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Strategic energy planning at the regional level for integrated energy systems

Abstract for the Second International Conference on New Pathways for a Just and Inclusive Energy Transition: [Connection Multiple Stakeholders and levels](#)

The grand challenge of tackling climate change requires every possible stakeholder to participate in reducing greenhouse gas emissions at a global scale. With the overarching Paris agreement, various plans and strategies towards a net-zero emission society are plentiful today at both national, regional and local levels. These are all reaching towards a net-zero emission society in the future but have separate pathways and target years.

Despite striving for the same end goal various plans, strategies and targets can have an unintended negative impact on each other and the overall smart energy system if these are viewed as part of an integrated and holistic energy system. The transition towards a 100% renewable energy system is highly complex since analysis of adequate conversion, efficiency improvements, storage technologies and different smart grids must be included and utilized via sector integration and balance technologies. optimized biomass utilization and balance technologies. Misalignment of plans and strategies can as such lead to untapped potential off synergies for the overall system while specific regions or areas are at risk of being decoupled from certain development pathways in the future. These pitfalls can be further enhanced if local government directly adopt national targets into the local planning since this adoption prioritize to only pursuit national targets rather than the overall collective objective of transitioning towards an integrated 100% renewable energy system. Strategic energy planning can be a powerful tool to identify and then minimize the risk of misalignment of plans and strategies between different planning levels and consequently help to focus the transition towards a holistic and integrated energy system. This identification can be done through investigations of different energy scenarios outlining the transition pathways of the energy systems. Investigations of various pathways can aid and scope different transition pathways at both the national, regional or local level and be understood in coherent context.

In the current Danish paradigm, the national target is to quadruple the amount of land-based wind- and solar power while municipalities must plan to eliminate gas fired areas, and industry must decarbonize to avoid additional costs caused by a new national CO₂ taxation. At the local level, 96 of 98 municipalities in Denmark have developed local climate actions plans, through the DK2020 initiative, where the overall aim is to reach a net-zero emission future. All these targets and plans are formed in a period where uncertainty regarding Power-to-X end products and the carbon capture storage or utilization discussion is ongoing. Uncertainty is a prerequisite of the future, but national plans and strategies are plentiful, and an extensive acceleration of the transition is demanded from the national side. The role of strategic energy planning will as such be important in this new paradigm below the national level, but the role and output from strategic energy planning is however not clearly defined. This can also be seen as a result of strategic energy planning not being a mandatory task for the local level in the municipalities and the regions. The extensive

acceleration from national targets potentially enhances the focus on short-term result orientated solutions which risk to be sub-optimizations in the medium- and long-term perspective for the integrated energy system.

A mean to ensure the long-term perspective and avoid suboptimization within the Danish energy system is to activate and utilize strategic energy planning at a regional scope. The regional perspective can help to create an overall alignment of underlying local plans or provide valuable insights to the local level if strategic energy planning is lacking in specific local areas.

The strategic energy planning at the regional level can strengthen the link between strategic energy planning at national and local level in Denmark and provide insights to the discussion on renewable energy capacities and infrastructure. Subsequently creating more alignment of plans between the planning levels, and help to improve and favor discussion within the region across administrative borders on how to participate, utilize and operationalize the renewable energy transition as part of a smart integrated energy system.

The methodology and tool applied must be action oriented and not overly complex why EnergyPLAN is an adequate modelling environment. This can potentially be linked to MUSEgrids to help novice energy planners to comprehend and understand the model. Ensuring a broader audience in modelling and design of the scenarios will be essential to enhance cooperation and collaboration across planning levels and administrative borders to make discussions including rather than excluding.

Investigating this will be done under the following research question:

How can strategic energy planning at municipality and national level benefit from technical energy system scenarios at the regional level to ensure a just and adequate development towards a more robust and resilient energy system?