The Electricity Market of Non-Interconnected Islands in Greece

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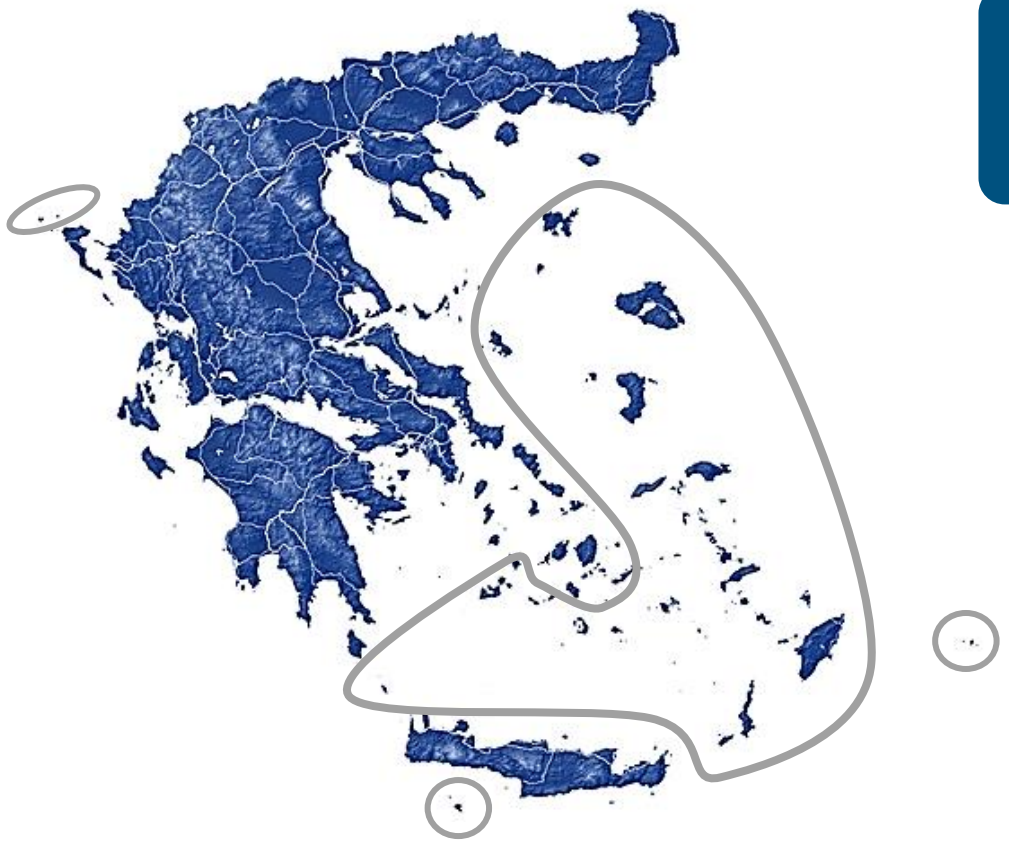
Operation – Power Supply Management of NIIs

The Market of Non-Interconnected Islands (NIIs)



28 **Autonomous Electrical Systems**

- **1 large** (peak load over 200 MW, Rhodes Island)
- **11 medium** (peak load from 5MW up to 100 MW)
- **16 small** (peak load up to 5MW)

HEDNO, as Operator of NIIs, is responsible for:

- ❑ the management of power generation in the electrical systems of NIIs,
- ❑ the expansion planning of the electrical systems of NIIs,
- ❑ the operation and the clearing of the Electricity Market of NIIs,
- ❑ the settlement of cash obligations and claims for the participants in the Electricity Market (Producers and Electricity Suppliers)

Installed capacity in NIIs

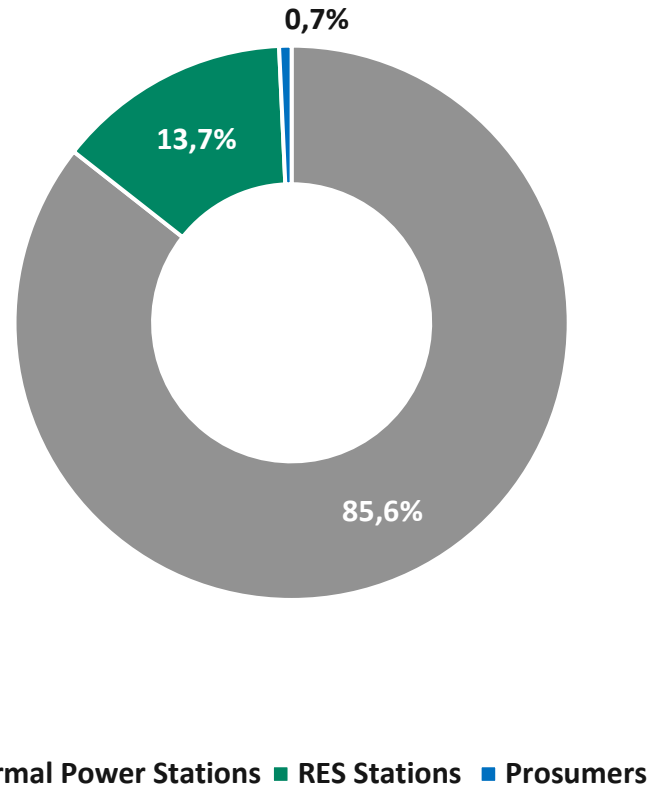
30 Thermal Power Stations (~1020 MW)

696 RES Stations (~163MW)

- 51 Wind Parks (108.02 MW)
- 641 PV Stations (51.46 MW)
- 2 Hybrid Power Stations (2.95 MW)

1219 Prosumers (8.62 MW)

- 960 roof-top PV units (4.68 MW)
- 259 net metering PV units (3.94MW)



Challenges and prospects in NIIs

Challenges

One and only thermal producer in each electrical system of NIIs (PPC SA)
- aged power stations (in most of the electrical systems)
- predefined mix of the thermal units (size and fuel)

High seasonality of demand (load with high variation between the base load and the peak load)

Autonomous electrical systems:
- no alternative supply
- different technical requirements among the electrical systems
- technical limitations in the exploitation of RES production

Difficulties in the management and coordination of Producers (Thermal and RES Producers)
- technical and contractual difficulties

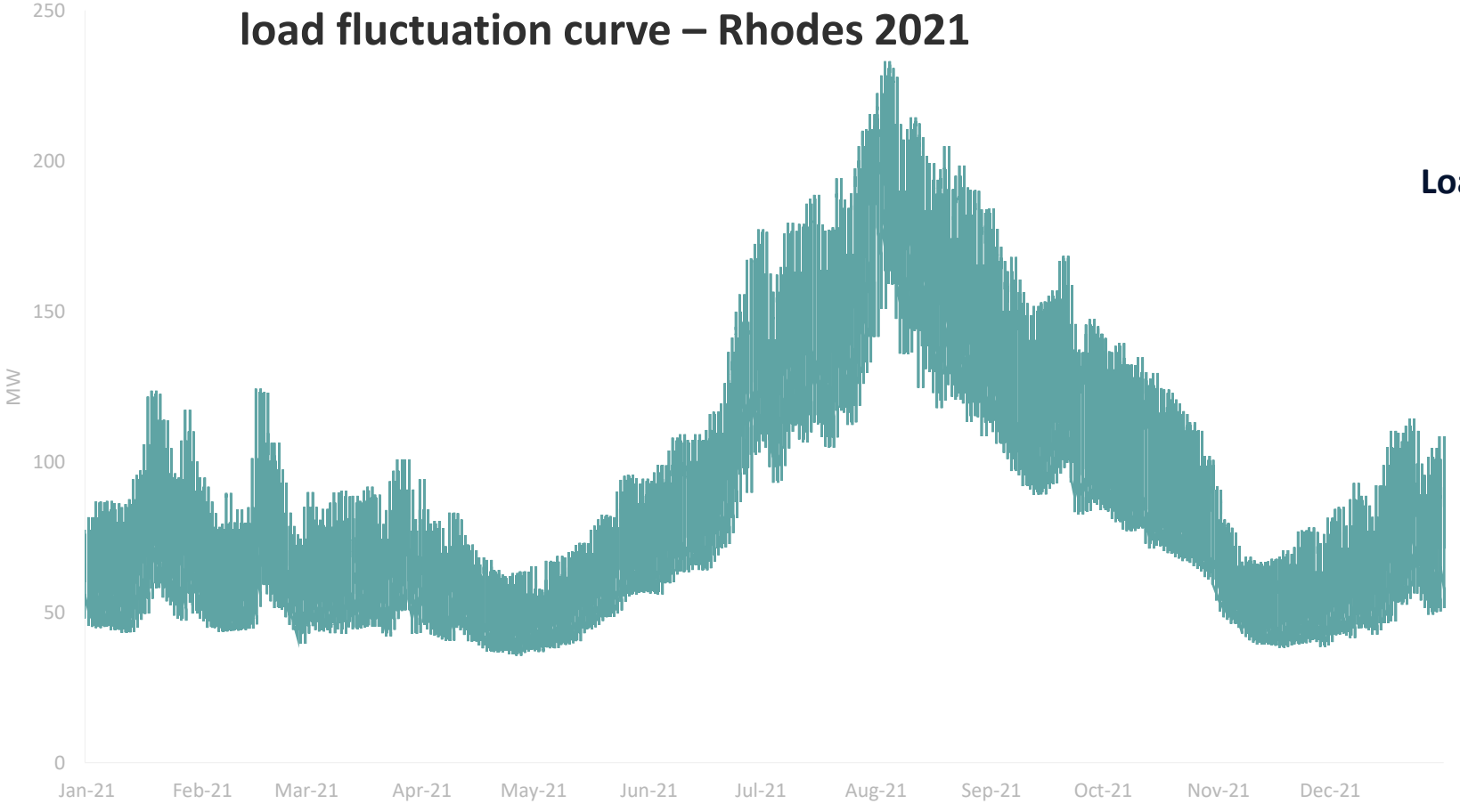
Constantly changing legislation and regulatory framework

Prospects

High potential of wind production

High level of solar irradiance

Intense seasonality of load



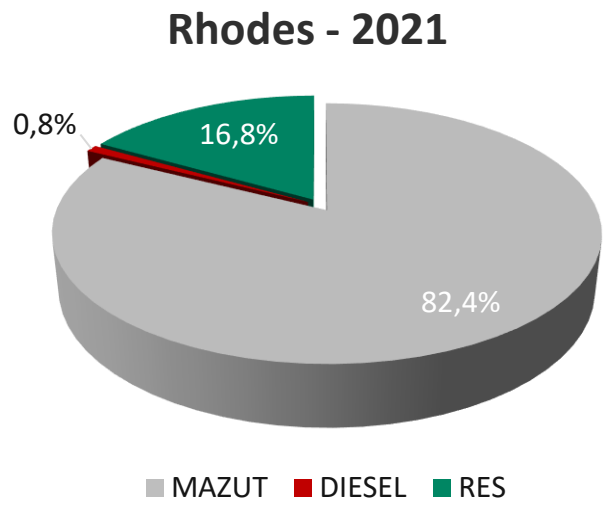
Load Factor: 37,5%

Minimum: 36 MW

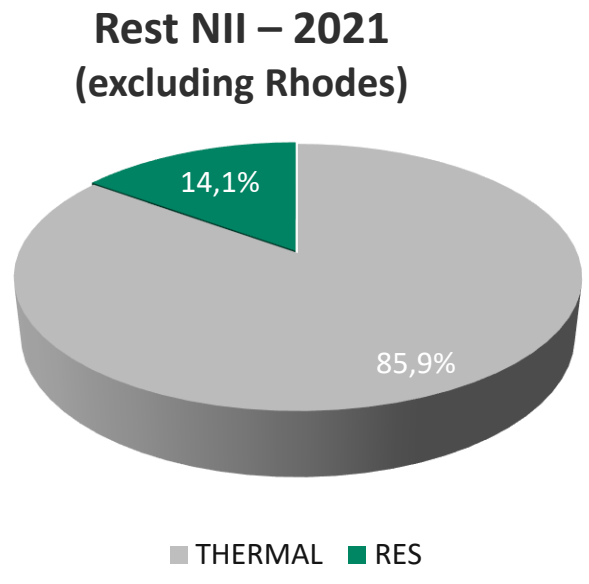
Maximum : 235,8 MW

RES power penetration in the NII - 2021

2021 NII Energy Balance (Demand: 2.262 GWh, RES Generation: 340 GWh)



Demand: 774 GWh, RES Generation: 130 GWh

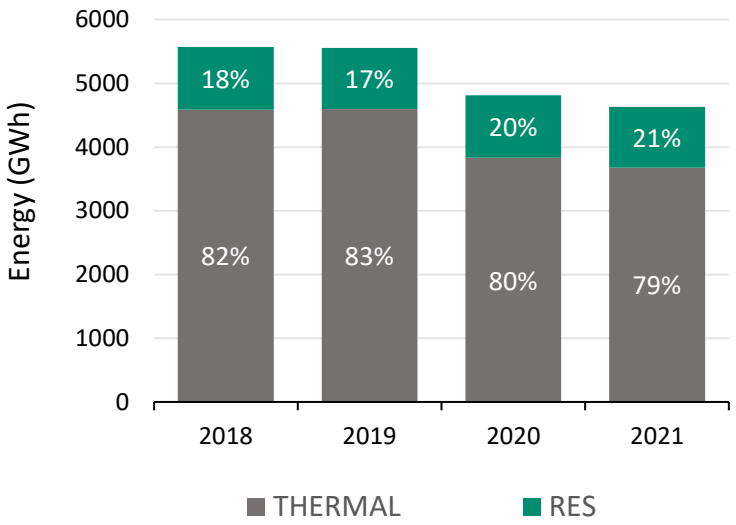


Demand: 1.488 GWh, RES Generation: 210 GWh

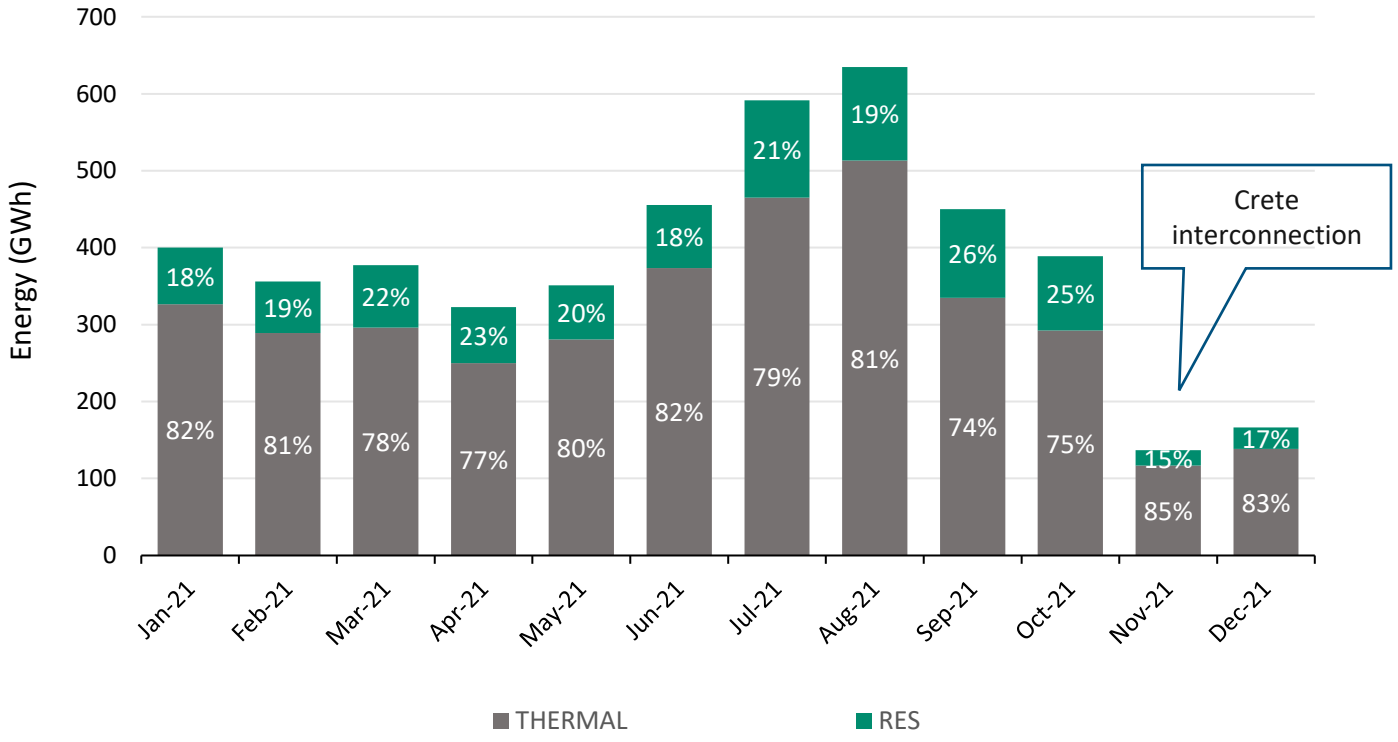
Electricity Production in NIIs

Annual Production (years 2018-2021)

	Thermal	RES
	GWh	GWh
2018	4,586.12	986.08
2019	4,594.66	960.76
2020	3,831.72	978.19
2021	3,676.97	954.01



Monthly Production in year 2021



Actions to increase the penetration of RES in NIIs

Actions of the Operator of NIIs

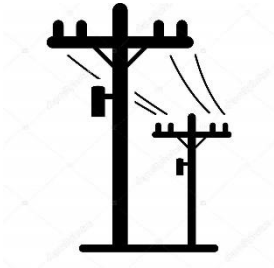
- Implementation of the national legislation for the development of RES projects
- Implementation of Day-ahead Dispatch Schedule (DDS)
- Integration of advanced monitoring and control systems (SCADA)
  - ❑ Energy production monitoring in real-time
  - ❑ Management of the energy production in real-time
- Conducting of RES penetration studies
- Support and implementation of innovative RES projects
  - ❑ HPS in Tilos Island (TILOS Horizon2020)
  - ❑ HPS in Ikaria Island
  - ❑ HPS in Astypalea Island
  - ❑ Chalki GR-eco Island
  - ❑ HPS in Agios Efstratios Island
- On-time service of requests from RES Producers

Institutional Framework

HEDNO

Discrimination of HEDNO responsibilities

Under Law 4001/2011, the Hellenic Electricity Distribution Network Operator (HEDNO S.A.) was appointed NII Operator.



A. Network Management

B. Electrical Systems Management

- ✓ Generation Management
- ✓ Operation of the Market
- ✓ Operation of the NII Systems

NII Management Code

- **The NII Code, which was put into force in 2014, completed the regulatory framework for the liberalization of the Electricity Market in the NII, allowing immediate and unhindered involvement of the stakeholders, in both the supply and the production of electricity from conventional power plants.**
- **The implementation of the NII Code was predicted to occur gradually, through a transitional phase of five (5) years, which was considered necessary for the gradual deployment of the necessary infrastructure (Energy Control Centers, Information System, etc.) for the management of the NII Systems and Market, which will be carried out from scratch.**
- **Nowadays, a collaboration between the NRA and NII Operator has been established, in order to examine and evaluate the necessity of modifying certain provisions and aspects of NII Code, so as to respond to the current environment and needs of NII.**

Market Transformation in the NII

HEDNO Goals:

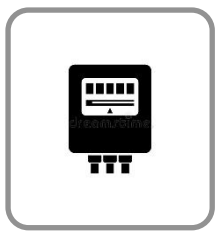
- ✓ The safety of the NII Electrical Systems in terms of continuous and uninterrupted service of demand
- ✓ The more accurate and economical Generation Management
- ✓ The increase of the RES power penetration
- ✓ The provision of equal access of the stakeholders to the NII Market

The particularities of the NII Electrical Systems, imposed the need for development of infrastructures, so as to achieve:

- ✓ Increase in the reliability and security of supply of the Electrical Systems
- ✓ Minimization of electricity cost
- ✓ Generation Management, in order to increase the RES power penetration
- ✓ Operation and Market Settlement

Infrastructure development and modernization of Electrical Systems

SCADA-EMS



New Telemetry systems

Energy Control Centers

Monitoring & Control Systems (SCADA)

Central Monitoring System

- Located in Athens in the headquarters of the Operator of NIIs (HEDNO)
- The Central Monitoring System communicates and co-operates with the local monitoring and control systems located at each electrical system
- Separate Energy Management System located in Rhodes Island

Monitoring & Control Systems (SCADA)

Basic functionalities of SCADA systems

Real-time monitoring (time resolution of 1 sec) and **registration of data** (energy production and other management data) in HEDNO's database server

Automated management of the real-time operation procedures (no human intervention)

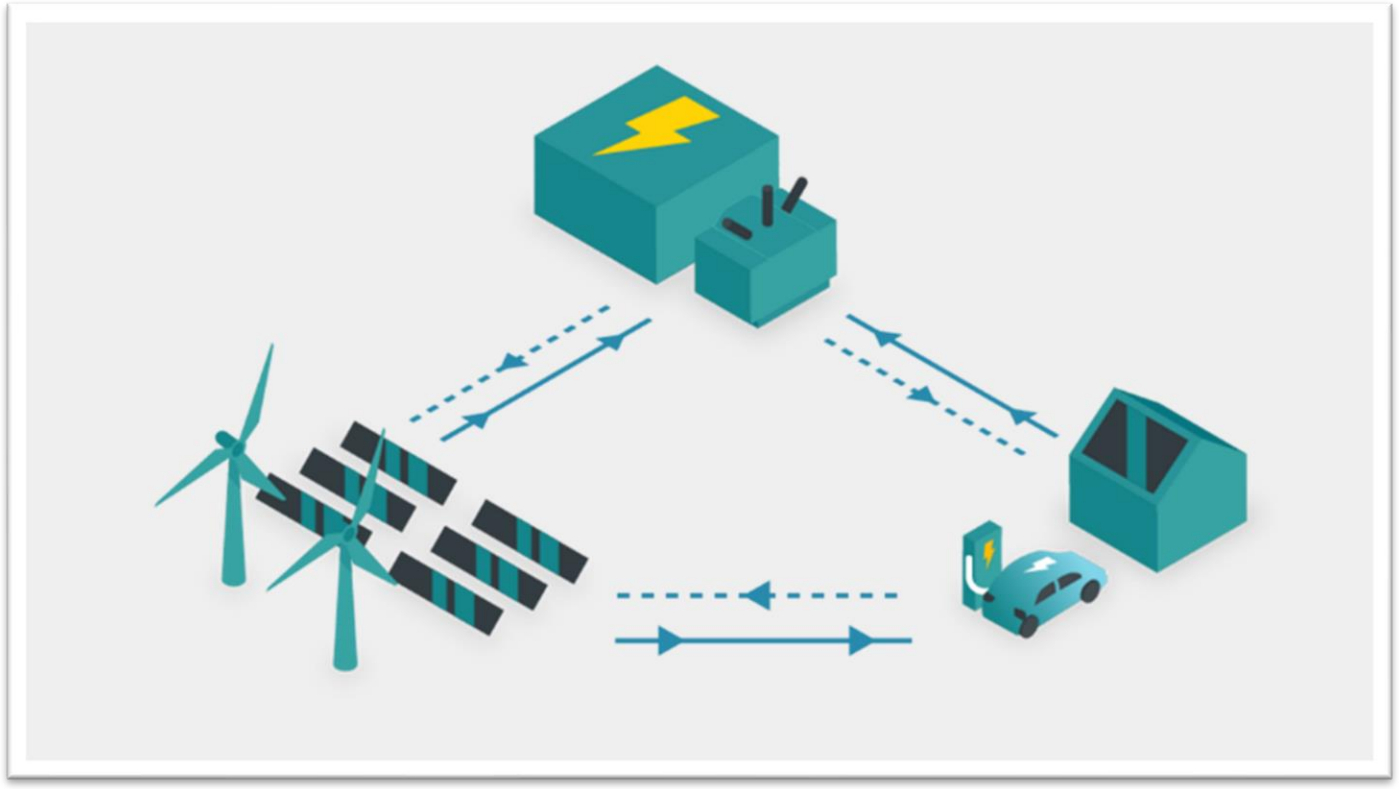
- automated set-points to Wind Parks (max power generation) and Hybrid Stations (dispatch set-point)

Estimation of PV production during the real-time operation, based on sampling of PV production and utilizing appropriate algorithm (estimation update every 1 min)

Maximization of RES penetration, while ensuring uninterruptible power supply

Availability declaration (RES Stations, Thermal Units and Hybrid Power Stations)
Forecasting of load and RES production
Issue of Day-ahead Dispatch Schedule

Special Pilot Projects in NIIs



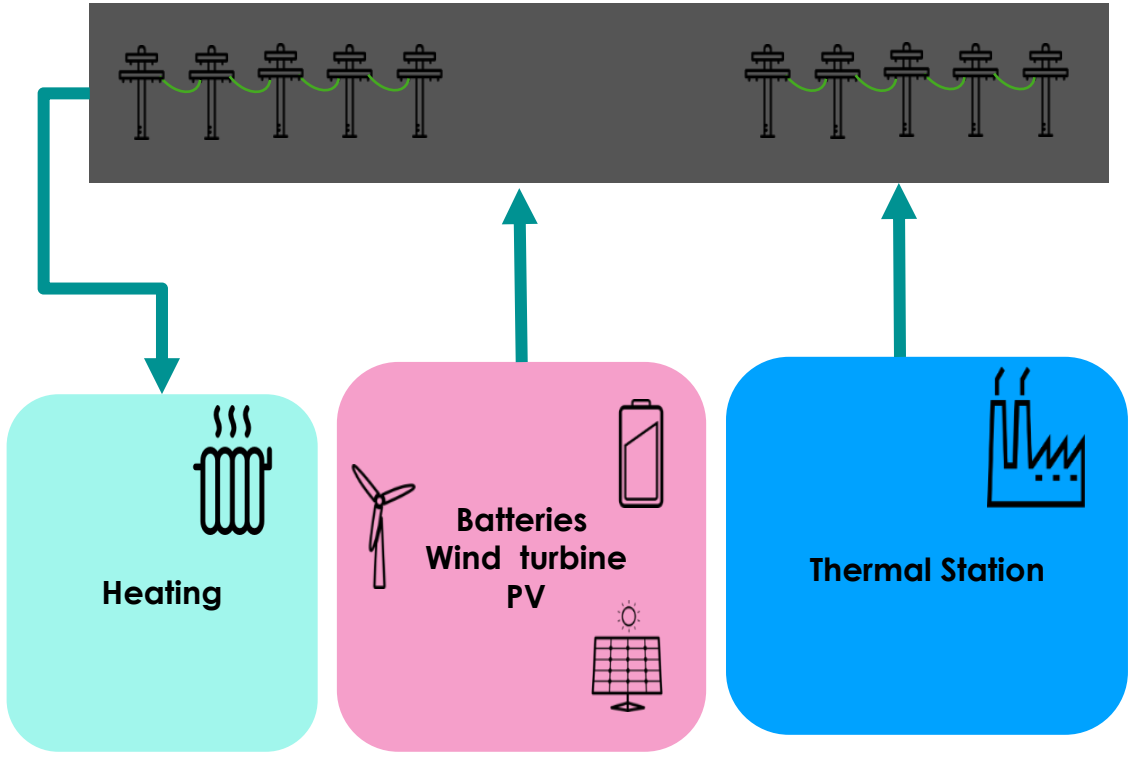
Innovative projects in NIIs

1. **Hybrid Power Station of Ikaria** (phase: in operation)
   - ❑ Guaranteed power: 2.55 MW
   - ❑ RES: Wind Turbines (3 x 0.9 MW) + 2 x small Hydro (1 MW + 3 MW)
   - ❑ Pumped hydroelectric storage
2. **Hybrid Power Station of Tilos** (phase: in operation)
   - ❑ Guaranteed power: 0.4 MW
   - ❑ RES: Wind turbine (1 x 0.8 MW) + PV (1 x 0.16 MWp)
   - ❑ Storage: Batteries (2.4 MWh)
3. **Agios Efstratios - Project «Green Island»** (phase: under construction)
   - ❑ RES: Wind turbine (1 x 0.9 MW) + PV (1 x 0.225 MWp)
   - ❑ Storage with batteries (2.5 MWh) + Thermal Storage
   - ❑ District heating system
4. **Astypalea – Smart and Sustainable Island** (phase: in tender from RAE)
   - ❑ Hybrid Power Station: PV (~3 MWp) and Battery Storage System (~7.2 MWh)
   - ❑ Electric vehicles, as flexible loads
5. **Chalki GR-eco island** (phase: in operation)
   - ❑ PV station (1 MW)
   - ❑ Electric vehicles + Smart lighting
   - ❑ Virtual net metering

★ Location of innovative projects in NIIs

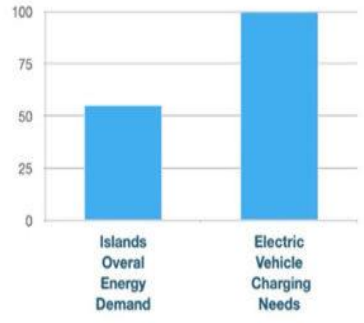
Ai-Stratis Green Island

1. **Agios Efstratios is a small island in north-eastern Aegean, with only 270 inhabitants (2011) and Average Peak Demand ~ 0.32 MW.**
2. **The Ai-Stratis – Green Island project involves**
   - a Hybrid system for the production of electricity and
   - district heating system from RES to be used in buildings and to produce hot water for domestic use
3. **The aim is to make the island completely autonomous with RES penetrating the electricity system at more than 85%.**
4. **The project is financed by the European Union, carried out by Center for Renewable Energy Sources (CRES) and is in the implementation phase.**
5. **HEDNO cooperated with all involved parties and specialized the management principles of Agios Efstratios.**



Astypalea Smart and Sustainable Island

1st phase (by 2023)



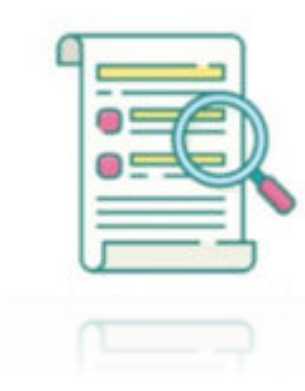
2nd phase (by 2026)

- **The project will foster Astypalea's clean energy transition by establishing renewable energy infrastructure, that will gradually replace the ageing diesel generators.**
- **Renewable energy sources will cover both the daily electricity requirements and the additional demand arising from the adoption of e-mobility.**
- **A state-of-the-art hybrid RES system, that is designed to prioritize the supply of the integrated electric vehicle charging network on the island, will ensure smooth transition in two phases.**
- **HEDNO has conducted studies to establish the principles of management and the pricing scheme of the project.**

The role of HEDNO

- **The mission of the HEDNO is to accelerate the green transition of the Greek islands focusing mainly on maximizing the penetration of RES.**

- **Working closely with all parties involved (NRA, Ministry, Contractors) to establish new operation principles and meet the technical specifications for balancing energy needs with RES production.**



Thank you for your attention

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