Using the Q-methodology to structure the drivers for collaboration behaviour in the Dutch heat and cold energy storage field

Jorick Weijers (BSc.) Delft University of Technology, jorickweijers@DO_NOT_SPAMgmail.com

July 6th 2015

Abstract

Heat and cold storage networks can have a significant contribution in saving CO_2-emissions and creating a more environmental friendly energy market in the Netherlands. Urgency for the usage of heat and cold stems from multiple reasons. Despite these reasons, there is minimal development in the heat and cold energy storage field in The Netherlands. Therefore, a systems analysis from three perspectives is performed into the performance of the field. The technological and economical perspectives do not negatively affect the field's development; the institutional design perspective for which the IAD framework is used, shows that interactions do not lead to collaboration. A Q-methodology study is performed to find the main drivers for collaboration. The results from this Q-methodology show that four perspectives in the field can be seen as main drivers for collaboration behaviour: the Early Adopters-, the Policy Sceptics-, the Quid pro quo- and the Second Movers-perspective. These perspectives are not all institutionalized in Dutch (in-)formal institutions and hence, partly burden collaboration in the Dutch heat and cold energy storage field. This study can be improved by looking at other institutional market designs for the development of the field. Herewith finding other reasons why the field's development is not as large as could be expected.

Keywords: heat and cold energy storage, collaboration, Q methodology, institutional design, IAD framework

1. Introduction

Heat and cold energy storage is hot. On the one hand, this is true, but on the other hand, it is false. It is true, because in the Netherlands a lot of energy production overcapacity is available for 100% of the time to serve as balancing capacity in the energy system. Much of this is capacity based on fossil fuel resources, which have the capability to be able to deliver a more flexible energy output than renewable sources that partly, create this unbalance (Stikkelman, 2013). Patterns of demand and supply are changing during the day and this creates a complex system (RVO, 2014). Furthermore, intermittent energy production creates an unbalance on the Dutch energy grid. This results in an opportunity for storage, if this can take over some of this excess generation capacity. Energy storage is also hot because heat and cold storage can store energy from zero or low CO_2 emitting sources and therewith create a more environmental friendly energy market in the Netherlands, since less fossil sources are then used (Buck, Valkengoed, & Leguijt, 2009). Their benefits could contribute to lower emission targets of the Dutch government as partly set by European directive 2009/28/EC (Intelligent Energy Europe, 2011). Moreover, a necessity for heat and cold storage stems from the European energy efficiency directive, which delegates the obligation to perform heat and cold potential mapping to a national level before the end of 2015 (Steinbach, 2011). Combining this with the trend of decentralisation in society with local energy initiatives leading to new initiatives, a potential source of energy remains untapped: waste heat, despite the demand for heat and also an increasing demand for cold in the Netherlands, 1324 and 84 PJ respectively (Agentschap NL, 2013; Buck et al., 2009; CBS, 2012). Nevertheless, only 4% of the Dutch were connected to a district heating grid in 2012 (Agentschap NL, 2013).

Clearly, there is a need in the Netherlands for using heat, with pressure from the regulatory regime and which would lead to expect a big heat and cold energy storage field. There is a knowledge gap since this not the case and the reason therefore is unclear, hence the following problem statement is developed.

“Different aspects of energy storage in the Dutch heat and cold field seem not yet well enough developed or market conditions are not suitable for a large scale development of the field”.

With energy storage the definition “Energy storage is the storing of some form of energy that can be drawn upon at a later time to perform some useful operation” (Gil et al., 2010) also incorporates the wide range of heat grids, buffer capacity and geothermal storage. The research is scoped by the geography of the Netherlands.

By performing a systems analysis in chapter two, the aspects which now burden the development are found. Insights provided that the development is burdened by the institutional design. Therefore, further research with the Q-methodology technique, which is used to structure the discussion around the Dutch heat and cold energy storage field is described and designed for this specific field in chapter three. A discussion and comparison with market parties should lead to applicable factors, which drive or obstruct the collaboration around energy storage in the Dutch heat and cold chain. This serves also as a test for the factors found in literature to their applicability to elucidate about collaboration behaviour (Bennet & Murphy, 1997). The results are presented in chapter four. The structuring resulted in four perspectives that are presented in chapter five, in combination with the validation results. In Chapter seven, conclusions are drawn. The results are discussed in chapter eight combined with the field’s implications.

2. Problem analysis

A system analysis was performed to see why the heat and cold energy storage field in the Netherlands is not developing. The systems analysis comprised three different aspects of the heat and cold energy storage field: technological, economical and institutional aspects.

The technological perspective looks at the maturity of technologies. Using the maturity framework of (Ortt, 2010) the conclusion can be drawn that at a level many technologies (adaptation phase (Ortt, 2010)) are implemented, mainly as individual and stand-alone initiatives, as shown in Figure 1. However, in general the energy storage infrastructure is not yet implemented on a wider scale or connected to each other and the energy system, especially not in the transmission and distribution chains. The same applies to storage within the heat and cold infrastructure. It is not yet widely implemented, deducting leads to the same conclusion for the entire heat sector, which is not developed widely, especially if you compare it to the other heat provider in the Netherlands, the natural gas sector, which has a full (100 %) coverage of households (Gasunie, 2015).

The economics are closely related to the technical design of the system and the chosen technology. Economic needs, drivers and characteristics of the value chain have many options for electrical energy storage functions to complete a business case. Therefore it is concluded that economic aspects do not burden the development of the heat and cold energy storage in the Netherlands to the extent that this does not influence the results of the research.

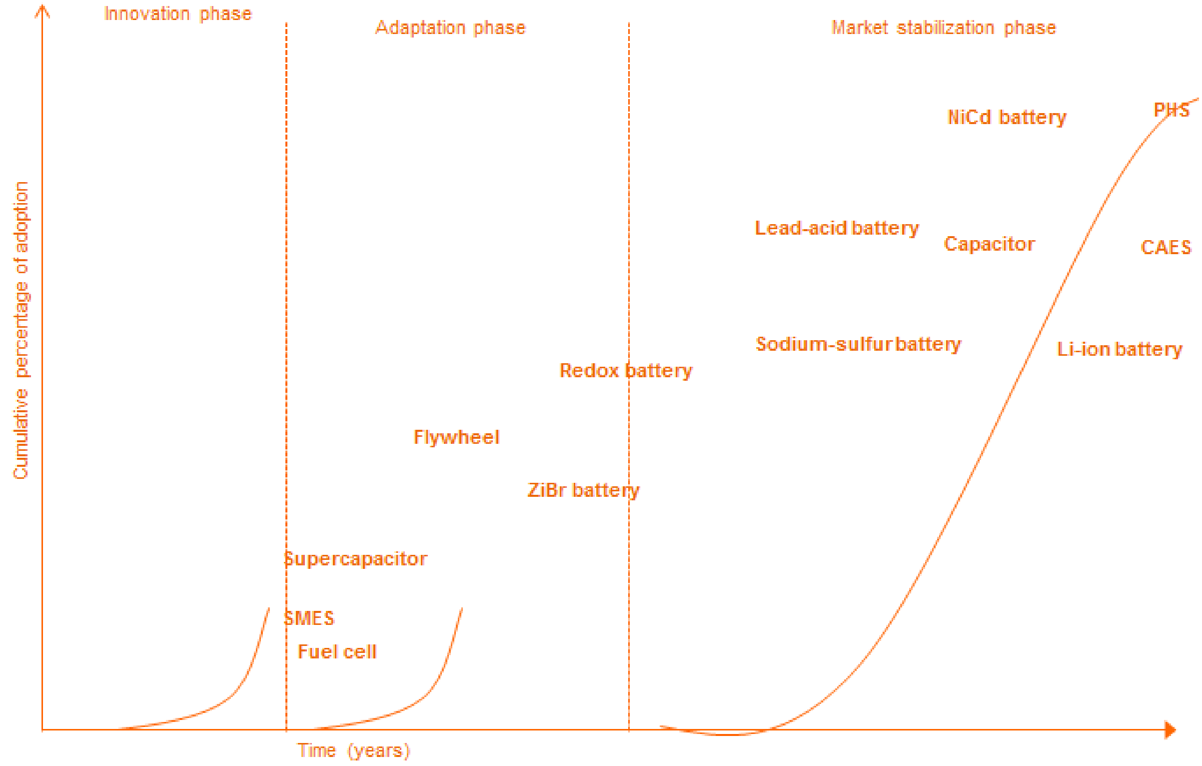

Figure 1 Maturity of energy technologies

A part of the economic design can be argued to relate much to the institutional design. Given that the institutional design puts a very limiting scope on the business case. The Institutional Analysis and Design (IAD) framework (Ostrom, 2011) shows that despite that the number of interactions is high, no desired outcomes are found. This desired outcome should be collaboration to develop the field further; this means that currently there is not much collaboration.

The institutions are not well suited to the social and physical conditions (both technical and economic) of the heat and cold energy storage field. Furthermore, the institutions are not yet able to create the right incentives in order to create collaboration behaviour to grow the field's development. See figure 2 for a graphical representation. Without stating the obvious, the drivers of the community of users, puts a big impact on the effect of any process design for institutional artefacts

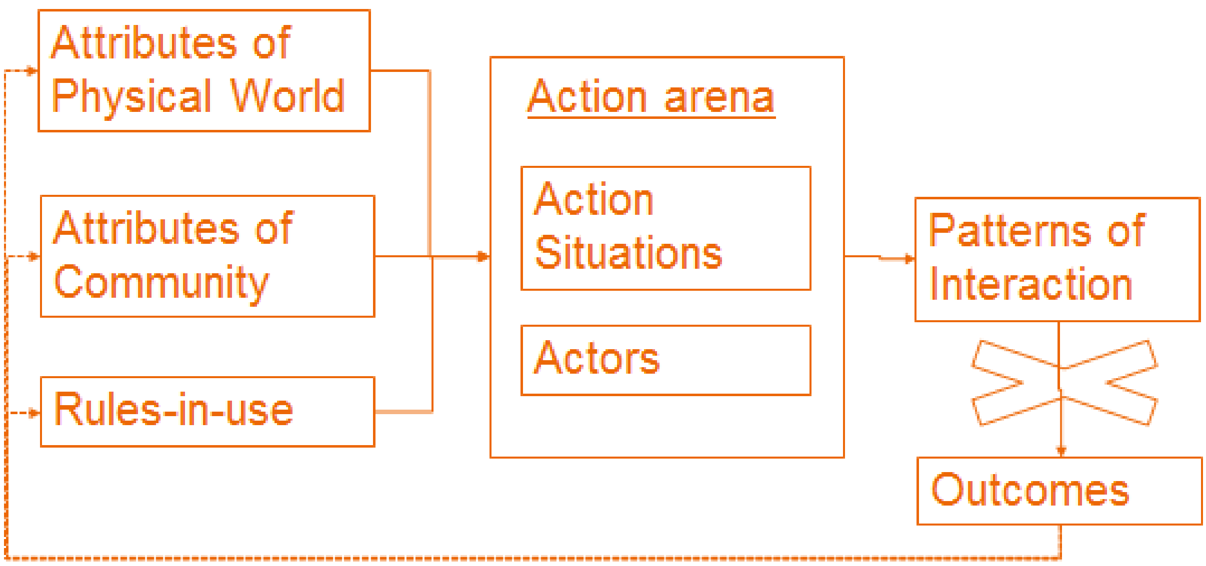

Figure 2 IAD and the lack of desired outcomes

(Auer, 2006). Therefore more research is needed to see which drivers ensure more collaboration in the heat and cold energy storage field in the Netherlands.

To conclude from the previous sections in this chapter the technological perspective seems not to put a burden on the field's development and economically speaking, there is also no burden on further development. Institutionally the heat and cold energy storage field is a complex system with many different stakeholders. The interactions are there, but resulting collaboration is limited, despite the urgency for the economic growth and the interactions (outcome IAD). This paper also tries to see whether the insight into drivers for collaboration behaviour can be used in future market design or government policies. Therefore, the following question was formulated:

"*Which are the most important drivers for collaboration behaviour in the Dutch heat and cold energy storage field?*"

The next chapter will describe the process that is followed to use Q-methodology for structuring of this question.

3. Q-methodology

Q-methodology derived from the well-known Delphi method. It was developed around 1930 as social science study for subjectivity (Brown, 1980). This is a more specific version of the Delphi method focussing on the opinion of experts, not per se in long-term forecasting (Helmer, 1967). Since then, it has been used for multiple fields all of social science for instance to uncover patterns of perspectives in both cases with a clear hypothesis as well as in cases where that is lacking (Barry & Proops, 1991; van der Lei, 2009; Van der Voort et al., 2009; Webler, Danielson, & Tuler, 2009) It has been applied on biomass and other renewable energy sources more recently (Cuppen, 2012; Gijzel, 2014; Webler et al., 2009). A study with Q-methodology can reveal positions or perspectives in a discussion without the mentioned hypotheses.

A main strong point from Q-methodology is that "by allowing the categories of the analysis to be manipulated by respondents, the researcher loses the exclusive power to signify the reality of the researched" (Robbins and Krueger, 2000: 645). Q-methodology differs from other statistical models since it takes statements of respondents and uses those values for statistical analysis rather than using particular large numbers of participants (n-cases) as in traditional statistical research (Exel, 2005). Furthermore, not standard surveys and questionnaires are used, respondents are asked to express their views on isolated statements, within a total group of statements. Based on the ranking or sorting of these statements they can be viewed in the context of all statements presented to a participant. Another characteristic of the Q methodology is that it often chooses both the participants and the statements that are included in the research by looking what can be expected in the field. Herewith an applicable set is created.

Q-methodology is often characterised by the six steps as described below. The Q-methodology that is applied to this research follows these steps from (Brown, 1980). A short description is provided for all of the steps.

1. Define the concourse; The definition of concourse is normally performed by a literature research, consisting of several factors that form the basis for the Q-sample.
2. Define the Q-sample (sample of statements); The set of final statements that are presented to the participants in order to be ranked.

3. Create the P-set (set of participants); Selecting the persons or companies from which an opinion of the topic can be expected
4. Q-sort; The process of the interview with experts with knowledge of the field of interest, ranking of the statements according to a pre-defined distribution.
5. Analysis (factor rotation); Statistical factor analysis to find correlations between Q-sorts.
6. Interpretation; Combining the knowledge from the interviews with the significant factors to come to common perspectives.

4. Applying the framework for Q-methodology in the heat and cold energy storage field

Applicable drivers to form the concourse are derived from literature and two expert interviews. To determine the Q-set three different approaches are taken. By performing a literature research several drivers are found to have influence on collaboration behaviour between stakeholders. Rather than to have a long list of drivers that could be applicable for multiple fields, a set of drivers for the Dutch Institutional Analysis and Development framework (IAD) proposed by Ostrom et al. (1994) is used for this part of the research in combination with the knowledge gained from systems perspective. Next to that also drivers found in the first stage are developed into the Q-set; this Q-set is than given to expert stakeholders in the Dutch heat and cold energy storage field, the P-set (participants). In an interview, stakeholders are asked to rank the factors in the set. The result of the ranking is than tested according to correlation and with a Principal Component Analysis of the Q-sorts. The opinions on the statements form the sample size, if compared to normal statistical analysis. The 73 drivers that have been identified in the literature study have been categorised into 31 statements in the final Q-set. This has been performed via the identified categories in (Barry & Proops, 1991; Cuppen, 2013; Dyer, 2002; Ligtvoet, 2013). The final Q-set consists of 42 statements in the following categories (drivers): Field (11), Other (5), Common goal /Strategy (5) Collective action / Regulation (5), Interaction (4), Price / Cost (4), Time (2), Risk (2), Image (2) and Information / Knowledge (2) (see table 2 after the References).

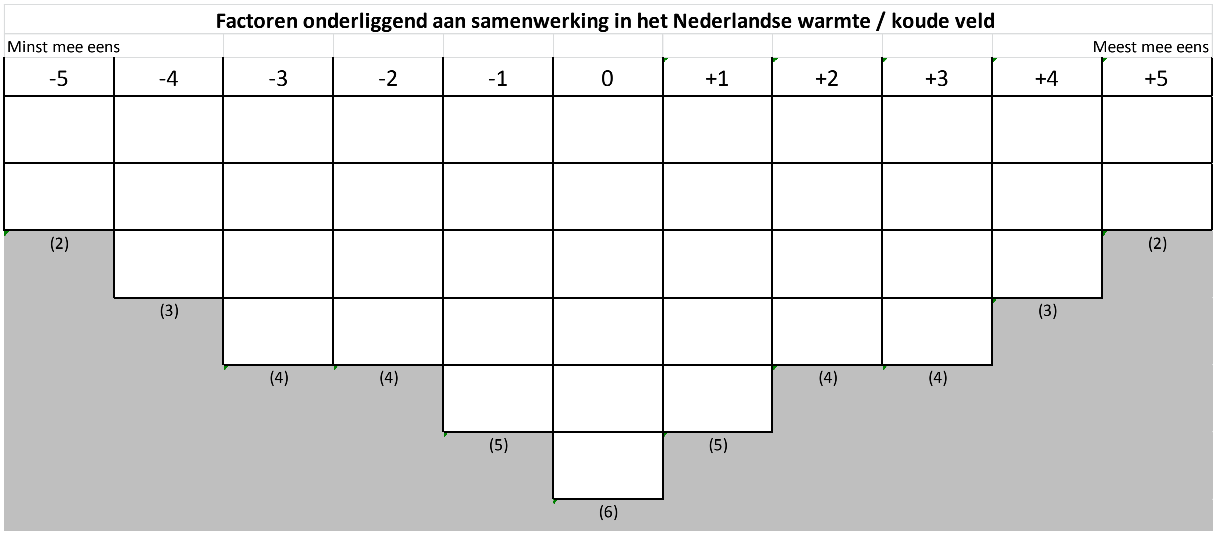

Figure 3 Q-sort pre-determined quasi normal distribution

energy storage is used. To ensure the applicability of these drivers, it is important to keep a 'systems perspective' into account. The

Now that the set of statements is clearly defined, one must find the correct participants to ensure a proper Q-sort as next step of the method. Finding the correct participants influences the applicability of the results, experts of the field can be more specific and their opinion and then the Q-sort becomes more relevant than the opinion of a layman. Given the actor analysis performed earlier in the systems analysis a clear view of the important players was already envisioned, nevertheless seven iterations have taken place before the P-set was finalised (see table 3 before the References).

The P-set is the group of 20 participants who are interviewed to do the Q-sort. Next to that they are also subject to a set of questions. These are essential to the succeeding of this research, since they have to sort the factors for collaboration behaviour in the Dutch heat and cold energy storage field. They consist of the following categories: producers, end-users, installation & project management companies, grid owners, financing companies and researcher. For each category two to three people were interviewed. The Q-sort consists of the participants ranking the statements according to the pre-determined distribution in figure 3.

Steps 5 and 6 are discussed in the following chapter.

5. Results and validation: four perspectives

The results have been compared quantitatively by the Q-sorts from the twenty participants that were selected for the P-set. The output as provided by the Principal Component with the PQMethod (Schmolck, 2014) has been interpreted with the second part of data, the post-sort interviews with the motivation and explanations of the participants. This, in combination with a Varimax rotation resulted in resulted in a total of four perspectives which explain a significant amount of variance (68%). Perspective one has eight participants loading significant, whereas perspective two has two, perspective three has three loaders and the fourth perspective has six participants loading significantly on the perspective. A short description is provided of each perspective, related to that a table with the normalised relation between the categories of drivers as defined in chapter 3 is provided. The relation from a driver to collaboration behaviour is shown in red if the participants in that statement disagree that the driver leads to collaboration, the green numbers respectively do relate to collaboration within that perspective.

Early Adopters perspective

Many participants load on this perspective. This results in a less sharp agreement on the reasons for collaboration. Important for them is the sharing of both profits and losses as a starting point for collaboration "this enables bigger projects with in itself more collaboration" (P-17). Next to that a believe is that government ambitions could slightly help to start the first collaboration behaviour but a strong notion in the comments leads to the interviewers interpretation that in the end, the companies will do it themselves. There is an important disagreement that the number of interactions is too low in the heat and cold field, they say there are more than enough interactions which lead to collaboration. Next to that they are hands-on related to infrastructure and backbones. "If it is not there we will make it there" (P-14).

Many loaders are one of the early movers in the field and already own a grid, or produce and supply heat to a heat grid or other interested parties. The most interesting loader might be the Province of North Brabant, given that the local governments are not always are first movers. Apparently this is the case in the Dutch heat and cold field. One of the participants, who is owner of a heat grid, said:

"Collaboration is always needed, for a collaboration agreement I do however put more effort than in the relation between supplier and customer".

Just like in other perspectives, the participants in this perspective put trust on the most agreed position as a condition before collaboration can start. Distinguishable for this perspective is the importance they put in a collective agreement or expectation in collaboration or a project. The expectation or gain from a perspective seems important "It is per se about getting the entire field towards sustainable heat, from my perspective also the parties should gain in order to get them moving (P-15)", also participant 2 commented "collaboration is time consuming, the negotiations etc., it might be much better for individuals to get a heat pump up and running, this would probably not develop the fields faster though" Despite the complexity in the field they do not agree (most disagree) that the complexity puts a burden on collaboration, "especially for that reason I would collaborate (P-5)". Next to that they do relate a lot of value to the repeating character of the collaboration "If you already know the other parties, you can save an enormous amount of time (P-2)".

Relationship values between drivers and collaboration					
Categories:	Statements per category	Early Adopters	Policy Sceptics	Quid pro quo	Second Movers
Other	8	-0.29	-0.18	-0.31	-0.54
Interaction	5	-1.06	-0.42	0.00	-0.79
Time	2	0.86	1.15	-0.39	0.51
Price / Cost	2	1.71	-0.67	-0.33	0.89
Common goal / Strategy	5	0.84	-0.05	0.54	0.30
Image	2	0.43	-0.92	0.21	0.46
Collective action / Regulation	10	-0.72	0.17	0.31	-0.11
Information / Knowledge	2	0.88	0.87	-0.32	-0.06
Risk	2	0.78	-0.27	-0.57	0.76
Supply / Demand	2	0.69	0.89	-0.27	1.36

Table 1 Average Z-score values of the relation between categories and collaboration per perspective

Policy Sceptics

These participants are known for their scepticism in relation to changing policy related to energy and the heat and cold energy storage market. In their opinion it burdens development and growth and does not stimulate collaboration behaviour at all "It would be nice if they would be a bit consistent for 10 years or so (P-8, Energy financer at a bank)". These participants do not collaborate to put innovations into the market which suits their profile: banker (risk averse) and a close related end-user (does not have the position to do that). Neither is climate change an important driver for collaboration "there are many other ways to handle that (P-12, a direct related heat customer)". Furthermore these participants are not per se sceptical towards collaboration, but they see hurdles on the road towards the collaboration: "So you must assume that in the future heat will not flow in the nets anymore" and "the costs should go down first before more collaboration will start driven by end-users" (End-customer heat).

They are also sceptical with relation to the inter comparability of heat and cold via different tax regimes within the Netherlands

Quid pro quo

and put that on +4 in the ranking. In similar agreement they expect that more sustainability ambitions by the local government could create more collaboration. One of the participants commented that "heat should be the choice; however gas can still be lying next to it in the ground" (TKI). Herewith referring to the complexity of the market, but this can be bridged with collaboration.

<u>Second Movers</u>

This perspective is known for a second-mover perspective, this cannot be generalized to risk aversive, but they do not take the first action in the market for collaboration and economic growth. It looks like they wait until goals are set by amongst others the government or they do not wait, but do see it as a task of the government to set goals and ambitions related to heat and cold. The distinguishing statements fifteen (Sustainable (local) government ambitions enable heat and cold initiatives *(+5*) and three (Collaboration exists because governments organise collaboration (-meetings) (*+3*) confirm that. Next to that the collaboration serves to ensure the recipients of heat. They do also have sustainability as a high aspect to collaborate. But most important is that they tend to wait to collaborate until the moment that infrastructure is provided by other parties.

Forming a general conclusion, to the extent in which this is possible given the disclaimer on generalizability due to the small sample size, it would formulated as to create a policy to change the red negative values into green positive values, starting with the lower valued negative relations in the most perspectives: Interaction and Information / Knowledge. Combined with the stimulation of the higher valued positive relations in the most perspectives: Price / Cost, Supply / Demand, Image and Risk. Finally, it would be advisable to steer with policy on the Policy Sceptics perspective (for Common goal / Strategy and Image) and on the Quid pro quo perspective (for Time, Information / Knowledge and Supply / Demand) since they have a negative relation with collaboration when the category has three positive relations the other perspectives.

According to Gijs de Man these four perspectives are seen common in the market. This results in a positive recommendation for the validity of both Q-methodology as a method and the interpretation of the researcher of the Q-sorts and the Principal Component Analysis. No other common perspectives were suggested in the validation-interview.

6. Conclusions & recommendations

The answer to the research question can be formulated with the information gained from the Q-methodological results: "*Which are the most important drivers for collaboration behaviour in the Dutch heat and cold energy storage field?*"

The most important drivers for collaboration behaviour in the heat and cold energy storage field in the Netherlands are represented in four perspectives: the Early Adopters, Policy Sceptics, Quid pro quo and the Second Movers. With therein the categories of drivers: Interaction, Information / Knowledge, Price / Cost, Supply / Demand, Image and Risk, which have the strongest positive relations towards collaboration behaviour in the Dutch heat and cold energy storage field.

<u>Recommendations</u>

The recommendation is made that a systematic research into market models for the heat and cold energy storage field in the Netherlands could enable other views on the drivers for the structure of the field. This can be used to change the market structure so that perspectives can ground better in the field and crate more collaboration.

Also further research into embedding collaboration perspectives in future policy is needed, so that the policy agenda for the 'heatvision' can be formed with the drivers from this research (Kamp, 2015).

7. Discussion

The comparison shows that despite creativity in policy design, the impact on collaboration will be different for participants in each of the four perspectives in this Q-research, based on the underlying different relations with collaboration. However the information and insights gained from this relations and the recognition of perspective brings more than that. It structures the discussion, why the heat and cold energy storage field in the Netherlands is not developing yet.

However this paper has only assessed the collaboration parts fitted within the institutional design perspective. To explain the stage of development of the heat and cold energy storage field in the Netherlands better, another viewpoint towards institutions or a combination of the latter could be used to improve the details of the results.

8. References

Agentschap NL. (2013). warmte en koude in nederland. Retrieved January 7, 2015, from http://www.rvo.nl/sites/default/files/Warmte en Koude NL 2NECW1202 jan13.pdf

Auer, M. (2006). Contexts, multiple methods, and values in the study of common-pool resources. *Journal of Policy Analysis and Management*, *25*(1), 215–227. http://doi.org/10.1002/pam.20163

Baldwin, E. (2013). The effect of stakeholder involvement on electricity generation: an IAD study of state electric sector decision-making. In *Vincent and Elinor Ostrom Workshop in Political Theory and Policy Analysis Annual Fall Mini-Conferenc*. Retrieved from http://www.indiana.edu/~workshop/publications/materials/conference_papers/Baldwin_2013_Y673_SMCP.pdf

Barry, J., & Proops, J. (1991). Seeking sustainability discourses with Q methodology. *Ecological Economics*, *28*, 337–345.

Bennet, P., & Murphy, S. (1997). *Psychology and Health Promotion*. Buckingham: Open University Press.

Bronder, & Pritzl. (1992). Developing strategic aliances: Conceptual framework for successful co-operation. *European Management Journal*, *10*(4), 412–421.

Brown, S. R. (1980). *Political subjectivity: Applications of Q methodology in political science.* New Haven, CT: Yale university Press.

Buck, A. de, Valkengoed, M. P. J. van, & Leguijt, C. (2009). *IPO ROUTEKAART WARMTE*. Delft.

CBS. (2012). *Hernieuwbare energie in Nederland 2012*. Hardinxveld-Giessendam.

Chisholm, D. (1989). *Coordination without hierarchy*. Berkely: University of California Press.

Cuppen, E. (2012). Diversity and constructive conflict in stakeholder dialogue: Considerations for design and methods. *Policy Sciences*, *45*, 23–46. http://doi.org/10.1007/s11077-011-9141-7

Exel, J. Van. (2005). Q methodology : A sneak preview. *Social Sciences*, *2*, 1 – 30. Retrieved from http://qmethod.org/articles/vanExel.pdf

Gasunie. (2015). Eindverbruiker. Retrieved June 17, 2015, from http://www.gasunie.nl/begrippenlijst/eindverbruiker

Gijzel, D. J. (2014, June 19). *Tunnel Visions on Sustainability: Sustainability aspects and its selection process for road tunnel construction projects*. TU Delft, Delft University of Technology. Retrieved from http://repository.tudelft.nl/view/ir/uuid%3Abfc8799e-4728-44ba-aa81-184a8631e644/

Gil, A. M., Martorell, I. M., Lazaro, A., Dolado, P., Zalba, B., & Cabeza, L. F. (2010). State of the art on high temperature thermal energy storage for power generation. Part 1—Concepts, materials and modellization. *Renewable and Sustainable Energy Reviews*, *14*(1), 31–55.

Groenewegen, N. L. (2013). *Factors influencing collaboration within a partnership of large infrastructural projects in the netherlands*. Tu Delft.

Huisman, R. (2010). *De mogelijkheden voor structurele financiering van warmteprojecten in Zuid-Holland*. Erasmus School of Economics, Erasmus Universiteit Rotterdam.

Intelligent Energy Europe. (2011). Policy development for improving RES-H/C penetration in European Member States: RES-H Policy. Retrieved January 20, 2015, from http://www.res-h-policy.eu/RES-H Policy_2011-June_factsheet.pdf

Kamp, H. (2015). *Warmtevoorziening in verandering*. Den haag.

Ligtvoet, A. (2013). *Images of cooperation – a methodological exploration in energy networks*. *Next Generation Infrastructures Foundation*.

Ortt, R. J. (2010). Understanding the pre-diffusion phases. In *Gaining momentum managing the diffusion of innovations* (Series on , pp. 47–80). London: Imperial College Press.

Ostrom, E. (1997). A Behavioral Approach to the Rational Choice Theory of Collective Action. *American Political Science Review*.

Ostrom, E. (2007). Institutional Rational Choice: An Assessment of the Institutional Analysis and Development Framework. In P. a. Sabatier (Ed.), *Theories of the Policy Process* (2nd ed., pp. 21–64). Cambridge: Westview Press. Retrieved from http://digitalcommons.usu.edu/unf_research/60/

Ostrom, E. (2011). Background on the Institutional Analysis and. *Policy Studies Journal*, *39*, 7–27. http://doi.org/10.1111/j.1541-0072.2010.00394.x

Ostrom, E., Gardner, R., & Walker, J. (1994). Rules, Games, and Common-Pool Resource Problems. In *Rules, Games, and Common-Pool Resources* (pp. 3–21). http://doi.org/10.2307/2083092

RVO. (2014). *Eindrapportage veldtesten, Energieprestaties van 5 warmtetechnieken bij woningen in de praktijk*. *Energy Matters in opdracht van Rijksdienst voor Ondernemend Nederland*. Retrieved from nl

Schmolck, P. (2014). PQMethod (Version 2.35). Retrieved May 4, 2015, from http://schmolck.userweb.mwn.de/qmethod/downpqwin.htm

Steinbach, J. (2011). *Report on European harmonised policy to promote RES-H/C (IEE project "Policy development for improving RES-H/C penetration in European Member States (RES-H Policy)*. Retrieved from http://www.res-h-policy.eu/downloads/RES-H Policy D17 report-final.pdf

Stikkelman, R. (2013). *Converting excess wind power into valuable products*. Delft.

Van der Lei, T. E. (2009). *Relating actor analysis methods to policy problems. Technology Policy and Management*. TU Delft.

Van der Voort, H. G., Dunning, D., Krauss, P., Van Roost, M., Peerenboom, S., de bruijn, J. A., … Groenleer, M. l. p. (2009). *Inzicht in resultaat*. Delft.

Webler, T., Danielson, T., & Tuler, S. (2009). *Using Q method to reveal social perspectives in Environmental research*. Greenfield MA. Retrieved from http://www.seri---us.org/sites/default/files/Qprimer.pdf

Final Q-Set			
#	**English translation**	**Source**	**Category**
1	Despite the complexity, collaboration in the heat and cold energy storage field in the Netherlands is, in my case, not necessary.	(Chisholm, 1989)	Other
2	At this moment, I do not dispose of the right capacities to collaborate.	(Ostrom, 2007)	Interaction
3	Collaboration is developing because governments facilitate collaboration (-meetings).	(Chisholm, 1989)	Collective action / Regulation
4	Collaboration is developing because governments initiate projects.	(Chisholm, 1989)	Collective action / Regulation
5	For collaboration you need, at first, trust.	(Ostrom, 1997)	Other
6	I collaborate to gain information of third parties in the value chain.	(Ligtvoet, 2013; Ostrom, 1997)	Information / Knowledge
7	I collaborate to improve my image.	(Ostrom, 1997)	Image
8	I collaborate to the principle of reciprocity.	(Ostrom, 1997)	Other
9	I collaborate because of the repeating character of the collaboration.	(Baldwin, 2013; Groenewegen, 2013)	Other
10	I collaborate because it improves the efficiency of projects.	(Ostrom, 1997)	Time
11	I collaborate with other parties to save money for all parties concerned.	(Ostrom, 1997)	Price / Cost
12	By collaborating I can make use of economies of scale.	(Ostrom, 1997)	Price / Cost
13	I collaborate to save time during the project in relation to doing the project on my own.	(Ostrom, 1997)	Time
14	I collaborate with other persons, because they possess more knowledge	(Groenewegen, 2013)	Information / Knowledge
15	Long-lasting (local) government-ambitions result in heat and cold initiatives.	Wim Voogd, Dirkjan van Swaaij	Field (Collective action / Regulation)

16	You cannot compare different types of heat and cold via the tax system.	Dirk Jan van Swaaij	Field (Collective action / Regulation)
17	Delivering heat/cold cannot be compared by CO_2-emission rights.	Dirk Jan van Swaaij	Field (Other)
18	The supply of heat/cold can harm other heat/cold alternatives in the spatial environment.	Wim Voogd, Dirk Jan van Swaaij	Field (Collective action / Regulation)
19	I collaborate to divide the risks of the project in comparison to the situation of doing the project on my own.	(Groenewegen, 2013)	Risk
20	I collaborate to share both profit and loss.	(Ligtvoet, 2013)	Price / Cost
21	The regulatory regime is too individual focussed in relation to collaboration.	Own input	Collective action / Regulation
22	I collaborate to promote the synergy between companies.	Own input	Common goal / Strategy
23	Collective solutions are too complex.	Own input	Collective action / Regulation
24	Because of varying policy of the Dutch government, it is impossible to collaborate on a longer periodical basis.	Own input	Collective action / Regulation
25	The technical design of heat/cold projects is not future proof.	Dirk Jan van Swaaij	Field (Other)
26	The project management of heat/cold projects is not future proof.	Dirk Jan van Swaaij, Wim Voogd	Field (Other)
27	The number of interactions in the heat/cold field is too small.	IAD	Interaction
28	Initiatives for collaboration are split up.	Own input	Interaction
29	Initiatives for collaboration are divided throughout the Netherlands.	Own input	Interaction
30	The (ground) water-system is not suited for large-scale implementation of heat/cold projects.	Own input	Other
31	There is too much competition to be able to collaborate.	Own input, Dirk Jan van Swaaij, Wim Voogd	Field (Interactions)
32	I collaborate to guarantee that supply will be certain.	Dirkjan van Swaaij	Field (supply /demand)
33	I collaborate to guarantee that demand will be certain.	Dirkjan van Swaaij	Field (Supply / Demand)
34	I collaborate in the heat/cold field when infrastructure is available.	Own input, Dirk Jan van Swaaij, Wim Voogd	Field (Collective action / Regulation)
35	I collaborate in the heat/cold field, because I/we facilitate the necessary infrastructure.	Own input, Dirk Jan van Swaaij, Wim Voogd	Field (Collective action / Regulation)
36	I collaborate to put innovations in the market.		Risk
37	I collaborate in the Dutch heat/cold field to reduce climate changes.	(Ligtvoet, 2013)	Image
38	I collaborate to join new markets, in order to increase my profits.	(Bronder & Pritzl, 1992)	Price / Cost
39	I collaborate to realize a common or equal activity.	(Huisman, 2010; Ostrom, Gardner, & Walker, 1994)	Common goal / Strategy
40	I collaborate to aim for a common or equal strategy.	(Huisman, 2010; Ostrom et al., 1994)	Common goal / Strategy
41	I collaborate because of common or equal expectations in a project/collaboration.	(Huisman, 2010; Ostrom et al., 1994)	Common goal / Strategy

42	I collaborate because of a common or equal culture in a project/collaboration	(Huisman, 2010; Ostrom et al., 1994)	Common goal / Strategy

Table 2 Q-set (statements in the Concourse)

Company (type)	**Function description**	**Description PQMethod**
Ministry of Finance	Direction of International Affairs and Taks on usage.	MinFin
TU Delft	Professor Energy system analysis.	TUDelft
Branch organisation horticulture	Policy specialist Energy and entrepreneurship at industry association of horticulturists.	Branche
Installation company & project manager	Commercial manager installation and project management.	Instal
Ministry of Interior and Kingdom Relations	Direction of spatial environment.	MinBZ
Bank	Renewable energy financer	Bank1
Net owner and production capacity owner	Director (Owner of installations and heat/cold grid).	NetOwn
Bank	Project finance powers and renewables.	Bank2
Close related end-user 1	Inhabitant and participant in a Collective Property Ownership foundation with forty-three households.	Close1
Province of Noord-Brabant	Policy advisor heat Province of Noord-Brabant: Focus on reusing industrial waste heat within households and companies. Usege of heat cold storage.	ProvNB
Producer and distributor heat and cold	Commercial Director (and grid owner).	Produ1
Close related end-user 2	Foundation "Reeshof heat", Organised end-customers in heat grid, who are not fund of the grid.	Close2
Housing cooperation	Director Responsible for finance, administration and sustainability.	HCoorp
Geothermal heat owner and producer	Amongst others: Owner geothermal plant, energy cooperation and paprika farmer.	Geoth
Producer and distributor heat and cold	Sustainable spatial development of customers within a distributor and producer of heat and cold.	Produ2
TKI EnergyGO	1) Chair interest group renewable energy + Chair TKI from the Topsector Energy. 2) Domaincoordinator: "heat" of Energydeal.	TKI
Producer and distributer heat and cold	Producer and distributer of heat: Strategic decisions on heat topics.	Produ3
Ministry of Economic Affairs	Senior policy maker of the direction Energy and Sustainability..	MinEZ
Municipality of The Hague	Programme director: strategy and policy on sustainability and heat (= special intra departmental department).	Munici
Installation company & project manager	Director	PBWKZH

Table 3 P-set (participants in the Q-sort)