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# Using Strategic Energy Planning to develop and implement a 100 % Renewable Smart Energy System

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## Research Strategy

### Background:

Denmark is currently moving towards a 100 % renewable energy system. Studies [1] shows that the transition of the energy system should be based on the concept of smart energy systems, where the different grids, thermal, electricity and gas and storage technologies are coordinated in order to find an optimal solution for the overall energy system in Denmark. This smart energy system based on renewable energy sources is highly dependent on fluctuating electricity from e.g. wind and photovoltaic [1, 2], which means that there to a great extent is a need for flexibility in the future energy system in order to cope with the fluctuating energy production.

The transition to a 100 % renewable smart energy system cannot be supported sufficiently through national political decisions and development of strategies and plans directing the technological path. The municipalities are an important actor in order to ensure a stable foundation and a sense of ownership in the local communities [3]. A large amount of the Danish municipalities are already conducting strategic energy planning locally, by setting up goals to be self-sufficient with renewable energy and CO<sub>2</sub>-neutral [4, 5]. In the same time the Danish Energy Agency had a financial supported initiative supporting the municipalities to work with strategic energy planning in new constellations across the municipal borders [6]. However the initiative ended in the fall of 2015 and it is therefore now uncertain if the municipalities will continue the co-operation between the municipalities. The municipal strategic energy planning work are important in order to ensure that the transition of the energy system happens in an appropriate way, where their local knowledge and connection to local stakeholders can help to ensure the balanced interplay between the energy production and the demand side in the energy system. Therefore this PhD seeks to identify and develop tools that municipalities can use in the strategic energy planning in order to reach local and national goals for a 100 % renewable smart energy system.

### Research Question

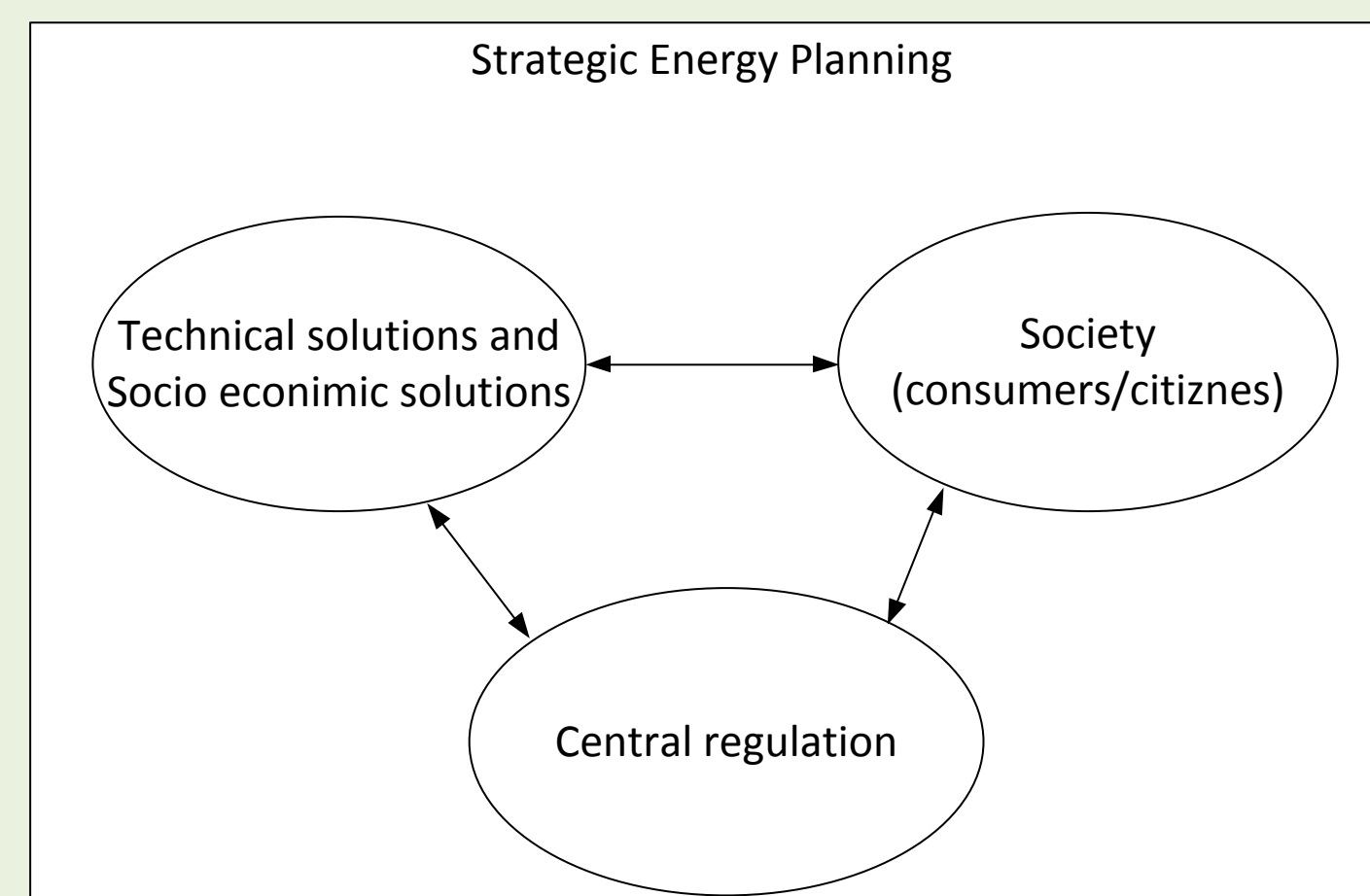
*How are strategic energy planning handled in the municipalities today, in order to ensure the national goal of a balanced 100 % renewable smart energy system, and what approaches and tools are required if the municipalities should succeed in implementing local energy plans that can ensure the overall national goals of an integrated energy system?*

*• How should different stakeholders, especially the consumers, be involved in the energy planning processes both on national and local level?*

### It is about

- Identifying the current status of strategic energy planning, the wanted technological path and the tools available for the municipalities to conduct local energy planning
- Identifying Stakeholders in the energy planning on a national level and on the local level
- Connecting the technical solutions, central regulation and societal elements
- Identifying institutional barriers for the development and implementation of strategic energy plans
- Identifying and developing approaches for the municipalities to use in the strategic energy planning to activate the consumers and to get them involved

Combining Technical knowledge and Social Science

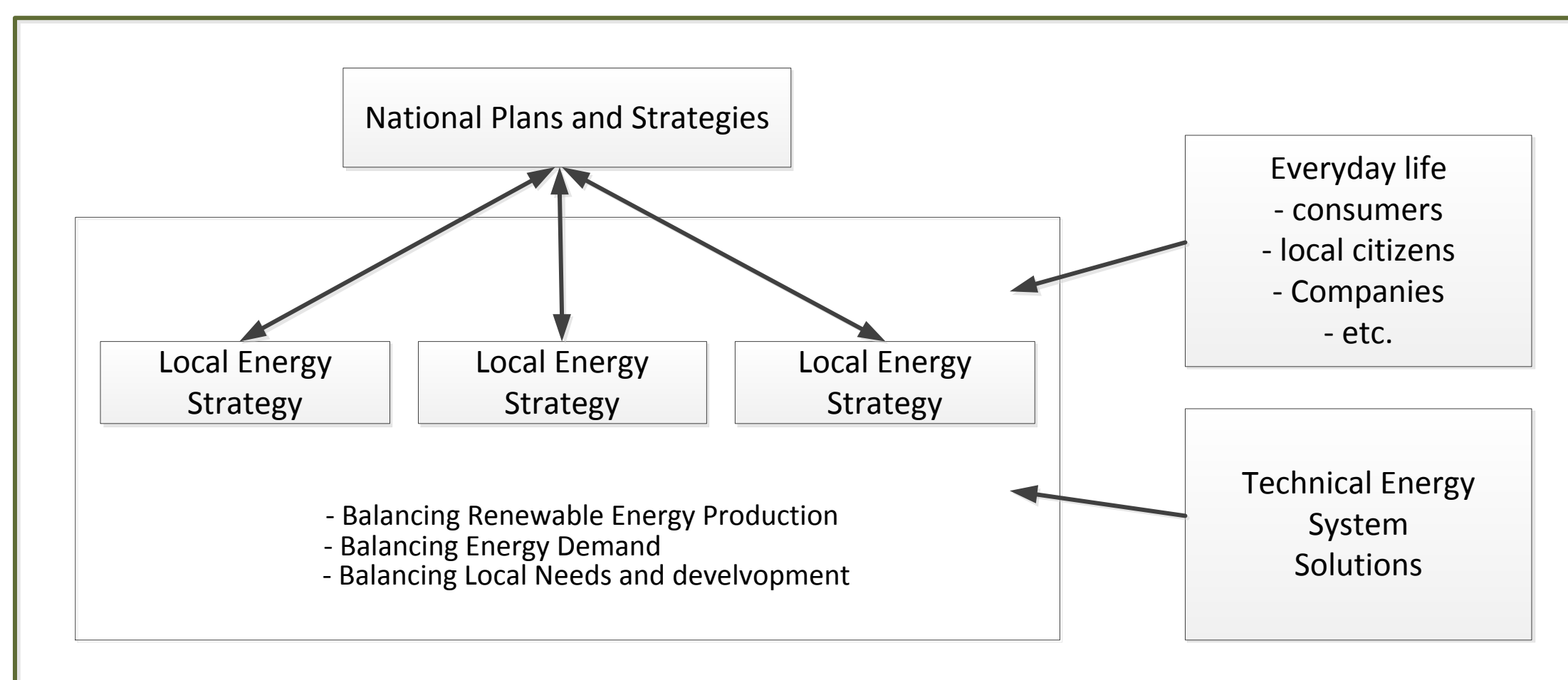


### Methods

- Literature review
- Interviews
- Surveys
- Case studies (Case municipalities)

### Expected results

- A combination of approaches, tools and gathered knowledge that can provide the municipals with the needed skills to develop and implement the most appropriate energy plans that ensures local development and reach the national goals.
- Provide both scientist and nonscientific actors with approaches and tools that can be adjusted locally to the different conditions and challenges (e.g. large urban areas or primary rural areas with smaller towns and villages) so the most appropriate solutions can be developed in order to secure a balanced 100 % renewable smart energy system.



[1] B. V. Mathiesen, H. Lund, K. Hansen, I. Ridjan, S. Djörup, s. Nielsen, P. Sorknæs, J. Z. Thellufsen, L. Grundahl, R. Lund, D. Drysdale, D. Connolly and P. A. Østergaard, "IDA's Energy Vision 2050," 2015.[2] Socialdemokraterne; Det Radikale Venstre; Socialistisk Folkeparti; Venstre; Dansk Folkeparti; Enhedslisten; Det Konservative Folkeparti, "Aftale mellem regeringen (Socialdemokraterne, Det Radikale Venstre, Socialistisk Folkeparti) og Venstre, Dansk Folkeparti, Enhedslisten og Det Konservative Folkeparti om den danske energipolitik 2012-2020," 2012. [3] J. Mattes, A. Huber and J. Koehrsen, "Energy transitions in small-scale regions - What we can learn from a regional innovation systems perspective," *Energy Policy* 78(2015) 255-264, 23 December 2014. [4] Skive Kommune, "Klima og Energi Strategi 2029," 2016.[5] B. V. Mathiesen, R. Lund, D. Connolly, I. Ridjan and S. Nielsen, "Copenhagen Energy Vision 2050 A sustainable vision for bringing a capital to 100% renewable energy," 2015.[6] Energistyrelsen, "www.ens.dk," [Online]. Available: <http://www.ens.dk/undergrund-forsyning/el-naturgas-varmeforsyning/strategisk-energiplanlaegning-kommunerne/puljer>. [Accessed 14 Marts 2016].