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A governance perspective on NZEB niche development in India: a comparative case study

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1. Introduction

Globally, the building sector continues to consume vast amounts of energy. In recent decades, growing urbanization, stable economy and improved standards of living in developing countries, have resulted in increased demand for energy commonly used in buildings (UNEP-SBCI, 2009). As global warming and fossil fuel depletion highlight the need to save energy and reduce carbon footprint, the energy consumption and demand in buildings continue to increase (IEA & WEO, 2013). Energy efficient buildings have seen an increased uptake in the past decade but many challenges still obstruct it to become a mainstream practice in developing economies (BPIE, 2011). Very recently, extremely high performing buildings using a new concept of net zero-energy building (NZEB) have gained attention by the research community, early adopters (passive design consultants, technology providers) and policy makers in developed countries setting ambitious targets to transform their building stock toward low, near zero or zero energy buildings and leading to radical innovations in building sector practices.

NZEBs are buildings with the highest level of energy efficiency and should ideally reduce the overall demand for energy in buildings. This can be achieved by adopting passive design strategies, the use of efficient technologies, and as the energy demand is optimized the building would then use renewable energy systems to meet the energy demand through self-generation (Marszal & Heiselberg, 2009). Hermelink et.al (2013) defines NZEBs as buildings that are self-sufficient in their energy needs by first reducing the energy demand and then using on-site renewable energy sources. Such buildings offer a promising solution to deal with future energy challenges with limited environmental impact. To support the uptake of NZEBs in the building sector, countries need to transform their building innovation systems. This means development and implementation of innovation policies and stimulating innovation business models are needed (Geels, 2004).

These transformations generally imply changes in structure, user practice, regulations, networks, infrastructure, culture and new technologies (Loorbach & Rotmans, 2005). To do so, innovative approaches should be encouraged to support the transition towards low energy buildings (or NZEB) in a more sustainable fashion with inclusive policies and strategies, especially in developing economies such as India. Although India's green building sector has gained momentum in recent years with several supportive policies and strategies from the government, but so far has seen limited impact at the sectoral level. Currently, India's internal nationally determined contribution to mitigation of climate change includes reduction of GHG emissions (of the 2005 levels) by 30% till 2030, which is seen as an ambitious target (IEA & WEO, 2013). In this view scaling up of the NZEBs can be viewed as a "The game changer" for curbing GHG emissions from the building sector (TERI, 2015)

The Indian buildings sector is expanding rapidly; 70% of the building stock for 2030 is yet to be built (NRDC & ASCI, 2012). In terms of energy consumption, this poses a great challenge as buildings are responsible for nearly 33% of total energy consumption in the country (NRDC & ASCI, 2012). In this perspective, large scale development of NZEBs has the potential to deal with future energy challenges and ensure energy security for the country especially in urban settings. To achieve this, a major transformation and innovation

is required to fundamentally reduce the consumption of energy in new buildings which is a formidable task, as it requires drastic changes in technologies and construction practices. At the moment the market niche of NZEBs in India is at a nascent stage of niche formation, with only a handful of NZEB demonstration projects; needing a large scale implementation and adoption (Jain et.al,2016 (under review).

Mainstreaming NZEBs would also require radical transformations which are expected to face huge resistance from the status quo. Governments and governance systems play a special role in stimulating innovation and supporting the wider diffusion and adoption of new sustainable technologies (in our case NZEB technologies), by introducing innovation policies and a conducive framework for implementation (Edquist, 2005). Stone (1989) conceptualizes governance as "creating the capacity to act" by bringing together the resources required to accomplish the collective ends of society. Similarly, De Boer *et al* (2013) define governance in terms of the combination of the relevant multiplicity of responsibilities and resources, instrumental strategies, goals, actor-networks and scales. As a context, governance, to some degree, restricts and enables actions and interactions in a certain part of society (Bressers et al, 2013). This can also apply to innovation systems, for instance incentives, networks, structure, and culture that have to do with the introduction and innovation diffusion of NZEBs in Indian building sector. In this perspective, the paper aims to analyze the state of governance in the selected regions in India to assess how supportive or obstructive the context is and the existing strengths and weaknesses towards large scale implementation of NZEBs and scaling up innovation.

Thus the main research question is: ***What is the state of governance in New Delhi and Ajmer regions of India regarding NZEB niche development?*** A comparative analysis of the state of governance for NZEB niche development was conducted for both regions to assess the context independently. The paper is structured as follows. In section 2, we present the theoretical frameworks of the Governance Assessment Tool (GAT), and Strategic Niche Management. Section 3, will present the case study design and case selection with description of the New Delhi and Ajmer regions, the methodology used, and information on how data were analyzed. In Section 4, we present the results of the case study analysis. In Section 5, we discuss the results. In section 6, the conclusions are presented.

2. Theoretical Framework

This section presents the two theoretical frameworks which will be of interest to understand the niche development process with a governance perspective. To do so, first the Strategic Niche Management (SNM) is presented which explains the diffusion of new sustainable technologies through the formation of protected niches. Later section 2.2 elaborates on governance and its influence on facilitating and stimulating innovation and supporting wider diffusion of sustainable innovation. A descriptive tool of Governance Assessment Tool will be introduced which can provide a vision towards current and possible future pathways for the governance context. This can be helpful to evaluate like any other policy, the introduction and innovation diffusion of NZEBs in the Indian building sector and future policy programs. The paper will attempt to compare the SNM with the GAT to further the understanding and analytical approach to assess niche developments and deepen our understanding of innovation and diffusion of sustainable technologies in a given sector.

2.1 Strategic Niche Management

Theoretical frameworks such as Strategic Niche Management (SNM; Kemp et. al.1998; Hoogma, 2002; Raven, 2005; Schot &Geels, 2008) provide insight into fostering technological and social change and at the same time initiating sustainable innovations at niche level. SNM is an analytical framework designed to facilitate and study the introduction and diffusion of new sustainable technologies through societal experiments forming a niche (Schot & Geels, 2008).

SNM advocates that successful radical innovation spur from socio-technical experiments in which various stakeholders collaborate, exchange information, knowledge and experience (Caniëls & Romijn, 2008). Thus SNM involves participation of several actors within the dominant sectoral regime making it a multi-actor approach. It states that governments (as one of the participating actor or stakeholder) can be instrumental in facilitating wider transitions, and illustrates how widespread technology change within well-established socio-technical systems can be achieved (Schot et.al 1999; Rip and Kemp, 1998; Weber et.al., 1999). This can be done by facilitating the process of niche formation and setting up a set of successive experiments or by policy instruments (proposed by government) that supports niche development e.g. subsidy schemes, regulatory exemptions, programs that include pilot projects etc. Many SNM scholars explain the success or failure of a niche by analyzing interaction between the three main niche process namely *shaping of expectations, building social networks, and learning process* (Mourik & Raven,2006;Caniëls & Romijn,2008;Schot & Geels,2008).

2.2 Governance Assessment Tool

The 'Governance Assessment Tool' (GAT) was developed as a descriptive model to assess the quality of governance in a specific context to evaluate a particular implementation setting. The basis for the tool was a collection of insights on governance as developed by Bressers and Kuks (2003, 2004), and has a background in the Contextual Interaction Theory (CIT) (Bressers & Kuks, 2004).The GAT helps to assess and identify the strong and weak points in the governance context when it comes to enabling and supporting collaborative and adaptive management in practice (in our case innovation for NZEB niche development). The tool predominantly draws attention to understanding of existing situations that can obstruct policies and projects under complex and dynamic conditions (Bressers & De Boer , 2012). Therefore, it is of interest to use the assessment tool to deepen our understanding of energy transitions and innovations of niche developments through implementation process. In this paper the GAT will be used as primary analytical framework to assess the governance system surrounding the NZEB niche within the building sector. GAT will complement the governance and policy components of Strategic Niche Management (SNM). The GAT results will be analyzed through an "SNM lens".

2.3. Governance Assessment Tool and NZEB niche development

Using the GAT for the assessment will provide insights to the current governance context of NZEB demonstrations projects and NZEB niche development in regions under study. The assessment can highlight the challenges in the governance regime which might obstruct or slow down the large scale implementation and adoption of NZEBs, but may also help to identify potential drivers and strengths. In addition, the results can be used to make a holistic ex- ante evaluation of how the governance context can influence collaborative management of the NZEB niche development process in a particular region.

For these reasons, it will be interesting to use GAT in order to understand and assess the building sector in India vis.-a-vis. NZEB niche development. It will also be of theoretical interest to use GAT in a way that allows for assessing niche development of sustainable innovations (like NZEBs). This is rather novel since GAT has not been used for this purpose (certainly not in transition studies research) to assess developments and diffusion of sustainable innovations in the built environment, nor in the topical field of energy.

2.3.1 The dimensions of the Governance Assessment Tool

The GAT framework introduces five aspects of governance. GAT can be seen as a check list to describe all relevant aspects of the governance context. In GAT, governance is no longer considered an extension to public policies. Moreover, policies are no longer developed by one central actor (nor are only one target

group assumed). Interactions between different actors and networks at multiple levels contribute in developing policies (Bressers & De Boer , 2012). However, the variety of actors has diverse perspectives, ambitions; strategies, instruments, resources and responsibilities. Hence, the five developed dimensions of governance are useful to assess the governance context regarding a particular aspect. Figure 1- presents the five interrelated dimensions of governance that are central to GAT.

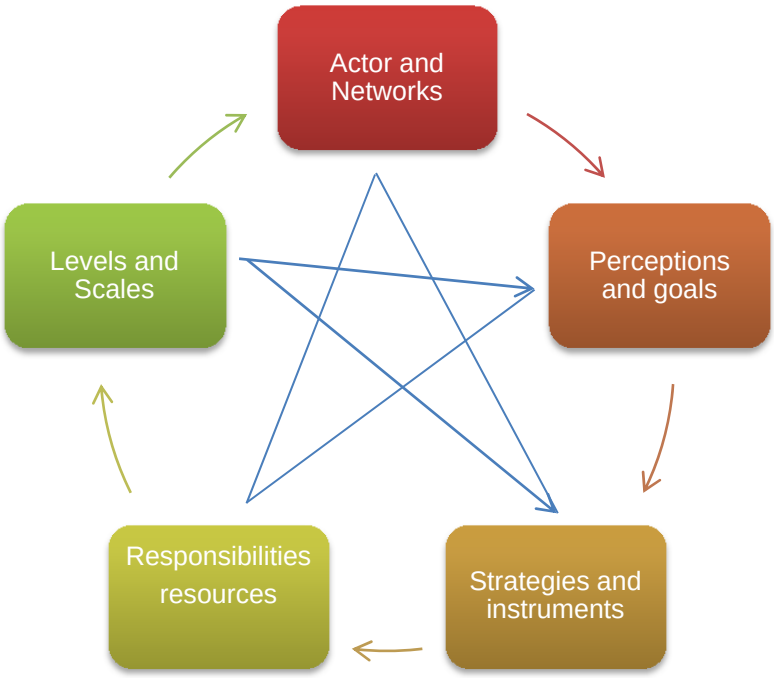

Figure 1 : Five dimensions of GAT ((Bressers & De Boer , 2012)

The five dimensions provide a clear overview of the governance context (or contents of a governance regime in a certain area with certain issue). To understand how a governance context enables or restricts actions and interactions, the model was complemented with four quality criteria: *extent, coherence, flexibility and intensity* (Bressers & De Boer , 2012).The governance dimensions and qualities together form the core of the GAT.

By analyzing the five dimensions of governance according to the four qualities of the governance regime, one can attain a very pragmatic understanding of how different elements of governance interact and hence influence a particular implementation setting (in our case NZEB niche development). ***Extent*** is a quality of a governance regime that refers to how completely it considers the various elements that have an impact on the process at stake (in this case NZEB niche formation). The ***coherence*** of that same regime relates to how the various elements of the regime strengthen rather than weaken each other. Given that the actors are different and important in different settings within a particular governance context; effective implementation will also be influenced by the flexibility available. In a ***flexible*** governance regime, actors have formal and informal liberties and stimuli to act towards the implementation actions that assist in achieving goals. Finally, ***intensity*** is “the degree to which the regime elements urge changes in the *status quo* or in current developments” (Bressers et.al, 2013). These dimensions can be used to follow up the first descriptive step and enable a more in-depth picture of the governance setting.

3. Research Design and Methodology

To assess the governance of the two selected regions for NZEB niche development, the study uses a descriptive model of "GAT" which is complemented by four evaluative qualities. For the empirical study, two regions in India were selected to assess the strengths and weaknesses of the governance context toward implementation of NZEB in a large scale.

3.1 Descriptions of the two case study regions

3.1.1 Delhi region

Among all the state and Union Territories, the city of Delhi is overwhelmingly urban; with 75 % of its total area (1483 sq. km) falling in urban jurisdiction and the population density in urban area is as high as 14, 698 persons per sq. km as per 2011 Census. 16.37 million Population i.e. 98 % of the total population (16.79 million) of Delhi is residing in urban areas. The highly urban character of Delhi exerts a tremendous pressure on public delivery of services including housing, construction of new buildings, energy demand, and poses a great challenge for the city administration.

Figure 2 : Location of Delhi

The demand for housing in Delhi is relentless, as more and more people continue to come to this Metro City in pursuit of education and employment opportunities, population growth as well as in-migration. Housing and urban development is a priority sector in the development of planning process in Delhi. The Delhi Government is only one of the many players in the housing sector because land, land development and public housing fall under the jurisdiction of the Delhi Development Authority (DDA).

Delhi has the highest per capita power consumption among the States and Union Territories of India, with a consumption of 1265 KWh per capita per annum as compared to the national average of 606 KWh (TERI, 2015). The power demand in Delhi is growing at the rate of 5-6% yearly (IEA & WEO, 2013). The number of electricity consumers in Delhi has grown by 90.47% during the last ten years, with the highest growth in residential and commercial buildings. The Central Electricity Authority, the Ministry of Energy, and the Government of India, in the report of 18th Electric Power Survey have projected a maximum demand of electricity in Delhi of 6398 MW by the end of 12th Five Year Plan (by March- 2017). The forecast of energy requirements made in the report indicates that the total demand may rise to 9024 MW by the year 2021-22.

Renewable Energy: A Solar Photo Voltaic (SPV) Power Plant of 2.14 MWp at Indira Gandhi International Airport has been successfully installed and commissioned. It is proposed to develop New Delhi Municipal Council (NDMC) area as Solar City by installing SPV panels on rooftop of government buildings, metro stations, bus stops, etc. The New Delhi Municipal Corporation (NDMC) area has also been selected to be developed as a smart city under the Smart Cities Mission. The government of India has approved for the

installation of the Grid Connected Rooftop Projects in Delhi. The Delhi Urban Art Commission (DUAC) has recommended the urban development ministry to increase the floor area ratio for all green buildings by 1%. The Green Rating for Integrated Habitat Assessment (GRIHA) has become compulsory in Delhi and hence it is easy to develop green architecture buildings in the city. With regard to the recent announcements by the Governor, green buildings in Delhi are being developed at a faster rate than normal conventional buildings.

3.1.2 Ajmer Region

The Ajmer region is upcoming and one of the fast growing cities in the state of Rajasthan with a total population of 542,321 (as per census 2011). Nearly 99.6% of the city population in the city is served by grid based power and also 5% of the total power supply in the city comes from renewable sources of energy. The city currently lags behind in innovation and transformation in the building sector toward energy conservation measures and various other sustainable initiatives. Currently there are no LEED[1] or GRIHA certified buildings. The population is growing rapidly and so is the demand for more housing. This will increase the demand for energy in the city. The concept of low or zero energy building can bring innovation in the building sector toward NZEB niche formation in the region. Recently , the city has proposed to run its railway station on solar energy and public sector buildings (Ajmer Municipal Corporation) have also installed roof top solar PV for energy generation using net metering policy.

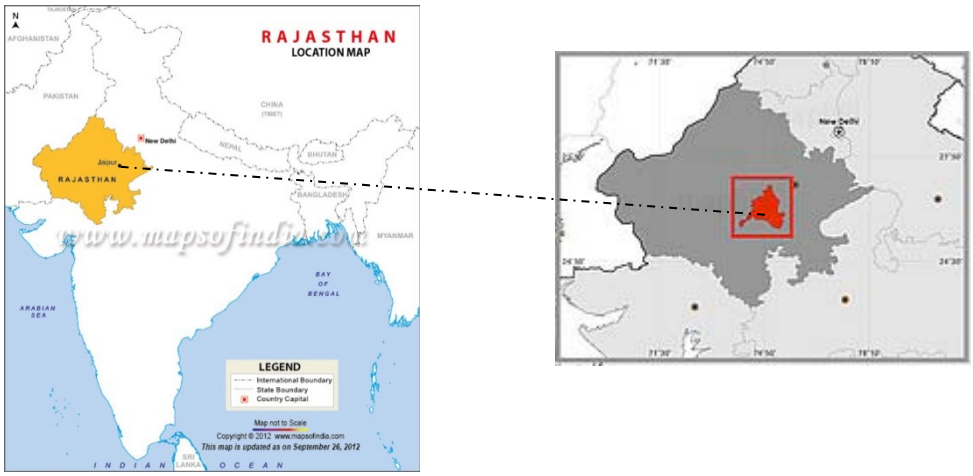

Figure 3 : Location Ajmer city

The selection of the two mentioned regions (cities) for the case study analysis was largely derived from the difference in sizes/population of the cities, growth in demand for energy and the market for energy efficiency in buildings. The Delhi region is a big metro city in India and would be an interesting case to highlight the governance aspects towards update of NZEB niche in this region and has the potential to lead and pave the way for other regions. In contrast, the Ajmer region is a relatively smaller city in India, where concepts of energy efficiency in buildings have not yet been surfaced with any green certified building. Hence the two contrasting regions would provide a more pragmatic understanding of NZEB niche formation and the state of governance for future uptake in these regions.

3.2 Data collection

The data collection started with the identification of key stakeholders of the Indian building industry with a focus on stakeholders that have a significant role in promoting building energy efficiency in India (e.g. Table 1).

[1] Leadership in Energy and Environment Design –United States Green Building Council

Table 1: Key Stakeholders in the Indian Building Industry **(TERI, 2015)**

Key Stakeholders	Institutions
National Ministries	MoHUPA, MoUD, MoEF, MNRE MoP, BEE
Other federal institutes	CIDC, NBO, BIS
Sub-national ministries/departments/ PSU	State governments and local authorities , CPWD, PWD ,HUDCO Delhi development Authority, Ajmer Development Authority
Building sector associations	NAREDCO, CREDAI,IGBC, GRIHA council, Builders Associations
Private sector buildings / construction organizations/ service provider	Developers, Architects, consultants, facility managers
Financial Institutions	NHB, HFC, Banks, MFCs, FDI
Research & Academia	IITs, CBRI, Building centers, CEPT University, TERI, Development Alternatives, IIHS, TIFAC
Manufacturers and suppliers of building material, technologies and products	Several

Acronyms
MoHUPA-Ministry of Housing and Urban Poverty Alleviation
MoUD-Ministry of Urban Development
MoEF- Ministry of Environment & Forests
MNRE-Ministry of New and Renewable Energy
MoP-Ministry of Power
BEE-Bureau of Energy Efficiency
CIDC-Construction Industry Development Council
NBO-National Building Organization
BIS-Bureau of Indian Standards
CPWD-Central Public Works Department
PWD-Public Works Department
HUDCO-Housing & Urban Development Corporation Limited
NAREDCO-National Real Estate Development Council
CREDAI-Confederation of Real Estate Developers' Associations of India
IGBC-Indian Green Building Council
NHB-National Housing bank
HFC-Housing Finance Companies
MFC-Micro-finance companies
FDI- Foreign Direct Investment
IIT-Indian Institute of Technology
BRI-Central Building Research Institute
TERI-The Energy & Resources Institute
IIHS-Indian Institute of Human Settlements
TIFAC- Technology Information, Forecasting and Assessment Council

To assess the governance system, selected key stakeholders were identified for data collection which entailed a set of ten “in-depth” interviews in New Delhi region and a set of seven “in-depth interviews” in the Ajmer region followed by secondary sources of data (published reports, newspaper articles), participation in meetings and field trips to the selected regions. The interviews involved experts from national ministerial authorities, the state governments, city authorities (municipal bodies, development authorities), building sector associations, financial institutions, private sector buildings owners, construction developers, service providers, architects, consultants, research and academia, and manufacturers and technologies suppliers.

A semi-structured questionnaire was prepared for stakeholders in both the regions respectively. The questions were largely based on the five dimensions of the GAT framework along with the four complemented quality criterions. All the interviews were conducted face to face, recorded and transcribed into text files, which were used for analysis into the qualitative analysis software program of Atlas. Ti. This program assists researchers to locate, code, and annotate findings in text files, to weigh and evaluate their

importance, and to visualize the complex relations, supporting data analysis (in this case of interview transcripts) (Muhr & Friese, 2004).

3.3 Data analysis

In Atlas. ti. data were treated using a coding scheme, consisting of codes resembling the (5 dimensions and 4 quality criteria's). This allowed for a systematic comparative analysis. Each dimension of the GAT framework formed the basis for developing codes in the transcribed documents against the four quality criteria's. All of the five components became the main coding clusters in the Atlas. ti. Program and a set of sub codes were further developed along with their occurrences. The sub codes and their occurrences were then used to weigh and evaluate their importance to assess the context with respect to the governance dimensions, and hence supported analysis of the data. The qualitative data analysis was supported by published articles and reports, on growth of green buildings in the region, information on news articles about latest schemes and policies and previous research.

Interviews and meetings with the representatives of all relevant stakeholders during the regional visits, as well as studying the secondary data, provided a clear picture of the governance context. This enabled to assess it along the four governance criteria of *extent, coherence, flexibility* and *intensity*. The essence of those criteria will be repeated each time before describing the observations done in New Delhi and Ajmer region. The focus of the analysis will again depart from the perspective of the realization of the NZEB or low energy building projects in the respective region.

This would give a pragmatic understanding of the state of governance and the factors that influence the implementation setting in both regions during a comparative assessment with respect to NZEB niche development. We shed light on what commonalities and differences can be seen in their respective governance contexts in terms of supportiveness towards large scale adoption of NZEBs

4. Results

4.1 Governance assessment in the New Delhi region

4.1.1 Extent: are all relevant elements taken into account?

Levels and scales: All governance levels ranging from national, state and local level relevant for NZEBs are present but currently there are no specific NZEB goals at each level. However, there are several separate goals from related policies (energy efficiency (EE) and renewable energy (RE)). These related policies are formulated at different levels from national government to state level and downstream by municipal bodies for implementation. Hence institutional levels for EE and RE in buildings are present which can be used to develop specific NZEB goals in future, however they look fragmented currently.

At national level, there are three separate institutions which deal with goals and policies for energy efficiency, renewable energy and buildings respectively. At one level the Bureau of Energy Efficiency (BEE) which is the statutory body under the Ministry of Power; Government of India (GoI) facilitates and coordinates energy efficiency initiatives as per the Energy Conservation Act (EC Act, 2001). Secondly, the Ministry of New and Renewable Energy (MNRE) develops and facilitates large scale adoption of RE technologies through integration in buildings. In addition, building bye-laws are considered to be the strongest tool available in existing institutional setting in the building sector. They are governed by the Ministry of Urban Development (MOUD).Thus, at the national level; currently three agencies deal with different aspects for NZEB. This leads to fragmentation at the lower levels of government when the policies have to be implemented (at compliance of bylaws). Moreover, they are often considered as restricting.

The regional or state levels will be the most prominent government levels active in the NZEB implementation. They play an enforcing role to facilitate, and implement the policies. They hold the power to amend the policies to suit the regional and local climatic conditions and may, by rules made by them, specify and notify the use of energy in the buildings. State level government often designates an agency as designated agency (state nodal agency) to coordinate, regulate and enforce provisions of this EC Act within the State. In the Delhi region, the State Designated Agency has been set up as Energy Efficiency Renewable Energy Management Centre (EEREMC) to implement policies and programs of BEE and MNRE both hence entrusted to a single agency at the state level. However the interaction between the national level and the state level is often disconnected. For these reasons, this aspect of the context can be considered as neutral but progressive regarding for NZEB adoption in the future.

Actors and networks: Relevant actors for NZEBs are present in the building industry in the Delhi region but only a handful is actually involved and looks like sufficiently motivated towards using the NZEB concept. It may be due to only few NZEB demonstration projects in Delhi at present. The actors that are motivated consist of energy efficiency experts, passive design architects, motivated clients (mostly public sector), technology manufacturers and suppliers (high performance energy efficiency technology providers, on-site RE generation technology providers, advanced metering and building control technology providers) etc. More relevant stakeholders especially government actors need to be actively involved to support the uptake and develop a mature NZEB niche, along with creating awareness. There is a potential to include mainstream architects, educational institutions and research community; construction contractors, builders and developers, the industry association, and the green building Councils. In sum, all the actors that are necessary for decision making are present, but as the subject is so new it could still be that potential relevant actors are not sufficiently motivated yet. The present extent of actors is rather considered neutral but progressive.

Problem perceptions and goals: NZEB stakeholders take an increasing number of perspectives into account while assessing the niche development of NZEBs in Delhi Region. Hence the extent is assessed as good and supportive. Both the national and state level, large scale NZEB adoption is set to meet several challenges. In the Delhi region, the existing energy infrastructure is poor and inadequate to deal with the exponential rise in energy demand. Only a few NZEB pilot demonstration projects are insufficient (as they exhibit the potential but do not drive the market) and hence are slow to change the societal expectations. Economic benefits also need to be re-assessed as NZEBs are costly due to the use of expensive technologies. In addition, various definitions describe NZEBs, however in densely urban settings such as Delhi, the NZEB definition needs to be re-assessed as per local and regional limitations and needs. For example due to high urban density, on-site NZEBs may not be a feasible option in case of high rise buildings. Grid readiness is also seen as a problem towards large scale NZEB uptake. Nevertheless, various problem perspectives are taken into account by the stakeholders, making this as a supportive context in terms of views for NZEB adoption.

Strategies and instruments: Several strategies and instruments are in place to deal with NZEB implementation, indicating a high degree of extent. Most importantly the mandatory implementation of ECBC under the 12th five year plan is extremely crucial; more so because the updated version ECBC includes concepts of near zero energy goals with RE integration. This is considered as highly supportive.

Most of the existing instruments are either regulatory based or incentive based (solar subsidies, feed-in-tariff, and extra FAR[2]). The net metering policy that has recently been launched in the Delhi region is considered an important instrument for grid connected NZEBs in the region. The types of instruments used concern regulatory and incentive based ones. They reflect a high degree of extent in terms of separate instruments, and can potentially be combined into one holistic, integrated NZEB policy.

MNRE recently announced the Solar City initiative which will provide funds to cities for developing and implementing similar strategies at the city level. MNRE has developed climate zone-wise energy efficiency and passive architectural guidelines for residential and commercial buildings which could be followed by CPWD and Municipal Corporations all over the country including Delhi. The guidelines are in harmony with ECBC 2007, NBC 2005. An addendum to the National Building Code (NBC) 2005 has been finalized by including a chapter on sustainable building design, namely, 'Approach to Sustainability', so that it is adopted in all future constructions. The Delhi region has a separate cool roof manual (MNRE) for the building sector which concerns one of the many passive design strategies used in buildings.

Previously, the national level government has shown interest towards developing a long term roadmap for NZEBs through bilateral project agreements with the United States. The Energy Conservation and Commercialization (ECO) Bilateral Project Agreement ran in three phases in which the NZEB concept was introduced in ECO III (2006-12) and again in USAID PACE D TA Program (2012-17), focusing on the extension of ECBC (near zero energy goals), NZEB knowledge dissemination portal. Hence the motivated efforts were largely initiated by these agreements through international partnerships of BEE GoI.

Another key development in recent years has been the National Action Plan on Climate Change (NAPCC) launched by the GoI. The NAPCC along with its eight missions serves as the first country-wide framework on climate change. One of the missions is the National Mission on Sustainable Habitat encompassing promotion of energy efficiency in the residential and commercial sector as one of the components.

Responsibilities and resources: The extent is restrictive regarding the responsibilities and resources, since there is an imbalance and inconsistency between the large range of responsibilities which have been assigned to multiple actors especially between the national and state levels. The responsibilities have been assigned to various actors, and the often-limited level of financial and knowledge resources, which are decreasing for some stakeholders. There is a limited level of financial and knowledge resources available to the government in making innovative and cohesive policies.

Similarly, the building sector energy efficiency programs are often implemented through cooperation with international aid programs (e.g., ECBC implementation with UNDP, EE high rise residential building guidelines with the Swizz Development Cooperation etc.). This highlights the lack of financial means the Indian government has as well as knowledge resources to spur the demand for concepts such as NZEBs. This adds to the complexity and duplication of action within the Indian building sector. At state level SDA's have the responsibility to implement both EE and RE policies.

4.1.2 Coherence: are the elements reinforcing rather than contradicting each other?

Levels and scales: At national level, the three agencies of BEE, MNRE and MOUD work within their respective jurisdictions and authority. The interactions between levels is limited and hence restricts the opportunity to work together holistically for NZEBs. They have separate goals and missions. An inter-ministerial coordination mechanism is absent. In addition there is a lack of unified policies and national programs for NZEBs at this stage. This fragmentation was already mentioned above under extent .Hence this makes the context restrictive.

At state level the institutional framework allows for the two ministries to work together for the implementation of EE and RE policies (State Nodal Agency). This can be considered as positive and improving the situation. Currently, the SDA's do not collaborate at the local level with ULBs to initiate enforcement of the policies for EE and RE in buildings. The NZEB stakeholders perceive a lack of trust amongst the existing levels and work within their respective authorities and follow the top-down hierarchical institutional framework. Hence this context is considered as restrictive.

Actors and networks: The strength of interaction between the existing actors is weak and is only possible through a formal platform, for example in the form of a conference or a workshop. In the past this has been possible through bilateral project agreements between the GoI and the United States (the USAID ECO III program; 2006-12; and the PACE D TA program; 2012-17). These programs brought all the important stakeholders from building industry and technology providers from India and the U.S. in shaping the large scale implementation of NZEBs in India. The ECO III project worked towards identification and development of a collaboration framework between the US DOE National Research Laboratories, U.S. academic institutes and research centres, and the CEPT University in India (PACE-R). The project involved a series of workshops and exchange programs.

Currently, the USAID PACE-D TA program is working towards formation of a NZEB alliance and an online knowledge portal to activate and engage relevant building industry actors to increase actor interactions. Thus far NZEB network in Delhi region was mostly the result of the activities conducted under the two USAID programs with agreement of the GoI. The active stakeholders in the NZEB network have not been engaged directly with each other expect when attending the workshops and conferences. They appear to be engaged in direct components of the programs (e.g. in alliance formation, and separate demonstration projects). Hence as a result, they ended up competing with each other rather than collaborating. This relates to a lack of trust and collaboration between configurations of different NZEB pilot projects.

The active stakeholders can be viewed as relatively closed group. They operate in silos. For example there is a strong network of EE lighting manufacturers and HVAC manufacturers but they fail to interact in common platforms. Similarly the builders association does not interact with technology manufactures about NZEB knowledge. As a result, there is a large gap in knowledge exchange between certain stakeholders. Most of the stakeholders also refrain from sharing project data and exhibit a lack of trust. Therefore, the context is considered as restrictive.

Problem perceptions and goals: The NZEB niche development and its related problem perspectives are so far not reflected in the national government's policy goals. As there is still no shared/single goal or target for NZEBs in India both at national and state level including the Delhi region. Various goals have been stipulated by the government on energy efficiency and renewable energy in separate visions and programs. For example, the state government has announced an ambitious solar PV capacity installation target for the year 2020 with 20,000 MW installations. A mandatory implementation of ECBC in the 12th five year plan is expected to enable greater shift in the building sector paradigm which sets minimum standards for energy performance in buildings. In addition, the government has set targets for reducing GHG emissions through the NAPCC which includes a mission for sustainable habitats. This encourages implementation of energy efficiency in buildings. In effect the goals are there but to some extent they are enforced by different ministries but do not converge together to support each other as they are conceptualised in isolation. As a result these goals are in conflict with each other and add to fragmentation and complexity. Hence the part of the context is considered as restrictive.

Strategies and instruments: A neutral degree of coherence was observed in terms of instruments and strategies, as they are currently not balanced and are relatively fragmented for implementation at each level,and address only one aspect of NZEB i.e. either energy efficiency or renewable energy component. On the other hand they are not really working against each other. Each of these instruments needs to become strong at the ground level for implementation for a comprehensive NZEB policy, with strengthening of urban local bodies or municipalities. At the national level the focus is more on solar or RE level integration in buildings and downsizing of EE policies. This may potentially impede future niche development for NZEBs.

Responsibilities and resources: The coherence is restrictive since several actors are involved with different aspects of NZEB adoption in India. No clear responsibility is identified at a single level. This leads

to institutions working in isolation with each other and follow top-down hierarchical structures. Most interviewees mention that these actors are given multiple responsibilities which are even overlapping amongst each other and lead to duplicity of efforts almost at all the levels of implementation. This also creates competence struggles and thereby avoidance of cooperation. A low degree of coherence is observed since these actors do not reinforce each other nor create synergies for effective implementation. The existing responsibilities of the SDA's are not well supported by appropriate resources from the governance context. Their resources are derived from sources that often have different goals. Since most of the actors have insufficient personnel and technological infrastructure, they focus more on fulfilling their individual tasks than on recognizing and responding to the each other's needs.

4.1.3 Flexibility: are multiple roads to the goals permitted and supported?

Levels and scales: A highly inflexible governance setting is observed with less possibilities of up scaling and down scaling the policy issues between different levels. The institutional framework imposes a hierarchal system following decision making and responsibilities regarding formal set rules. Hence, these levels work within their own jurisdiction boundaries and are restricted in this way. For instance, buildings with preset NZEB goals will also need additional level of approval at different stages of project cycle. Hence many agencies will be involved at various levels; however, ULB's, SDA's, and energy distribution companies refrain from showing flexibilities or convergence with any other agency. The fair degree of adaptiveness is only seen at state level where states have the power and flexibility to modify the national level policies and programs to suit the local and regional need and notify them. However, the other stakeholders involved in local implementation actions are stringent and do not encourage any change from business as usual in terms of practices and procedures .For NZEB adoption this situation is viewed as restrictive.

Actors and networks: The flexibility regarding actors and networks is assessed as supportive. Since the network is limited and less active, it is relatively easy for new interested actors to enter the existing loose network. It forms is a so-called 'issue network', and is quite fragmented and with few institutions. This is considered on the good side as flexible. However, actors with good knowledge about NZEBs (the ones who have directly worked on NZEB pilots) may get a better say and authority in the project implementation.

Problems perceptions and goals: Since NZEBs are not yet part of the government policy; the reassessing of goals is possible. NZEBs technical and economic aspects can be explored, as the concept is still in its infancy. Thus case specific modifications are still possible, similar to those adopted in the Indira Paryavaran Bhawan project (NZEB pilot) in the New Delhi region, with relaxation in permissible built area and extension of roof for solar installations. NZEB definitions need reassessment specific to Delhi region, which can be explored by front runners and public sector pilot projects. The re-alignment of goals is potentially possible. This is considered as supportive for large scale NZEB implementation in the future. An optimized packaging of separate policies can be beneficial in the long run for the NZEB niche development and uptake thereafter. Hence goals are supportive for re-alignment. The flexibility of perspectives and goal ambitions context is considered as supportive. It should be considered that this degree of flexibility is partly a positive side effect of weak and fragmented government policies. Improvement on that side might endanger the flexibility observed, however.

Strategies and instruments: The flexibility of strategies and instruments is also assessed as supportive, as existing instruments looks flexible enough to be integrated with other existing policies and clustered. However, independent policies themselves are complex and have long process applications for implementation. For example the net metering policy application process is extremely lengthy and not user friendly. Even the process of approval takes more time. Similarly, all of the NZEB stakeholders considered ECBC to be complex and difficult to understand. In spite of that, existing instruments can be applied in conjunction with each other. For example ECBC compliant buildings can easily take incentives from MNRE for solar integration and also for net metering application.

Responsibilities and resources: Since most of the NZEB aspect is introduced in the Indian building sector by international bilateral programs, along with Ministry of Power (BEE) the responsibilities are not flexible and follow a bureaucratic approach of command and control. There are fewer opportunities to jointly use different resources for joint purposes. In addition, there is competition for the scarce resources available due to dependency on external resources. Hence, the context can be considered restrictive.

4.1.4 Intensity: how strongly do the elements urge changes in the status quo or in current developments?

Levels and scales: Most of the NZEB stakeholders consider central level regulatory measures as the strongest driving force for the large scale implementation in the building sector. They view that the central government ministries should take an active role in developing a comprehensive set of unified NZEB policies and regulations. Currently, NZEB is not seen in national agenda's nor missions but only piecemeal and by various ministries. Hence there is neither integrated approach nor program from the national level government towards spurring NZEB uptake. In sum, the present intensity is considered neutral, but may improve in the near future; the scenario is likely to change.

Actors and networks: A neutral degree of intensity is observed regarding the actors and networks. The existing network exerts only marginal pressure on any change from the business as usual scenario. Lack of support policies neither incentivize people to adopt NZEBs but rather slightly towards energy efficient buildings (ECBC is a voluntary code) in Delhi's building sector, and the GRIHA rating for all new public sector buildings. Regulatory measures and incentives with lucrative financial implications are viewed as an important impetus to manage the actor network. Actors look for government initiatives to guide the network in the desired direction. However, currently this condition is absent.

Problems perception and goals: NZEB stakeholders see that few NZEB pilots only show that the concept is feasible and RE integration is possible in buildings; however they do not show large scale societal and economic benefits. More so as performance of existing NZEB pilots are not shared in public domain. This does not cause any shift in the existing building sector's regime. An awareness and interest among the industry is seen about energy efficiency buildings (through other market based green certifications such as LEED and GRIHA certifications) but not particularly for large scale adoption of NZEBs in the Delhi region. However, present goals in the 12th five year plan and at state level to implement ECBC code are considered to be in line with the market transition for energy efficient buildings. This is considered as rather positive. They can work towards a roadmap for large-scale NZEB uptake with large scale solar PV installation targets which have been recently initiated as the Delhi Solar policy, which is also considered as positive. The goals that are accepted for the future at the state level are pretty ambitious, but will be confronted with a still existing strong emphasis on low initial cost building. The intensity can therefore be considered as neutral as many economic goals are much stronger and without ample evidence that NZEB can actually be profitable this will exert "neutral /restrictive" overall influence.

Strategies and Instruments: A supportive degree of intensity is observed regarding strategies and instruments. Due to ambitious national level targets on RE installation, state SDA's are implementing many solar specific instruments which are mostly subsidies or incentive based. This is to some extent, improved the market validity of the RE integration by raising enough awareness and knowledge about solar integration in buildings and with reduced costs. Hence, these instruments have to some extent been successful in changing the expectations and move the market towards more technology interventions in buildings.

Responsibility and resources: Implementation is expected to occur according to goals determined by higher levels of government yet there is insufficient effort bestowed on ensuring the results are achieved and given minimal support for doing so. The existing intensity is weak as there is lack of financial resources, knowledge and skills for adoption and uptake of the NZEB niche in the Delhi region with only few NZEB

pilot projects. It is only through the public sector NZEB pilot demonstrations that the government agrees for additional budgets for the high cost of NZEBs. There is a perceived need to increase the knowledge gap among the various actors in the building industry. In spite of the existing knowledge high upfront costs of these projects sometimes slow down the niche development process from private sector stakeholders. According to the interviewees, the state implementation agencies should get involved in increasing the stability of funding resources, recognizing and supporting innovative locally tuned implementation process through flexible and supportive instruments and communication. The context is observed to be of medium support.

4.2 Governance assessment in the Ajmer Region

The descriptions in this second case will often be briefer as the national elements are already dealt with in the Delhi case.

4.2.1 Extent: are all relevant elements taken into account?

Levels and scales: The levels and scales dimension has a neutral extent, as all governance levels ranging from the local level to the national level are relevant and present for NZEB, but with some restrictions. It is positive in terms of the large extent of the levels involved from national, state to local level implementation. But multiple agencies at the same level create restrictions and make the context complex. With several building level approvals from different authorities at different stages of the construction process makes it relatively restrictive in nature.

Actor and networks: Currently, there is no active NZEB stakeholder network in the Ajmer region. Absence of NZEBs or any green building in the region is seen as the primary cause for such a situation. It seems that existing mainstream building sector actors do not have the capacity to design NZEBs due to lack of awareness and knowledge. These actors also see this as the responsibility of local urban bodies or development authorities to guide the network, raise awareness and build capacity. So far the traditional building sector actors include architects, project developers, contractors, and material suppliers, and from public sector municipalities, development authorities or energy distribution operators. In addition energy efficiency and renewable energy technology manufactures and suppliers have not been able to establish a niche market in the Ajmer city nor have they been involved in any network that advocates the uptake of NZEBs. Neither can educational institutions, the research community and NGO's potentially be motivated to participate. Due to absence of some of the key actors, the context is rather restrictive.

Problem perceptions and goals: The extent is observed to be supportive. The Rajasthan state government has notified ECBC implementation which hopes to bring several transformations in the commercial buildings sector in state and the city pertaining to the use of energy efficiency design and technologies for the construction of buildings. The existing actors see NZEB pilots from the public sector as crucial to raise knowledge and awareness. Many mainstream actors believe that NZEBs would be costly due to the intervention of new technologies. Hence the lack of knowledge and expertise among existing architects was also brought to light. This could be a major challenge in the region as architects usually play a lead role in the design and supervision of building design and construction. Hence demonstration projects may help in changing these expectations which will encourage learning and awareness about the concept and therefore support in goal setting at regional level. Recently, the AMC has installed roof top solar PV systems to generate electricity and meet the buildings energy demand with self-generation.

Strategies and instruments: Several instruments are part of the policy strategy but they do not particularly address the concept of NZEB, which makes it difficult for interested actors to understand the application of these instruments for construction of a holistic NZEB concept. Currently, there are

regulatory based and subsidy based instruments which provide an impetus for investment to a certain extent. Examples are net- metering and a solar roof top policy. Awareness raising and capacity building is important instrument to nurture a new niche for future large scale implementation. However, sadly they are still missing. Therefore, the extent is restrictive.

Responsibilities and resources: An overall restrictive governance context was observed with respect to designated roles and resources. There is a lack of understanding on the level of responsibility with local ULB, energy distribution authorities, or with development authority. The key officials from the local government are not aware or updated about national and state level initiatives for EE and RE implementation. There is a lack of sufficient resources to raise the capacity of city officials in NZEB or EE building implementation.

4.2.2 Coherence: are the elements reinforcing rather than contradicting each other?

Levels and scales: The coherence aspect of the levels and scales is viewed as restrictive and highly complex. At the levels and scales dimension rigid hierarchical approach is followed, making each level an isolated one, thus making the implementation of NZEB concepts very difficult. The various levels, state and regional level follow a command and control authoritative approach. At the local level, various separate levels deal with each aspect of NZEB (e.g. getting building permits with ADA, AMC, approval for energy with AVVNL, no clear implementation plan communicated for ECBC code implementation). Due to a lack of coherence between the different government levels NZEB stimulation is likely to suffer.

Actor and networks: The level of interaction between various existing regime actors is rather disconnected. The network for NZEBs is negligible, especially actors concerning the issues for energy efficiency and renewable energy in buildings. Another observation was lack of knowledge and expertise; the existing building sector stakeholders fail to collaborate or interact and develop networks. Mostly the mainstream actors were having expectations from other important actors to take the responsibility and initiate the network. For example, public agencies such as the Ajmer Development Authority (ADA) and the Ajmer Municipal Corporation (AMC) expect architects to take the lead in initiating, and vice versa architects expect the ADA and AMC to develop and expand the network formation for concepts like NZEB. Perhaps it is fair to state that there is a status of 'deadlock' since there is nobody who initiates action, and the actors are only waiting at each other and nothing happens. Not surprisingly, thus far no awareness raising or capacity building initiatives have been organized to garner interest from the important stakeholders in the building sector in the region.

Problem perceptions and goals: The various perspectives do not look like in conflict with each other as the problems highlighted are mostly lack of knowledge and expertise on NZEBs and expectations among stakeholders that NZEBs are costly. In general, the stakeholders agree on this, and rather easy way to neglect green buildings and NZEBs and as nothing is bound to happen afterwards.

Strategies and instruments: Various isolated strategies are present which are directed from the state level on solar policy, and energy efficiency but not approached in a holistic manner. The integration of energy efficiency and renewable energy in building design and construction is not dealt with in a combined fashion

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Responsibilities and resources: As for responsibilities and resources, they are disjointed in a very complex way with no clear boundaries. This encourages several authorities towards corruption and non-compliance of the responsibilities and under-utilization of resources.

4.2.3 Flexibility: are multiple roads to the goals permitted and supported?

Levels and scales: There is lack of flexibility between levels, regarding both vertical and horizontal scales. The institutional framework leads to following multi-level hierarchical system with less room for flexibility, and making it difficult to move up and down a level.

Actors and networks: Since the network is not really active, it is relatively easy for interested building sector stakeholders to conceptualise and initiate the network once the benefits of NZEBs or highly energy efficient buildings are known to them. Hence the context is supportive for new actors to participate. Any active and interested actor with knowledge about NZEBs can steer the network formation.

Problem perceptions and goals: Since there are no concrete goals by the ADA and AMC for the building sector towards efficient use of energy, it is still possible to re-assess the goals or introduce them. Recently the ECBC code was issued at the state level, setting a minimum energy performance standard for commercial buildings which can be updated to include NZEB goals. In addition, the Rajasthan state solar policy will support to make NZEB goals more robust. Energy efficiency design, technology and renewable energy goals for the building sector can be packaged together to give one holistic NZEB policy or code. Hence the context is seen as supportive for flexibility regarding the setting of goals and problem perspectives.

Strategies and Instruments: Since the NZEB concept is still in a nascent stage with no pilots yet, it may actually be possible to combine and make use of different instruments. The context is supportive.

Responsibilities and resources: Finally the flexibility of responsibilities and resources is also assessed as neutral. The line between the practical responsibilities of the development authorities and ULB is mostly as sharp as it is on paper. Pooling of resources is also difficult between the authorities. This often turns out to prevent pilots for becoming successful. This seems to discourage flexibility.

4.2.4 Intensity: how strongly do the elements urge changes in the status quo or in current developments?

Levels and scales: Intensity looks like a neutral governance context, for NZEB implementation. There seems to be no strong political / national support for forceful measures, but several national programs and schemes on solar city, or smart city etc. can help to make the integrated NZEB concept more acceptable among building sector stakeholders. Although, most regulatory measures are only voluntary ones in the preventative sphere.

Actors and networks: Since, many existing stakeholders are not aware of the NZEB concept, and neither do the clients look very convinced (due to perceived high capital costs), there is an absence of (any) NZEB demonstration projects. Apparently, there is no pressure from an actor or actor coalition towards behavioral change or management reform. However, is this only due to lack of awareness, or lack of technical knowhow. The context does not motivate towards any strong changes from the business as usual scenario.

Problems perceptions and goals: The goal of mandatory ECBC implementation with separate RE goals is ambitious as compared to the existing business as usual scenario. This is particularly due to lack of compliance check and implementation check by the public authorities with no measurement and verification protocol. The lack of awareness and capacity among the existing building sector actors may lead for a scenario to change much slower than might have been expected.

Strategies and instruments: The existing instruments do not exert any transformation at large scale. Amending existing policies and bye-laws will take several years. Moreover, there is a lack of compliance to existing policies, there are violations of bye- laws, and there is a problem with corruption and public authorities.

Responsibilities and resources: The intensity of responsibilities and resources is also assessed as neutral. An increasing level of effort is made towards the adoption of solar roof top policy by installation of solar technology for self-generation in public buildings and the resources are being used with partial government subsidies. This creates interest from the building sector toward replication of the effort. However, it is difficult to say whether funds are sufficient for NZEB niche development. However, the authorities currently lack the capacity to facilitate the uptake of more NZEBs. Hence, a poor context. .

4.3 Overview

Table 2: GAT Results - Delhi region

	Criteria			
Dimension	Extent	Coherence	Flexibility	Intensity
Levels and scales	(+)		(-)	(+)
Actors and networks	(+)			
Problem perspectives and goal ambitions	(+)	(-)	(+)	(+)
Strategies and instruments				
Responsibilities and resources				
	*Colours **red**: poor; **orange**: medium , **green**: good*			

Table 3: GAT Results - Ajmer Region

	Criteria			
Dimension	Extent	Coherence	Flexibility	Intensity
Levels and scales	(-)		(-)	
Actors and networks				
Problem perspectives and		(-)	(+)	(-)
Strategies and instruments				
Responsibilities and resources				
	*Colors: **red**: poor; **orange**: medium , **green**: good*			

The Delhi region governance context can be seen as incoherent, flexible and fairly intense with large extent. Hence from extent perspective Delhi region can be seen as comparatively in a position to adopt NZEBs with supportive context for actors and networks, problem perspectives and strategies and instruments. The major drawbacks of incoherency are minimized in their impact on actors involved through the other qualities. In this context, actors are not forced to abide by the policy and instruments that are not in line with the goals of the integrated NZEB adoption in governance context. In this context, local level actors have the authority, flexibility and support to address their own issues (inside a given boundary). Hence the incoherent but flexible and moderately intense context of Delhi region shows that the governance context in Delhi is in a position to actively collaborate and manage NZEB niche development and adoption in large

scale provided the supportive qualities are enhanced through collaborative management and uptake of more NZEBs.

In case of Ajmer region, it was observed and assessed that the governance context is rather seen incoherent, flexible and weak along with narrow extent. This less extent of governance makes it less supportive towards NZEB adoptions as primary elements needed for implementation are currently not in place. Due to deficiency in extent, relevant issues and problems, actors and policies are ignored. The incoherent, relatively flexible and weak intensity reflects limited governance capacity. Flexibility is given to lower level actors to enable them to overcome issues associated with incoherence. However, in weak governance context, opportunities will exist where the incoherence can lead to undesired (and unnoticed) defections from the intended goals.

In both cases, it was seen that Government initiatives are largely taken through various strategies and instruments which partly support NZEB demonstration project implementation. In Delhi region, existing NZEB pilots are seen to be supported by the government by showcasing public buildings as NZEBs, with increased budget. This initiative was however, not seen in case of Ajmer region.

What is initially interesting to note is the wide variety of configurations that have been observed in both cases. Given the interpretative nature of this application, the factors leading to these differences brought into the picture, though a further examination of the cases could provide additional insights about the influencing factors and whether or not there are relationships between the various qualities related to them. In addition, the results can be used to make a holistic evaluation of how the governance context influences collaborative management of NZEB niche development and useful in comparing the existing strengths and weakness in the governance context for large scale adoption.

5. Discussion

From a SNM perspective, which can be used to initiate sustainable innovations at niche level, the GAT was useful in assessing the state of governance for fostering such innovations (Jain et.al, 2014). SNM uses the three theoretical building blocks of problem perceptions and visioning, social network formation and learning process as primary niche formation process, which show similarities to the GAT components of actor and networks, problem and perceptions directly and through learning process resulting from combined effect of all the GAT components.

Therefore, it was interesting to use GAT in order to understand and assess the governance context in the building sector in selected regions a vis.-a-vis. NZEB niche development. The study is of theoretical interest as GAT allows for assessing niche development of sustainable innovations (like NZEBs). This is rather novel since GAT has not been used thus far to assess developments and diffusion of sustainable innovations in the built environment, nor in the topical field of energy. The challenge to use GAT in this way, however, urges us to rethink how to incorporate key theoretical notions of Strategic Niche Management with GAT.

In both the SNM and GAT assessment frameworks, *actors and their networks* are highlighted as overlapping drivers for innovations and for assessing the governance context in which innovations evolve. Therefore, evaluating and assessing actor (and actor-network) interactions forms a critical part of the GAT assessment framework. As social interaction processes in multi-actor arenas are mostly driven by actors involved, these interactions form a central stage in the theoretical basis that is key to both GAT and SNM. Thus the interaction process is considered as an ultimate driver for niche development, sustainability transitions and innovation. In this sense we believe that actor -networks can be seen as the key units of analysis in both GAT and SNM framework, in particular because they form the key social configuration in

which other important drivers for supportive governance context occur, such as problem perceptions and goals, levels and scales, strategies and instruments, and resources and responsibilities.

The theoretical components of SNM can be viewed as similar to some key elements of GAT. Combining insights from the two concepts may allow for broadening the scope and furthering understanding of long term sustainable transitions, sectoral innovations, implementation of transition–oriented policies, and assessment of the role and state of 'governance' in niche development processes in sectoral systems. Furthermore, the four quality criteria mentioned in the GAT model can be used to evaluate the niche development process with respect to the three building blocks of the SNM. For example, actor interactions, expectations, learning process can all be evaluated as per the four quality criteria's to understand the overlaps with the GAT framework. However, the validity can be further elaborated based on the future empirical research. It will be interesting to further understanding of the governance context of niche development of sustainable innovations (like NZEBs) through more empirical cases along with the GAT.

6. Conclusion

In this paper the state of governance towards NZEB niche development was analyzed in the Indian regions of both Delhi and Ajmer. The study adopted a case study research design to assess the governance against four qualities used in the "Governance Assessment Tool" of *extent, coherence, flexibility and intensity* of the five structural components of the GAT. The five components are Levels and scales, Actors and networks, Strategies and instruments, problem perspectives and goals, and Responsibilities and resources.

Analyzing the elements presented, the qualities observed in the two selected cases showed many interesting results. In the Delhi region, the governance context was moderate in extent, incoherent, moderately flexible and Intense. This shows that the governance context in the Delhi region is to some extent supportive towards NZEB niche development. It was observed that in Delhi region, all the levels relevant for NZEB adoption are present but they are currently fragmented for NZEB niche development, however in future is seen as positive for large scale adoption. Similarly most of the relevant actors needed for NZEB niche development are present, but are less motivated towards building up the alliance network and initiate knowledge building and learning which is also seen as important element in Strategic Niche Management. An Increasing number of critical aspects for NZEB adoption are taken into account by the existing NZEB stakeholders in the regions which provide a good test bed for creating visions and goals for future uptake of the concept. Most of the instruments and strategies are also present both related to energy efficiency and renewable energy integration in buildings, but they are not holistic as one NZEB policy or a code for implementation at this stage. The responsibilities and are seen as a weaker section in the governance context for NZEBs, as the resources are less both in terms of capital investment and skilled human resources.

Similarly in the Ajmer region, the governance context was assessed as rather restrictive for NZEB niche development. The study shows a lack of extent, creating restrictive capacity of the governance to act towards development of a new NZEB niche. In addition the region was seen as incoherent, moderately flexible along with weak intensity. Thus, NZEB niche innovation and adoption is seen as difficult for wider future uptake. The levels and scale are not in line for NZEB niche formation at city level. The actors are not aware and do not have enough knowledge about NZEBs, therefore the network for NZEBs is also presently missing. Due to lack of knowledge and awareness the visioning and goal setting is currently not present. Various instruments which can support NZEB adoption are only present in paper with very little adoption. Similar to Delhi region, Ajmer region also lacks resources both in terms of capital and skills based capacity to design, construct, adoption and implement large scale NZEBs.

Using GAT in our opinion was useful and brought many aspects to light regarding the quality of the governance of NZEB niche development. Using GAT for an assessment provided insights to the current governance context of NZEB demonstrations projects. The assessment highlighted the challenges in the regime which are obstructing or slowing down the introduction and diffusion of NZEB innovations, and at the same time identifying potential drivers to spur NZEB niche development. In addition, the results can be used to make a holistic ex- ante evaluation of how the governance context can influence collaborative management of the NZEB niche development process.

The Strategic Niche Management provides us with an analytical approach to assess niche developments with primary evaluation based on a) visioning and goal setting b) social network formation and c) learning process. With using GAT, further understanding of the quality of governance in a given context was gained with additional insight into existing institutional levels, strategies and instruments, and the resources and responsibilities available. Thus research on governance of NZEB niche development can be explored further by integrating the two concepts, SNM and GAT for further research. Thus GAT as qualitative assessment towards the state of governance which can be complemented with mainstream SNM approach thus can be used for informed decision making by the government and policy makers towards introduction and diffusion of new sustainable technologies in a developing country.

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