

SWEET Call 1-2020

SURE activity overview

1 Abstract

In view of a system transformation to a much higher share of renewable energy, the project *Sustainable and Resilient Energy for Switzerland* (SURE) addresses the need for an integrated assessment of sustainability and resilience, analyzing the multiple dimensions of environment, use of natural resources, public health, economics, security of supply, and social well-being. Extending existing research in this field, a novel quantitative model- and data-based framework will be developed and applied based on combining holistic systemic approaches, comprehensive indicator databases, energy infrastructure and system modelling, and explicitly representing social and policy aspects. Focusing on Swiss national developments as well as selected regional case studies, resilience will be analysed with a long-term perspective (including 2035 and 2050 as focus years) with a scenario approach that simulates transition pathways as well as future disruptive events (using shock scenarios with disruptions at different scales), related uncertainties and the implications for the energy system and society as a whole. The results feed into a stakeholder-informed, multi-objective decision analysis to develop strategies and policy measures to design an energy system that is more robust against disruptions and allows for rapid recovery in case a disruption takes place. The project's output will be manifold, including a web-based platform backed by the comprehensive analytical framework that helps a broad audience to understand interdependencies of the various dimensions of sustainability and resilience in a prospective way, and to illustrate the trade-offs between competing objectives related to a sustainable and resilient energy sector transformation. Ultimately the project will provide recommendations and guidelines to policy makers, technology developers and businesses on the design of their respective strategies towards a more sustainable and resilient energy future.

Keywords:

- Indicator database on resilience and sustainability
- Holistic multi-model scenario analysis
- Combining scenarios on transformation pathways and disruptive events
- Stakeholder-supported evaluation using Multi-Criteria-Decision-Making approach
- Energy and decarbonisation strategies

2 Workpackages/projects

SURE will focus on five main thematic areas, which are each addressed by one or more WPs:

1. Sustainability and resilience criteria and indicators:

This thematic area deals with the identification of means for measuring sustainability and resilience, and compiles a database of measurable indicators, which is a fundamental step for a consistent and quantitative assessment. The database will comprise indicators covering the main three dimensions of sustainability (environment, economy, society), and describe the various resilience functions, including short- vs. long-term aspects, infrastructure vs. supply security, and pre- and post- disruptive event strategies. Prior to inclusion in the database, each indicator is screened concerning its relevance and suitability for the proposed assessment, its amenability for quantification, and its ability to sufficiently differentiate between the scenarios.



2. Analysis of long-term overarching pathways, disruptive events and associated uncertainty:

This thematic area deals with the model-based assessment of sustainability and resilience with respect to overarching long-term pathways, closely connected to the objectives of the Swiss Energy Strategy 2050, and how these pathways perform with regard to specific sustainability and resilience criteria and indicators based on disruptive events. The analysis is multidimensional and considers social behavior and norms, energy demands, infrastructure and grids, holistic energy system approaches, macro-economic assessment, and environmental assessment. The uncertainty in the response of the energy system under different intensities of the disruptive events, as well as under different future configurations is quantified. The political environment and regulatory aspects are also considered in the analysis, as well as options for a circular economy with closed nutrient and material cycles driven by renewable energy.

3. Integrated assessment of sustainable and resilient configurations of the energy system:

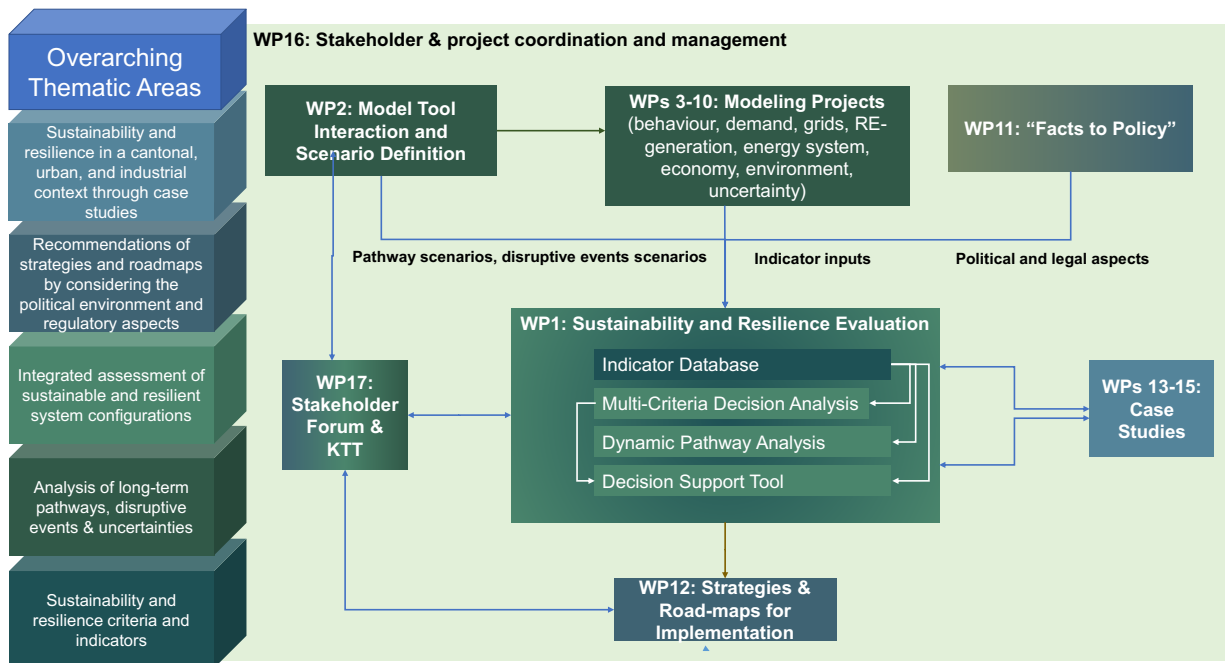
The outcome of the quantified analysis is a dataset of the performance of the energy system under different configurations and disruptive events, based on a large number of multidimensional sustainability and resilience indicators. With the engagement of the stakeholders' forum, a two-stage integrated assessment of the sustainability and resilience of the energy system is performed. In the first stage, stakeholders reveal their preferences regarding the overarching long-term transition pathways that meet their expectations and aspirations on key sustainability and resilience metrics. In the second stage, stakeholders identify optimal policy mixes to implement the preferred long-term pathways of the first stage. In this regard, the integrated assessment of sustainable and resilient configurations of the energy system will evaluate and identify those long-term transition pathways that ensure a sustainable and resilient energy system and that are technically feasible, economically attractive, put a low burden on the environment and are acceptable to the relevant stakeholders.

4. Recommendations of strategies and roadmaps by considering the political environment and regulatory aspects:

The integrated assessment of sustainable and resilient configurations results in the preferred long-term pathways and policy mixes reflecting different stakeholder groups. A consolidation and reflection on these responses by key stakeholders is required to be able to recommend policy measures and regulations that address shortcomings of available instruments and to propose novel approaches. The feedback of stakeholders in their responses is obtained with a dedicated workshop and will help to gain a deeper understanding and additional insights related to their preferences. These insights, together with the quantitative analysis of the integrated assessment is used to formulate and recommend strategies and roadmaps for the implementation of sustainable and resilient transition pathways towards a low carbon energy system with high shares of renewable energy at the national scale.

5. Sustainability and resilience in a cantonal, urban and industrial context through case studies:

The holistic integrated assessment framework of SURE developed through the thematic areas 1-4 is complemented and validated through case studies that look at the sustainability and resilience aspects at subnational and actors' levels. A dedicated cantonal case study for Ticino assesses and ensure the coherence between federal and regional sustainability and resilience solutions that meet the aspirations and expectations of local actors. A case study at the urban and sub-urban scale in Zurich aims to take into account aspects that can arise from the specificities of an urban energy planning. Finally, a case study on the transport sector and energy-intensive industries investigates the interdependence of the operator of the Swiss train system (SBB) and the Swiss energy system, in order to assess specific impacts on sustainability and resilience due to the activities of large actors of the energy system , as well as aspects related to process heat provision for industrial companies and areas.



SURE can be clustered along three main phases. Most WPs run for more than one project phase but have a work focus that can be associated to the time structure as follows:

In the **first project phase** the stakeholder forum will be established as well as the sustainability and resilience indicators database. The life cycle assessment framework and the economy-energy-grids-demand-behavior modelling tools in SURE will be further enhanced in order to enable the quantification of the identified sustainability and resilience indicators, and to represent and simulate the complete analytical chain from the application of policy instruments to the impact on sustainability and resilience indicators. The first project phase also includes the specification of the model interfaces and a first definition of the long-term pathways and disruptive events. This phase involves WP1, WP2, WP3-11, as well as the case study WPs 13-15.

In the **second project phase** the overarching long-term pathways are quantified with the modelling toolbox of SURE, and their performance is assessed with respect to the sustainability and resilience indicators via a series of disruptive events. The analysis includes quantification of uncertainty, behavioral analysis, and impacts of the circular economy, as well as the political environment and regulatory aspects related to the implementation of these pathways. In this second phase, the overarching long-term transition pathways and their associated disruptive events will be refined, depending on the outcome of the quantification. The second project phase mainly involves work of WP3-WP11 and WP13-WP15.

In the **third project phase** the integrated assessment of the long-term pathways and the policy mixes is conducted, based on the active engagement of stakeholders. The outcome of the integrated assessment is used for the recommendation and formulation of strategies and implementation roadmaps that lead to a sustainable and resilient long-term energy system in Switzerland. The third project phase involves work primarily in WP1 and WP10-WP12, with the support of WP13-WP15, and work with WP17 for the dissemination of the results.



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