Nicolás Pardo-García

ENERGY AND DECARBONIZATION SCENARIOS OF LOCAL RENEWABLE ENERGY COMMUNITIES: BERCHIDDA MUNICIPALITY

Nicolás Pardo-García: AIT Austrian Institute of Technology GmbH, Integrate Energy System Unit, Scientist
Giefinggasse 4, 1210 Vienna, Austria
Phone: +43 (0) 50550 6083, e-mail: nicolas.pardo-garcia@ait.ac.at

Overview

EU energy policy aims to deliver energy to consumers at affordable prices, enhance security of supply, and decarbonize the energy sector. The new Clean Energy Package included the empowerment of the customers among its priorities. It states that consumers is entitled to have an active role in the EU energy system, leveraging on the possibilities offered by renewable energy. This work assesses future scenarios in the Municipality of Berchidda (Italy) for the development of the renewable energy community (REC) and foresee how the local resources as well as flexibility measures will support its future energy and decarbonization targets (2030) including black out protection.

Method

This work aims to reflect future possible scenarios for the development of the energy community in the Municipality of Berchidda and foresee how the local resources as well as flexibility measures will be needed under 2030 horizon. This includes energy demand for the overall sector as well as electric and heat production from local sources. Balmorel model tool is used for calculation purpose, as allows to reflect future scenario and dependence from the national grid including blackouts events as well as flexibility measures such as demand side response, energy storages or smart charging for e-vehicles. The three explored scenario are:

- Reference Scenario (Ref-SC): In this scenario, half of the current fossil fuel heating systems are replaced by heat pumps (HPs), use of e-vehicles is promoted and the expansion of renewable energy sources RES (mainly PV) as well as flexibility measures are considered.
- Blackout Scenario (BK-SC): This scenario keeps the same objectives as Ref-SC, but additionally it is explored how flexibility measures and local resources can support the mitigation of blackout events and reduce the dependence on the national transmission grids.
- 100% Electrification Scenario (ELC-SC): In this scenario, the fully electrification of all economic sectors is explored. The impact of dependence on the national grid, as well as utilization of local resources and flexibility measures under this new boundary conditions is assessed.

Results

In all scenarios, PV capacity rise to 2.1 MWp, which maximum technical potential identified. For Ref-SC there is a need batteries capacity of 0.4 MWh that grows to 1 MWh in case of BK-SC to mitigate the impact of black-out. In BK-SC, the high increase of the use of batteries together with the flexibility measures allows reducing the effective transmission capacity in 15%, from 1.5 MW to 1.3 MW. However, the high increase in the electric demand in ELC-SC increase the dependence on the national grid by 40% to 2.1 MW. In heating sector, Ref-SC and BK-SC perform similar, biomass boilers and HPs are the main technologies with an installed capacity of 2.9 MW and 1.4 MW respectively. In ELC-SC, HP installed capacity increase to 6.0 MW and the thermal storage capacity grows up to 1.5 MWh to take advantage of the fluctuations of the electricity prices. Transport sector reduce its energy needs due to the reduction of the population and the use of e-vehicles. Ref-SC and BK-SC perform equally with an overall energy demand of 3.9 GWh, 14% reduction compared to the reference year (2017). In ELC-SC due to the massive use of e-vehicles energy demand downsizes to 1.7 GWh, 62% less. In terms of CO_2 emissions, Ref-SC and the BK-SC perform similarly with around 2,474 tons of CO_2 emissions; 34% less. In ELC-SC, there is not direct CO_2 emissions anymore. However, indirect CO_2 emissions rise to 1,562 tons of CO_2.

Conclusions

The overall conclusion is that flexibility measures can support the electrification of the energy community and reduce the dependence on the national grid. In general, the electrification of the heating and transport sector produces an increase the needs of PVas well as the use batteries. However, there is mismatch between local production and consumption at seasonal level that can produce curtailment in PV production during the summer periods. Black-out protection implies a high expansion of batteries covering partially electricity demand during the most critical blackout event. Even more, this electric battery capacity together with the other flexibility measures could reduce the needed effective transmission capacity with the national grid. Fully electrification increase seasonal mismatch between local production and demand, increase the needs of the effective capacity in the transmission line and expansion of the use of thermal storage systems to take benefit of the electricity prices. In terms of decarbonization, in all the assessed scenarios there is a clear reduction of the overall CO_2 emissions. Although, the fully electrification stops direct CO_2 emissions, it rises indirect CO_2 emissions due to highest electricity imports.

References

European Commission (2019), “Clean Energy Package”, Available in: https://energy.ec.europa.eu/topics/energy-strategy/clean-energy-all-europeans-package_en

Wiese, F., Bramstoft, R., Koduvere, H., Pizarro Alonso, A., Balyk, O., Kirkerud, J.G., Tveten, Å.G., Bolkesjø, T.F., Münster, M., Ravn, H. (2018), “Balmorel open-source energy system model”. *Energy Strategy Reviews* 20, 26–34

Pardo-García, N., de Asis Brasil Weber, N., Suna, D. (2023), “Decarbonization scenario assessment for the study cases”, LocalREs Project Grant Agreement No. 957819.