



*Establishment of a FramewORk for Transforming current
EPES into a more resilient, reliable and secure system all
over its value chain*

Framework for islanding operation in distribution system



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Abbreviations and Acronyms

Acronym	Description
AI	Artificial Intelligence
CDC	Capacity-weighted Deterministic Control
CDC+F	Capacity-weighted Deterministic Control with Forecasts
DDC	Distance-weighted Deterministic Control
DDC+F	Distance-weighted Deterministic Control with Forecasts
DER	Distributed Energy Resources
DG	Distributed Generator
DSO	Distribution System Operator
DT	Digital Twin
EDS	Electrical Distribution System
EPES	Electric Power and Energy Systems
ESS	Energy Storage System
FDG	Follower Distributed Generator
HV	High Voltage
LV	Low Voltage
MFC	Master-Follower Control
MG	Master Generator
MV	Medium Voltage
PV	PhotoVoltaic
RL	Reinforcement Learning
RLC	Reinforcement Learning Control
RLC+F	Reinforcement Learning Control with Forecasts
SGC	Smart grid controller
SRLF	Smart recursive load flow
STLF	Short-term load forecasting
TSO	Transmission System Operator



Executive summary

The transition toward more resilient, secure, and sustainable energy systems necessitates innovative solutions for managing modern distribution networks. In this context, we present here a technical framework for islanded operation of medium voltage (MV) grids, addressing both the operational complexity and the increasing presence of distributed energy resources (DERs).

This work, resulting from Task 3.2 and 3.6 of the eFORT project, focuses on the development and validation of advanced islanding control strategies using a Digital Twin (DT) of a real MV distribution system in Sarentino Valley, South Tyrol, Italy. The DT, built with open source tools, enables accurate modeling, control, and simulation of grid operations under isolation conditions.

Relying on a Master-Followers hierarchical control strategy, where the Master Generator regulates with quick adjustments power balance, frequency, and voltage of the grid, while Follower Generators provide a power baseline and the necessary margins to the Master, two types of control strategies were explored:

1. **Deterministic Control Algorithms**, including capacity-weighted and distance-weighted methods, which explicitly allocate power setpoints to distributed generators based on a predefined Master load target and forecasted loads.
2. **Reinforcement Learning (RL) Based Control**, using a modified Deep Deterministic Policy Gradient (DDPG) approach to learn optimal control policies through simulated interactions with the DT. These policies dynamically adapt to grid conditions without the need for explicit, pre-defined rules.

Results demonstrate that RL-based control outperforms classical deterministic methods in handling variability, minimizing constraint violations, and reducing power losses, particularly when supported by short-term load forecasting.

This deliverable contributes to the eFORT project's goals by demonstrating a scalable, modular, and data-driven approach to improve the autonomy and resiliency of MV distribution systems. The framework developed here is applicable to various real-world scenarios and serves as a steppingstone for further deployment in smart grid environments.

