

SWEET-EDGE: ENABLING DECENTRALIZED RENEWABLE GENERATION IN THE ALPS

Author(s): Michael LEHNING¹, Jérôme Dujardin¹, Annelen KAHL¹, Evelina TRUTNEVYTE²

Allocation to 1 – 3 topics: Dezentrale Produktion (in alpinen Regionen) von erneuerbaren Energien, PV, Windkraft

3 additional keywords:

Alpine demonstration projects

Optimal siting of new installations

Context of existing infrastructures

Connection to mountain regions YES/NO?: YES

Submission as a PAPER and/or POSTER?:

Please name young authors here: Jérôme Dujardin

Summary and Objectives of the EDGE project

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 seeks to combine research with innovation from three Pilot and Demonstration project clusters (P&Ds) to ensure feedback loops between theory and practice, and to use the outcomes for delineating 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 will deliver 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.

Specific Alpine Demonstration Projects

The role of the Alps in the Swiss energy turn around will be to provide extra energy for cities, agglomerations and industries. The Alps will increase the role they have been playing for decades due to their **hydropower facilities** and will in addition produce **more energy from photovoltaics (PV) and wind energy** than they will consume. However, a variety of factors are in the way of a rapid development, which is required if Switzerland does not want to depend too much on import of winter electricity. The factors include economic risks because of currently low electricity prices, resistance

¹ WSL Institute for Snow and Avalanche Research, SLF Davos and EPFL, lehning@slf.ch, cryos.epfl.ch

² University of Geneva

against PV and wind installations on mountains from landscape and wildlife protection groups, challenges with local logistics and infrastructures and **an incomplete understanding of the true potential of wind energy and PV in high mountains**. The understanding is incomplete because near-surface wind fields are very complex in the mountains and because PV yield is both boosted by snow on ground and low temperatures but also decreased by potential snow accumulations on the panels.

SWEET-EDGE sets out to develop Alpine demonstration projects, which are both **economically viable and acceptable for the society**. To achieve these goals, it is important to find the best locations for such installations but also to embed the developments in the local context. The project will bring the theoretical analysis of [Dujardin et al., 2021] to practice in pushing real development projects. Our Alpine demonstration projects will try to work with resort towns such as Davos or Verbier and existing infrastructures from reservoirs and dams to avalanche defense structures. We present plans for wind and solar resource exploitation combined with snow production in ski areas. We further present a wind test site at the Lukmanier site with small turbines and how the Muttssee PV installations are used to investigate the interaction with the snow cover on the ground and with potential snow build-up on the panels. These examples clearly demonstrate that a careful integration with local conditions opens up a wide potential for high-Alpine PV and wind installations, which overall increases the share of decentralized renewable generation in the Swiss energy mix and helps to close the winter electricity gap.

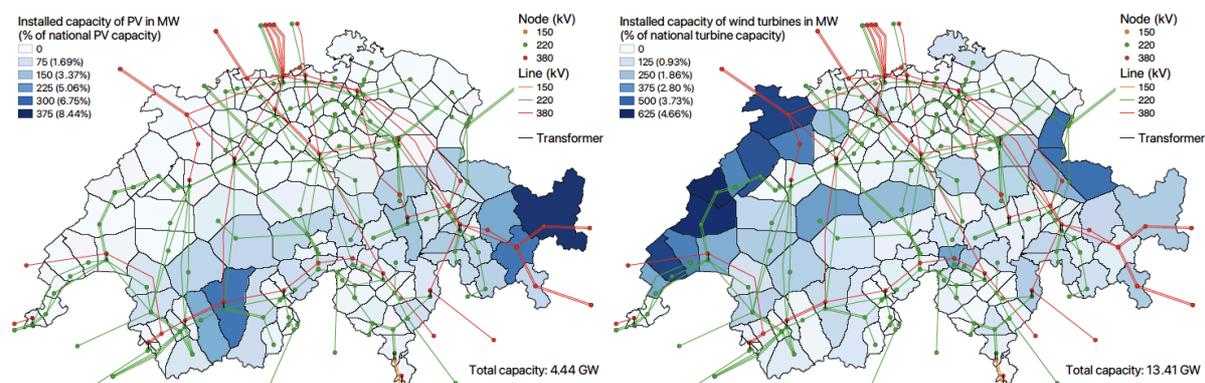


Figure 1: Installed capacity in MW of PV panels (left) and wind turbines (right) in each geographical cluster of Switzerland for the optimal scenario, which minimizes import of electricity and replaces nuclear generation by wind and PV only. From Dujardin et al., 2021, adapted.

Reference:

Dujardin, J., A. Kahl, and M. Lehning (2021), Synergistic optimization of renewable energy installations through evolution strategy, *Environ Res Lett*, 16(6), doi: ARTN 064016, 10.1088/1748-9326/abfc75.