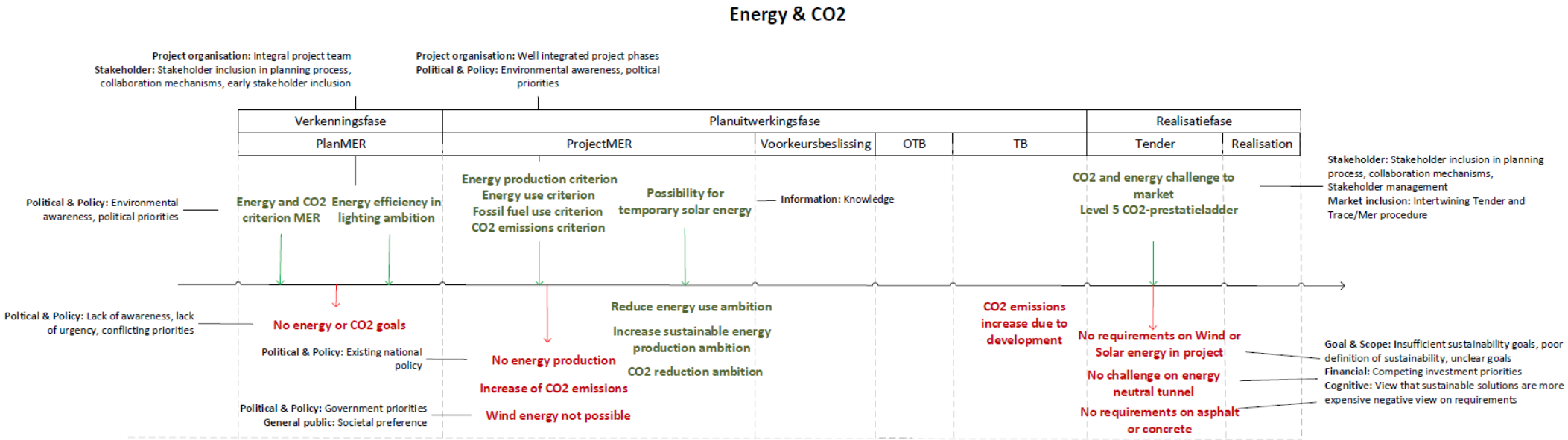

Figure F.3: Timeline of Energy & CO_2 in Zuidasdok

5.4 Materials & Waste and Construction & Market

Ambitions on materials and waste and the use of sustainable materials to diminish CO_2 emissions are articulated in the PlanMER due to the sustainable mind-set of the project organisation. The ProjectMER states that dealing with resources, materials and waste is relevant in the Realisatiefase of the project and is therefore pushed to later phases. There are two underlying reasons for this, firstly a lack of sense of urgency and dealing with other priorities at the political level. The second factor is much more influential, the broadly shared view that climate is best addressed in later phases. As materials, resources and waste are concerns for the development, it are concerns of the contactor. There is no awareness of the positive consequences of early inclusion of materials and waste aspects. While the dominant view is to address these issues later, several suggestions are made. For instance the use of waste disposal pipes, and transport over a conveyor belt. These suggestions are made by stakeholder involvement, and the believe that this involvement can help create additional value. Furthermore, the measures might create financial benefits. The suggestions are based on knowledge and available technology. Zuidasdok addresses materials and waste in the ProjectMER. A requirement is articulated to involve the contractor in decision on sustainable transport and the use of scarce resources. During the ProjectMER it is clear that the construction will result in an increase of CO_2.

The TB includes several new measures. First it includes Duurzaam Bouwen. This long-term policy drives projects to use sustainable materials and construction methods that limit CO_2 emissions. Furthermore, the TB states that mitigation and compensation measures are challenged to the contractor. Important is trust between market and project organisation and clarity on the goals and requirements. Lastly the concept of modular development is introduced. Through long-term thinking and the implicit sustainable mind-set, the drive to think of ways to introduce structural sustainability is present. Optimal use of space can be reached by integration of road development and spatial development, and in this way sustainable solutions can emerge. In the tender the contractor is challenged to use sustainable materials, as a result of earlier inclusion of the aspect in the planning. Through intertwining MER and tender, the TB is able to leave room for the contractor. Subsequently, the contractor is challenged to include materials and waste in his considerations and think of ways to diminish CO_2 emissions. The flexibility of the TB creates room for the contractor to come up with his own solutions to the challenges. There is a challenge on smart logistics, based on the suggestion made in the ProjectMER. No challenges are set on concrete or asphalt.

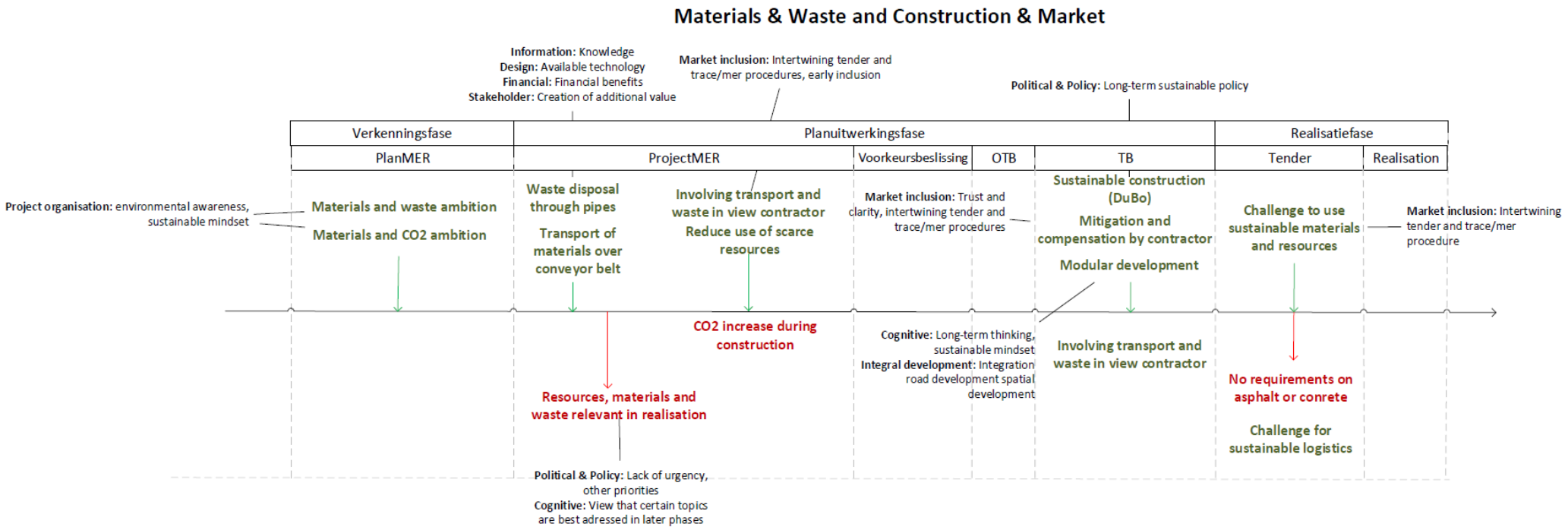

Figure F.4: Timeline of Materials & Waste and Construction & Market in Zuidasdok

5.5 Water

Water and water security is introduced as criterion in the PlanMER. The project is located in a water rich, low lying area, between five polders. The need for a proper study to the impact of the project to the water system is evident. Water storage is deemed an important issue. Furthermore, it is stated that water storage and security are to be addressed in later phases. During this phase the ambition for a robust water system is articulated. This is the result of political priority. In the ProjectMER water storage is a criterion, a continuation of the ambitions and goals of the previous phase. Furthermore, suggestions are made on flood damage considerations, extra water storage in roofs, buildings and vegetation and extra suggestions for water drainage. These suggestions are the result of a combination of sustainable mind-set, knowledge and information on the problem and available technology.

Climate consideration are intertwined with water concerns. While that is the case it also becomes clear in this phase that climate change and the change in weather and precipitation patterns are not included in the studies and the project. This can be attributed to a lack of related goals and a lack of urgency. The political decision-makers do not deem it necessary to include these changes in the MER or other studies during this phase. Risk and damage limitation in is also not part of the project, as the problem is tackled on a higher level. That lack of inclusion of climate change in water management remains until the TB. Climate measures are difficult to realise, and future weather is not part of the decision-making process due to technical restriction and different priorities at the political level. During this phase the climate adaptation requirement are increased. Due to municipal policy a higher safety level with regard to water issues and flooding is put in place for the Zuidplein. In the end no climate adaptation targets related to water are set. Knowing that climate change exists and impacts water management does not mean that it becomes part of the consideration. Water management will be influenced by a changing climate, Zuidasdok did not anticipate on this.

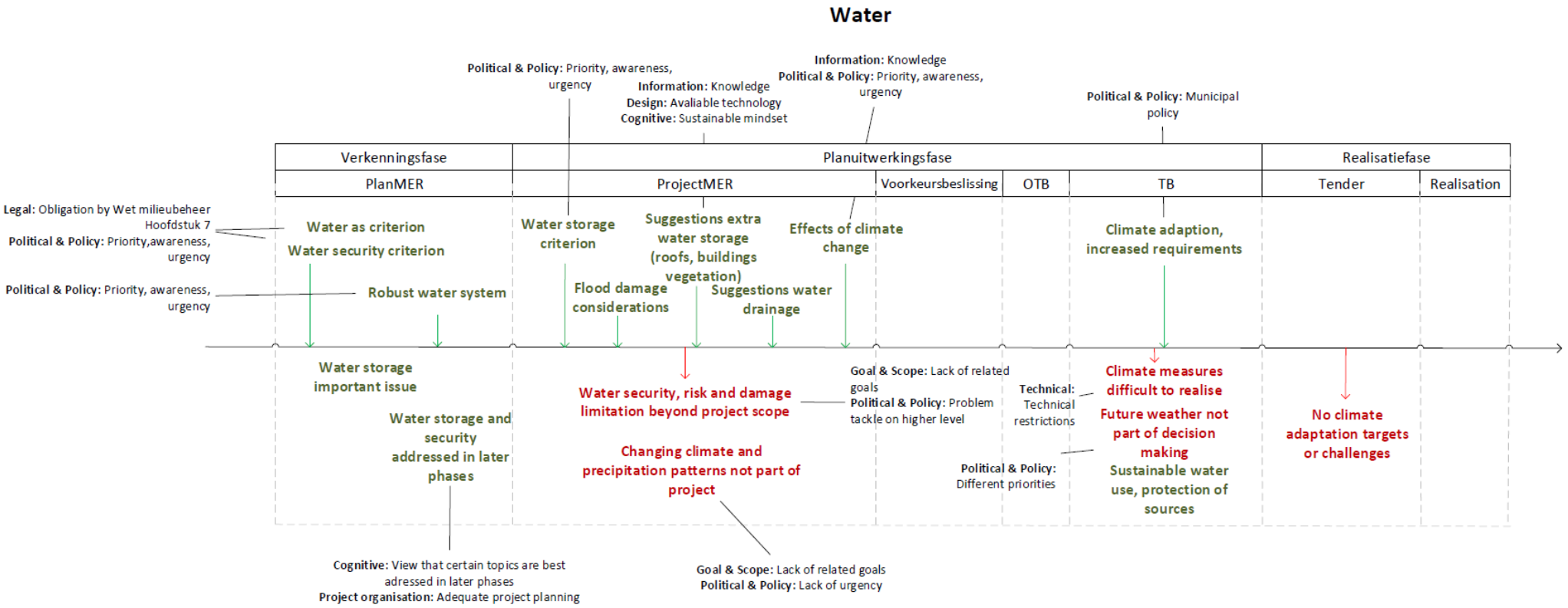

Figure F.5: Timeline of Water in Zuidasdok

5.6 Air Quality

Air quality is a criterion in MER, as it is obliged (Wm, Art. 7). NO_2 and PM_{10} are the main focus of the study. In the PlanMER no variant exceeds the legal standards. The criterion is again used in the ProjectMER. The TB states that air quality is not an issue in Zuidasdok. On average the air quality will improve. Inclusion of air quality is a legal obligation, but it does not have a distinctive role in the study. MER is used to distinguish alternatives or variants from each other. On some criterion this is difficult, as in the case of air quality all alternatives involve a road that emits harmful gasses. Additionally air quality is a by law required criterion, that can lead to a study that only satisfies that requirements but does not result in useful findings for the decision-making process.

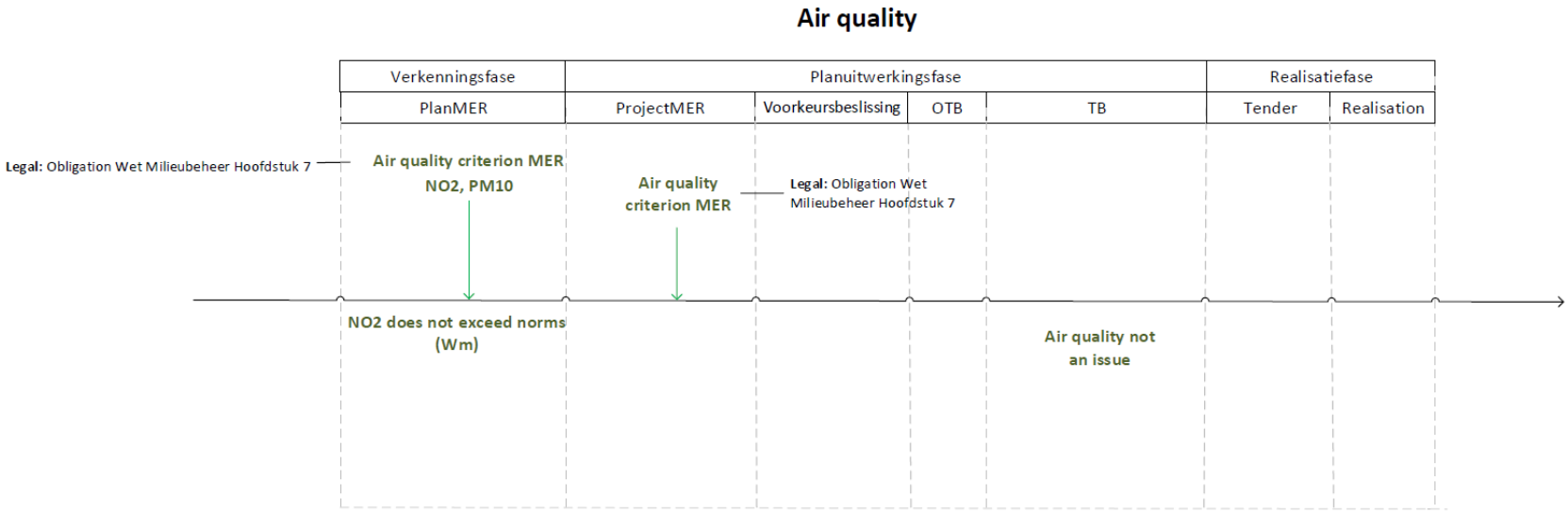

Figure F.6: Timeline of Air quality in Zuidasdok

5.7 Climate resilience

A climate adaptation criterion is introduced in the ProjectMER. This can be attributed to the ruling political party. The political decision-makers can guide the focus of a MER on the parts that they find important. Subsequently, through the ProjectMER it becomes clear that climate change has not been part of the design. Other priorities, lack of urgency, awareness on both the political field and at the stakeholders' level combined with inexperience of the project organisation and little related project goals, results in no inclusion of climate adaptation in the design. Even though this is the case, during the ProjectMER climate change becomes somewhat of a topic. Aspects such as climate change, extreme weather, increasing damage, heat stress, and climate adaptation in water security are introduced. Vital to this introduction is the political awareness, which drives the project to include some of these elements. Furthermore, increasing amount of knowledge was necessary to achieve this. Precipitation patterns are not part of the study primarily due to a lack of legal standards.
In the Voorkeursbeslissing it becomes clear that climate concerns and future weather are not a part of trade-offs. This is attributed to a lack of sustainability goals and other priorities. In the TB it becomes clear that climate measures are difficult to realise, mostly due to technical restrictions. It is also during this phase that climate adaptation requirements are increased on the Zuidplein, following municipal policy. Modular development is introduced, resulting from sustainable mind-set and integration of road and spatial development. By reserving space for future development, demolition in the future is minimized and future opportunities maximised. The local Bestemmingsplan, made during this phase, put emphasize on the connection between water and climate concerns, and result in the ambition for sufficient flood security and clean water. During the tender ambitions and earlier notes are translated to climate adaptation requirements for the PvE. While this is promising the requirements are generally considered vague. Several reasons exist for that, there are insufficient sustainability goals and thus there is no way to embed these requirements in earlier goals. Furthermore, there is a large fear of scaring of the market. Specific requirements limit the solution space, and thus could scare of potential contractors. Lastly, there are no legal standards, there is a fear and risk of creating slow procedures. Specific requirement need to be monitored. This can be difficult as monitoring requires a lot of information and an assessment framework. Dealing with climate adaptation most likely means dealing with innovations. Current assessment frameworks might not be usable on innovations.

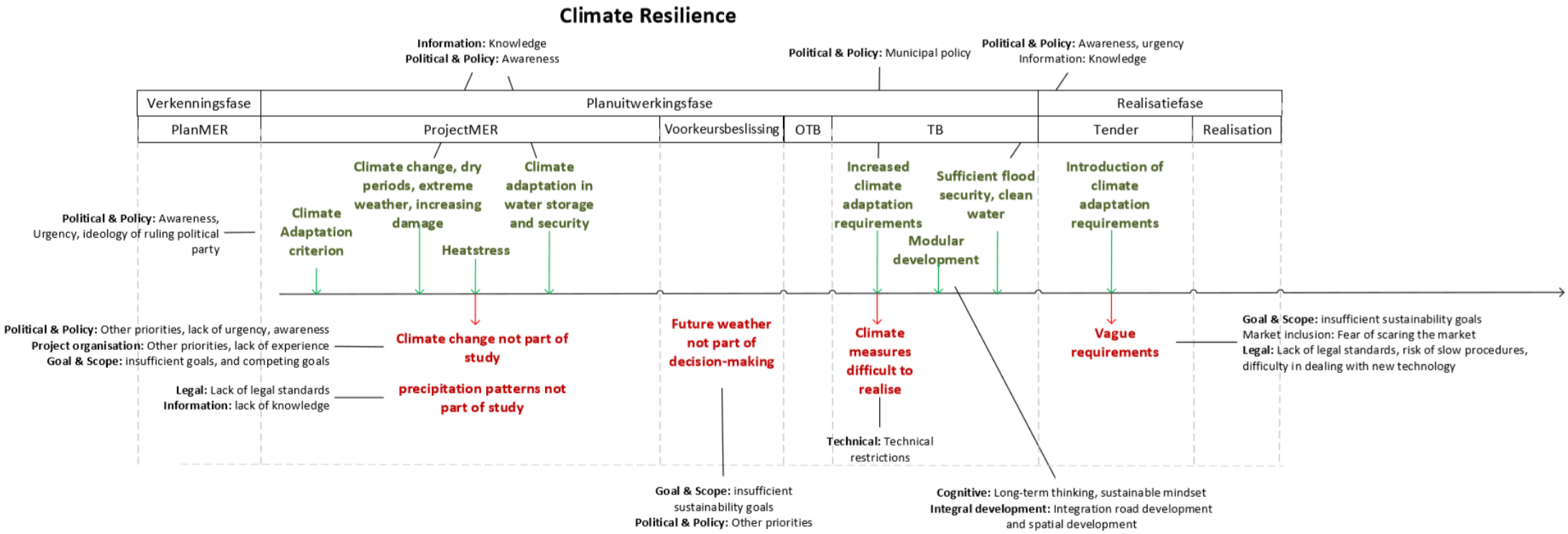

Figure F.7: Timeline of Climate Resilience in Zuidasdok.

6. Results Case Study Zuidasdok

Table F.9 is an overview table of the factors found in Zuidasdok and is the conclusion of this case study and chapter.

Table F.9: Found factors in case study Zuidasdok, either with a positive or negative impact on the inclusion of climate concerns.

Early inclusion		**Market inclusion and incentives**	
Integration of spatial, sustainable and road development	+	Challenge market	+/-
Inclusion and clarity in project goal and scope		Market's creativity	+
Clear climate goals and ambitions	+	Competition	+
Explicitness on climate concerns in early project	+	Use of CO2-prestatieladder	+
Aligning climate goals with project goals	+	Trust	+
Lack of climate focussed sustainability goal	-	Intertwining planning process and tender	+
Climate measures side-effect of reaching other goals	-	Flexible TB	+
Climate measures obstruct main goal	-	Shirking responsibilities	-
Conflict climate concerns and main (mobility) goal	-	Symbolic use of CO2-prestatieladder	-
Conflict climate concerns and inpassing	-	Climate concerns only addressed in realisation phase	-
Conflict climate concerns and liveability	-	**Participation and mind-set of stakeholders**	
Main (mobility) goal prioritised above climate concerns	-	Alignment of needs and interests by project director	+
Lack of involvement of climate in trade-offs and decision-making	-	Early stakeholder inclusion	+
Form, mind-set and priorities of project organisation		Collaboration mechanisms to help alignment of goals	+
Project director connection between project organisation and owners	+	**Participation and mind-set of general public**	
Human drivers of climate mitigation and adaptation	+	Conflict societal preference and climate measures	-
Awareness	+	**Laws and legal standards**	
Sense of urgency	+	Legal requirements	+/-
Connection between parties	+	Lack of legal standards	+/-
Inexperience	-	Slow procedures	-
Information and knowledge in decision-making		Current assessment framework not usable on innovations	-
Knowledge on climate change	+	**Political decision-makers, political environment and policies**	
Lack of knowledge on positive consequences of early inclusion	-	Municipal sustainable policy	+
Lack of use of knowledge and information in decision-making	-	Political player focussed on climate	+
Incapability of MER to study certain aspects	-	Climate awareness	+
Form and restrictions of design requirements		Long term policy on materials (Duurzaam Bouwen)	+
Targets are maximum	-	Sense of urgency	+
Lack of goals results in lack of specific targets	-	Political climate priorities	+
Requirements limit solution space	-	Alignment of needs and climate concerns (water, flooding)	+
Decreases financial feasibility	-	Ideology of ruling party	+/-
Scaring of contractors	-	National policy on CO2	+/-
Monitoring difficulty	-	National policy water	+/-
Little requirements due to fear of scaring market	-	Shirking responsibilities	-
Financial feasibility, financial incentives and budget		Vague existing policy	-
Conflict financial feasibility and climate concerns	-	Path dependency of political decisions	-
Sustainable solution viewed as more expensive as conventional	-	**Perceptions, misconceptions and cognitive barriers**	
Limited budget	-	Long-term thinking	+
Financial uncertainty innovations	-	Sustainable mind-set	+
Availability of technology		Evident problem	+
Available technology limits solutions	-	Knowledge and information (drive mind-set)	+
Technical and spatial restrictions	-	View that certain topics are best addressed later	-
Type of contract			
D&C	-		

Appendix G – Case Study RijnlandRoute

1. Description of RijnlandRoute

On December 10th, 2008 the Provinciale Staten of Zuid-Holland drew up the Startnotitie for the start of the RijnlandRoute Project (Provincie Zuid-Holland, 2018a). The Verkenningsfase proposed to research six alternative routes in 2005 (Nieuwenhoven, 2005). The start of the RijnlandRoute project in 2008 involved the Integrale Benadering Holland Rijnland IBHR (Projectteam Integrale Benadering Holland Rijnland, 2009) a Cost-benefit analysis (Dusseldorp, Modijefsky, & Vervoort, 2012), and the start of the 1e fase MER.

The projects main purpose is to decrease road congestion around Leiden, by creating a better connection between the A4 and A44 through the N434. The region has over 400000 residents and is growing. The A4 and A44 serve as the main transport roads of people and goods between Den Hague and Rotterdam in the south and Amsterdam in the North. The North-South connection is well suited for its purpose. The East-West connection however is lacking capacity. The provincial road N206 is the main corridor between the roads and for traffic heading west or east. As a result this road cannot keep up with the traffic flow. This is similar for several roads the Ir. G. Tjalmaweg, at Katwijk and the Plesmanlaan, Lelylaan, Churchilllaan and Europaweg at Leiden (Royal Haskoning, 2010). The roads are congested and with increasing population congestion problems will increase. The whole problem is enhanced by the characteristics of the provincial and municipal roads. For instance the N206 has large parts where the maximum driving speed is 50km/hour, the road consists of 1 lane on both sides, with several parts with 2x2 lanes, it contains several crossroads with traffic lights and the route has several bridges which are opened frequently (Provincie Zuid-Holland, 2010).

The I/C ratios of Plesmanlaan and Europaweg are respectively 1.02 and 1.04 in 2005 resulting in structural delays. Tjalmaweg is 0.98 and Churchilllaan 0.83. Without a change in the road system more congestions and higher I/C ratios are imminent (Provincie Zuid-Holland, 2010). Three main goals were formulated:

- Significantly improve the east west connection for road traffic.
- Improve liveability in the region Holland Rijnland and connected municipalities.
- Creating possibilities for spatial-economic development in the region.

The 1e Fase MER studied four alternatives consisting of altogether nine variants. The 2e Fase MER continues by studying 3 main alternatives which make up 7 variants.
The alternative Zoeken naar Balans is chosen by the Gedeputeerde Staten (GS) of Zuid-Holland as Voorkeursalternatief (Provincie Zuid-Holland, 2012b). The GS named both Zoeken naar Balans as Churchill Avenue as potential solutions.

Zoeken naar Balans proposes a new 2x2 road south of Leiden connecting A4 and A44. The road is routed through a 2.5 km long tunnel. The new road (N434) can relieve the N206 and is primarily for traffic that is not destined for Leiden, the N206 is for local traffic.

Churchill Avenue proposes the construction of a 3.5km tunnel underneath Leiden. This alternative crosses an urban area, and not the green space below Leiden, as ZnB proposes. As a result this alternative is considered the environmental friendliest alternative.
Zoeken naar Balans variant F is chosen as the preferred solution. The variant is a slightly cheaper variant to the main ZnB concept. The southern part of the route between A44 and A4 will remain a two way road (2x1) the rest of the project is to be done according to the Zoeken naar Balans alternative. (Provincie Zuid-Holland, 2012b).

The Planuitwerkingsfase started in 2013. The Planuitwerkingsfase entailed three main components, working towards a TB, a Provinciaal Inpassingsplan (PIP) and a tender procedure. The Ontwerp Provinciaal inpassingplan was finished in March 2014. The PIP plans where and how the N434 will be constructed. The OTB was finished in April 2014 and concerns itself with changing the

A4 and A44. The Tracébesluit and Provinciaal Inpassingsplan were adopted in December 2014. During the following period the tender procedure was started. Early 2017 Comol5 won the tender for the first component of the project, the tunnel, A4 and A44. In 2019 Ir. G. Tjalmaweg will be tendered and the last component Europaweg after that (Provincie Zuid-Holland, 2018b). Currently the first component of the project is in the Realisatiefase. Table G.1 shows a timeline of RijnlandRoute.

Table G.1: Timeline of RijnlandRoute

Date	Event
1-1-2004	Verkenningsfase
10-12-2008	Start Rijnlandroute (Startnotitie PS)
15-10-2009	IBHR report
24-2-2010	1e fase MER
1-5-2012	2e fase MER
29-5-2012	Voorkeursbeslissing (GS)
26-6-2013	Start Planuitwerkingsfase (Uitvoeringsbesluit GS)
18-3-2014	Ontwerp Provinciaal Inpassingsplan (OPIP)
24-4-2014	Ontwerp Tracébesluit A4 & A44
1-11-2014	Report Zienswijzeprocedure
10-12-2014	Adopting PIP
17-12-2014	Adopting Tracébesluit
23-3-2016	New decision PIP
13-12-2016	Start Tender DBM contract Part I
27-1-2017	Decision tender Comol5
2017-	Realisation

2. List of Documents Analysed

Table G.2: Overview of use documents in RijnlandRoute case study, documents with publication date, Title, Type and author.

Date	Document	Title	Type	Author
17-4-2005	Verkenning	Samenvattende rapportage van de uitkomsten Verkenning RijnlandRoute	Report	Provincie Zuid-Holland
13-10-2009	PlanMER	Vragen van leden van de Ideeëngroep RijnlandRoute	Questions	Ideeëngroep RijnlandRoute
15-10-2009	PlanMER	Eindrapport Integrale Benadering Holland Rijnland	Report	projectteam IBHR
1-1-2010	PlanMER	Hoofdrapport: 1e Fase MER Rijnlandroute	Report	Provincie Zuid-Holland
1-1-2010	PlanMER	Bijlagen: 1e Fase MER Rijnlandroute	Report	Royal Haskoning
1-1-2010	PlanMER	De Studie in Beeld - Samenvatting: 1e Fase MER Rijnlandroute	Report	Royal Haskoning
20-12-2010	ProjectMER	Stand van Zaken RijnlandRoute	Letter	Provincie Zuid-Holland
1-5-2011	ProjectMER	Milieueffectrapport RijnlandRoute (tweede fase) - samenvatting	Report	Provincie Zuid-Holland
1-4-2012	ProjectMER	2e fase MER RijnlandRoute, Achtergrondrapport bodem en grondwater versie 2.0	Report	R.B.G. Stroot & E.J.G. Stamsnijder
24-4-2012	ProjectMER	Natuur- en voortoets 2e fase MER RijnlandRoute versie 2.0	Report	M. Schillemans, H.. Venema, M. Aragon van der Broeke, V. Wisgerhof
24-4-2012	ProjectMER	2e fase MER RijnlandRoute, achtergrondrapport Ontwerp	Report	M. Janssen, A. Molenaar, T. Scherer, Y. Roselaar
26-4-2012	ProjectMER	Milieueffectrapport RijnlandRoute (tweede fase) - achtergrondrapport Oppervlaktewager 2.0	Report	Maurits van Brenk
26-4-2012	ProjectMER	2e fase MER RijnlandRoute, achtergrondrapport verkeer versie 2.0	Report	Goudappel Coffeng
26-4-2012	ProjectMER	2e fase MER RijnlandRoute, achtergrondrapport verkeer versie 2.0 - Bijlagenboek	Report	Goudappel Coffeng
27-4-2012	ProjectMER	Milieueffectrapport RijnlandRoute (tweede fase) - achtergrondrapport gezondheid 2.0	Report	Maaike Teunissen
27-4-2012	ProjectMER	Milieueffectrapport RijnlandRoute (tweede fase) - Luchtkwaliteit versie 2.0	Report	E. Gort-Krijger
27-4-2012	ProjectMER	2e fase MER RijnlandRoute, achtergrondrapport Natuur versie 2.0	Report	Marcel Schillemans
1-5-2012	ProjectMER	Milieueffectrapport RijnlandRoute (tweede fase) - achtergrondrapport lanschap, cultuurhistorie en recreatie	Report	Gerritsen

1-5-2012	ProjectMER	Bijlageboek bij het milieueffectrapport RijnlandRoute (tweede fase) versie 2.0	Report	Provincie Zuid-Holland
1-5-2012	ProjectMER	Milieueffectrapport RijnlandRoute (tweede fase) hoofdrapport versie 2.0	Report	Provincie Zuid-Holland
1-5-2012	ProjectMER	Milieueffectrapport RijnlandRoute (tweede fase) Samenvatting versie 2.0	Report	Provincie Zuid-Holland
16-5-2012	Voorkeursalternatief	Nota Voorkeursalternatief RijnlandRoute	Report	Provincie Zuid-Holland
25-10-2012	Commissie m.e.r.	Aanvulling 2e fase MER RijnlandRoute versie 2.0	Memo	Provincie Zuid-Holland
10-10-2013	OTB	Tunnelveiligheidsplan versie 1.1	Report	G.W.E.B. van Herpen-van Leenen, T. Reitsma, S.A. Lezwijn
14-2-2014	OTB	Veldinventarisaties RijnlandRoute	Report	V.J. Wisgerhof
25-2-2014	OTB	Kwalitatieve Beschrijving Verkeersveiligheid	Report	Ministerie van Water, Verkeer en Leefomgeving
1-3-2014	Zienswijze	Ontwerp-tracébesluiten A4 en A44 (RijnlandRoute)	Announcement	Rijksoverheid
1-3-2014	OPIP	RijnlandRoute inpassingsvisie en landschapsplan	Report	MTD Landschapsarchitecten
1-3-2014	Project-MER/PIP	RijnlandRoute Nota van Antwoord MER en voorontwerp inpassingsplan RijnlandRoute	Report	Provincie Zuid-Holland
10-3-2014	OTB	QRA tunnel RijnlandRoute - Bijlage Tunnelveiligheidsplan	Report	Arcadis
12-3-2014	OTB	Scenarioanalyse	Report	G.W.E.B. van Herpen-van Leenen, L. Pronk
12-3-2014	OTB	Verkeersafwikkeling RijnlandRoute - Terugslag van A4 naar RijnlandRoute	Report	Goudappel Coffeng
12-3-2014	OTB	Tunnelveiligheidsplan Definitief concept	Report	G.W.E.B. van Herpen-van Leenen, T. Reitsma, S.A. Lezwijn
21-3-2014	Project-MER	Analyse van het wegontwerp in relatie tot het MER (2e fase) RijnlandRoute	Note	Tauw bv
21-3-2014	OTB	Natuurtoets O-PIP en OTB's A4 en A44 RijnlandRoute	Report	Tauw bv
21-3-2014	OTB	Mitigatie- en compensatieplan TB	Report	Tauw bv
21-3-2014	OTB	Deelrapport Water OTB's/OPIP RijnlandRoute	Report	Tauw bv
21-3-2014	OTB	Mitigatieontwerp RijnlandRoute	Report	Tauw bv
1-5-2014	Uitgangspunten	Uitgangspunten verkeersmodel RijnlandRoute	Report	Ministerie van Infrastructuur en Milieu
1-5-2014	OTB	Ontwerp-Tracébesluit A44 RijnlandRoute - I Besluit	Report	Rijkswaterstaat
1-5-2014	OTB	Ontwerp-Tracébesluit A4 RijnlandRoute - I Besluit	Report	Rijkswaterstaat
1-5-2014	OTB	Ontwerp-Tracébesluit A4 RijnlandRoute - III Toelichting	Report	Rijkswaterstaat
1-5-2014	OTB	Ontwerp-Tracébesluit A44 RijnlandRoute - III Toelichting	Report	Rijkswaterstaat
8-5-2014	TB	Integraal ontwerp voor de stedelijke omgeving	Powerpoint	Bert Driesse & Mark Verberkt
23-9-2014	Project-MER	Analyse milieueffecten optimalisaties in relatie tot het MER RijnlandRoute 2e fase	Note	Tauw bv
1-11-2014	Zienswijze	Nota van Antwoord RijlandRoute	Report	Rijkswaterstaat
12-11-2014	TB	Deelrapport Water TB's/PIP RijnlandRoute	Report	Maurits van Brenk
14-11-2014	OTB	Nota van Wijzigingen Tracébesluiten A4 en A44 RijnlandRoute	Report	Rijkswaterstaat
14-11-2014	TB	Kwalitatieve Beschrijving Verkeersveiligheid	Report	Ministerie van Water, Verkeer en Leefomgeving
17-12-2014	TB	Tracébesluit A4 RijnlandRoute - I Besluit	Report	Rijkswaterstaat
17-12-2014	TB	Tracébesluit A44 RijnlandRoute - I Besluit	Report	Rijkswaterstaat
17-12-2014	TB	Tracébesluit A4 RijnlandRoute - III Toelichting	Report	Rijkswaterstaat
17-12-2014	TB	Tracébesluit A44 RijnlandRoute -III Toelichting	Report	Rijkswaterstaat

3. Description of Analysis Process and Findings of Documents

The documents were read, and sustainability aspects identified. These aspects come in many forms. It can be ambitions, goals, criteria of MER, results on criteria, notes, targets, suggestions, requirements, answers to questions and policy. From that list of aspect seven overarching aspects were found. These seven aspects were tested on applicability for this research. The test was done to identify if the aspect could be considered climate mitigation, climate adaptation or either. All seven overarching aspects fitted at least one definition see. Table G.3 shows the legend of table G.4 which shows the aspects that were identified.

Table G.3: Legend and seven overarching aspects

Sustainability and spatial development
Energy and CO2
Materials and Waste
Water
Air Quality
Construction and Market
Climate resilience

Table G.4: Climate aspects found in documents, with colouring of seven overarching aspects.

Aspect	Found in	Type
Effects on nature, soil and water are important yet are not distinctive for different alternatives	Samenvattende rapportage van de uitkomsten Verkenning RijnlandRoute (pp. 17)	Statement
Air quality as test criterion	Samenvattende rapportage van de uitkomsten Verkenning RijnlandRoute (pp. 18)	Criterion
Little environmental impact (land, green) of main alternatives	Samenvattende rapportage van de uitkomsten Verkenning RijnlandRoute (pp. 22)	Score on Criterion
Environmental impact (land, green) of Korte Vliet Tracé are ok, tunnel entrances surpass emission targets	Samenvattende rapportage van de uitkomsten Verkenning RijnlandRoute (pp. 24)	Score on Criterion
Six main test themes, including: Environment and Liveability, Nature and Landscape	Samenvattende rapportage van de uitkomsten Verkenning RijnlandRoute (pp. 26)	Criterion
Creation of definition 3P's, demolition, shifting responsibilities, yet not used in the project	Vragen van leden van de Ideeëngroep RijnlandRoute (pp. 1)	Questions
Climate change is a challenge for Randstad (IBHR)	Eindrapport Integrale Benadering Holland Rijnland (pp. 15)	Statement
Structuurvisie Randstad 2040 serves as a lead on sustainable development	Eindrapport Integrale Benadering Holland Rijnland (pp. 61)	Statement
Use Ladder van Verdaas, alternatives to road infrastructure	Hoofdrapport: 1e Fase MER Rijnlandroute (pp. 23)	Assessment framework
Three goals, sustainability not one	Hoofdrapport: 1e Fase MER Rijnlandroute (pp. 25)	Goals
Environment part of Criteria	Hoofdrapport: 1e Fase MER Rijnlandroute (pp. 26)	Criterion
Air quality as assessment criterion	Hoofdrapport: 1e Fase MER Rijnlandroute (pp. 88)	Criterion
Air quality results negative at tunnel entrances	Hoofdrapport: 1e Fase MER Rijnlandroute (pp.100)	Score on Criterion
Air quality mitigation, through air holes, roofs and screens at entrances, and innovative measures to decrease emissions	Hoofdrapport: 1e Fase MER Rijnlandroute (pp.100)	Suggestions
Natural environment criterion	Hoofdrapport: 1e Fase MER Rijnlandroute (pp.114	Criterion
Soil and Water criterion	Hoofdrapport: 1e Fase MER Rijnlandroute (pp.169)	Criterion
Soil and Water results negative	Hoofdrapport: 1e Fase MER Rijnlandroute (pp.178)	Score on Criterion
Air quality measures: ventilation, treatment of polluted air, electrostatic cleaning, vegetation	Bijlagen: 1e Fase MER Rijnlandroute (pp. 39)	Suggestions
Use of glass roof for road, potential for solar panels and renewable energy production	Bijlagen: 1e Fase MER Rijnlandroute (pp. 39)	Suggestions
Use of noise reducing asphalt, LED lighting, Heat network, cradle to cradle techniques	Bijlagen: 1e Fase MER Rijnlandroute (pp. 39)	Suggestions
RijnlandRoute fully sustainable	De Studie in Beeld - Samenvatting: 1e Fase MER Rijnlandroute (pp. 43)	Goal
Air quality improves, yet not at tunnel entrances	Milieueffectrapport RijnlandRoute (tweede fase) - samenvatting (pp. 23)	Result
Quality of natural environment decreases	Milieueffectrapport RijnlandRoute (tweede fase) - samenvatting (pp. 24)	Result
Water problems due to digging are no issue	Milieueffectrapport RijnlandRoute (tweede fase) - samenvatting (pp. 24)	Result
Water and Soil criterion	2e fase MER RijnlandRoute, Achtergrondrapport bodem en grondwater versie 2.0 (pp. 8)	Criterion
Water and Soil best result Churchill Avenue	2e fase MER RijnlandRoute, Achtergrondrapport bodem en grondwater versie 2.0 (pp. 39)	Score on Criterion
Sustainable green is required in Oostvlietpolder	2e fase MER RijnlandRoute, achtergrondrapport verkeer versie 2.0 - Bijlagenboek (pp. 10)	Goal

Air quality, NO2	Milieueffectrapport RijnlandRoute (tweede fase) - achtergrondrapport gezondheid 2.0 (pp.25)	Criterion
Negative air quality effects: mechanical ventilation	Milieueffectrapport RijnlandRoute (tweede fase) - Luchtkwaliteit versie 2.0 (pp. 51)	Suggestions
Negative air quality effects: relocate entrances	Milieueffectrapport RijnlandRoute (tweede fase) - Luchtkwaliteit versie 2.0 (pp. 51)	Suggestions
Negative air quality effects: cleaning, energy is an issue	Milieueffectrapport RijnlandRoute (tweede fase) - Luchtkwaliteit versie 2.0 (pp. 51)	Suggestions
Sustainable and climate proof province (structuurvisie)	Bijlageboek bij het milieueffectrapport RijnlandRoute (tweede fase) versie 2.0 (pp.27)	Policy
Lack of sustainability in MER1	Bijlageboek bij het milieueffectrapport RijnlandRoute (tweede fase) versie 2.0 (pp. 55)	Questions
No criteria on sustainability in MER1, proposed for MER2	Bijlageboek bij het milieueffectrapport RijnlandRoute (tweede fase) versie 2.0 (pp. 60)	Questions
Sustainability is included in MER2	Bijlageboek bij het milieueffectrapport RijnlandRoute (tweede fase) versie 2.0 (pp. 60)	Reaction
Sustainable and climate proof province (structuurvisie)	Milieueffectrapport RijnlandRoute (tweede fase) hoofdrapport versie 2.0 (pp. 161)	Policy
Energy transition is not relevant in the MER	Milieueffectrapport RijnlandRoute (tweede fase) hoofdrapport versie 2.0 (pp. 125)	Goal
Choice preferred solution is based on financial and spatial/environmental aspects.	Nota Voorkeursalternatief RijnlandRoute (pp. 21)	Choice
Air quality, mitigation of pollution	Aanvullende toelichting op de gevolgen voor de natuur (pp. 5)	Suggestions
Water storage climate proof in 2050 (Watergebiedsplan)	RijnlandRoute inpassingsvisie en landschapsplan (pp. 22)	Goal
Climate proof province	RijnlandRoute inpassingsvisie en landschapsplan (pp. 25)	Goal
Energy as part of goals location Valkenburg	RijnlandRoute inpassingsvisie en landschapsplan (pp. 26)	Goal
Need for integral sustainable design	RijnlandRoute inpassingsvisie en landschapsplan (pp. 45)	Goal
Unsatisfactory consideration of sustainability in variant choice	RijnlandRoute Nota van Antwoord MER en voorontwerp inpassingsplan RlR (pp. 57)	Comment
Priorities of project not at sustainability	RijnlandRoute Nota van Antwoord MER en voorontwerp inpassingsplan RlR (pp. 57)	Reaction
Variant satisfies air quality standards	Analyse van het wegontwerp in relatie to het MER (2e fase) RijnlandRoute (pp. 4)	Note
No use of wind turbines due to hindrance to bird populations	Mitigatieontwerp (pp. 22)	Note
Climate adaptation water ambition NWP	Deelrapport Water OTB's/OPIP RijnlandRoute (pp. 15)	Note
Water security, sustainable clean water production, robust water system	Deelrapport Water OTB's/OPIP RijnlandRoute (pp. 16)	Note
Sustainable material use: Birds	Mitigatie- en compensatieplan TB (pp. 29)	Measure
Sustainable material use: Bats	Mitigatie- en compensatieplan TB (pp. 43)	Measure
Sustainable construction: reuse of materials, limit emissions, thoughtful use of space and energy	Ontwerp-Tracébesluit A4 RijnlandRoute - III Toelichting (pp. 21)	Measure
Working towards integral sustainable design, and creating chances to increase spatial quality	Ontwerp-Tracébesluit A4 RijnlandRoute - III Toelichting (pp. 45)	Goal
Sustainable construction: reuse of materials, limit emissions, thoughtful use of space and energy	Ontwerp-Tracébesluit A44 RijnlandRoute - III Toelichting (pp. 24)	Measure
No decrease in air quality	Analyse milieueffecten optimalisaties in relatie tot het MER RijnlandRoute 2e fase (pp. 11)	Note
Climate change ecologic adaptivity	Nota van Antwoord RijnlandRoute (pp. 65)	Comment
Climate adaptation water ambition NWP	Deelrapport Water TB's/PIP RijnlandRoute (pp.17)	Note
Water security, sustainable clean water production, robust water system	Deelrapport Water TB's/PIP RijnlandRoute (pp.18)	Note
Measures for water management	Tracébesluit A4 RijnlandRoute - I Besluit (pp. 13)	Measure
Measures for water management	Tracébesluit A44 RijnlandRoute - I Besluit (pp. 10)	Measure
Sustainable construction: reuse of materials, limit emissions, thoughtful use of space and energy	Tracébesluit A4 RijnlandRoute - III Toelichting (pp. 22)	Measure
Efficient energy use: Dynamic street lighting	Tracébesluit A4 RijnlandRoute - III Toelichting (pp. 30)	Measure
Working towards integral sustainable design, and creating chances to increase spatial quality	Tracébesluit A4 RijnlandRoute - III Toelichting (pp. 48)	Goal
Sustainable construction: reuse of materials, limit emissions, thoughtful use of space and energy	Tracébesluit A44 RijnlandRoute -III Toelichting (pp. 25)	Measure
Efficient energy use: Dynamic street lighting	Tracébesluit A44 RijnlandRoute -III Toelichting (pp. 34)	Measure
Working towards integral sustainable design, and creating chances to increase spatial quality	Tracébesluit A44 RijnlandRoute -III Toelichting (pp. 53)	Goal

4. Description of Analysis Process and Findings of Interviews

Table G.6 is the transcript of the interview with Expert 3, Expert 4 and Expert 5, details of interviewees in table G.5. Below table G.6 the main findings are elaborated on, which forms the basis of the findings used in the main text.

Table G.5: Interview RijnlandRoute, with name, date, company, and project role

Date	Name	Company	Project role
2-10-2018	Expert 8	RWS	Technisch Manager
2-10-2018	Expert 9	WNZ	Manager Planstudie
2-10-2018	Expert 10	RWS	Contract manager

Table G.6: Interview 2-10-2018, 15:00, Den Haag, RijnlandRoute

Interviewer:	To be precise I analyse where climate mitigation and climate adaptation, is implemented during the Planuitwerkingsfase of Dutch road infrastructure projects. I analyse the urban planning process, and part of the tender procedure.
Expert 9:	RijnlandRoute is already a little dated, the TB was established in 2014. And if you consider the climate aspect in sustainability, then you see that during the last 4 years that aspect has changed tremendously. Just consider the Paris Agreement or a new government with a new cabinet that has different views on climate and sustainability.
Expert 8:	Yes and the OTB was published in 2013, it takes two years to construct that, and before that the project was 15 years topic of conversation.
Expert 8:	Considering your topic, you said you researched urban planning documents. In this project there are two parts to that, the provincial roads and PIP and main roads (Rijkswegen) with two times a TB. And that influences how you handle environmental effects and concerns.
Expert 9:	And it also relates to the pressure on the project. The GS put a lot on pressure on the project, it needed to be decided on quickly. That results in less time to think a little deeper about the project.
Expert 8:	Why did you merely focus on the climate aspect of sustainability?
Interviewer:	I think climate change is an important issue. To tackle that many aspects of our society need to go through a transition. Therefore I wanted to focus primarily on forms of sustainability that were closely linked to climate change and the subsequent issues.
Expert 8:	If you consider urban planning documents, and the MER carried out in that process, many environmental aspects are tackled, yet not climate.
Expert 9:	Climate aspects are dominated by requirements put in place by other parties, and usually a project does satisfy the requirements but does not go further than what is necessary. Take for instance water, a project must comply with the requirements concerning water of local water authorities.
Expert 9:	These requirements are usually based on prognoses of KNMI or other relevant research groups. So as RijnlandRoute the requirements were satisfied yet not more than that.
Expert 10:	Yes that is usually the case, and take RijnlandRoute, the standards for precipitation were increased before the project. So more precipitation is expected, and that standard will have its impact on for instance the size of water storage areas
Expert 8:	About energy, first of all the project is mostly static, it is about increasing the size of roads, A4, A44 and the construction of a new road N434. The energy use of these roads is limited. Some lighting, security systems and traffic systems. The main focus with regard to energy is the tunnel. Tunnels are large users of energy. The question thus was raised, what to do with the energy consumption of the tunnel. The result was that the contractor will be responsible for the energy bill. As a result the contractor will try to find ways to limit the use of energy.
Expert 9:	But the tunnel is not energy neutral or anything, as for instance the A16.
Expert 10:	We had four EMVI criteria in the tender. Sustainability was one of them. And in the A16 that criterion had more weight.
Expert 9:	Yes that is also a possible instrument. The weight of a criteria can be very instrumental in reaching such goals.
Expert 8:	Low energy consuming tunnel was certainly part of the consideration. However, the project did not want to make a tunnel that used up large amounts of energy and subsequently compensating for that by a large solar fields located in the polders around Leiden and then also stating the importance of these polders and their typical landscape.
Expert 8:	And sustainability is also an important ambition of the Provincie Zuid-Holland. But in RijnlandRoute we rather focussed on reducing the use of energy than compensating for it and why focus on resolving the problem locally when it can also be done nationally. Why not place a large windmill at sea in place of placing it in the project area? Therefore it made more sense to introduce a stimulant that would limit the use of energy, by having the contractor pay for the energy, than focussing on an energy neutral tunnel.
Interviewer:	Did that result in anything?
Expert 10:	Yes, I think you could argue that for instance the A16 is truly energy neutral, and the tunnel of the N434 is relatively energy efficient (zuinig). But we do see that since the contractor will pay for the energy use, constructing an energy efficient tunnel is really part of the considerations.
Interviewer:	So what that means in terms of my project, is that contract factors can be very instrumental in reaching sustainability goals.
Expert 10:	What we also see is that the Tracébesluit leaves some room to alter some restrictions, the contractor is than capable of making a design that is more environmentally friendly. In RijnlandRoute this meant that the contractor made a design were some parts were a little lower than the Tracébesluit meant for. As a result this saved a lot of sand, which saves energy due to transport and extraction. And this is also seen in the use of concrete, each wall is calculated extensively in order to build the thinnest wall. Of course it is cheaper but also concrete and using concrete increases CO_2 tremendously.
Expert 8:	Liveability and impact on the environment are very much in conflict with each other in this project. From the liveability perspective the solution is rather good, a 2.5 km tunnel, and a deepened surface level. However, from climate consideration a road on surface

level would have been much more environmental friendly, through much lower use of materials and costs. So if you say that liveability is not really part of a sustainability than solutions would be rather different.

Expert 9: But that is part of the total weighing of interests.

Interviewer: That seems mostly like a political choice.

Expert 10: It is a choice of a politician to increase the feasibility of the solution.

Expert 9: The solution was very pressured by the surroundings and local participations. For a time for instance it was the case that the tunnel would have an open roof construction. However, through the process more and more parts received a roof. So there is a lot of pressure from local politicians but also local residents. And that is in conflict with CO_2 mostly. However that confrontation does not happen. It is interesting to see that during such a decision that confrontation does not happen.

Expert 8: Take for instance the m.e.r., there are certain elements that are legally required to study in m.e.r.

Expert 9: We are of course obliged to do a m.e.r. yet a project can decide for itself were the focus must be of that m.e.r. We see a MER usually as an instrument that must be used but is, regrettably, not really a part of the decision-making process. This is sadly the case, usually since the mobility issue or money are prioritized over the environment. Real honest considerations (afwegingen) are usually not the case. Commissie m.e.r. can play a positive role in that, however the final say is for the minister which has a budget and has its own priorities. And it is always the case that there is a lot of money involved and that makes it difficult, and the considerations and decision-making process is a political process and when politics get involved we usually lose sight of honest considerations and decision-making process based on arguments.

Expert 8: The solutions we choose in many parts of the country are primarily to incorporate the solution in the landscape (inpassing), for instance through a tunnel, however these solutions are quite environmentally unfriendly.

Expert 9: And in such cases, it is a very complex mix of wishes and requirements that lead to a solution that can be complex in itself.

Expert 10: Yes, and once a decision has been made, it is up to the project organisation and contractors to make the best of it. The solution is going to be realised and then it is up to us to make it as sustainable as possible. But that is also about balancing and weighing different priorities. The EMVI criteria in RijnlandRoute involved sustainability, but also hindrance to the local environment and traffic flow. It is than a consideration of interests, which the project owner must decide upon. The project organisation will come up with ideas, suggestions and proposals however, it is up to the project owner to decide on those matters. It than comes down to what is more important to the project owner.

Expert 9: Maybe a very robust tunnel is also considered sustainable since it will withstand for a long while, and lower maintenance.

Expert 8: No not really, the different systems in the tunnel, ventilation, security etc. demand maintenance and have a limited lifespan.

Expert 10: Something that is quite interesting in this project is the following, since the contractor will pay the energy bill, he introduced an innovation. By using sunlight over glass fibre, the amount of energy necessary for lighting at the entrances of the tunnel is very limited. Sunlight is routed onto the glass fibre. At the entrances of the tunnel light is mostly very bright to help the drivers change from light surroundings to the darkness of the tunnel. By using lenses and glass fibre these lights do not require electricity. Furthermore it is a dynamic system, if it is dark outside less light is needed, and if the sun shines brightly so do the lights. He saves 17% of energy of the tunnel.

Expert 9: Is it an expensive system?

Expert 10: Yes quite, around €3 million, it is a consideration of the contractor, he must decide whether it is cheaper to pay the electricity bill or this system.

Expert 9: Talking about security, Dutch roads have, internationally speaking, a very high security level, that requires many systems. All those systems use energy. A tunnel such as in Norway without lighting is sustainably speaking very good, however we would not accept it.

Expert 10: For instance the deepened road, if that was constructed a bit broader with an emergency lane, that would have saved the energy for the security systems. But that has to do with available space, that would have cost more etc.

Expert 9: Related to that, the tunnels capacity will also be limited. With a growing population it might not be able to provide enough space in the future, and what then? If it was at surface level, an extra lane can usually be realised, in a tunnel that is much more difficult if at all possible.

Expert 9: We have tried to incorporate sustainability into the project. For instance nature. We have tried to create an ecological system, quite a lot of energy and time was invested in creating a good ecological system.

Interviewer: That is interesting, as it is similar to climate concerns, as it is a spatial quality aspect competes with financial aspects or mobility objectives.

Expert 9: Yes, but that was also a wish of the people in the surrounding area.

Expert 10: What we introduced quite late in the project was a new fast bike lane. Through a change in policy, favouring bicycles, this was achieved. This connects Katwijk and Valkenburg and Leiden Central station. The hope is that it will take away cars from the road.

Interviewer: And that was introduced later, thus after the Tracébesluit was adopted. There was no earlier plan for it?

Expert 10: There was a plan for it for quite some time, however, there was not money for it, so it was dropped. The wish for it was still there. The project decided to do it in a later stage since the minister has made more financial resources available, and it is going to be subsidised.

Expert 8: This also shows the tension between the budget and wishes. Since the budget must also be accounted for at the end of a Planuitwerkingsfase. All the different wishes on many different areas must fit into the budget. Sometimes it becomes clear, that due to market forces more money is available than expected, and in such case dropped ideas and wishes can resurface.

Expert 9: Let's go back to water, water must usually be compensated for in its own area. However, in those areas there are usually very conflicting interests. Flora and fauna and other environmental and ecological concerns. Sometimes that can be a motor to improve the area in many aspects. And that is also a form of sustainability, to broaden the goal, not merely compensation for water but incorporating that in the area and subsequently improving it. There are no frameworks or legal obligations for, it will come down to the creativity of the project organisation.

Expert 8: Another aspect that we discussed in the project was bridges. There are several bridges in the area. The main problem was the need for moveable bridges. Bridges that could open to let large ships through. However, such bridges cost energy primarily to construct but

	also to function. And it was questionable if such bridges were necessary, or if normal non-opening bridges would suffice. Especially considering some of the bridges would open eight times a year.
Expert 9:	The industrial area in Katwijk favoured the bridges that could open. It shows that there are many pressuring the decision-making process.
Interviewer:	One aspect that has not been discussed is air quality and CO_2, in the MER the focus is very much on NO_2 and PM_{10} yet not on CO_2?
Expert 9:	Via NSL the air quality and impact of roads on air quality is monitored. A project needs to be signed up here. Along the main road network the air usually does not surpass European standards.
Expert 10:	And the NSL does involve taking measures at the source.
Expert 9:	Yes, and it involves not only road infrastructure but also the agriculture sector and the industry. It does not involve sea transport sector and air transport sector. The findings of those sectors are analysed and in reaction to that a large set of measures is taken. And so if you want to develop a road than it is signed up at NSL, and the question is asked whether that project can be developed without exceeding legal air quality standards.
Expert 8:	Air quality is problem that cannot be addressed locally, thus it must be addressed nationally. That can also be the case with energy saving measures. Why should we do that locally when it can be done much more efficient nationwide.
Expert 10:	RWS is currently doing a project which involves building a wind turbine park at Maasvlakte 2 that will produce energy for all infrastructure of RWS. So the idea is that you do not build wind turbines all around the Netherlands. But on one place, were it is possible and responsible.
Expert 8:	It is symbolic to do it on location of course. So you can say the tunnel is powered by the windmill that stands on top of the tunnel.
Interviewer:	In Almere A6 they are building a large solar field to produce enough energy for the A6, so that it is an energy neutral road.
Expert 10:	At RijnlandRoute this was not possible. An important reason to build a tunnel was to keep the current landscape. The Provincie Zuid-Holland does not want to build a tunnel of €1 billion to save the landscape and then put a windmill or solar panels on top of it.
Interviewer:	Considering factors found in the literature. One is scope and goal factors. If the goals are early on articulated very clearly it results in successful implementation, how did that happen in RijnlandRoute?
Expert 8:	It is mostly the case, if you come into the project at a later stage the possibilities are fairly limited. For instance if you choose it will not be a tunnel but a road on surface level, that will have influenced 80% of your solution space. The large choices that are made in early stages tremendously influence the rest of the project. Was sustainability a part of this project, no, it was primarily about how to incorporate a solution for the mobility issue into the complex area, with typical landscape, buildings and participating residents. That was the main goal that was articulated very early, and has been leading in the project, and has come to results.
Expert 9:	Many of these sustainability concerns do not play a role in the early planning process since it is fairly easy to incorporate it in later stages. It than becomes important to challenge the market to find solutions that incorporate sustainable elements.
Expert 10:	That is true, but it does help. The urban planning documents of the planning process will also involve drawing up a budget.
Interviewer:	How do project organisations play a role, In Zuidasdok, a GroenLinks Councilman was involved in the project as a real driver for sustainability?
Expert 10:	The relevant authorities were primarily from VVD.
Expert 8:	There was no champion of sustainability in the project. Who helped focus on sustainability?
Expert 10:	No
Expert 9:	That means that the political circumstances are extremely important in such a project.
Interviewer:	What is the importance of information factors?
Expert 9:	What that mostly means is the question whether there is policy on the topic. Is there policy that requires time and resources of the project. That is an important trigger to draw attention to a problem. It can also obstruct, since there is a constant confrontation with policy, and the subsequent availability of financial resources.
Expert 9:	It would be interesting to have a look at projects that are currently in the Planuitwerkingsfase and have a look how sustainability is addressed there. Since the amount of policies on that issues is growing. In a rather short time frame much has changed in respect to sustainability.

5. Analysis of RijnlandRoute

The analysis of RijnlandRoute is based on the findings in interviews and documents. With those findings timelines are constructed. This section includes the seven constructed timelines. And discusses what is happening in the project with each aspect.

5.1 Sustainability and Spatial development – Sustainability criteria

In the Verkenningsfase environmental aspects are legally required through the Wet Milieubeheer Hoofdstuk 7. The focus of a the m.e.r. differs between projects. This focus can be attributed to the project organisation and a political decision. Political priorities will result in a certain focus of the m.e.r.

The environmental criteria remain in place in the 1e Fase MER, as it is legally required. While environment is part of the m.e.r., climate aspects are not. Several reasons can be identified. Firstly, are no legal climate standards. As a result the effects study and the consequent decision do not account for climate aspects and concerns. The law does not prohibit introducing climate aspects into the m.e.r. The questions that follows is, why is it not included? That is the second point. There is no political pressure. There is a lack of sense of urgency and of awareness at the political level. As a result there is no incentive to include climate aspects into the m.e.r. A lack of driving force to include climate aspects into the m.e.r. was noticed in RijnlandRoute. The lack of policy in creates a lack of guidance for the decision-makers. Policy is considered a trigger to draw attention to a problem. Currently it is viewed that climate mitigation and adaptation measures are best introduced during the tender phase. It is than up to the contractor to deliver a sustainable solution within the boundaries of the project. These boundaries are set earlier without any regard for climate concerns. As a result the solution space is limited. In RijnlandRoute for instance the contractor is challenged to make a tunnel energy efficient. The more climate friendly alternative would be to build a road on surface level.

In the 2e fase MER the variants all score negative on environmental criteria. The sustainability criteria are translations of the ambitions of the province. These criteria are not relevant from a climate viewpoint. However, these aspects were introduced in the 2e Fase MER, and the introduction can help understand how an introduction is achieved. The sustainability aspects of 2e Fase MER while a translation of provincial ambitions, are a reaction to public participation. The Zienswijzeprocedure helped voice a public need for sustainability. Public awareness and participation lead to inclusion of an extra criterion.

Environmental concerns are part of the Voorkeursalternatief. One of the main alternatives, ZnB scored best on all economic and financial aspects while CA scored best on environmental aspects. The decision was made in favour of ZnB. The primary reason is financial. the CA alternative was more expensive and ZnB would satisfy the main goals of the project. It is noteworthy that the general public preferred alternative CA, due to environmental concerns. The decision for ZnB shows how political preference is prioritised above the MER. The MER has limited use in the decision-making process. Something that further pressured the decision was the general publics need for a quick fix for the congestion problems. Environmental criteria become part of the EMVI-criteria. In the tender a sustainability criterion is added. This can be attributed to the political circumstances and stakeholder and project owner priorities. political circumstances do not help prioritise sustainability above other criteria. This has to do with a lack of environmental awareness and a lack of urgency. Moreover, the public would not allow just any solutions. Their problems must be solved, sustainability is a lower goal. The importance of other goals makes it difficult for any party involved to push for sustainability. The solutions must first of all solve the perceived problem. However the introduction of a sustainability EMVI-criterion does convey a change in perception of the importance of sustainability.

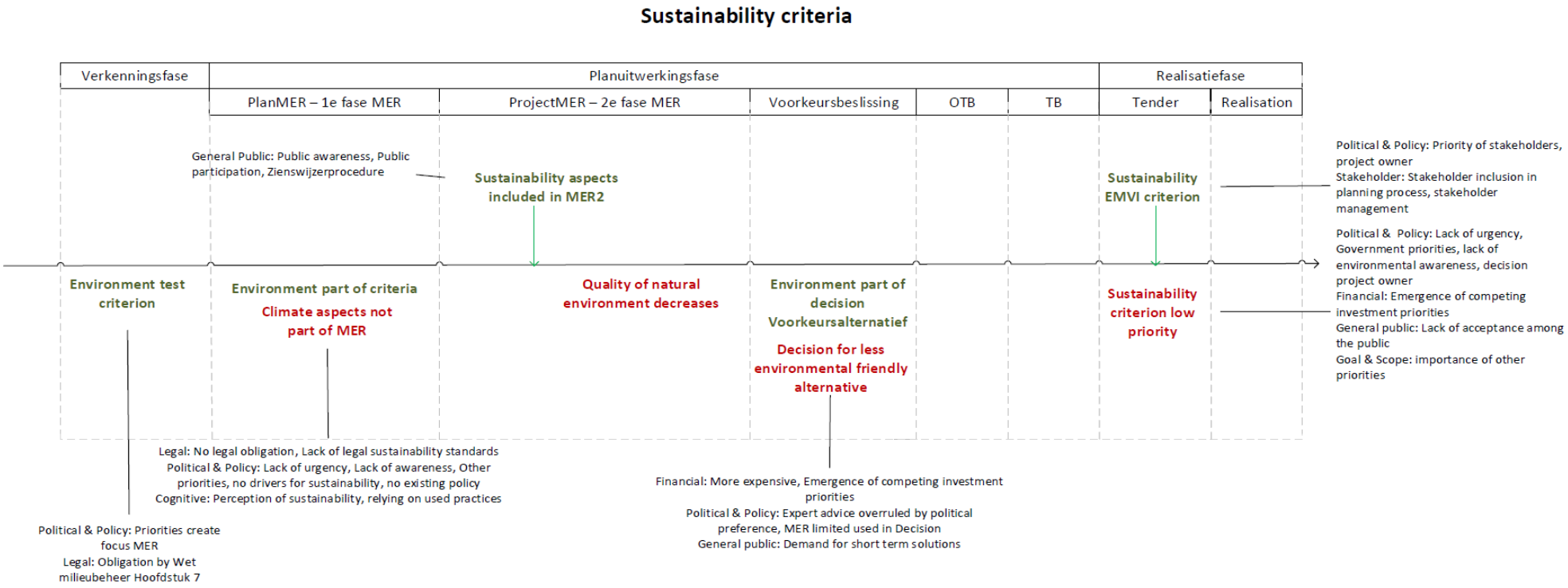

Figure G.1 Timeline of Sustainability Criteria in RijnlandRoute.

5.2 Sustainability and Spatial development – Sustainability Ambitions and Goals

Through public participation the concept of sustainability is defined, according to the 3Ps. The inclusion of stakeholders and the general public, helps to extract views and interests of the public on sustainability. The existence of Structuurvisie Randstad 2040 is a driver behind these public participation processes and establishes a long-term sustainable policy on which the project organisation can fall back.

In the 1e fase MER, as a consequence of long term sustainable policy, the ladder of Verdaas is used. Furthermore, the instrument is used following the advice of the commissie m.e.r., the advice itself is legally embedded in the m.e.r. Regardless, of the increasing sustainable mindset the project does not include a sustainability project goal. Several reasons exist for this. Firstly, there is a political need for a solution. The Gedeputeerde Staten of Zuid-Holland put a lot of pressure on the project organisation for a quick solution. This pressure is related to the demand of the public for a short-term solution to the congestion problem. The goals are formed around the primary needs of the area and its residents, focused on liveability and accessibility. The public demand forms the political views and influences financial decisions. Sustainable and climate concerns thus have to compete with liveability, accessibility and financial concerns.

The second main reason for not incorporating sustainability in the project goals is a cognitive reason. Sustainable solutions are mostly innovative and are seen as riskier than conventional solutions. Another reason is the view that sustainable measures are easily incorporated during the last phase of a project. While this could be the case, inclusion of sustainability or climate goals make the aspects an integral part of the project, and thus they will play a part during considerations. While it is a political choice for these goals, based on public demand the public was not heard well. Since the 1e Fase MER also entails a call for a fully sustainable RijnlandRoute from the general public. Through public participation an extra variant is added in the MER. It is Churchill avenue, a variant that proposes a tunnel under the city instead of a road through the fields south of Leiden.

The 2e Fase MER takes the demands of the public on environmental issues into account. The municipal council of Leiden takes a decision is made to keep the Oostvlietpolder sustainable green. Instrumental for this is the inclusion of the municipality of Leiden as stakeholder and the creation of a shared vision between project organisation and stakeholders for local sustainable priorities. Nature is named by general public as an important concern in the development of RijnlandRoute. Part of this concept of nature is the need for a good ecological system, demanded by stakeholders and general public. The demand for a sustainable solution respecting nature is also present in a goal of the Inpassingsvisie and Landschapsplan.

During the construction of the OTB it becomes clear that while sustainability aspects are part of the MER phase they are not necessarily part of the final decision. Sustainability is not a priority during this phase. The main focus is on solving the congestion issue and improving mobility. The lack of sustainability goals becomes clear. Clear goals on climate in the earlier phases oblige considerations of climate in later phases. The priorities further compete on financial aspects. The limited budget limits the decision makers in their solution space. The main goal is to solve congestion within the given budget. Sustainability can be addressed later if financial resources allow it. This also means that through market forces solutions can resurface in later phases. Even though sustainability is not a priority, the public demand for an integral sustainable design, articulated in 2e fase MER, is incorporated in the OTB and TB. The public demand for this is strong enough to oblige project organisation and political decision-makers to include this goal in the final urban planning documents.

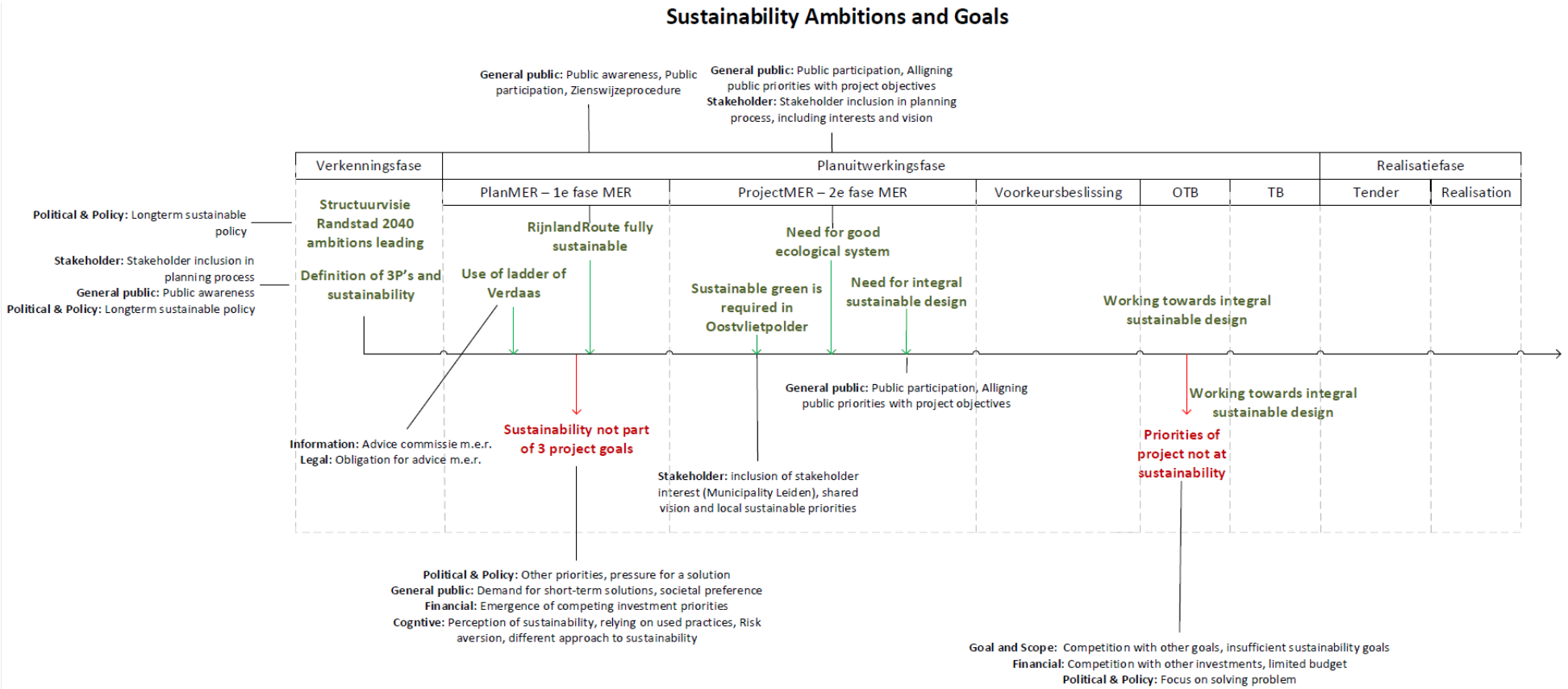

Figure G.2: Timeline of Sustainability Ambitions and Goals in RijnlandRoute.

5.3 Energy & CO_2

During the 1e Fase MER suggestions for CO_2 or energy measures are made. Due to available knowledge on technologies the use of LED lighting is suggested. Furthermore, it is suggested to build a roof over the road that where solar panels can be imbedded into. The ideas of the early 1e Fase MER and the implicit energy reducing mind-set is not present in the following phase. During the 2e Fase MER it is explicitly stated that the energy transition is not part of the MER. There is no legal requirement to include it in the MER. The priorities of political parties on solving the congestion problem, not energy transition. There is a lack of sustainable policy. In the Inpassingvisie en Landschapsplan a sustainable energy supply goal for the Valkenburg area is articulated. The use of wind turbines in the area is difficult as it conflicts with ecological interests (birds). Other interests and societal preference create a strong opposition to wind turbines in the area. That feeling is supported by other (larger) stakeholders. The value of ecology is in conflict with the energy transition interests for the area. During the planning process it was first proposed to use a deepened road with an open roof. Due to the societal preference to close the roof and limit the impact of the road on the ecology and liveability in the area the deepened road gradually became a tunnel. While this complied with societal demand it also meant more need for lighting and materials and thus higher emissions of CO_2. This confrontation between CO_2 and liveability does not happen. The political awareness and sense of urgency is too little to make energy and CO_2 part of the agenda. As a result there is no confrontation during the decision-making process

Due to Duurzaam Bouwen policy during the OTB phase, energy efficiency and reducing CO_2 emission becomes a theme in RijnlandRoute. In both TBs the use of dynamic street lighting is introduced. This measure reduces the energy consumption and CO_2 emissions. The measure also increases the safety of the road. The measure serves two purposes. CO_2 reduction is considered a side-effect of a safety measure. Through the alignment of different goals co-benefits are created. That alignment can be instrumental in achieving CO_2 or energy goals, as they are mostly viewed as lower goals to other priorities. The TBs leave room for changes in the reference design. This flexibility in the design requirements creates a wider solution space for contractors in later phases. A disregard for the contractor's challenges in later stages can result in a narrow design space and obstruct potential energy saving innovations.

During the contract phase the contractor lowered the use of concrete by building lower than anticipated in the reference design. This saved concrete and sand, and thus also transportation and production of both resources. The main reasons are the flexibility of the TB and the trust of the project organisation towards the market. Through clear communication of requirements the organisation is able to steer the designs into a desired state. Financial benefits also play a role since less resources result in less costs. During the tender and contract phase energy consumption becomes a concern on the agenda, primarily through political awareness. The elaboration on that concern is a challenge for the market. Through a DBM contract the contractor is challenged to improve the lifetime of the road and tunnel, as he is responsible for its maintenance. Furthermore, the contractor will pay the energy bill. As a result there is a financial incentive to limit energy use. The focus of RijnlandRoute thus diverges to energy saving measures, energy production is not part of the project. In the realisation the contractor, Comol5, has a response the financial incentive and introduces a new energy saving measure: sunlight over glass fibre. The technology for this, while innovative, is available and can be used. The trade-off between costly innovation and paying the energy bill under conventional measure is made. The new measure proofs more attractive and also feasible. It is clear that energy production itself is not part of the project. Within RWS it is viewed as better to produce energy sustainably on one location, as opposed to sustainable production in every distinctive project. It is viewed as more cost-effective and more efficient. Additionally it improves the incorporation of solutions in the specific areas and increases project's feasibility.

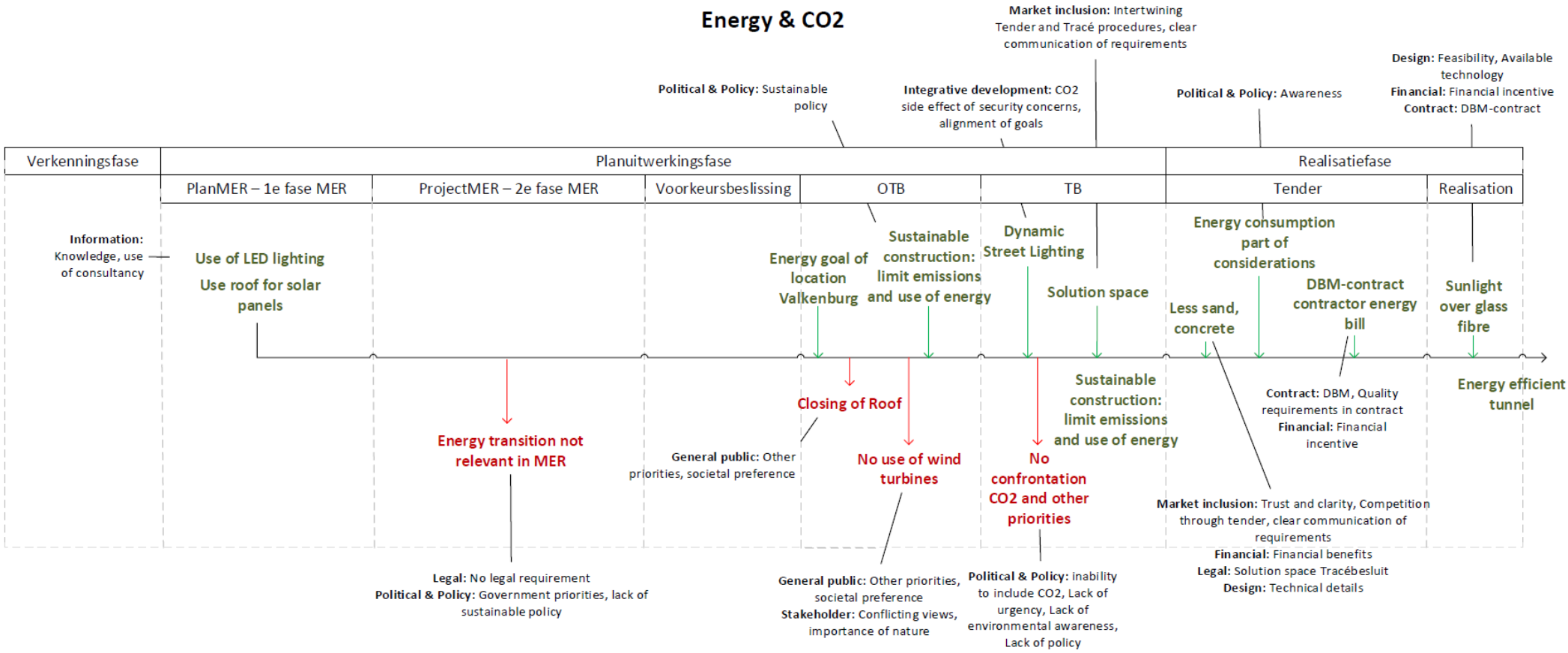

Figure G.3: Timeline of Energy & CO_2 in RijnlandRoute.

5.4 Materials & Waste and Construction & Market

Materials, waste are not part of the project for a long time. During the OTB and TB phase this changes. Through public and stakeholder involvement the need for the use of sustainable materials is introduced. In the OTB and TB this is formed around the need for sustainable materials for birds and bats living areas. While there is a demand for sustainable material use related to ecologic interests in this case it is not always the case. During the same time in the planning phase the decision is made to further close the roof on the tunnel. Through the voicing of public priorities and preferences the roof is closed. This is related to ecologic and liveability interests of the local residents. The roof requires more concrete and other materials and is thus deemed less climate friendly than simply deepening the road. Again climate concerns loose to other project priorities. During the OTB Duurzaam Bouwen is introduced. This concept focusses on reuse of materials, the limitation of emissions and limitation of material use. This measure is part of RWS policy to improve sustainability, and thus it was achieved by creating sustainable policy on the higher level of decision-making.

The TBs leaves solution space for the market. The contractor is able to slightly diverge from the requirements of TB. This flexibility can be achieved through thoughtful intertwining of the urban planning procedure and tender and contract phase.

The contractor uses the aforementioned flexibility in the TB to limit use of sand and concrete, which are large contributors to the CO_2 emissions during the development of a road infrastructure project. The contractor is able to do so through the flexibility, which shows the trust of the project organisation in the contractor. Through clear communication of requirements, the contractor has a clear solution space and framework to work in. Apart from the solution space given to the contractor, the contractor must be willing to think beyond what is required. In RijnlandRoute the contractor chooses for less sand and concrete since it will diminish the costs of the project.

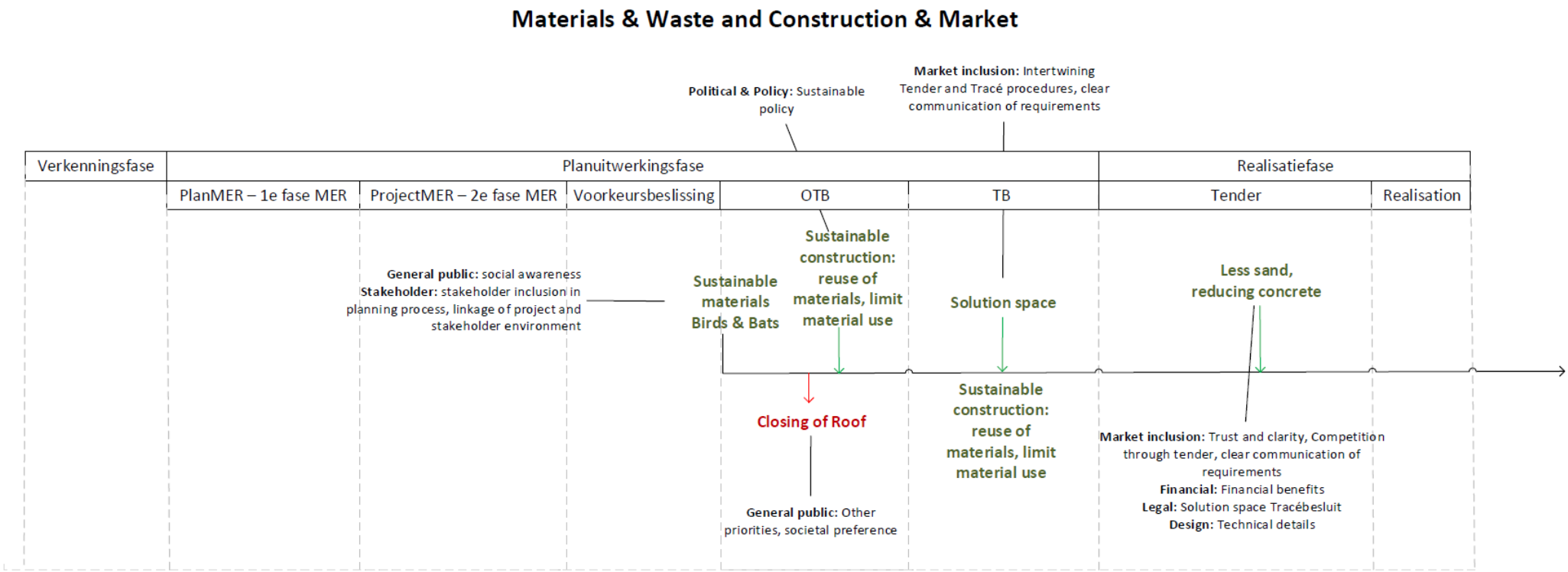

Figure G.4: Timeline of Materials & Waste and Construction & Market in RijnlandRoute.

5.5 Water

Before the start of the project water requirements are put in place by the local water authorities, Waterschap or Hoogheemraadschap. The requirements consider weather prognoses. Important is the availability of the appropriate data and knowledge. With the help of organisation such as KNMI the right prognoses can be made. In order to involve these elements in the requirement not merely knowledge is needed but also awareness at the local stakeholder and public level. Local awareness stimulates the authorities to include climate aspect in the requirements. A similar thing happens to the precipitation standards. Through a changing climate the overall precipitation and maximum precipitation per unit of time will increase. These expected changes are part of the new precipitation standards.

In the 1e Fase MER water is part of the MER. Several water criteria are introduced. The main reason for this is Wet Milieubeheer chapter 7, a legal provision which obliges the inclusion of water in the MER. The 2e Fase MER also includes those criteria. The water criteria on which variants are tested results in the following. Water issue due to digging, for instance for a tunnel, will not create more issues. The 2e Fase MER concludes that the alternative Churchill Avenue scores bests on the water criteria.

During the next phase of the Voorkeursbeslissing and OTB the water standards are satisfied. RijnlandRoute and the chosen alternative, ZnB satisfy the needs prescribed in water standards, which as mentioned before include climate concerns. Connected to the precipitation standards is the demand for water storage. Through the Watergebiedsplan goals are articulated for water storage to be climate ready for 2050. The existing policy is instrumental to getting RijnlandRoute to include these standards in the project. During the OTB this is further elaborated on. Water management is integrated with improving flora and fauna and liveability aspects in the area. Through integral development the compensation task is paired with sustainable development and spatial development. The total development results in win-win situation for both water interests and liveability concerns. Creating co-benefits is leading in this situation. The general public calls for maintaining the existing green in the area. by aligning this public objective with the need for water storage and water compensation the project improves both elements. Water measures related to climate adaptation are implemented through the National Waterplan (NWP). Goals and ambitions about water safety or flood security, sustainable clean water production and a robust water system are articulated in this plan. This form of existing policy stimulates the tackling of these ambitions and goals in RijnlandRoute. The NWP is also present in the TB. The TB further articulates measures for sustainable water management. Mostly based on standards and requirements and legal provisions on water compensation for newly paved areas.

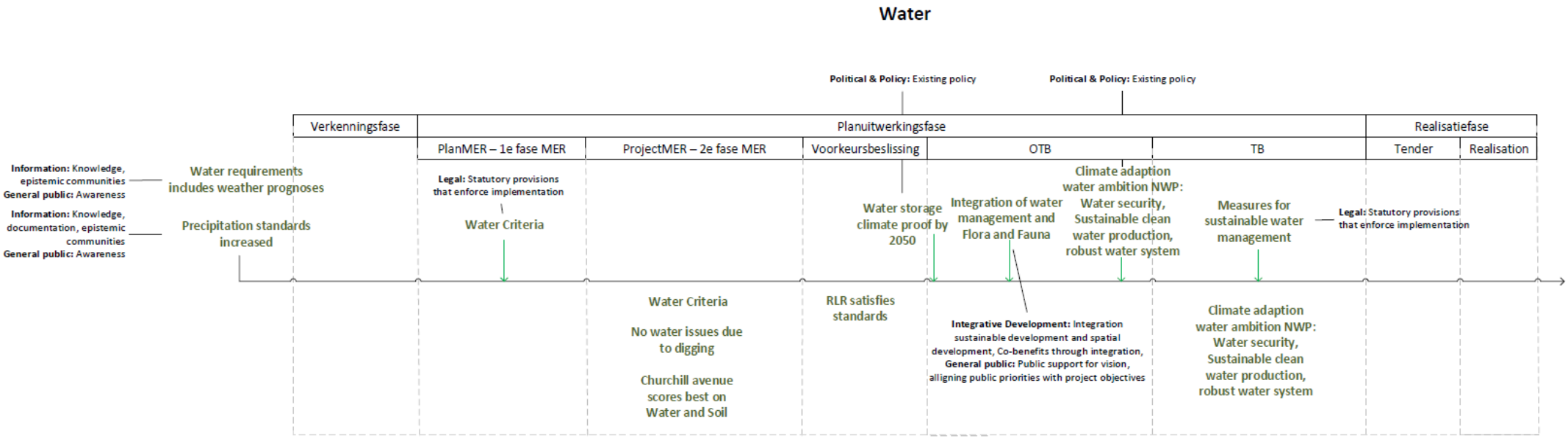

Figure G.5: Timeline of Water in RijnlandRoute.

5.6 Air quality

Air quality is introduced in the early Verkenningsfase as a concern in the project. Air quality is a criterion in MER. The Wet Milieubeheer chapter 7 requires taking air quality into account. Secondly, it is due to a wish of the public to improve air quality, mostly originated from liveability concerns. The 1e Fase MER includes air quality in the assessment framework. The result of alternatives including a tunnel are negative. As the air quality is worsens at tunnel entrances, a local decrease of air quality is foreseen. During this phase ideas on how to deal with these problems are proposed. The reason for the emergence of those suggestions can be attributed to both the availability of knowledge and technology, but also the awareness of the problem as indicated by the results given in this phase. Air quality mitigation, through air holes, roofs and screens and innovative measures including forms of ventilation, treatment of polluted air, electrostatic cleaning and the use of ventilation are suggested.

The 2e Fase MER continues with the assessment of alternatives and variants on the air quality criteria. The air quality over all improves. However the tunnel entrances remain a problem. The polluted air escapes the tunnel at the entrances, were it is much more concentrated. Suggestions such as mechanical ventilation, relocation of entrances and cleaning air are still part of the considerations.

In the OTB the air quality standards are satisfied, and the solution will not further decrease the air quality. During the latter phases the project is signed up at the NSL. Air quality is not to be addressed locally but nationwide. Several notes must be made on that. Firstly, a national approach to air quality is in itself good. It is a problem that can be tackled nationally. Secondly, it removes responsibility at the local level. A project must only comply with the standards and nothing more. The project is not challenged to find ways of cleaning the air. In the end this way of handling air quality is favoured by the political decision-maker.

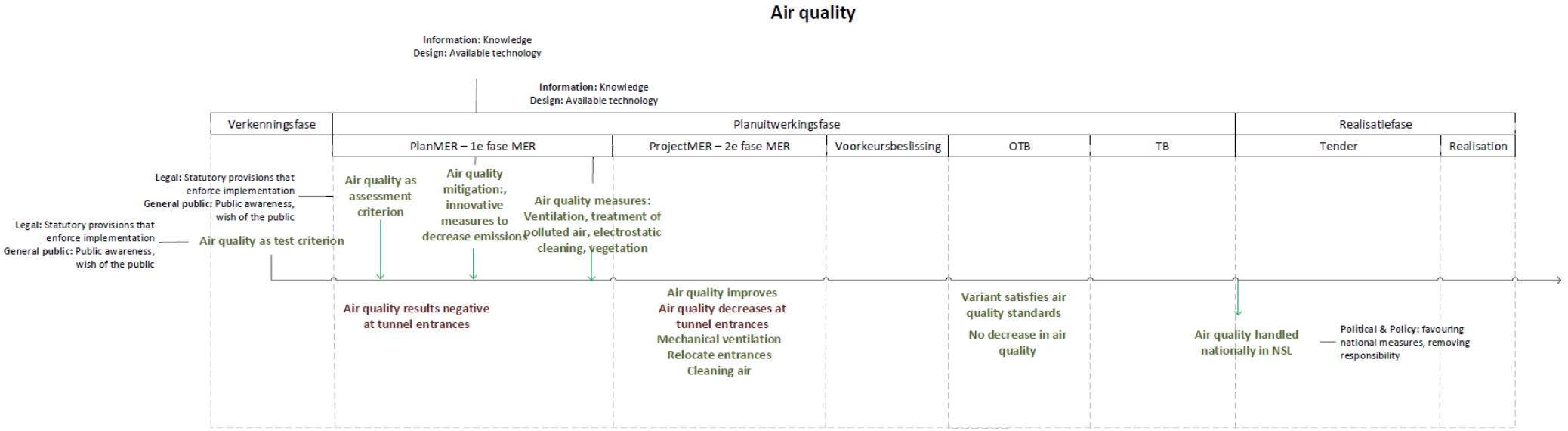

Figure G.6: Timeline of Air quality in RijnlandRoute.

5.7 Climate resilience

In the Verkenningsfase future climate prognoses are introduced in the precipitation standards, this is attributed to existing knowledge, epistemic community and awareness. Climate change as a challenge for the Randstad is mentioned in IBHR, a document written during this phase. The document creates a sort of framework for projects in the Randstad. Climate change is a challenge, and is included in RijnlandRoute through political factors, mainly the IBHR policy document, and through information on the problem of climate change, which creates awareness.

In the 2e Fase MER climate resilience is again brought forward. Through the Structuurvisie the goal of a sustainable and climate proof province is articulated. This policy document is proof of the sense of urgency and awareness of dealing with climate change at the political level, this is closely related with the public awareness.

In the OTB phase not much is further said on climate resilience. During the public participation process between OTB and TB a comment is made on the lack thereof. The dangers of climate change for nature, flora and fauna is voiced. The public shows support for climate proof measures. There is no direct answer on this. It is part of measures concerning nature. A lack of real climate resilience measures is noticeable in the later stages. While the policy documents showed great promise, the later documents do not voice further measures. Of course part of those measures is related to materials and waste, market and construction and water, and are therefore somewhat present. However, being prepared for the future climate is not a central theme in the project.

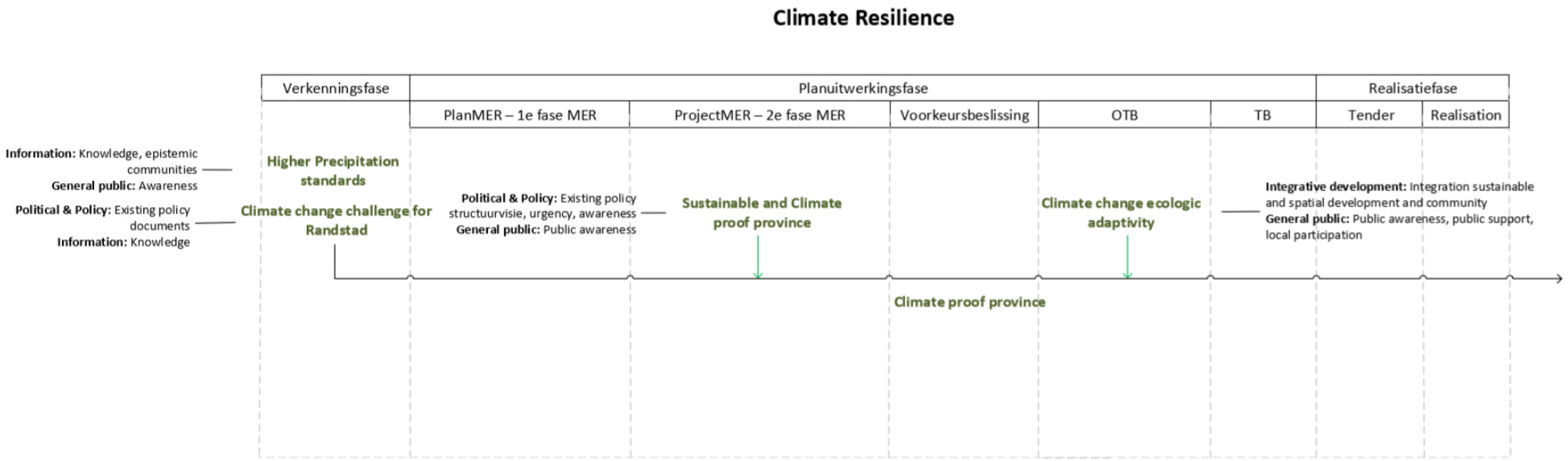

Figure G.7: Timeline of Climate Resilience in RijnlandRoute.

6. Results Case Study RijnlandRoute

Table G.9 is an overview table of all the factors found in Zuidasdok. This table is the conclusion of this case study and this chapter.

Table G.9: Found factors in case study RijnlandRoute, either with a positive or negative impact on the inclusion of climate concerns.

Integral development factors		**Stakeholder factors**	
Alignment of climate ambitions with competing ambitions	+	Shared sustainable visions between stakeholders	+
Co-benefits	+	**Market inclusion factors**	
Goal and Scope factors		Flexible TB	+
Use of Ladder van Verdaas	+	Financial incentive (pay energy bill)	+
Early inclusion of climate concerns	+	Market's creativity	+
Early sustainable project goals	+	Communication	+
Lack of climate focussed sustainability goal	-	Trust	+
Conflict climate concerns and liveability	-	DBM contract	+
Conflict climate concerns and main (accessibility) goal	-	Disregard of contractor's challenges, in early planning process	-
Conflict energy production and other goals	-	**General public factors**	
Conflict public's health and climate	-	Public support	+
Path dependency of early decisions, limitation of solution space	-	Public awareness	+
Lack of involvement of climate in trade-offs and decision-making (not on agenda)	-	Public participation	+/-
Lack of early inclusion of climate	-	Public pressure for quick solution	-
Project organisation factors		Conflict public wishes and climate	-
Creativity of project organisation	+	**Legal factors**	
Lack of human drivers of climate mitigation and adaptation	-	Legal requirements	+/-
Information factors		Lack of legal requirement to include climate in MER	-
Use of MER in decision-making	+	**Political & Policy factors**	
KNMI, other research groups	+	National policy water includes climate	+
Knowledge on available technologies	+	Long term policy on materials (Duurzaam Bouwen)	+
Availability information on climate change	+	Long term policy on energy (Duurzaam Bouwen)	+
Lack of use of knowledge and information in decision-making	-	Long term policy on climate adaptation (NWP)	+
Project goals more important than results studies	-	National policy energy production	+/-
Political preference over expert advice	-	National policy on air quality (NSL)	+/-
Requirements factors		Political priorities guide MER	+/-
Requirements based on research	+	Lack of political climate pressure	-
Use of sustainability or climate EMVI criterion	+	Lack of climate awareness	-
Water authorities decide water requirements	+/-	Lack of sense of urgency	-
Relative weight of EMVI criteria	+/-	Climate not part of the political agenda	-
Requirements are maximum	-	Political pressure for quick solution	-
Financial factors		Lack of climate focussed policy	-
Budget follows early project goals	+/-	Conflict of competing policy and climate policy	-
Trade-off between financial benefits of sustainable/conventional measure	+/-	Shirking responsibilities	-
Conflict public wishes and budget	-	**Cognitive factors**	
Conflict financial feasibility and climate concerns	-	View that certain topics are best addressed later	-
Limited budget	-	Negative view of local energy production	-
Technical factors		National approach to certain aspects is preferred to local	-
Available (knowledge on) technology	+/-	Sustainable solutions viewed as riskier	-

Appendix H – Case Study A16 Rotterdam

1. Description of A16 Rotterdam

In November 2005 the Startnotitie of Rijksweg 13/16 Rotterdam is published. The reason for this decision is structural congestion problems on A20 and A13. The roads are part of the main road network and cross each other in Rotterdam. Due to the large traffic flow the intersection of A13 and A20 is heavily congested. The Ministerie van V&W and Gemeente Rotterdam decide that a solution must be found. A solution that solves both the congestion and increases local spatial qualities (Ministerie van V&W 2005). With this Startnotitie the Verkenningsfase of the project was launched. In June 2008 RWS publishes the Variantennota, which includes variants that can be tested via a MER. During the construction of the Variantennota it is decided that a connection between A13 and A16 is the main solution to the existing problems. 8 variants are constructed. In August of 2009 the main report concerning this MER is published. Four main goals are articulated:

- Reliable and acceptable travel times
- Good accessibility of Rotterdam-Centrum and the surrounding region
- Reduction of traffic on underlying road network
- Improvement of liveability around A13-A20

The MER analyses effects of different variants on the environment (RWS, 2009). This results in the MMA, Meest Milieuvriendelijke Alternatief, or most environmental friendly alternative. The MMA of A16 Rotterdam is a combination of different variants. MMA. In Rotterdam A16 this meant that variant 5 is optimized by replacing several building block. The MER and findings are open for public participation. First three hearings are held to involve local communities. Accompanied with that the MER is open for viewing in 2009. The Trajectnota/MER continued until 2013. In 2013 the Planuitwerkingsfase commenced. Central in this phase is the translation of the Trajectnota/MER into a OTB. The OTB is published on May 27th, 2015. The OTB elaborates on the idea of the MER. A solution where the A16 is extended through the Lage Bergsche Bos to the A13. The Lage Bergsche Bos is a small forest. As a result the impact of the road on the area must be limited. Liveability and ecology are important values in that specific area. To comply with the wishes of the people the road will be routed through a tunnel. The tunnel will be slightly under surface level, however the roof will not. As a result the roof will create a sort of dike in the park. The tunnel is not to be drilled, as it would have to much impact on wildlife. A cut and cover method is used.

At the end of 2015 another document is published, the Kansenboek. The Kansenboek is a summary suggestions, obtained through a participation process (RWS, 2015c). The document consists of findings and insights of a workshop with several interested parties. The Kansenboek focusses on sustainability and suggests several measures to create a sustainable project, it thus serves as an inspiration. The Kansenboek does not have its effect on the TB (RWS, 2016). As the OTB the TB creates the basis for an extension of A16 through a tunnel at Lage Bergsche Bos to the A13. The adoption of the TB on June 29th, 2016 marks the end of the Planuitwerkingsfase and the start of the Realisatiefase.

In 2016 RWS starts the tender procedure. Five contractors reacted on the tender (RWS 2017b). De Groene Boog wins the tender procedure. De Groene Boog is a coalition of Besix, Dura Vermeer, Van Oord, John Laing, Rebel and TBI. This group will be responsible for design, building, financing and maintenance as RWS decided to use a DBFM-contract (RWS, 2018). In 2019 the construction of the project will start, around 2024 the new road will be opened. Table H.1 shows a timeline of A16 Rotterdam from Startnotitie till the decision on the tender.

Table H.1 Timeline of A16 Rotterdam	
Date	**Event**
November 2005	Startnotitie
April 2006	Richtlijnen
June 2008	Variantennota
Augustus 2009	Trajectnota/MER
September 2009	Zienswijzeprocedure
2013	End Trajectnota/MER
2013	Start developing OTB
May 2015	Present OTB
September 2015	Zienswijzeprocedure
November 2015	Kansenboek published
June 2016	Present TB
29-6-2016	Adopting Tracébesluit
2017	TB irrevocable
November 2017	Start Tender procedure
April 2018	Groene Boog wins Tender
2019	Start construction

2. List of Documents Analysed

Table H.2: Overview of use documents in A16 Rotterdam case study, documents with publication date, Title, Type and author.

Date	Document	Title	Type	Author
1-11-2005	Startnotitie	Inspraak Startnotitie Rijksweg 13/16 Rotterdam	Public announcement	Verkeer en Waterstaat
1-11-2005	Startnotitie	Startnotitie Rijksweg 13/16 Rotterdam	Report	RWS
1-6-2008	Variants	Variantennota Rijksweg 13/16 Rotterdam - Hoofdrapport	Report	RWS
1-6-2008	Variants	Variantennota Rijksweg 13/16 Rotterdam - Nota onderbouwing bijlage technische Rapportage Modelberekeningen	Report	Goudappel Coffeng
1-6-2008	Variants	Variantennota Rijksweg 13/16 Rotterdam - Nota onderbouwing bijlagenrapport	Report	RWS
1-6-2008	Variants	Variantennota Rijksweg 13/16 Rotterdam - Technische rapportage	Report	RWS
1-8-2009	MER	Trajectnota/MER Rijksweg 13/16 Rotterdam - Deelnota Ontwerp	Report	RWS
1-8-2009	Variants	Gezondheidsonderzoek varianten Rijksweg 13/16 Rotterdam	Report	RWS
1-8-2009	MER	Trajectnota/MER Rijksweg 13/16 Rotterdam - Hoofdrapport	Report	RWS
1-8-2009	MER	Deelnota ontwerp- Bijlage A Technische ontwerpverantwoording	Report	RWS
1-8-2009	MER	Deelnota ontwerp- Bijlage C Rapport kunstwerken	Report	Arcadis
1-8-2009	MER	Trajectnota/MER Rijksweg 13/16 Rotterdam - Deelnota Bodem en water	Report	RWS
1-8-2009	MER	Trajectnota/MER Rijksweg 13/16 Rotterdam - Deelnota Ecologie	Report	RWS
1-8-2009	MER	Trajectnota/MER Rijksweg 13/16 Rotterdam - Deelnota Effecten tijdens de bouw	Report	RWS
1-8-2009	MER	Trajectnota/MER Rijksweg 13/16 Rotterdam - Deelnota Landschap en cultuurhistorie	Report	RWS
1-8-2009	MER	Trajectnota/MER Rijksweg 13/16 Rotterdam - Deelnota Lucht	Report	TNO
1-8-2009	MER	Trajectnota/MER Rijksweg 13/16 Rotterdam - Deelnota Ruimtegebruik	Report	RWS
1-8-2009	MER	Trajectnota/MER Rijksweg 13/16 Rotterdam - Deelnota Sociale aspecten en recreatie	Report	RWS
1-8-2009	MER	Trajectnota/MER Rijksweg 13/16 Rotterdam - Deelnota Verkeer	Report	RWS
29-8-2008	PvE	Deelnota Ontwerp - Bijlage B Programma van Eisen	Report	RWS
1-9-2009	Zienswijze	Trajectnota/MER Rijksweg 13/16 Rotterdam	Public announcement	Inspraakpunt Expertisecentrum publieksparticipatie
17-9-2009	Zienswijze	Verslag van de hoorzitting over de Trajectnota/MER Rijksweg 13/16 Rotterdam	Report	Centrum publieksparticipatie
22-9-2009	Zienswijze	Verslag van de hoorzitting over de Trajectnota/MER Rijksweg 13/16 Rotterdam gehouden op 22 september 2009	Report	Centrum publieksparticipatie
29-9-2009	Zienswijze	Verslag van de hoorzitting over de Trajectnota/MER Rijksweg 13/16 Rotterdam gehouden op 29 september 2009	Report	Centrum publieksparticipatie
20-12-2013	TB	Effecten A13-16 op watersysteem Delfland	Memo	Hoogheemraadschap Delfland
1-4-2014	Zienswijze	Nota van Antwoord - Zienswijzen Trajectnota/MER A13/A16 Rotterdam	Report	Rijkswaterstaat West-Nederland Zuid
1-1-2015	OTB	Pre wateradvies Rijksweg A13-A16	Letter/Memo	R van den Berg
4-3-2015	OTB	Pré advies HHDelfland op whh-plan A13/16	Email	Walter Vincent
1-5-2015	OTB	Ontwerp-Tracébesluit A16 Rotterdam - Notitie validatie van het MER	Report	E. Buwalda

1-5-2015	OTB	Ontwerp-Tracébesluit A16 Rotterdam - Verkeersrapport	Report	M. Bulsink
1-5-2015	OTB	Ontwerp-Tracébesluit A16 Rotterdam - Natuurtoets & Mitigatie- en compensatieplan	Report	N. von Meijenfeldt
1-5-2015	OTB	Ontwerp-Tracébesluit A16 Rotterdam -Tunnelveiligheidsplan	Report	S. Lezwijn
1-5-2015	OTB	Ontwerp-Tracébesluit A16 Rotterdam - Inpassingsvisie & Landschapsplan	Report	Roline den Hartog, Kees Neven, Sjaak Punt, Expert 1Bomhof, Roel Bakker, Verali von Meijenfeldt
1-5-2015	OTB	Ontwerp-Tracébesluit A16 Rotterdam - Waterhuishoudingsplan	Report	Arcadis, Witteveen + Bos
1-5-2015	OTB	Ontwerp-Tracébesluit A16 Rotterdam - Deel I Besluittekst	Report	RWS
1-5-2015	OTB	Ontwerp-Tracébesluit A16 Rotterdam - Deel II Plankaarten	Maps	RWS
1-5-2015	OTB	Ontwerp-Tracébesluit A16 Rotterdam - Deel III Toelichting	Report	RWS
1-9-2015	Zienswijze	Kennisgeving ontwerptracébesluit A16 Rotterdam	Public announcement	Rijksoverheid
1-10-2015	Zienswijze	Evaluatie A16 Rotterdam	Report	Tjakko Dijk, Onno de Vries, Skadl Rennooy
30-10-2015	TB	Inpassingsovereenkomst A13/16 Rotterdam	Report	RWS, MRDH, Gemeente Rotterdam, Gemeente Langsingerland
1-11-2015	TB	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam	Report	Edwin van der Wel, Geert Jan Naaijkens, Verali von Meijenfeldt, Wouter Pustjens, Esther Heijink
1-5-2016	Zienswijze	Rotterdam en Langslingerland beter bereikbaar A16 Rotterdam Opbrengst participatie inpassing	Report	RWS
24-5-2016	TB	Wateradvies Tracébesluit A16 Rotterdam	Letter/Memo	Hoogheemraadschap Delfland
1-6-2016	TB	Wateradvies HHSK inzake tracébesluit en waterhuishoudingsplan A16 Rotterdam	Letter/Memo	Hoogheemraadschap van Schieland en de Krimpenerwaard
22-6-2016	TB	Tracébesluit A16 Rotterdam - Notitie validatie van de TN/MER	Report	E. Buwalda
22-6-2016	TB	Tracébesluit A16 Rotterdam - Verkeer en Vervoer	Report	J. Tigelaar
22-6-2016	TB	Tracébesluit A16 Rotterdam - Natuurtoets en Mitigatie- en compensatieplan	Report	N. von Meijenfeldt
22-6-2016	TB	Tracébesluit A16 Rotterdam - Kwantitatieve Risicoanalyse QRA Tunnel A16 Rotterdam	Report	Herman Rouwenhorst
22-6-2016	TB	Tracébesluit A16 Rotterdam - Inpassingsvisie en Landschapsplan	Report	Roline den Hartog, Kees Neven, Sjaak Punt, Expert 1Bomhof, Roel Bakker, Verali von Mei\jenfeldt
22-6-2016	TB	Tracébesluit A16 Rotterdam - Waterhuishoudingsplan	Report	A. Balla
22-6-2016	TB	Tracébesluit A16 Rotterdam - Deel I Besluittekst	Report	RWS
22-6-2016	TB	Tracébesluit A16 Rotterdam - Deel II Plankaarten	Maps	RWS
22-6-2016	TB	Tracébesluit A16 Rotterdam - Deel III Toelichting	Report	RWS
22-6-2016	TB	Tracébesluit A16 Rotterdam - Nota van Antwoord	Report	T.D.S. Peelen
22-6-2016	TB	Tracébesluit A16 Rotterdam - Nota van Wijzigingen	Report	W. Soepboer
1-8-2016	TB	Rotterdam en Langsingerland beter bereikbaar A16 Rotterdam	Report	RWS
1-8-2016	TB	A16 Rotterdam - Grondwaterstand bij aanleg tunnel Lage Bergse Bos	Report	RWS
1-8-2016	TB	A16 Rotterdam - Luchtkwaliteit	Report	RWS
24-8-2016	TB	Mededeling Tracébesluit A16 Rotterdam	Public announcement	Rijksoverheid

3. Description of Analysis Process and Findings of Documents

The documents were read, and sustainability aspects identified. These aspects come in many forms. It can be ambitions, goals, criteria of MER, results on criteria, notes, targets, suggestions, requirements, answers to questions and policy. From that list of aspect seven overarching aspects were found. These seven aspects were tested on applicability for this research. The test was done to identify if the aspect could be considered climate mitigation, climate adaptation or either. All seven overarching aspects fitted at least one definition see. Table H.3 shows the legend of table H.4 which shows the aspects that were identified.

Table H.3: Legend and seven overarching aspects

Sustainability and spatial development
Energy and CO2
Materials and Waste
Water
Air Quality
Construction and Market
Climate resilience

Table H.4: Climate aspects found in documents, with colouring of seven overarching aspects.

Aspect	Found in	Type
Air quality standards are exceeded	Startnotitie Rijksweg 13/16 Rotterdam (pp. 20)	Result
Nature, ecology, vegetation and green are important elements of the area	Startnotitie Rijksweg 13/16 Rotterdam (pp. 21)	Goal
Sustainable use of nature and landscape part of existing policy	Startnotitie Rijksweg 13/16 Rotterdam (pp. 28)	Policy
The provincial water management plan, and Hoogheemraadschappen policies are leading for project water security.	Startnotitie Rijksweg 13/16 Rotterdam (pp. 28)	Policy
Air quality MER criterion	Startnotitie Rijksweg 13/16 Rotterdam (pp. 31)	Assessment criterion
CO2 and NO(x) not part of MER	Startnotitie Rijksweg 13/16 Rotterdam (pp. 31)	Assessment criterion
Water MER criterion	Startnotitie Rijksweg 13/16 Rotterdam (pp. 32)	Assessment criterion
Water drainage not part of MER	Startnotitie Rijksweg 13/16 Rotterdam (pp. 32)	Assessment criterion
Drying out of soil MER criterion	Startnotitie Rijksweg 13/16 Rotterdam (pp. 33)	Assessment criterion
Green landscape, ecology important element in the project	Variantennota Rijksweg 13/16 Rotterdam - Hoofdrapport (pp. 18)	Note
Water management, water storage, is an important challenge in the project	Variantennota Rijksweg 13/16 Rotterdam - Hoofdrapport (pp. 19)	Note
Variant 4 focussed on air quality	Variantennota Rijksweg 13/16 Rotterdam - Hoofdrapport (pp. 38)	Note
Water and Soil part of effect criteria	Variantennota Rijksweg 13/16 Rotterdam - Nota onderbouwing bijlagenrapport (pp. 53)	Assessment criterion
Drought and drying out not part of criteria, as it is not expected	Variantennota Rijksweg 13/16 Rotterdam - Nota onderbouwing bijlagenrapport (pp. 61)	Assessment criterion
Water is a challenge in all scenario's	Variantennota Rijksweg 13/16 Rotterdam - Nota onderbouwing bijlagenrapport (pp. 62)	Note
Air quality improves due to development	Variantennota Rijksweg 13/16 Rotterdam - Nota onderbouwing bijlagenrapport (pp. 63)	Result
Water management important priority in the project	Trajectnota/MER Rijksweg 13/16 Rotterdam - Deelnota Ontwerp (pp. 12)	Goal
Water flow is disrupted	Trajectnota/MER Rijksweg 13/16 Rotterdam - Deelnota Ontwerp (pp. 23)	Result
Water drainage and storage at tunnels (precipitation)	Trajectnota/MER Rijksweg 13/16 Rotterdam - Deelnota Ontwerp (pp. 47)	Note
Water management is priority	Trajectnota/MER Rijksweg 13/16 Rotterdam - Deelnota Ontwerp (pp. 69)	Priority
Sustainable accessibility in Rotterdam area	Trajectnota/MER Rijksweg 13/16 Rotterdam - Hoofdrapport (pp. 13)	Policy
With Randstad Urgent program policy exists to create a sustainable and climate proof delta	Trajectnota/MER Rijksweg 13/16 Rotterdam - Hoofdrapport (pp. 37)	Policy
Public participation lead to the prioritization of nature and air quality	Trajectnota/MER Rijksweg 13/16 Rotterdam - Hoofdrapport (pp. 40)	Note
Air quality criterion in MER	Trajectnota/MER Rijksweg 13/16 Rotterdam - Hoofdrapport (pp. 96)	Assessment criterion
Water criterion in MER	Trajectnota/MER Rijksweg 13/16 Rotterdam - Hoofdrapport (pp. 101)	Assessment criterion
Water storage through connection with vegetation	Trajectnota/MER Rijksweg 13/16 Rotterdam - Hoofdrapport (pp. 158)	Suggestion
Existing policy to deal with effects of climate change, and reduce the causes	Trajectnota/MER Rijksweg 13/16 Rotterdam - Deelnota Bodem en water (pp. 23)	Policy
Climate change part of water storage standards	Trajectnota/MER Rijksweg 13/16 Rotterdam - Deelnota Bodem en water (pp. 27)	Standards
Climate change part of water storage standards	Trajectnota/MER Rijksweg 13/16 Rotterdam - Deelnota Bodem en water (pp. 87)	Standards
Include Hoogheemraadschap Delfland and their standards in water management	Deelnota Ontwerp - Bijlage B Programma van Eisen (pp. 8)	Standards
Reserve areas for water storage	Deelnota Ontwerp - Bijlage B Programma van Eisen (pp. 9)	Requirement
Guaranty stability of flood defences	Deelnota Ontwerp - Bijlage B Programma van Eisen (pp. 10)	Requirement
Sustainable water management part of the project	Effecten A13-16 op watersysteem Delfland (pp. 1)	Goal
Use a deepened road and solar panels, for sustainability	Nota van Antwoord - Zienswijzen Trajectnota/MER A13/A16 Rotterdam (pp. 51)	Comment/suggestion
Sustainable energy production will be part of considerations	Nota van Antwoord - Zienswijzen Trajectnota/MER A13/A16 Rotterdam (pp. 51)	Answer
Include climate change problem in project by addressing innovations.	Nota van Antwoord - Zienswijzen Trajectnota/MER A13/A16 Rotterdam (pp. 51)	Comment
Climate change is included in transportation forecasting	Nota van Antwoord - Zienswijzen Trajectnota/MER A13/A16 Rotterdam (pp. 51)	Answer
Suggestion to build new A13/16 on a dike for flood security in relation to climate change	Nota van Antwoord - Zienswijzen Trajectnota/MER A13/A16 Rotterdam (pp. 54)	Comment
Measures are taken nation-wide, solution is not possible and would become too complex	Nota van Antwoord - Zienswijzen Trajectnota/MER A13/A16 Rotterdam (pp. 54)	Answer
CO2 reduction and sustainability goals are in conflict with increasing traffic	Nota van Antwoord - Zienswijzen Trajectnota/MER A13/A16 Rotterdam (pp. 59)	Comment

CO2 reduction not part of project	Nota van Antwoord - Zienswijzen Trajectnota/MER A13/A16 Rotterdam (pp. 60)	Answer
Suggestion to Include CO2 in MER	Nota van Antwoord - Zienswijzen Trajectnota/MER A13/A16 Rotterdam (pp. 65)	Comment
CO2 is not included in MER as it will not help to distinguish between variants.	Nota van Antwoord - Zienswijzen Trajectnota/MER A13/A16 Rotterdam (pp. 65)	Answer
Energy and climate must be better included in MER	Nota van Antwoord - Zienswijzen Trajectnota/MER A13/A16 Rotterdam (pp. 78)	Comment
Water part of OTB	Ontwerp-Tracébesluit A16 Rotterdam - Deel I Besluittekst (pp. 19)	Measure
A13/16 is part of NSL	Ontwerp-Tracébesluit A16 Rotterdam - Deel III Toelichting (pp. 66)	Measure
Annual check on air quality	Ontwerp-Tracébesluit A16 Rotterdam - Deel III Toelichting (pp. 67)	Measure
Robust and sustainable water system	Ontwerp-Tracébesluit A16 Rotterdam - Deel III Toelichting (pp. 131)	Measure
Road must not be felt, seen or smelt	Ontwerp-Tracébesluit A16 Rotterdam - Inpassingsvisie & Landschapsplan (pp. 17)	Policy
Sustainable green new goal in the area	Ontwerp-Tracébesluit A16 Rotterdam - Inpassingsvisie & Landschapsplan (pp. 37)	Goal
Optimisation of sustainability of road through green integration	Ontwerp-Tracébesluit A16 Rotterdam - Inpassingsvisie & Landschapsplan (pp. 45)	Measure
Flooding at tunnel entrances solved	Ontwerp-Tracébesluit A16 Rotterdam - Inpassingsvisie & Landschapsplan (pp. 63)	Measure
Sustainable and robust water system, capable of adjusting to climate change	Ontwerp-Tracébesluit A16 Rotterdam - Waterhuishoudingsplan (pp. 18)	Policy
The spatial organisation must be climate proof and water robust, to be able to withstand heat, droughts and flooding	Ontwerp-Tracébesluit A16 Rotterdam - Waterhuishoudingsplan (pp. 20)	Policy
Water storage measures need to take climate change into account	Ontwerp-Tracébesluit A16 Rotterdam - Waterhuishoudingsplan (pp. 24)	Note
The construction need to be able to withstand changes in soil due to climate change	Ontwerp-Tracébesluit A16 Rotterdam - Waterhuishoudingsplan (pp. 24)	Requirement
Climate change and its consequences are part of reference situation	Ontwerp-Tracébesluit A16 Rotterdam - Waterhuishoudingsplan (pp. 29)	Note
Climate change, extreme weather, storms, droughts are considered in water management	Ontwerp-Tracébesluit A16 Rotterdam - Waterhuishoudingsplan (pp. 38)	Note
De design must satisfy standards of Hoogheemraadschappen, as climate change is part of the standards	Ontwerp-Tracébesluit A16 Rotterdam - Waterhuishoudingsplan (pp. 38)	Requirement
Surplus of water storage area, to anticipate climate change	Ontwerp-Tracébesluit A16 Rotterdam - Waterhuishoudingsplan (pp. 65)	Measure
People and profit main focus, a new impulse for planet necessary	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 5)	Note
Energy reduction part of considerations, limited solution space left.	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 5)	Note
Sustainability ambitions, efficient energy use, energy production, sustainable development, sustainable purchasing	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 6)	Ambitions
Sustainability leads to additional value and spatial qualities	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 6)	Ambitions
Reduce CO2 use, by energy efficiency	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 6)	Ambitions
Use of CO2-prestatieladder, DuboCalc for sustainable tender, 20% more sustainable in 2020 than in 2010	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 6)	Goal
Energy bill for contractor	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 10)	Measure
Future proof, space for more future development	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 10)	Measure
Use of Omgevingswijzer	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 11)	Measure
Sustainability ambitions were articulated in design process, Ambitieweb used	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 11)	Ambitions
Use of Trias Energetica in A16	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 14)	Measure
Decrease energy consumption tunnel as challenge to market	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 14)	Suggestion
Use of ground coupled heat exchanger (Warmte koude opslag)	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 16)	Suggestion
Energy efficient installation in tunnel	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 16)	Suggestion
Smart installations, ventilation that works if CO2 is high	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 16)	Suggestion
Light tunnel through sunlight or light colour	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 16)	Suggestion
Solar energy in cooperation with local residents	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 17)	Suggestion
Dynamic streetlighting	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 17)	Suggestion
Sunlight in tunnel to reduce energy use	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 18)	Suggestion

Sand and concrete are main materials, causing climate problems	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 21)	Result
Use of composite materials, causes lower CO2 impact	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 22)	Suggestion
Use of waste from local demolition projects	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 23)	Suggestion
Future proof, space for more future development	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 26)	Suggestion
Total Cost of Ownership as stimulant in Tender	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 26)	Suggestion
CO2 reduction during development	Een inspiratiedocument - Kansenboek duurzaamheid A16 Rotterdam (pp. 35)	Suggestion
Water storage anticipates climate change, design includes climate scenario's creating a robust solution	Wateradvies Tracébesluit A16 Rotterdam (pp. 1)	Measure
Water storage anticipates climate change, design includes climate scenario's creating a robust solution	Wateradvies HHSK inzake Tracébesluit en waterhuishoudingsplan A16 Rotterdam (pp. 1)	Measure
Water part of OTB	Tracébesluit A16 Rotterdam - Deel I Besluittekst (pp. 16)	Measure
Rotterdam A16 is part of NSL	Tracébesluit A16 Rotterdam - Deel III Toelichting (pp. 65)	Measure
Optimisation of sustainability in road and surroundings	Tracébesluit A16 Rotterdam - Deel III Toelichting (pp. 104)	Measure
Robust and sustainable water system	Tracébesluit A16 Rotterdam - Deel III Toelichting (pp. 136)	Measure
Energy transition in road development	Tracébesluit A16 Rotterdam - Inpassingsvisie en Landschapsplan (pp. 19)	Note
Road must not be felt, seen or smelt	Tracébesluit A16 Rotterdam - Inpassingsvisie en Landschapsplan (pp. 17)	Policy
Sustainable green new goal in the area	Tracébesluit A16 Rotterdam - Inpassingsvisie en Landschapsplan (pp. 37)	Goal
Optimisation of sustainability of road through green integration	Tracébesluit A16 Rotterdam - Inpassingsvisie en Landschapsplan (pp. 45)	Measure
Flooding at tunnel entrances solved	Tracébesluit A16 Rotterdam - Inpassingsvisie en Landschapsplan (pp.63)	Measure
Sustainable and robust water system, capable of adjusting to climate change	Tracébesluit A16 Rotterdam - Waterhuishoudingsplan (pp.20)	Policy
The spatial organisation must be climate proof and water robust, to be able to withstand heat, droughts and flooding	Tracébesluit A16 Rotterdam - Waterhuishoudingsplan (pp.22)	Policy
Water storage measures need to take climate change into account	Tracébesluit A16 Rotterdam - Waterhuishoudingsplan (pp.26)	Note
The construction need to be able to withstand changes in soil due to climate change	Tracébesluit A16 Rotterdam - Waterhuishoudingsplan (pp.27)	Requirement
Climate change and its consequences are part of reference situation	Tracébesluit A16 Rotterdam - Waterhuishoudingsplan (pp.31)	Note
Climate change, extreme weather, storms, droughts are considered in water management	Tracébesluit A16 Rotterdam - Waterhuishoudingsplan (pp.42)	Note
De design must satisfy standards of Hoogheemraadschappen, as climate change is part of the standards	Tracébesluit A16 Rotterdam - Waterhuishoudingsplan (pp.42)	Requirement
Surplus of water storage area, to anticipate climate change	Tracébesluit A16 Rotterdam - Waterhuishoudingsplan (pp.71)	Measure
Climate change part of design to make the design future proof and robust	Tracébesluit A16 Rotterdam - Waterhuishoudingsplan (pp.84)	Policy
Contract that makes contractor responsible for a longer period, creates sustainable use of materials	Tracébesluit A16 Rotterdam - Nota van Antwoord (pp. 55)	Answer
Challenge market to use sustainable materials	Tracébesluit A16 Rotterdam - Nota van Antwoord (pp. 68)	Answer
Solving traffic issues will decrease unnecessary emissions of CO2 due to congestion	Tracébesluit A16 Rotterdam - Nota van Antwoord (pp. 101)	Answer
New climate scenarios were not part of the testing in TB	Tracébesluit A16 Rotterdam - Nota van Antwoord (pp. 212)	Answer
No decrease of air quality due to development A16 Rotterdam	Rotterdam en Langsingerland beter bereikbaar A16 Rotterdam (pp. 6)	Note

4. Description of Analysis Process and Findings of Interviews

Table H.6 and H.7 are the transcript of the interview with Expert 6 and 7 details of interviewees in table H.5.

Table H.5 Interviews A16 Rotterdam

Date	Name	Company	Project role
17-10-2018	Expert 11	RWS	Manager Ruimtelijke kwaliteit
18-10-2018	Expert 12	RWS	Contract manager

Table H.6: Interview Expert 11 17-10-2018, 11:00, Rotterdam, A16 Rotterdam

Interviewer:	You were active in the Planuitwerkingsfase, as what?
Expert 11:	I participated in a part of the Planuitwerkingsfase as Advisor spatial quality
Interviewer:	What is the essence of that job?
Expert 11:	I focussed on integrating the solution in the current situation, both the social aspect of integration and the spatial aspect of what it will look like.
Interviewer:	I just explained the essence of my research, with the focus on climate mitigation and climate adaptation, do you have some thoughts on which types of sustainability are present in this project, A16 Rotterdam
Expert 11:	In the Planuitwerkingsfase we tried to incorporate the people, planet, profit way of thinking. Consequently we thought of ways to design a road considering each P and thus creating a balance between people, planet, profit. In my view, if you focus to much on one aspect of the 12, and you forget other elements, then the result can become worrisome. For example, in china in a village they focussed on sustainability, to that end the planted a lot of solar panels on a mountainous area. The underlying soil however deteriorated, due to a lack of sun. With the first rain of the rain season massive mudslides appeared. And that is the idea, that climate aspects are very intertwined with spatial aspects.
Interviewer:	I have seen that interrelation before in other projects as well. I suppose In the A16 that interrelation can be seen in the tunnel, since a tunnel will be the only way to make the project feasible, as it is the only option in Lage Bergse Bos. However, a tunnel is not sustainable, as it uses a lot of energy.
Expert 11:	That is an interesting one yes, I work on the Blankenburgverbinding, and there the common idea is that the development of a road is never sustainable. However, we have to make it as sustainable as possible. And that is also part of A16, the development of a road is in itself not sustainable, however if you must do it, then try to be as sustainable as possible.
Interviewer:	What does that look like, in what forms does sustainability come?
Expert 11:	In cooperation with (Gemeente) Rotterdam the main aspect was, how to deal with liveability. Noise reduction for instance, is an important aspect. Also the connection of the project with recreative concepts in the area is a part of liveability. For instance, the tunnel has a roof and on top of that roof a park will be built. We produce a civil technical solutions, and another party, the managers of the park are given the task to use that roof as part of the park. Sustainability mostly means: including new qualities or improving qualities in the project area. It is no longer just 3Ps it is about prosperity. What can be added to increase prosperity.
Interviewer:	The tunnel will become energy efficient, how did that come to be?
Expert 11:	That is achieved mainly in the contract phase. Themes such as energy and materials are introduced later in the planning process, mostly the contract phase. If you look at a project you will see that different themes or aspects will be addressed at different moments in time and will carry a different weight at different times. Energy and Materials, and subsequently CO_2 reduction can be considered in the early phases. For example: do not make plans to build very large concrete land tunnels. The most gains however, on these aspects are achieved in the last phase of the project. This is during the contract phase and depends on the work of the contractor. During the tender procedure there is a stimulant or incentive to see which party is able to create the most CO_2 and energy friendly design. And that depends on the creativity of the market. We try to trigger them to think of ways to build a tunnel in such a way that the amount of CO_2 production is limited.
Interviewer:	The Planuitwerkingsfase itself does not steer towards energy, CO_2 reduction and materials?
Expert 11:	Dealing with energy and materials is a concern, but on another level. A question could be, is everything going to be constructed in artificial construction, or will we use more of the existing landscape. For instance we can constructed a road on soil, with a wall of soil, or we can make a construction of concrete. The solution using soil, however, requires more space.
Interviewer:	How is water a part of this project? In what I have seen so far, the Hoogheemraadschappen include climate adaptation in their requirements, which the project must satisfy, is that what primarily happens?
Expert 11:	That is the main concept, yes.
Interviewer:	No more steps are taken than what is required?
Expert 11:	You will have to ask that to Expert 7. However, usually the Hoogheemraadschappen will require compensation for newly paved area, in order to be able to store enough water.
Interviewer:	With regard to air quality. If I read something about air quality, CO_2 is not part of that. For instance in the MER. Why is it that we have put in place requirements and standards on air quality, thus NOx and PM_{10}, $PM_{2.5}$ and not to CO_2?
Expert 11:	I think you have to pull these two concepts apart. The law on air quality is focussed on people. The standards are there to protect people's health. Furthermore, NO_x and other pollutants are a local phenomenon. CO_2 is a worldwide problem, and thus there is no clear standard, also the concentration is very hard to estimate. We can estimate the emission rate to some extent. The two are different things, or problems. NOx is about people's health, and CO_2 is about climate change and of course, CO_2 is not detrimental to our health.
Interviewer:	That lack of interest in CO_2 is something that is changing lately. This Trajectnota was carried out in 2009, and policy on climate adaptation and climate mitigation is growing.
Expert 11:	You are familiar with the CO_2-prestatieladder? Yes, well, in that way we do achieve CO_2 reduction. It is not so much viewed as a standard but as a challenge. The contractors were told to reach level 3 of the CO2-Prestatieladder, and that influences the development, it

	influences what is to be built and how that will be carried out. In that way CO_2 is factor, it plays a part in considerations. And as project you can say, the minimum level is this, but a contractor that creates a design were the next level is reached can score extra points.
Interviewer:	How much can you steer for climate aspects in the Planuitwerkingsfase, which is an urban planning procedure?
Expert 11:	Quite a lot actually, I see a lot of project where I think, is it wise to start that project on that location, with in mind the consequences of climate change, for instance decreasing soil level? We must address the issue of what to build and where to build in the Planuitwerkingsfase if we want to truly address the consequences of climate change.
Interviewer:	Do you think that mindset is used more and more?
Expert 11:	I think it is done very little. The main reason is the scarcity of usable space and that we are technically capable of building almost anywhere. For instance by using pumps, to decrease water level in a polder. With regard to climate change, a new way of thinking must emerge. We now notice that some Hoogheemraadschappen focus on retaining water in the polder, to prevent further settling, which is also strengthened by climate change. These elements however are not part of A16 Rotterdam.
Interviewer:	Were sustainability goals or ambitions articulated during the planning process?
Expert 11:	Yes, we decided on what the goal of the project was, and who was participating in the project. With them an ambition document was drawn up. That document contains sustainability ambitions, from a people, planet, profit viewpoint. There are ambitions on liveability and nature, and where thus named in the Planuitwerkingsfase. In the contract phase specific ambitions on CO_2 were articulated.
Expert 11:	What you see a lot in these types of projects, is that the solution is quickly brought forward. In this project we invested time in analysing what the specific aspects of the area were and what needed to be done. That resulted in a plan, and from that plan the contractor creates specific measures. How CO_2 reduction is done, or what building method is used is left as a challenge for the market.
Interviewer:	Are climate ambitions present in the planning process?
Expert 11:	With respect to water climate ambitions are present in the planning process, but on those other aspects not. We do what is required form us, legally but more is quite difficult. It is not part of the considerations.
Interviewer:	Reaching that, is that something that must be achieved with policy/laws?
Expert 11:	As is with air quality and noise, when we deal with rules, it is very clear what needs to be done.
Interviewer:	Is a legal framework to achieve this desirable? Considering that it will possible have negative impact on feasibility and integration in current landscape.
Expert 11:	Is a better legal framework desirable? There are two schools of thought on that. The Precise standpoint, thus thinking regulations and laws result in what is desired. And a freer mindset, results come from cooperation between stakeholders. By looking into the problems of the area and combining the strengths of different stakeholder solutions can be achieved. Working together is extremely important, especially with climate change, as climate change does not stop at the end of the A16. The surrounding area is also affected by the project and should participate in the project. Then it is also about what agreements are made. For instance do you want to live very secure, or are you ok with a small flooding of your land and house once in 15 years.
Expert 11:	For instance in Delft or Rijswijk, the newly built dwellings there are located in an area where the yeast fabric produces vast amounts of stench. However, the residents were given a choice, live in a smelly area but with very good public services. Spatial qualities overall were improved, in the area the negative effects are countered by positive effects.
Expert 11:	Or for instance the Biesbosch, the Biesbosch was always dry, however we expect more rainfall. We could decide to push farmers out, since they cannot live there anymore. Or we can talk with each farmer and discuss what they want, and for instance adjust their dwelling, so they can survive occasional flooding.
Interviewer:	I have identified a set of factors, which I would like to discuss with you. The first one is scope and goal factors; the idea is that clear goals and ambitions in the start lead to success.
Expert 11:	When I talk to students that sounds very logical, to work from abstract to specific, and to include ambitions very early on. However, in reality it is difficult to do that. If people have worked in this sector for a long time, they unfortunately loose that simplicity.
Interviewer:	What is the reason for that?
Expert 11:	After a while people no longer take a step back at the start of a project and think about what it is that the project requires. The concept of looking, thinking and then doing is forgotten. Starting early with these ambitions and goals and thinking what the project really needs is a success factor, also important is to make agreements on those ambitions. Quality is that what you agree upon, thus agree with other stakeholders what is important. If you only have project goals generated from the project organisation you are alone. And the other local stakeholders will not necessarily participate with you.
Interviewer:	Was there someone in A16 that was a driver of sustainability?
Expert 11:	Expert 12 is quite enthusiastic about sustainability, I am too and someone else from purchasing as well. However, there was never a formally designated person or driver for sustainability. As a result, if there is no advisor sustainability, then you depend on the enthusiasm of your people.
Interviewer:	Are there an advisor primarily responsible for sustainability in other projects?
Expert 11:	I have seen it in other projects. For instance in Heinenoordtunnel, there is someone who is coordinator sustainability. He monitors whether sustainability has gotten a place in the project.
Interviewer:	What about political factors, is there a sense of urgency?
Expert 11:	The main drive is to create a new road that solves the congestion problem. There is no ambition on involving climate aspects. That is interesting, since Rotterdam is very focussed on implementing climate measures in the city. However, that are mostly isolated project, that are not part of a large integral programme.
Expert 11:	Within RWS there are two schools of thought on sustainability. One is about doing sustainable things, for instance wind mills on the Maasvlakte 2. The other concept is doing things sustainably. Meaning the things that RWS do, must be done sustainably. The difference is that sustainability is a part of the main goal in the second thinking and it is the main and only goal in the first.
Expert 11:	In A16 the focus is on decreasing congestion and building A16, sustainability will always be a lower goal. So if a projects primary concerns is climate, for instance a climate proof area in cases of water protection works, then that will happen, as it is the main goal. Doing things sustainably is more difficult.
Interviewer:	I have also a factor on integral development, with the idea that if we get people and project together we can increase qualities, both spatial and with respect to climate. Is that the case?

Expert 11:	What is needed to achieve such a thing?
Interviewer:	Perhaps rules and policy, and also awareness at the level of policy makers
Expert 11:	Maybe it can work the other way around. Making people aware of where they live and which issues are related to that. That awareness is interesting, many people in the Netherlands do not know if they live in an area that is prone to flooding. And consequently, if that happens, do people know what happens next. Due to the flood, utilities will malfunction and even stop working. If people are aware of what would happen, and the chances of it happening than they will ask their civil servants to address the issue. It will than become a part of the public agenda. It does not happen yet, and that is since people do not know it happening. It becomes evident when there are several large floods, then something changes. As happened in Limburg in the 90's, when two floods happened, this impacted the urgency of the need for a solution. And now the question is: what we can do to prevent that people will only become aware of the problem and act after a disaster already struck?
Expert 11:	What we also see lately is that heat, storms or wind and a lack of water have become part of the agenda of RWS. Another interesting question would be to see what the advantages are of proposing sustainability and climate measures by a civil servant. Is it in the interest of politicians to do this? As it is not so appealing probably. It is appealing to open large new project of course but being the driver of a long-term project will be more difficult. It would also be interesting to have a look at Ruimte voor de Rivier, as they succeeded in addressing climate change and climate adaptation, and to get all parties on board.

Table H.7: Interview Expert 12, 18-10-2018, 10:00, Rotterdam, A16 Rotterdam

Interviewer:	In what way are you part of A16 Rotterdam?
Expert 12:	I am contract manager in A16 for RWS, I have been working on large project of RWS for the last 10 years. I have also worked in the Planuitwerkingsfase of A16 and now I work in the tender and contract phase of A16. We work in a cooperation (consortium) of six parties called the Groene Boog, one of the parties is a Belgian party. We are currently in the start of the realisation, and part of that phase is to bring two sides, project owner, RWS and contractors together.
Interviewer:	What kind of sustainability aspects are part of A16, I have seen the Kansenboek , and what can you say about that?
Expert 12:	The Kansenboek is indeed interesting. First, it shows the process that was used. It shows the steps. In almost every RWS infrastructure project we use Ambitieweb to identify what ambitions and aspects will be part of the project. So we always check which of the 12 elements/themes are used and what we can do with them within the scope of the project. What you will see is that the sustainability as a theme was introduced relatively late in the planning process. What you stated in your list of questions, the Trajectnota was started in 2009 and relatively long trajectory was started. In 2013 when the OTB was established, and thus a lot of important decision were already made, then the question was raised if sustainability needed a more prominent place in the project. What we did then was identify on which of the twelve themes we could improve further, considering that inevitably you touch upon all themes within the project. And that lead to the five main themes of the Kansenboek: Energy, materials, spatial quality, welfare and accessibility. That were the five themes of which we thought, we can take it to the next step considering in which phase the project was already. A consequence is that other aspects do not get this extra attention, and that is since we are primarily focussed on integration of a road. There are underexposed themes, if you want true integral area development you will have to shed some light on all of them. So in this way we take sustainability into account however it is very depended on the perceived problems and goals of the project and the phase in which it happens. I advise in new project that they start with this in the early phase of the Verkenning. In the Verkenningsfase it is important to decide which themes are relevant and if these themes are connected to the surroundings so local stakeholders, then that decision on important themes must be taken together with the stakeholders. That is something that did not happen in A16 Rotterdam. And in this way the real impact we can make is limited. In the end we were able to make a regional agreement with six main stakeholders. However, it would have been very useful to have had the chance to use the instrument: Ambitieweb early on in the project with these six parties. Then sustainability could have been a more integral part of the project. Along the way, partly due to people such as me that have an intrinsic drive to do something with sustainability, sustainability has been introduced. However it would be good to introduce sustainability early in the process and give it an important place.
Interviewer:	Why has it not happened yet, why is it not yet done that early in the project?
Expert 12:	Currently it does not happen yet in the early phases of the project due to the political climate. If we take the basic concept of: Scope, time, money and risks than those are the main framework in which we need to work. And then, for instance around 2010 the main goal was accessibility, improving traffic flows etc. and be sure to keep within budget. The goals of the project were relatively limited. Of course we had several other goals, for instance liveability. So we tried to make it broader than the narrow accessibility scope, however people were for quite some time scared of making a project too large, with the risks of decreasing feasibility. In those times it happened that projects were made too large and subsequently unfeasible. It is there that we notice a tension, between keeping the project small and clear and feasible and making a project larger including more qualities but decreasing feasibility. So that is the balance between extra themes, extra parties and stakeholders versus feasible projects. It is quite an interesting area of tension. Especially in area development with a lot of parties, it is important to discuss the themes at the start of project and articulate very clear and specific what is important and which ambition are present. As a consequence it becomes a clear theme, that is part of the process and which designers must include, it becomes a theme in your trade-offs just as quality, safety and maintenance. Sustainability should be part of that. As a consequence the theme is important throughout the process. In that case it is no longer, something extra, no it becomes an integral part of the process.
Interviewer:	So were there some main drivers of sustainability in A16 Rotterdam?
Expert 12:	Yes me, and there were several trainees that had their focus on sustainability, and so they helped the project. The main thing they did was organizing the public participation sessions, creating public support. Furthermore, there was for some time a project director who was focussed on sustainability, and that how we build in sustainability. An external factor pushed for including energy, the manager of the network, saw an increase in energy bill due to the opening of the new Coentunnel. He saw that rise and wanted to limit the energy costs, so the stimulant for sustainable energy consumption was a business decision. Subsequently, he project was asked if they could do something with that, and we responded by requiring a 50% decrease in energy consumption of the tunnel.
Interviewer:	What was the influence of that all in the contract or tender? For instance making the contractor pay for the energy bill.
Expert 12:	Due to such initiatives, as making the contractor pay the energy bill, support and a trend is created in the organisation. All of a sudden A16 was the example of a sustainable project, that was never a goal, however by doing what seems best we slowly became an example

project. And thus, such achievements can come from within, and do not always have to come from external factors. What was the result in the tender procedure? We included sustainability and reduction of nuisance as EMVI criteria in the tender. The tender will result in DBFM contract. The third EMVI is on risk management. So we did succeed in including sustainability as theme into the EMVI-criteria. Related to that we have a couple of standard instruments, CO_2-Prestatieladder en DuboCalc, which are used to score the EMVI-criteria. Furthermore, we have a couple of mechanisms connected to the contract, for instance part of the contract is that the energy bill for the coming 20 years is paid for by the contractor. And that will be a more expensive bill than the one we would pay. The State pays relatively little compared to what the public pays for energy. In that way the incentive to make the road and tunnel energy efficient, is larger than it would be for RWS. The requirement for 50% is reached, even more the tunnel will be the first energy neutral tunnel. So we see that a project which started with little concern for energy etc. results in an energy neutral tunnel in the tender, and thus the process has the potential to work very well.

Expert 12: That relates to the Tracéwet and Tracébesluit. The Tracébesluit has design decisions and requirements that can limit the solution space and obstruct optimisation of certain themes, such as sustainability. And thus we could be more explicit on what part of the TB are essential, and which aspects need more flexibility, in order to use the innovation of the market in the tender procedure later on. There is generally space for an extra meter in all directions, and that could limit sand use. But, it can also be about making space for solar panels or creating space for energy storage. We did not anticipate that and the space is limited, however we have enough space for solar panels. And as a consequence, this contractor came up with nine places that have potential for solar panels, that would produce enough energy for the road and tunnel, it would need about half of that production. And then we need to address the issue of were to incorporate that into the landscape. It is desirable to have such things implemented into the TB.

Interviewer: Related to that, I have heard that RWS builds a park full of windmills at Maasvlakte 2, some people within RWS would say that this creates enough renewable energy for the projects, and thus implementing solar panels into the project and landscape, and doing this as part of the project is not necessary, what is your opinion on that?

Expert 12: Yes, I am aware of that, it is a bit of an internal struggle in RWS. In the end it is a choice for the project organisation, however you will have to see what is possible and what not. I recently discussed this in RWS, and we concluded that the most sustainable tunnel is no tunnel, but that is not accepted by the locals. In terms of sustainability we will need to ask the more explicitly if sustainable solutions are part of the project or are there better alternatives. For instance in A16, a deepened road, without roof would be more sustainable and safer, however local residents will not want to that. That is really a tension between values and interests. So that is a tension we need to identify and discuss in such project, however if something as sustainability is not on the agenda, it is not discussed. Another question is indeed do we need to produce green energy locally, or on the Maasvlakte. Currently there are no windmills on the maasvlakte, and doing it locally triggers people to think of energy efficiency, saving energy and energy neutrality. I think it is positive that it is done locally, and people are working on it locally. However, it is essential that the market, through financial incentives, includes those aspects in their designs. Firstly, it is about reducing the consumption of tunnels, and then about producing energy locally but indeed that is something windmills could do as well.

Expert 12: However, when we do things locally, the people working on the project are challenged to think of new ways to reduce energy consumption. In this tunnel we will use only direct current. And what that means is that there will not be any switching between DC and AC. That saves a lot of adaptors, and the tunnel becomes more robust. So we are continuously looking for win-win situations. That is primarily technical, however in spatial development there is more space for progress. As we could in the early phases of the project, play more with how to include sustainability. Take for instance DuboCalc, that is used primarily in the Tender procedure, however it would be interesting to do that earlier, and think of what the main energy consuming elements of the design are and are there alternatives.

Interviewer: The Kansenboek summarizes innovations and possible solutions for the project. Were some of these implemented?

Expert 12: We used the Kansenboek as a tool for brainstorm sessions, to get some new ideas. With this we and COB discussed what options there were to build energy neutral tunnels, and from those discussions we created a document which also includes several measures we could implement. We are also looking into daylight in the tunnel, to reduce energy consumption. Materials is currently under discussion. In spatial quality we are looking into using green sound screens instead of concrete. Welfare is also a topic, and that comes back in nuisance due to construction. In EMVI we included limitation of nuisance due to construction, however every project does that, we want additional value. So we asked the market to think of ways to make the construction a positive experience for local residents. Our dream is, that people must be gutted when we leave. So we focussed on that, and the question how we can improve the function of the area while the area is under construction. And so we made a whole series of measures. So how can we create a positive experience, during five years of construction. So the contractor came up with all kind of measures that are related to project, but primarily strengthen several existing functions of the area. For instance at Terbrechtseplein, a large construction needs to be created over that area. It will be constructed with pillars and the top will be glided over it. To make that more interesting we will place a platform, with seats so that the residents can see that happening together. That will both increase the appeal of the civil technical science and also include local residents.

Interviewer: What about this factor: project organisational, how important is having the right people on the job

Expert 12: Very important, and not only within the project, but also outside of the project. So also the project owners. We are constantly looking for ways to put the project owners or political stakeholders on a stage. Currently we are looking into ways to have the minister present some part of the project, that fits within her current activities. The same goes for our regional stakeholders. Next year there is an election for Provinciale Staten, that means that around march we will be doing certain things that relate to the current councilmen. It is a win-win situation, we help them to show in their campaign what they have achieved in last years, and we help our project to gain more publicity and the political faction will not want to stop it later, as it was part of the campaign. And thus it is very important to make good stakeholder analyses, see who influencers are etc. to identify who can be useful for the project, both internal and external.

Interviewer: How about integral spatial development?

Expert 12: That gives you the largest solution space, if you participate early on you are able to guide the whole process better and implement certain themes earlier. Later on the space is smaller.

Interviewer: The market is a factor.

Expert 12: Yes, I think we leave too little for them. That is partly due to procedures and a lack of trust between the parties. There is room for improvement. I think the market is capable of doing more and wants to do more if we give them the chance. To be more precise, it is quite difficult for us to go back on our TB, and that limits innovation. For instance, noise standards, the Tracébesluit includes standards

	on sound and noise, it is difficult for us to do more than is required. In this project we were given the space to take measures that are beyond the standards, and we get some odd looks for that from RWS. The question rises, why would you go beyond what is required, in this case the region pays for it, so it is permitted. Additionally we have challenged the market to take extra measures to reduce noise. And the market is able to do that, however it was difficult to agree upon that internally, and to guide those measures through the procedures of RWS. Why is that, well it would create precedent, if we do it in one project why not in another. But we did it, and we noticed that there is still space in the market for innovative ideas.
Interviewer:	With regard to legal standards, would laws requiring certain measures help to achieve sustainability, or would it do that but very much limit the solution space and making development much harder?
Expert :12	Well that is something that we touched upon already, legal requirements such as in sound and noise reduction create the goals since we have to comply with standards. However, it is also our limit, we usually do not go beyond such standards. That is regrettable, since if we do not tackle such problems to our best abilities and focus merely on a congestion problem, it might result in liveability problems in 10 to 15 years. So we need to try to use the budget for that project optimally. Currently legal standards limit development since we do not go beyond the standard.
Interviewer:	Having clear requirements on design and technical aspects result in desired result, at least that sounds evident, is that the case?
Expert 12:	It is very complex, for instance, we now have a trade-off with 13 different factors. And those factors have their own weights, and some are qualitative and some quantitative. And how are you going to decide in that case. What we see is that it is not all rational in such cases, but feeling, experience is part of that decision as well. If we take a technical perspective, it is best to make everything as objective as possible to make an honest trade-off, however in some cases with certain aspects that is simply not possible, or you have a lack of information. That is part of the difficulty with a design process, on the one hand you want to make a global design, on the other hand you will use that design to make financial estimates and DuboCalc estimations. Then you have to go deep, and into specifics. But does that justify what it cost to make that design. And that is an important area of tension. Consequently, you must accept that in earlier stages you will think about design and solution on a higher level of abstraction. What that means, is that the trade-off with objective minuses and plusses are difficult to make. To make that trade-off it might be the case that the forming of a good project team is more important. If the right team, with people from all relevant areas and interests join together a more optimal solution can be made, since everyone will make sure their interests are served to acceptable extend. For instance with regard to safety, we have articulated that safety is extremely important to the project. Every time we decide on such matter a coach or advisor on safety is present to voice his concerns. The same could be done with sustainability.
Interviewer:	According to expert 11, if the public is aware of a problem and wants a solution, decision-makers and policy-makers will follow their wishes.
Expert 12:	Why would you choose, why not both? However, it is good that he said that, nowadays we are used to include local stakeholders or general public through a participation process, in this project during the creation of the OTB. We use the voice of the people, local residents to identify certain important themes. And then we do not ask, do you want sustainability? no, we ask, what are your concerns, what do you want for this area. In this case there were for instance concerns with the cutting down of trees. For a good integration, we do not drill the tunnel, but we do a cut and cover method. That method is now established, however we can think of ways to cut down as little trees as possible, for instance not 100 trees but 80, or to replant new trees.

5. Analysis of A16 Rotterdam

The analysis of A16 Rotterdam is based on the findings in interviews and documents. With those findings timelines are constructed. This section includes the seven constructed timelines. This section concludes with a list of findings from this analysis, that is consequently used to construct a list of factors in the main text.

5.1 Sustainability and Spatial development – Sustainability criteria

In the early phases of A16 Rotterdam during the Trajectnota/MER phase it is not possible to include sustainability. Several reasons can be identified. First of all there is no related project goal. A sustainability goal is not articulated. An underlying reason for this is the fear of making the project too large. Until 2010 broadening the project scope was considered risky and vied as limiting project feasibility, creating higher costs and complications. The second reason is the political playing field. There was no sense of urgency and sustainability was not part of the agenda. This is a problem with the length of the project. The project delivered the Trajectnota in 2009, around this time sustainability was not a hot topic as it is now. As a result the more important decisions were made before it even became a concern. This can be attributed to a lack of information on climate change and environmental concerns. Around the OTB sustainability was introduced in the planning process. Through increasing political awareness, sense of urgency and policy. Human drivers of sustainability are essential in A16 Rotterdam. Several project team members were stimulants behind the(late) inclusion of sustainability. Consequently, in the TB it was considered that the TB might limit the solution space. More flexibility is required. Technical rules and slow procedures accompany the TB.

During the tender EMVI criteria are articulated. The sustainability EMVI criteria are connected to the DBFM contract, which makes the contractor responsible for the project for a longer timeframe. The inclusion of sustainability as EMVI criterion is related to political awareness, sense of urgency, and the human drivers in the project organisation.

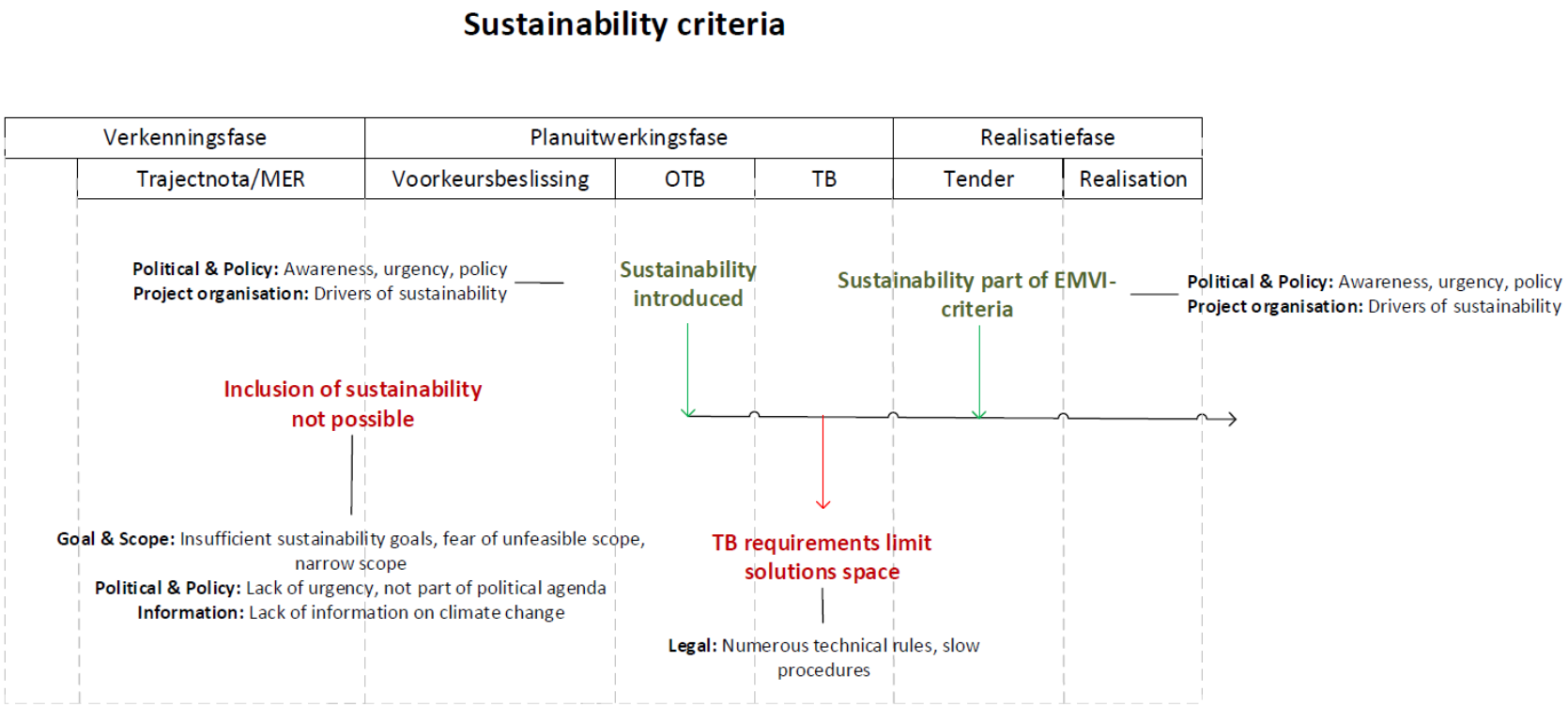

Figure H.1: Timeline of Sustainability Criteria in A16 Rotterdam

5.2 Sustainability and Spatial development – Sustainability Ambitions and Goals

A sustainable use of nature and landscape is the first form of sustainability ambitions and goals present. The ambitions follow existing policy, 'Natuur voor mensen, mensen voor natuur (2000)'. During the Verkenningsfase however, climate is not a goal, and sustainability is a lower goal. Competing goals and the fear for a large unfeasible project are the leading reasons for this. The main goal is to create a road that solves congestion, climate is not part of that main objective. In the Trajectnota/MER sustainable accessibility is introduced as an important goal, this ambition follows existing policy 'Rotterdam vooruit'. Furthermore, it becomes clear in this phase, through the Zienswijzeprocedure, that climate change is considered during the transportation forecasting. Due to awareness at the political level, as they decide what is included in the study, but of course based on knowledge and information. The effect of climate change on transport is limited

In the OTB de 3Ps is introduced. A balance between the three Ps during the construction of a road is the objective. The introduction is mostly driven by human drivers from the project organisation. Additionally, the ambition for optimisation of sustainability of road through green integration is articulated. The introduction of the concept can be attributed to human drivers, the advantages of integration of road and sustainable development and aligning of project goals with those of the general public. The wishes and needs of the public are mostly about liveability and that includes green. Through the connection of the project goals with this green goal both goals can be reached.

Through the TB and de Kansenboek sustainability resurfaces. The 3P mind-set of the previous phase survives. However, the three Ps are not in balance. Profit and People are prioritised above Planet. It is therefore that planet requires a new impulse. This is primarily achieved through human drivers. Several project team members stimulate Planet in the remaining process. This is achieved; however it follows primarily the wishes of the public and so liveability and nature are the objective. Climate does not get a place. The impulse is accompanied by the creation of the Kansenboek. The Omgevingswijzer and Ambitieweb are used. In the TB optimisation of sustainability through green integration and sustainable green are elements that remained in place after the OTB. Regardless of the Kansenboek de TB decides on the use of a large tunnel. The decision is in line with the publics wishes for liveability and thus has the publics support. Other goals and priorities are more important than climate concerns. It must be added that such decisions in these projects are not as rational as they are portrayed to be. It requires experience and intuition to make decisions. The trade-offs are far from rational, due to the enormous amounts of interests and aspects and the lack of information.

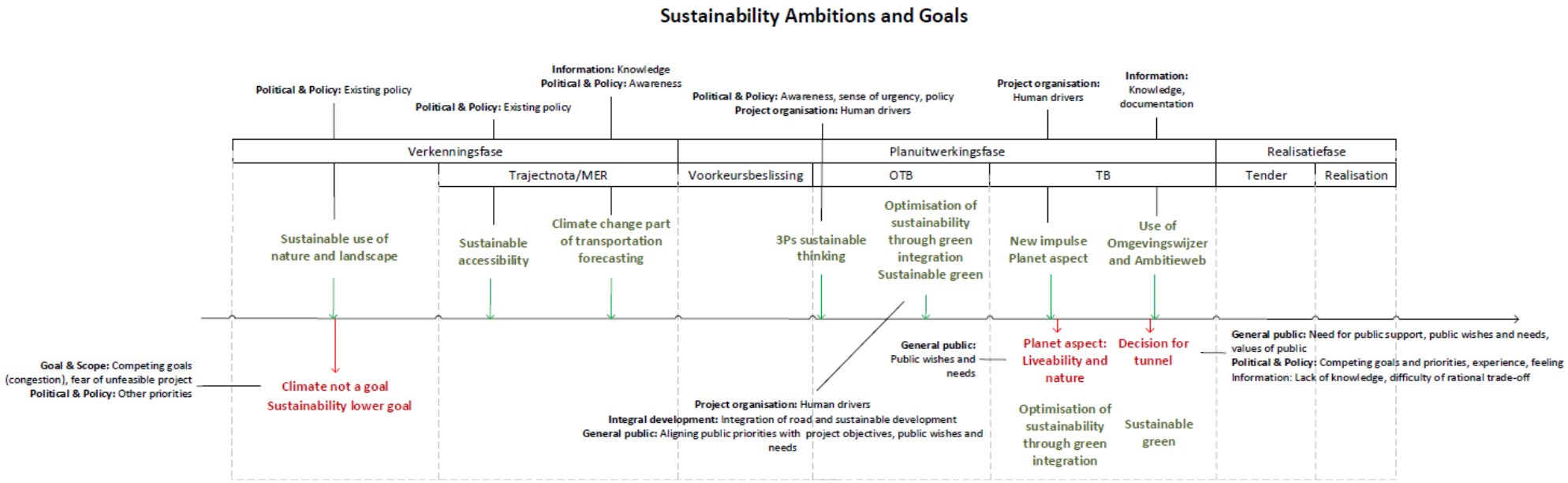

Figure H.2: Timeline of Sustainability Ambitions & Goals in A16 Rotterdam

5.3 Energy & CO_2

CO_2 is not part of the MER, as it would not help to make a distinction between the alternatives. Through human drivers and public participation sustainable energy production becomes part of the considerations in the following project.

It is in the TB phase that energy and CO_2 get a place. Primarily through the Kansenboek a set of suggestions and ambitions connected to CO_2 and energy are articulated. The Kansenboek and the suggestions is the result of a combination of factors. Firstly, there is political will to include these concerns in the project. The next factor is the general public, the general public is aware of the challenges and wants to participate. Similarly this goes for other stakeholders. The human drivers in the project organisation consequently push for a discussion between stakeholders, public and politics. With the use of collaboration mechanisms such as Ambitieweb or Omgevingswijzer. Through this a large set of ambitions and suggestions are made. The main suggestions, efficient energy use to reduce CO_2, sustainable energy production, ground couple heat exchanger techniques in the road, energy efficient and smart installations in the tunnel and sunlight in the tunnel. Furthermore, energy is one of five main ambitions. The energy reduction ambitions are limited by the TB. Through insufficient climate goals, late inclusion of stakeholders and changing political views the solution space of the TB becomes limited. The technical rules and requirements are based on the considerations in the planning process. Energy and CO_2 have played a limited role in that. As a result the TB does not leave room for it. Going back on the TB is undesirable. Earlier inclusion can prevent this from happening

The suggestions and ambitions lead to several measures in the tender procedure and during the contract phase. First the project organisation decides on the use of a DBFM contract and making the contractor responsible for the energy bill for 20 years. This is a translation of the ambitions to limit energy consumption. The challenge to limit energy use, is enforced by the energy bill. While there is a preference for the challenge a requirement was put in place to reduce the energy consumption with 50%. This requirement is partly the result of increasing energy costs as a result of the new Coen tunnel for the energy manager of RWS. Financial benefits are important elements, as are human drivers. Through the drive of several project team members the requirement was put in place. During the tender DuboCalc and CO_2-prestatieladder are used to help score the different designs on the EMVI-criteria. The use of these instruments is related to the experience with them within RWS the knowledge and documentation from earlier uses of the instruments. CO_2-Prestatieladder level 3 was given as a challenge to the market

Results can be found in the Realisatiefase. Firstly, the contractor came up with a way to make an energy neutral tunnel. The planning process resulted in design requirements that pushed the contractor to think about energy and CO_2. It is through the market inclusion and trust and clarity from the project organisation that the contractor is able to think of new ways to save energy. There is room for innovation. Through the DBFM contract the project organisation created a financial benefit for the contractor if the tunnel was energy efficient. Lastly, human activity, the right human drivers can help tremendously. The contractor, together with project organisation, actively looked for ways to improve on energy efficiency. This is also noticeable in the way the contractor found nine places to put solar panels, the use of DC in the tunnel and looking for ways to use daylight in the tunnel.

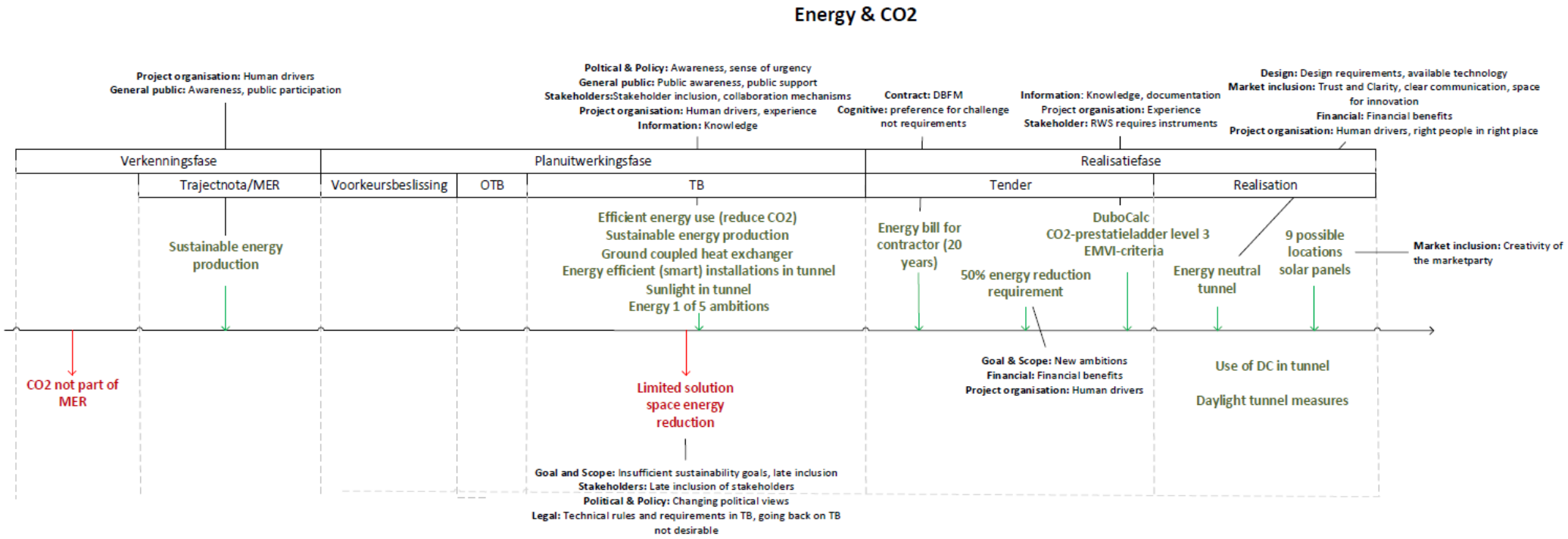

Figure H.3: Timeline of Energy & CO_2 in A16 Rotterdam

5.4 Materials & Waste and Construction & Market

The Voorkeursbeslissing favours a tunnel. A tunnel has a negative impact on material use and subsequently CO_2. The choice for a tunnel relates to two factors. Firstly, no goals on material use or sustainability existed in the early planning process. The priorities of the project do not lie at material use. Secondly, one of the main concerns is liveability. The public expresses her wishes for conservation of the current nature. While there is a conflict on paper, between nature or liveability and materials or sustainability there is not one in reality. Material use is not part of the agenda and not part of the considerations.

Through the Kansenboek, the need for thoughtful material use is given a voice. Materials becomes one of five ambitions. Measure concerned with smart construction logistics, use of composite materials, use of waste from local demolition and Total Costs of Ownership are introduced. Furthermore, sand and concrete are named as main contributors to CO_2 emission during construction.

A DBFM contract is used in the contract phase, with that the project organisation tries to stimulate sustainable material use. The contractor is responsible for maintenance and thus will try to limit those costs, by using sustainable materials. The project organisation uses this form to show trust in the market. The decision is based on long-term thinking and a preference for challenges rather than requirements. Further use of materials is under discussion in the realisation phase. Awareness, experience, sense of urgency and human drivers as well as financial benefits form important factor behind these discussions. The Kansenboek has given material use a kick-start. The current discussion can be attributed to that document and the discussion held during its making.

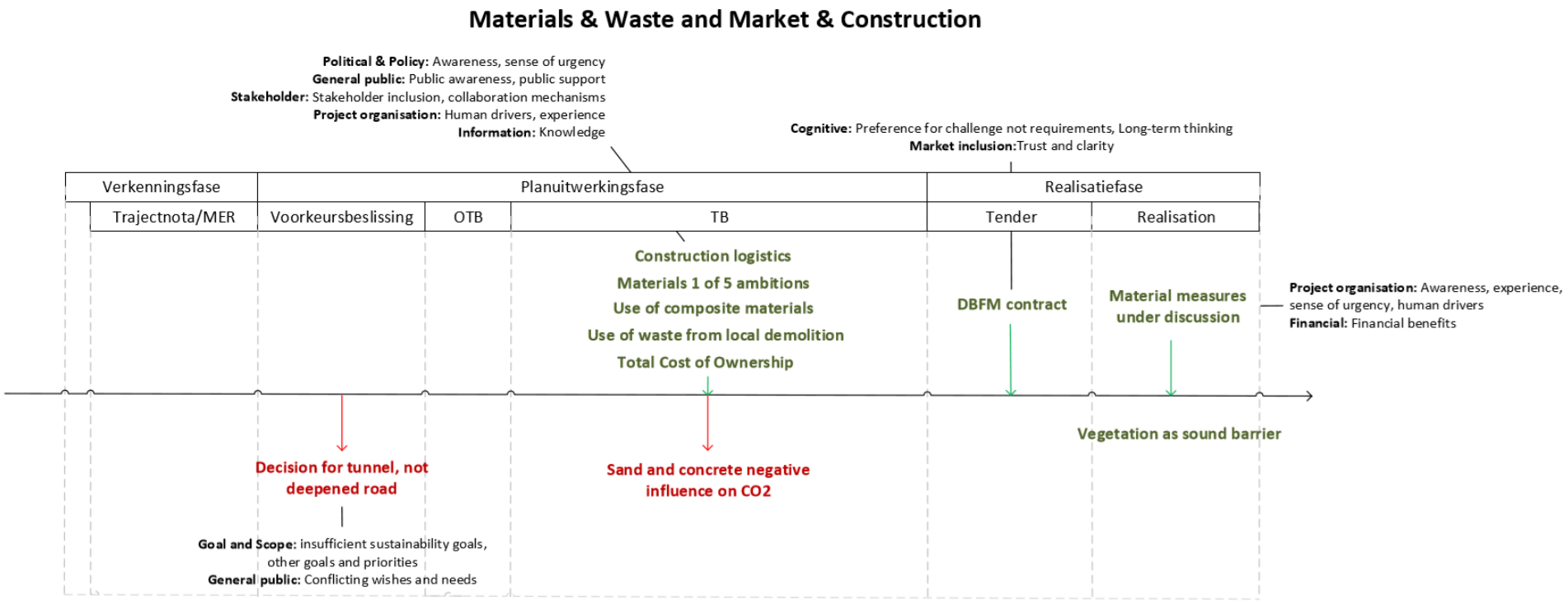

Figure H.4: Timeline of Materials & Waste and Market & Construction in A16 Rotterdam

5.5 Water

Water is a criterion of the MER as required by Wet Milieubeheer. The water requirements are set by the local water authorities, Hoogheemraadschappen. These water requirements are made with the use of models, which include climate change. Thus satisfying water requirements also means adjusting to climate change. Drought is not a part of the MER, as it is not expected.

In the Trajectnota/MER water management is a priority. It is ultimately a political choice, but a choice driven by necessity. The area is a water rich area, and the potential construction of a tunnel could cause multiple water issues. Furthermore, water storage through vegetation is suggested. Related factors are the integration of spatial sustainable development and road development. And aligning public and project objectives. The project needs to compensate for water, as it is required by law. By aligning that with the needs and wishes of the public, green and nature like areas. The result is storage through vegetation, a more robust system and also improvement of liveability in the area. As mentioned before, yet still the case in the Trajectnota/MER climate change is part of water storage standards and requirements of water authorities. In the Voorkeursbeslissing two elements related to water must be named. First the requirement to guaranty stability of the flood defences. Long-term policy, awareness, sense of urgency and priority underlie this requirements. Furthermore, as was introduced earlier, the need to reserve areas for water storage is articulated.

The OTB uses several earlier introduced elements. The design must satisfy requirements of Hoogheemraadschappen, water storage measures must include climate change. The potential flooding at tunnel entrances is solved. New elements are included. The need for sustainable and robust water system, capable of adjusting to climate change is articulated. As is the need for a construction that must withstand changes in the soil due to climate change. Dealing with extreme weather, storms, droughts are now part of water management. So while the climate aspect lacked in earlier phases it is incorporated in the OTB. Sudden inclusion can be explained by the time component. The Trajectnota/MER was published in 2009 while the OTB was published in 2009. Furthermore it is increasing due to long term sustainable policy and priority at the political level. Due to findings from scientific organisations, or the need to include climate change in water management has increased.

The findings in the OTB remain in place in the TB. The water component in A16 Rotterdam is characterised by a slow start followed by a sudden increase in environmental awareness in the OTB phase. Shift in perception and knowledge on climate change in the population is the prime reason.

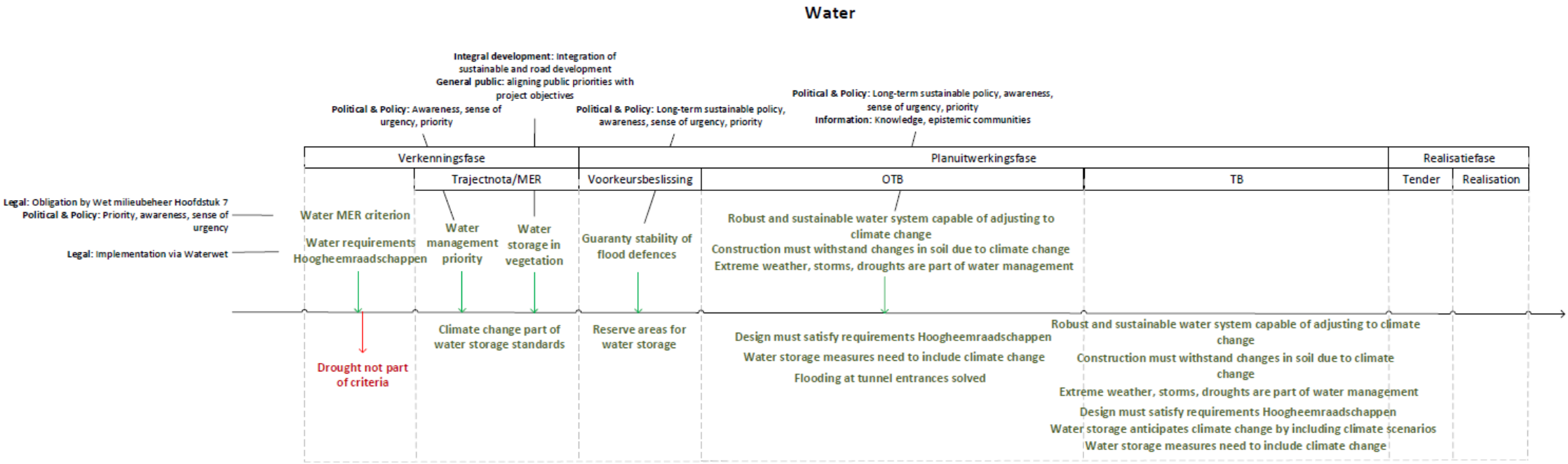

Figure H.5: Timeline of Water in A16 Rotterdam

5.6 Air quality

Air quality is introduced in A16 Rotterdam as a MER criterion in the Verkenningsfase. There is a legal demand for this. Before the project the air quality standards are exceeded in the area. In the Trajectnota/MER one variant is included that focusses on improving the air quality. Political factors, such as priority, awareness and sense of urgency about the current air quality stimulated the construction of the variant. As a potential health threat the air quality is area of interest. The needs and wishes of the general public are important. The MER indicates that development will help to improve the air quality in the area.

The OTB includes an annual check on air quality as a measure. Through development the overall air quality will increase. However, it will be checked regularly to notice if this goal requires more enforcement. Connected to this monitoring is the signing up of A16 at the NSL, air quality is done nationally. The idea is that national measures can increase effectiveness, as air quality is a national problem. While this is true, the NSL might remove some responsibility at the project level. With the construction of the tunnel air quality played a part, however it is unclear if that had any influence. The TB follows the findings of the OTB.

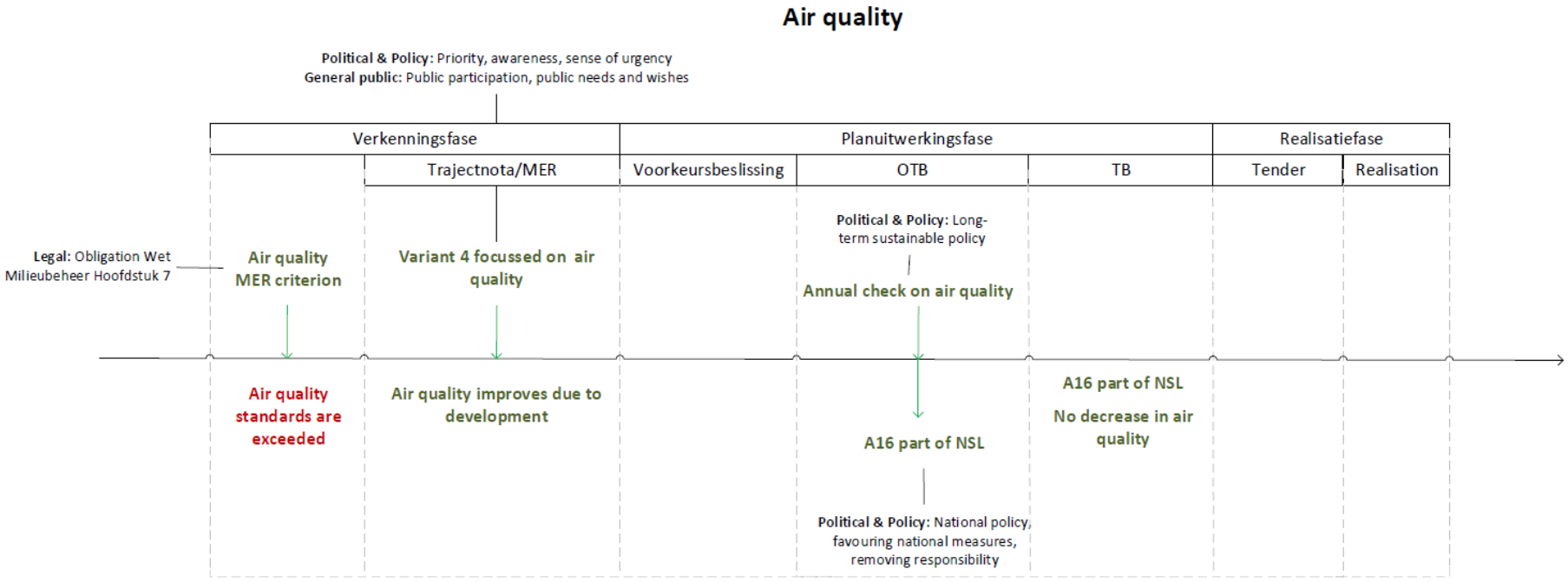

Figure H.6: Timeline of Air quality in A16 Rotterdam

5.7 Climate resilience

During the Trajectnota/MER the idea of a climate proof delta is proposed. Following the Randstad Urgent program. Additionally there is the Nationaal Milieubeleidsplan 4 which is policy solely focused on dealing with the effects of climate change. Both policies become part of the planning process. In the OTB another piece of policy, the 5e Deltaprogramma is named. The goal is to work towards a water robust and climate resilient spatial organisation.

The goals of the 5e Deltaprogramma are present the TB as well. In the TB the need for future resilience and space for future development was articulated. Through long-term thinking and thinking beyond this project and its scope the project organisation came up with ideas to reserve space for future development. This also creates financial benefits. While this is promising new climate scenarios do not play a part in the testing of OTB. The main reason is that these scenarios are new and untested and are not yet part of the water policy. Furthermore, the scenarios are not part of any legal framework. This makes it difficult to use the scenarios properly.

In the tender more on climate resilience is done. Things such as heat, wind, storms and lack of fresh water are increasingly part of the RWS agenda. This is mostly through policies and increasing awareness and understanding of the problem of climate change.

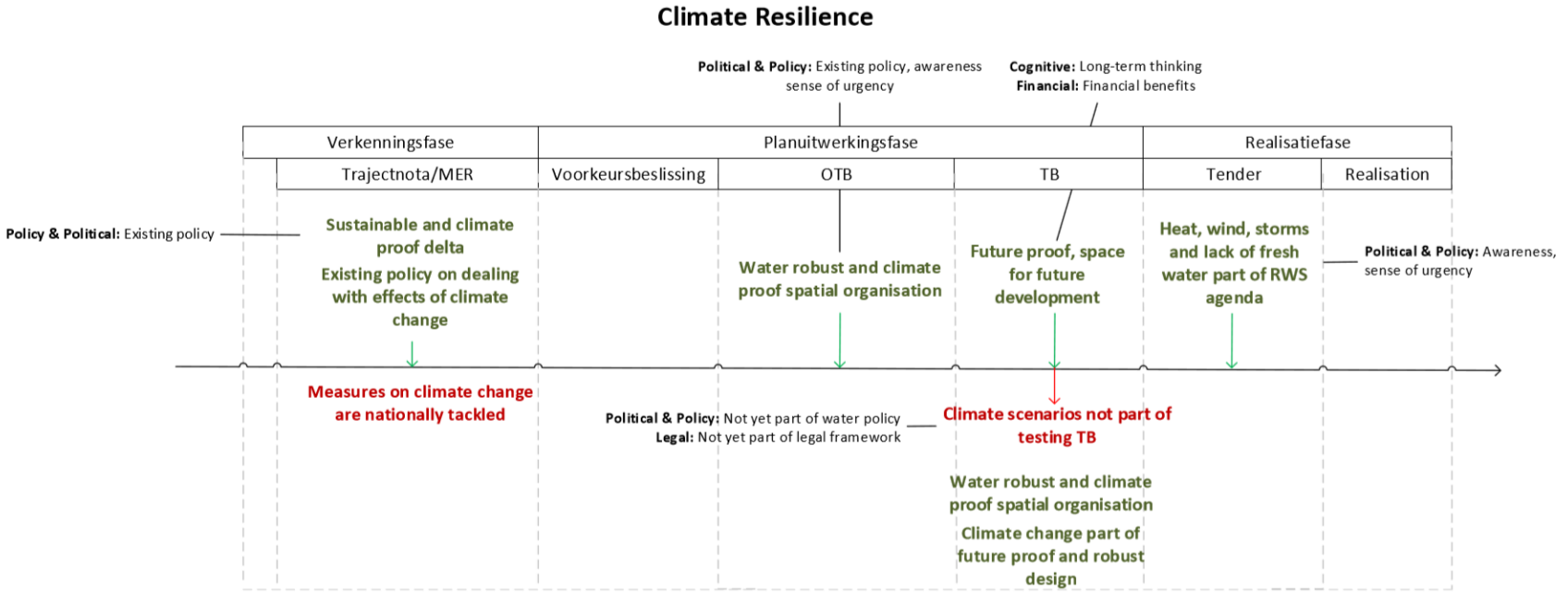

Figure H.7: Timeline of Climate Resilience in A16 Rotterdam

6. Results Case Study A16 Rotterdam

Table H.8 is an overview table of all the factors found in A16 Rotterdam. This table is the conclusion of this case study and this chapter.

Table H.8: Found factors in case study A16 Rotterdam, either with a positive or negative impact on the inclusion of climate concerns.

Integral development factors		**Technical factors**	
Sustainability integral part of project	+	Stringent technical rules in TB	+/-
Goal and Scope factors		**Stakeholder factors**	
Use of Omgevingswijzer	+	Early stakeholder inclusion	+
Use of DuboCalc	+	Stakeholder management	+
Use of Ambitieweb	+	Shared sustainable visions between stakeholders	+
Lack of climate focussed sustainability goal	-	Stakeholder awareness of climate change	+
Lack of early inclusion of climate	-	Number of stakeholders	-
Path dependency of early decisions, limitation of solution space	-	**General public factors**	
Conflict climate concerns and main (congestion) goal	-	Creation of ambition document (Kansenboek)	+
Conflict project's scope and project's feasibility	-	Agreements	+
Conflict climate concerns and liveability	-	Public awareness	+
Conflict climate concerns and inpassing	-	Public support	+
Project organisation factors		Public participation	+/-
Human drivers for climate concerns	+	Alignment project goals and public wishes	+/-
Knowledge of instruments	+	**Legal factors**	
Experience with instruments	+	Legal requirements	+/-
Project team members mind-set	+/-	Lack of legal framework for new climate scenarios	-
Lack of advisor sustainability or climate	-	**Political & Policy factors**	
Information factors		Long term policy on climate adaptation (Randstad Urgent, NMP 4, Deltaprogramma 5)	+
KNMI, other research groups	+	Regional sustainable policy (Rotterdam vooruit)	+
Incapability of MER to study certain aspects	-	Political appeal of climate measures	+
Lack of proper problem analysis	-	Alignment of measures with political activities	+
Lack of information on climate change	-	Connection climate concerns and political campaign (elections)	+
Requirements factors		Political player focussed on climate	+
Requirements based on research	+	Political awareness	+
Extra points for going beyond requirements in tender	+	Sense of urgency	+
Use of sustainability or climate EMVI criterion	+	Experience in decision-making	+
Water authorities decide water requirements	+/-	Intuition in decision-making	+/-
Financial factors		National policy on air quality (NSL)	+/-
Financial incentives	+	Lack of rational decision-making	-
Market inclusion factors		Lack of information in decision-making	-
DBFM contract	+	Multiple themes trade-offs in decision-making	-
Challenge market	+	Climate not part of the political agenda	-
Use of DuboCalc	+	**Cognitive factors**	
Use of CO2-prestatieladder	+	Perception of climate change in last decade	+
Financial incentive (pay energy bill)	+	Perspective of doing things sustainably	+
Market's creativity	+	Perspective of doing sustainable things	+/-
Facilitate innovation power of market	+	View that certain topics are best addressed later	+/-
Include local challenges (local energy production)	+	Fear of large integral but unfeasible project	-
EMVI-criteria	+/-	View that going beyond requirements undesirable	-
Inflexible TB	-		

Appendix I – Conceptual Model for Inclusion of Climate Considerations in Dutch Road Projects

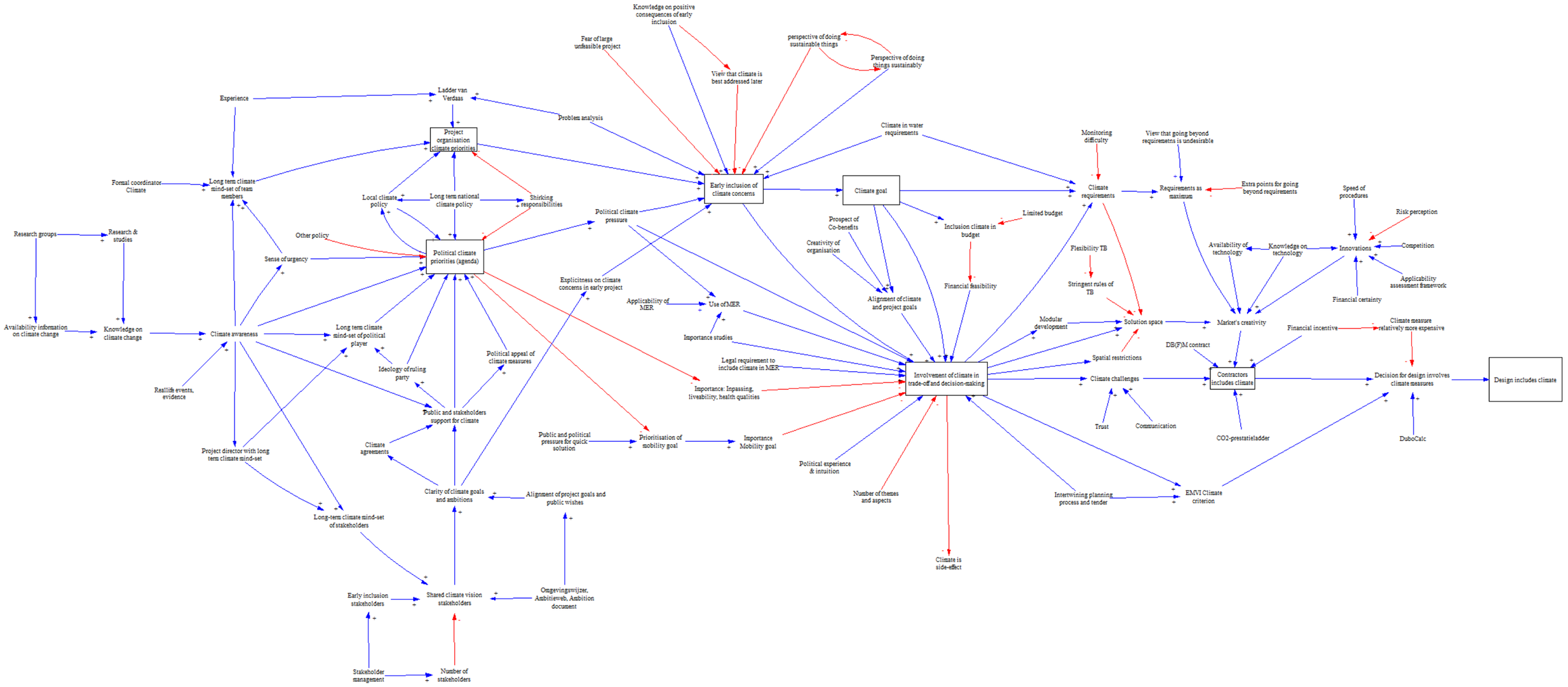

Figure: I.1: Conceptual model of inclusion of climate concerns in Dutch road planning. Blue arrows are positive connections, red is negative. The boxes represent central elements in the inclusion of climate aspects. Left the two decision-makers. In the middle the early inclusion of climate concerns and climate goal. In the centre the involvement of climate considerations ins decision-making and to the right to connection to the market.