Swiss Federal Office for Civil Protection and citiwatts.eu microgrid simulation

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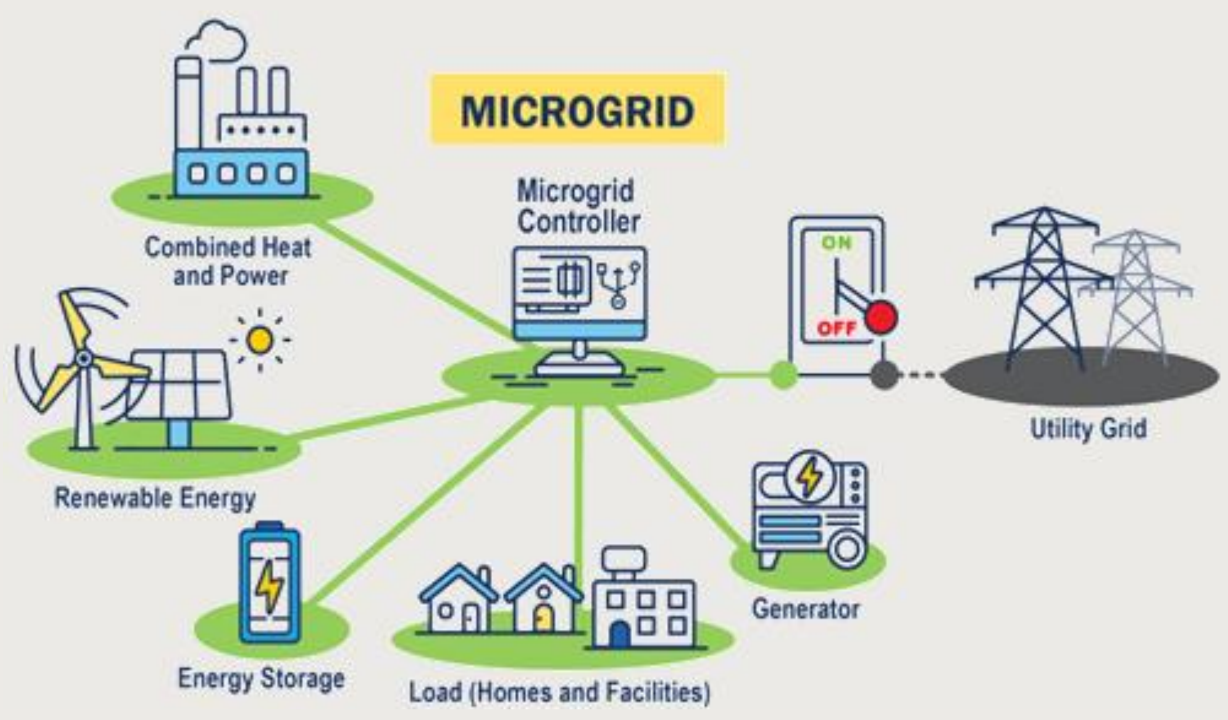
1. Motivation

The Swiss electricity grid is known for its reliability and strong integration with the European network. However, large-scale power outages (blackouts) cannot be completely ruled out due to technical failures, extreme weather events, cyberattacks, or imbalances between electricity supply and demand. Such events could have severe economic and social consequences, highlighting the need to strengthen the resilience of energy infrastructures.



2. Objectives

Improve the resilience of the electricity network in the city of Neuchâtel by maintaining electricity supply to critical infrastructures during a blackout by relying on local energy production, distributed storage, and the use of electric vehicles through Vehicle-to-Grid (V2G) technology.

3. Methods

The proposed strategy involves two main steps. First, autonomous microgrids are identified to supply essential facilities using local resources such as solar energy, biomass, and battery storage. Second, these microgrids can be interconnected to form "mini-grids," enabling energy sharing and improving overall system resilience. Electric vehicles compatible with V2G can serve as decentralized energy storage units, helping to stabilize the network. (Fig.1)

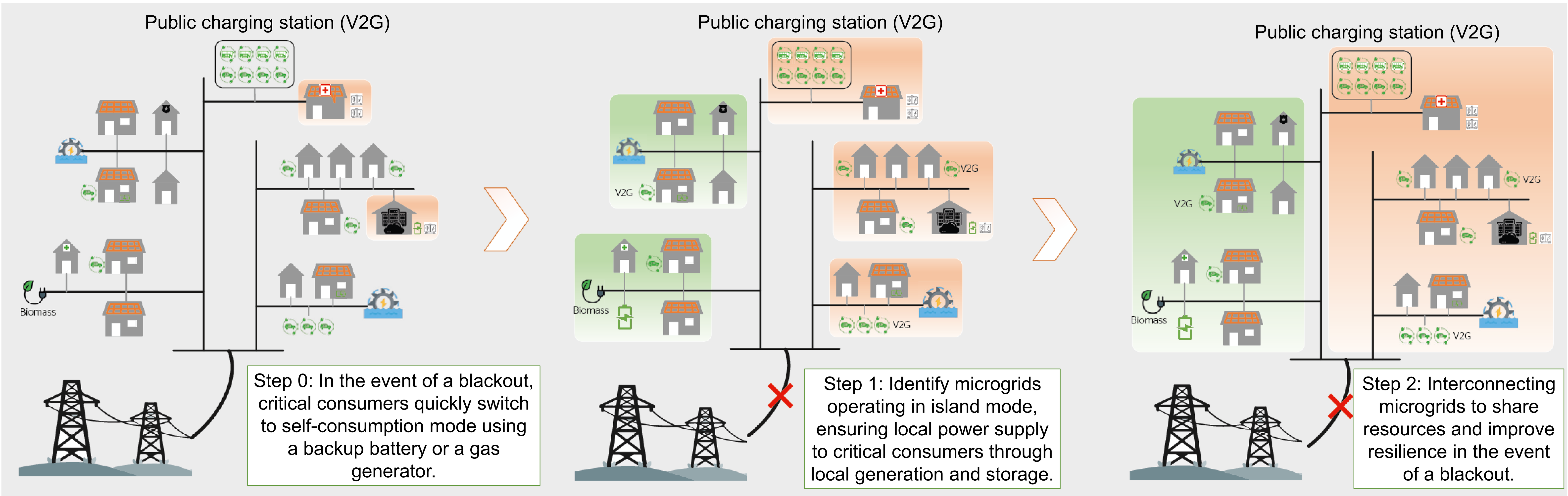


Fig.1: Steps to manage a blackout situation that maximize the resilience of the city's power grid.

4. Platform

To support this approach, a geographic information system (GIS) platform has been developed to visualize and simulate the electrical network using georeferenced data (Fig.2). Enhanced with artificial intelligence, DevSecOps security practices, and a large language model (LLM) interface, the platform allows scenario testing, data analysis, and decision support (Fig.3). This integrated solution aims to strengthen crisis management capabilities and could be replicated in other cities in Switzerland and abroad.

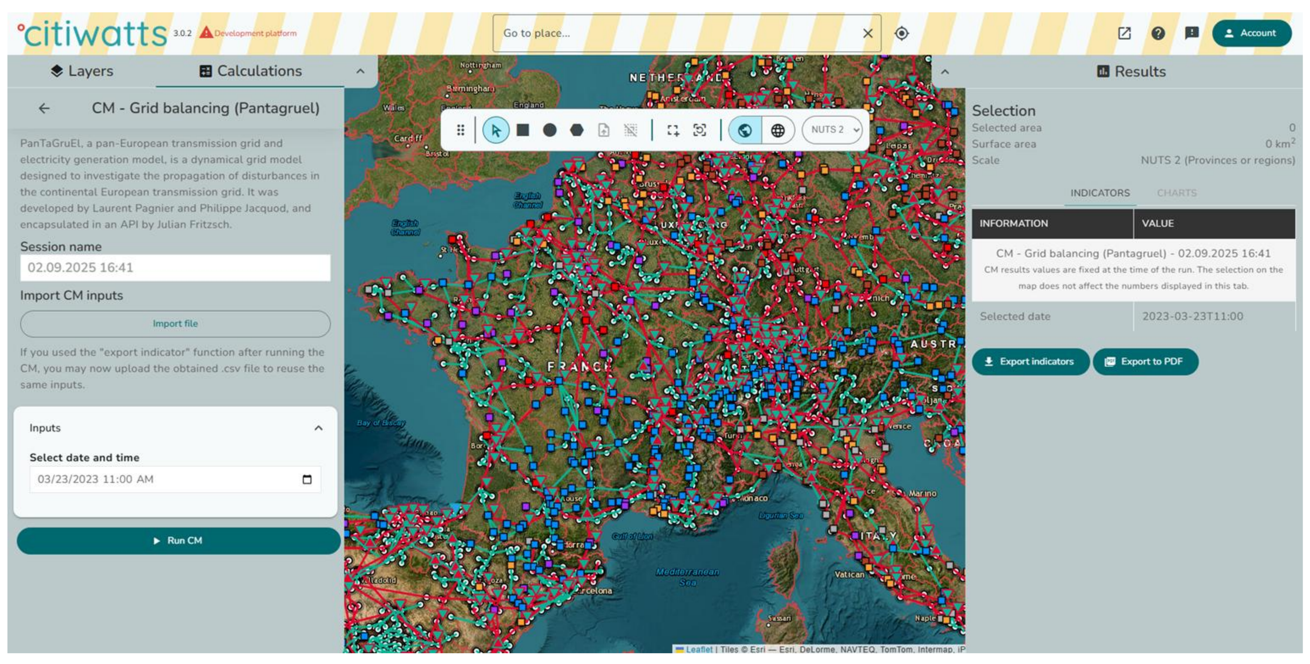


Fig.2 : European network with line capacity simulation.

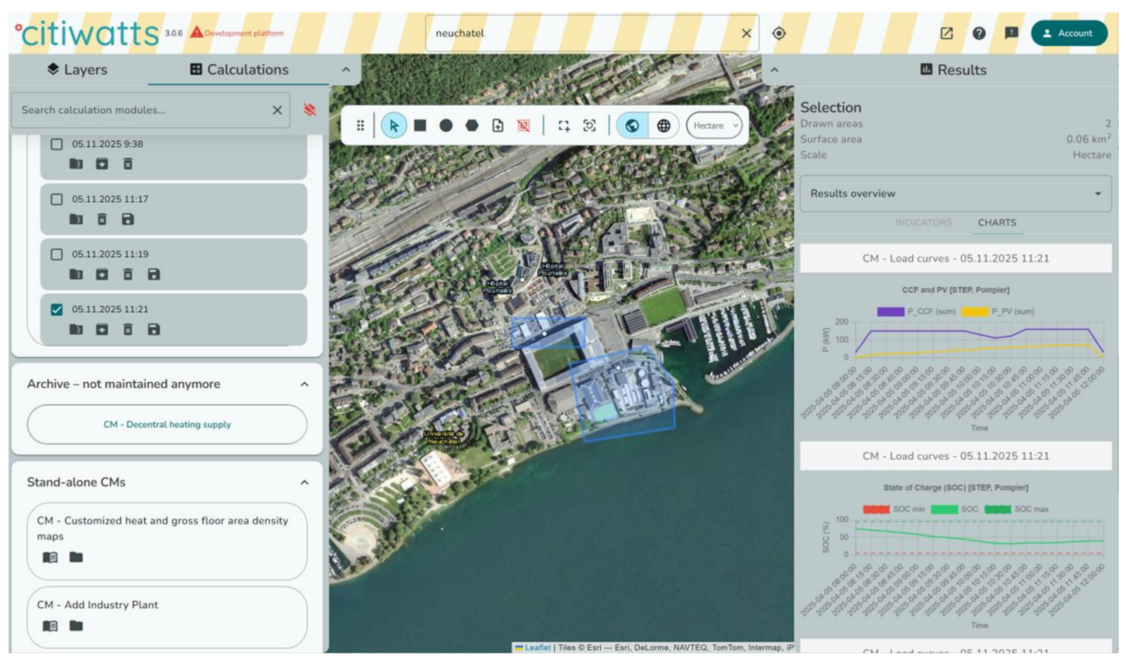


Fig.3: Aggregation of 2 microgrids load curves into 1 mini-grid with more resilience.

5. Conclusion

- Definition of baseline scenarios and prioritisation
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- Definition of priority energy zones
- Analysis of the conditions for deploying microgrids to enhance the resilience of electricity networks
- Economic and environmental model of microgrid deployment for electricity grid resilience adapted to the case study
- Economic model
- Implementation of the life cycle assessment (LCA) method

6. Future work

- Scenario analysis – Focus on the STEP, RHNE, Fire Service and V2H-Senn areas
- Economic viability (methodology suitable for application) – legal framework
- Relevant technical solutions
- Appropriate sizing
- Visualisation (resilience forecasting and planning tool) with guidance
- Network of potential industrial partners
- Towards a replicable demonstrator (useful in real time and during a blackout)

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