EASY-RES

Enable Ancillary
Services by Renewable
Energy Sources

Outcomes

OUR VISION

100% RENEWABLE
100% SECURE

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THE EASY-RES SOLUTION

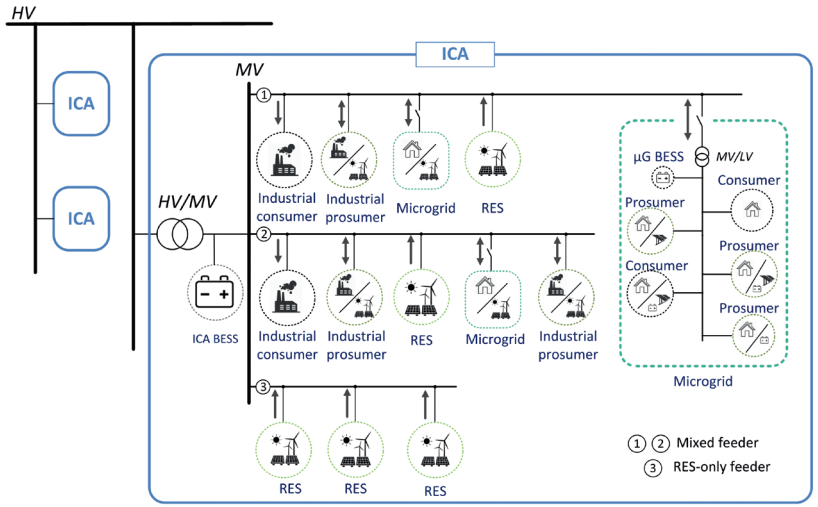
The EASY-RES project has managed to provide a solution to a long-standing problem: enable the robust, resilient and stable operation of large power grids with very large penetration (even 100%) of renewable energy sources (RES). Following the EASY-RES approach, conventional fuel-driven power plants that drive large synchronous generators (SG) can be decommissioned in direct proportion to the increasing RES penetration.

Following a bottom-up approach, we firstly focused on converter-inter-faced distributed RES (CI-DRES) like PV and wind generators. EASY-RES developed and tested a new converter – named Unified Virtual Synchronous Generator (UVSG) – which fully emulates the operation of SG, nevertheless with much larger capabilities for configuration and control. In this way the CI-DRES equipped with UVSGs can provide, in an unified way, a number of Ancillary Services (AS):

1. True inertia that is also controllable and independent of the DRES primary source power.
2. Act as Frequency Containment Reserve both upwards and downwards.
3. Limit the ramp-rate of the power injected into the grid.
4. Exhibit extended fault-ride-through and contribute in a controllable way to fault clearing within Distribution Networks (DN).
5. Exchange reactive power to support the voltage regulation in DNs.
6. Behave as configurable active harmonic filters.

EASY-RES dealt also with whole DNs or parts of them as Individual Control Areas (ICAs), where the DRES with UVSGs and properly sized battery energy storage systems (ESS) are optimally coordinated via a specifically designed ICT system to provide the aforementioned AS. Aggregation and disaggregation methods have been developed for the frequency-related AS, so that they can be offered to the TSOs. In this way, EASY-RES enabled the behavior of the ICAs as configurable and controllable dynamic virtual power plants with transparent properties.

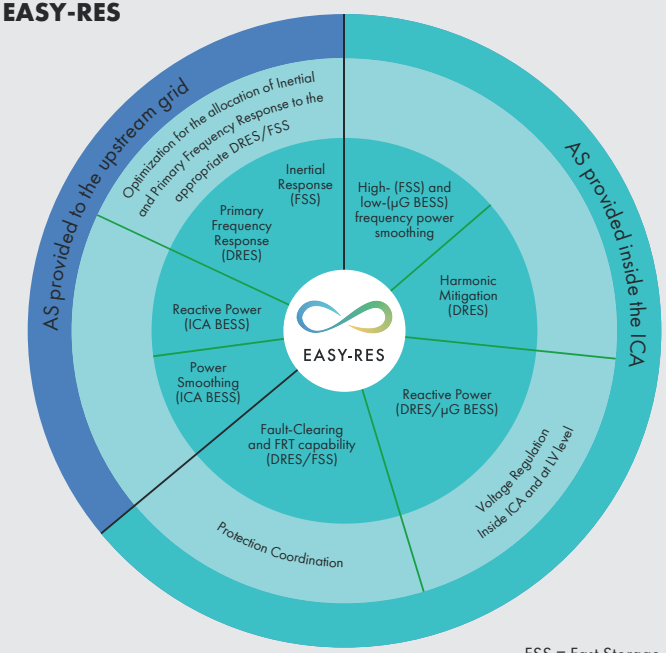
New business models have been developed for each AS and for various stakeholders like DRES owners, aggregators, DSOs and TSOs. The identification of the involved costs and the development of specifications for the measurement and quantification of each AS served as building blocks of those models.



ACHIEVED OBJECTIVES

1. Make the electrical power systems more robust against abrupt frequency changes because the EASY-RES CI-DRES can provide true inertial response of **equal amount** as large conventional SGs.
2. Maintain the stability of the power system – despite the decommission of conventional reserves in **direct proportion** to CI-DRES penetration – because the EASY-RES CI-DRES can be controlled to operate as Frequency Containment Reserves.
3. The penetration levels of CI-DRES in DNs can **increase up to the physical thermal limits** of the network's elements without being limited by voltage-regulation issues.
4. The EASY-RES CI-DRES are more **grid-friendly** since they can limit the ramp-rates of the injected power up to 10-30% of their nominal power per minute. Also, by acting as harmonic filters, they can **contain the voltage harmonic distortion** in the DNs to the current small levels despite the increased DRES penetration.
5. The long-term **grid security is preserved** even under large DRES penetrations due to the new smart and coordinated reaction of CI-DRES during faults. At the same time faults are cleared equally effectively with the legacy protection means, deferring thus, otherwise unavoidable, relevant investments.
6. The EASY-RES CI-DRES can offer multiple and vital AS in an unified way with an additional investment cost on hardware that is **less than 10% of the current DRES cost**.

DRES FUNCTIONALITIES IN EASY-RES



FSS = Fast Storage System
BESS = Battery Energy Storage System

EASY-RES KEY RESULTS

1 LAB-TESTED EASY-RES PROTOTYPE

MORE THAN **40** SCIENTIFIC PUBLICATIONS

16 KEY EXPLOITABLE RESULTS

TRL 3 → **TRL 5**

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MORE INFORMATION ABOUT THE PROJECT:

www.easyres-project.eu

CONTACT:

info@easyres-project.eu

THE EASY-RES PARTNERS:

ARISTOTLE UNIVERSITY OF THESSALONIKI

UNIVERSIDAD DE SEVILLA

Stadtwerke LANDAU a.d.ISAR

bayern innovativ Innovation leben.

elektro gorenjska

ΑΔΜΗΕ

UNIVERSITÄT PASSAU

Lancaster University

TU Delft

fenecon

stadtwerk haßfurt