Sustainability and Resilience Nexus in a Local Context With Low Self-sufficiency

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INTRODUCTION

As the need for transitioning to sustainability grows, the security situation in Europe has worsened over the past year, underscoring the urgent need to ensure resilience in the electricity system. The work presented here will address the connection of the perspectives of resilience and sustainability with regards to a current development in the city of Malmö in Sweden. In Malmö, the involved industries today struggle to make long term decisions that rely on increased electricity demand as they are in an area that has relatively low predictable electricity production and self-sufficiency compared to other parts of Sweden. At the same time indirect and direct electrification of industries are being pushed as a strategy for industries to decrease their climate impact.

Low self-sufficiency has made Sweden's south most region heavily dependent on import of electricity from other regions. Import from other regions has today reached its maximum capacity so the region has now made it into a priority to improve the self-sufficiency so that the hourly self-sufficiency by 2030 remains above 50 % at any point in time. To achieve this different strategies have been suggested, in this work the focus has been on strategies that require interorganisational collaborations. To assess the potential of such strategies there is a need to discover industry's dependence on and contribution to a resilient and sustainable electrical power system.

THE CHALLENGE

In general terms the system consists of the individual agents and the electrical system the agents' impact. The agents are describing relevant parts of the industrial sites and consists of physical, human, and cyber layers. There is a need for improved understanding of how local infrastructure systems and their agents adapt and change across time and space to support industries to take measures that improve resilience and sustainability. Previous research on combining sustainability and resilience indicators into a unified assessment has identified three generalized types of frameworks for organising sustainability and resilience: resilience as a component of sustainability, sustainability as a component of resilience, and resilience and sustainability as separate objectives (Marchese et al., 2018). For this work resilience and sustainability has been thought of in terms of three main areas:

ENGINEERING PERSPECTIVE: The focus is to monitor and revise risk models and use resources preventively in relation to interruptions, ongoing production, and financial pressures.

ORGANISATIONAL PERSPECTIVE: High organisational resilience ensure that the organisation can resist crises, stress and to learn from events and evolve. Industries in Malmö has started to investigate how they can withstand both long and short power outages to increase their own resilience. Utilizing an interorganisational strategy to resist and recover from stressful events is motivated by the fact that organisations are dependent on a stable surrounding for healthy and sustainable development.

SOCIETAL PERSPECTIVE: The main aspects for society are to ensure that the system handles changes and evolves without jeopardizing welfare or freedom of choice and flexibility for the future. System actors' (i.e., industry, electricity provider, grid owner, municipality, and region) dependencies and influence on the system today may change over time as actors' internal strategies changes.

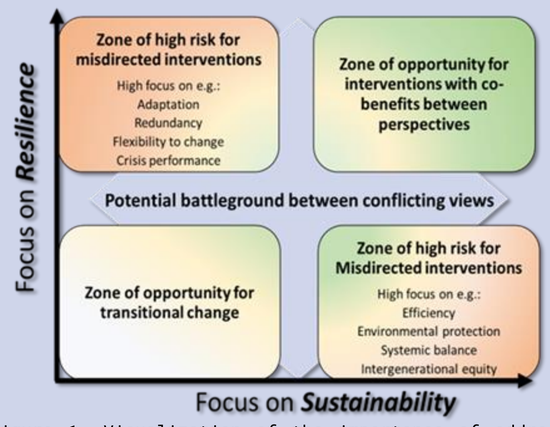

Figure 1. Visualization of the importance of addressing both resilience and sustainability when developing long term strategies for industrial energy supply and demand.

THE APPROACH

The suggested approach explores the connection between the different resilience and sustainability perspectives by developing a collaborative modelling approach according to Figure 2. The suggested modelling structure will aim to capture engineering, organisational and societal perspectives, and their connection to the dynamic interplay between local industrial systems and communities with low self-sufficient of electricity.

The project will utilize the six organising principles from Complex Adaptive System (CAS) to structure the exploration of different aspects related to system resilience and sustainability (Preiser et al., 2018).

The six principles may support identifying CAS features at system and agent level (Preiser, 2018). At the sociotechnical system level focus will be on exploring the CAS principles that the system is relationally constituted, radically open and contextually specific:

- Radically open, e.g., consider the impact insufficient electricity supply may have on local infrastructure.
- Contextually specific, e.g., consider what impacts self-sufficiency may have on the community and how industry's ability to sustain and expand depends on it.
- Constituted relationally, e.g., consider that strategies for sustainable transition impacts actions that industries must take to remain resilient.

At agent level the remaining three aspects may support an expanded view of the system by covering aspects that account for how different agents may interact, depend and adapt:

- Adaptive capacities, e.g., consider development in resilience maturity.
- Dynamic processes, e.g., consider how agents in a faulty and failure state impact the demand and availability.
- Casual and emergent, e.g., consider interactions between human and technical agents.

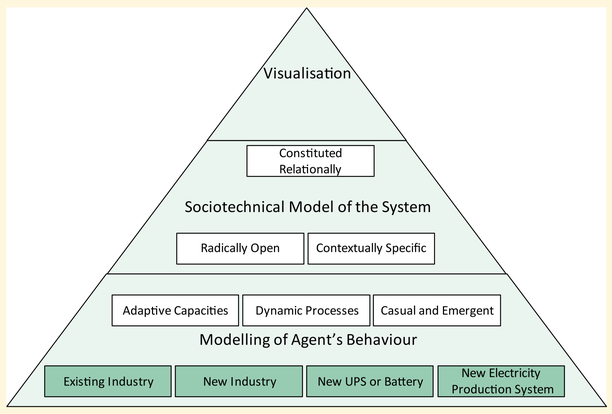

Figure 2. Illustration of a three-layer modelling structure. The CAS features constituted relationally, radically open and context dependent are captured at system level and the CAS features adaptive, dynamic and complex causality at agent level.

KEY INSIGHTS

While acknowledging that it may be improbable to avoid the battleground between sustainability and resilience, we advocate for integrating diverse perspectives across system levels and timeframes, rather than focusing on improving a singular aspect within current system.

For improving both resilience and sustainability it has been suggested to implement interorganisational collaborations as a strategy. This strategy is not without its challenges as the task of improving resilience and sustainability may have different meaning for different actors and may change over time.

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https://www.sbhub.se/malmo-energy-lab

https://sites.mdu.se/resilient

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