SWEET Call 1-2020

EDGE activities overview

1 Abstract

The overall EDGE objective is to fast-track the growth of locally-sourced decentralized renewable energy in Switzerland and to ensure that by 2035 and 2050, when ambitious shares of renewable energy are reached, the Swiss energy system is designed and operated in a technically and economically optimal as well as secure way, and that it is well positioned in the European markets. Specifically, the EDGE consortium aims to move beyond generic designs of decentralized renewable systems and markets to a regionalized analysis that is tailored to the Swiss cities, midlands, and the Alps. The pathways towards largely electrified and multi-carrier energy systems will be examined by analyzing electricity, mobility, and heating sectors. The consortium plans to combine research with innovation from three clusters of Pilot and Demonstration project (P&Ds) in urban settings (the cantons of Bern, Luzern, and Aargau), midlands (Waldkirch, St. Gallen), and the Alps (Davos and Bagnes-Verbier, Graubünden and Wallis). The mutual learning from setting up the P&Ds will ensure feedback loops between theory and practice, and ability to use the outcomes for delineating realistic national-level pathways for successful implementation of nearly or fully renewable Switzerland by 2050. As the energy system is a socio-technical system, the EDGE consortium delivers the essential interdisciplinary and transdisciplinary expertise, ranging from technology development to systems modeling, political science, management, economics, sustainability science, and energy practice, in order to identify the most efficient measures to unlock the full potential of decentralized renewable energy.

Keywords: *Renewable energy, regionalized analysis, grid integration, future scenarios, socio-technical analysis*

2 Workpackages/projects

2.1 WP#1: *Research focus on cities* (start: M1, duration: 48 months)

WP1 conducts a technical and socio-economic analysis with the focus on the Swiss cities in order to work out the designs, operation, and ways to foster the uptake of urban multi-energy systems with as high shares as possible of locally-sourced renewable energy. From the technical perspective, WP1 covers the topics of supply-demand matching, the role of new technologies (battery storage, power-to-x, electric transportation, and anthropogenic biomass technologies), distribution grids, and microgrids. From the socio-economic perspective, WP1 includes the topics of financing, coordination of actors in the energy value chains and various policy departments, new business models, and policy acceptance in the Swiss cities.

2.2 WP#2: *Research focus on midlands* (start: M1, duration: 48 months)

WP2 has a special focus on the rural areas in the Swiss midlands in order to look at potential design, operation, and ways to foster the uptake of multi-energy there. A detailed technical and socio-economic analysis will lead to scenarios with high shares of locally-sourced renewable energy. WP2 covers the topics of supply-demand matching for rural entities and communities, the role of new technologies (woody and agricultural biomass, battery storage, power-to-x, and electric transportation, including

agricultural machinery and transportation), distribution grids, and microgrids. Since activities in rural Swiss area are highly based on initiatives of small enterprises, the topics of financing, new business models, coordination of actors, and policy are particularly important to catalyze change.

2.3 WP#3: *Research focus on the Alps* (start: M1, duration: 48 months)

WP3 conducts the analysis of technical and socio-economic solutions to increase decentralized renewable energy production in the Swiss mountainous areas, acknowledging that Swiss urban areas are and will continue to be dependent on energy produced in the mountains. Therefore, the design, operation, and uptake of multi-energy systems with maximal shares of locally-sourced renewable energy will be analyzed in the context of existing hydropower. WP3 covers improved estimates of solar PV, wind, and biomass potentials, the analysis of supply-demand matching and export to urban areas, the role of new technologies (battery and thermal storage, power-to-x, and electric transportation, including mountain infrastructures), distribution grids, microgrids and particularly pumped storage. The socio-economic perspective is again different as larger players, such as hydropower companies and cities, need to interact with smaller local communities, and hence the aspects of financing, new business models and policy acceptance in the Swiss Alps will be investigated.

2.4 WP#4: *P&Ds in cities* (start: M13, duration: 60 months)

Despite many solutions for a higher integration of locally sourced renewable energy, communities and utilities are often overwhelmed by the number of options and hesitant to implement these solutions due to the lack of successful use cases. In WP4, the EDGE solutions will be demonstrated in the cantons of Bern, Luzern, and Aargau on different scales (district, community, group of cities), in different development stages (concept, design, implementation, operation, optimization), and in different community sizes/locations. Together with cities, and utilities, turn-key solutions will be developed for the specific challenges of the contributing community. These projects will show the economic, ecological, and energetic efficiency of the EDGE solutions as well as their social acceptance and replication potential in Switzerland. Eventually, recommendations will be provided on how to adapt the solutions for the context of other Swiss cities.

2.5 WP#5: *P&D in midlands* (start: M13, duration: 60 months)

WP4 starts with an existing plan for a biogas plant in Waldkirch, St. Gallen, and extend it to a fully integrated system with additional producers, such as PV and pyrolysis, and consumers, such as traffic, machinery and industry complemented by battery storage. The general approach is that existing plans for infrastructure generation or renewal will be augmented by additional components in a bottom-up and stepwise manner based on EDGE modelling and design. WP5 will coordinate planning activities between stakeholders and aim to launch implementation partly supported by additional SFOE funding.

2.6 WP#6: *P&Ds in the Alps* (start: M13, duration: 60 months)

WP6 develops interconnected alpine P&D projects in Davos and Bagnes-Verbier (Graubünden and Wallis). Existing plans for infrastructure build-up or renewal will be augmented by EDGE components in a bottom-up and stepwise manner. The implementation of infrastructure will be guided by detailed modelling and monitoring to find optimal solutions, assess the impact on the existing energy system and to allow projections of up-scaling. WP6 will coordinate planning activities between stakeholders and aim to launch real-world implementation partly supported by additional SFOE funding.

2.7 WP#7: *Deployment and integration of decentralized systems* (start: M1, duration: 72months)

WP7 takes the bottom-up estimates of renewable energy resources, designs and operation of decentralized systems, their techno-economic performance, and insights on implementation feasibility from WP1-WP3 in order to develop new scenarios and transition pathways to nearly or fully renewable Switzerland by 2050. WP7 is based on energy systems modeling and will combine three models with high spatial and temporal resolution as well as analysis of temporal pathways to seek for most robust scenarios. WP7 will investigate what these new Swiss scenarios mean for the transmission, centralized generation and storage, mobility sector, and the interconnection with Europe. WP7 will start early in the project to prepare the modeling tools for the ambitious task of representing fully renewable systems for Switzerland, and stepwise integrate the outputs from WP1-3 as they come.

2.8 WP#8: *Policy, markets, and finance to scale up renewable systems* (start: M1, duration: 72 months)

WP8 will investigate the questions on the design of policies, markets, instruments, and other measures to mobilize finance as well as socio-political, community and market acceptance for fostering the uptake of decentralized renewable generation in Switzerland. The foreseen tools include large-scale population survey, cantonal and federal policy analysis, market modeling, and distributional impact analysis in terms of Swiss cantons and municipalities, households from various income groups, key actors in the energy value chain, and gender. WP8 hence bridges the non-technical findings from WP1-WP3 to the national level.

2.9 WP#9: *Consortium management* (start: M1, duration: 72 months)

WP9 will provide the management and coordination functions for the project's activities.

2.10 WP#10: *Knowledge and technology transfer* (start: M1, duration: 72 months)

WP10 will structure internal and external communication activities to support knowledge and technology transfer in EDGE.

3 Contact information

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