

The Regulator experience in planning for the integration of energy storage in the Greek interconnected islands

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The current situation of the electrical energy systems in Greece and the interconnections of islands to mainland

The Greek electrical Systems

• 1 Mainland Electrical Systems (ES)



2 Big (With peakload above 100 MW, Rhode)

10 Medium (With peak load between 5MW and 100 MW)

16 Small (with peak load bellow 5MW)





30 Thermal Stations (1.012 MW)

691 RES stations (162,47 MW)





641 PV Stations (51,46 MW)

2 Hybrid Stations (2,95 MW)





Autoproducers (5,84 MW)

959 PV Roof (4,67 MW)

106 PV net metering (1,17 MW)

Thermal stations RES stations

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	Electrical System	n Installed Capacity (MW)
	Rhodes	320,45
	Agios Efstratios	0,84
	Agathonisi	0,639
	Amorgos	6,2
	Anafi	1,152
	Antikithira	0,413
	Arkioi	0,405
	Astypalaia	5,1
	Gavdos	0,83
	Donousa	0,99
al	Ereikousa	1,165
	Thira	80,187
	Ikaria	20,0224
	Karpathos	19,054
	Kythnos	7,195
	Kos-Kalumnos	213,688
	Lesvos	102,595
	Limnos	26,153
	Megisti	2,22
	Milos	25,5
	Othonoi	0,662
	Patmos	8,925
	Samos	49,63
	Serifos	9,215
	Sifnos	12,725
	Skyros	8,9
	Simi	9,875
	Chios	77,782
	TO	TAL 1.012

1 Mainland Electrical Systems (ES)



Region	Electrical System	Island
	Agathonisi	Agathonisi
	Amorgos	Amorgos
	Anafi	Anaf
	Antikithira	Antikithira
	Arkioi	Arkio
	Astypalea	Astypalea
	Gavdos	Gavdos
	Donousa	Donousa
	Ereikousa	Ereikousa
	Thira	Thira
	IIIId	Thirasia
	Karnathos	Karpathos
	Raipatilos	Kasos
	Kithnos	Kithnos
		Kos
		Pserimos
South Angon	Kos	Giali
South Aegen		Kalimnos
		Leros
		Lipsoi
		Tenedos
		Nisiros
		Tilos
	Megisti	Megisti
	Milos	Milos
	1 1100	Kimolos
	Othonoi	Othonoi
	Patmos	Patmos
	Rhodes	Rhodes
	100000	Chalki
	Serifos	Serifos
	Sifnos	Sifnos
	Skyros	Skyros
	Simi	Simi
	Agios Efstratios	Agios Efstratios
	Limnos	Limnos
	Lesvos	Lesvos
	203703	Megalonisi
	Chios	Chios
North Aegean		Oinouses
		Psara
	Ikaria	Ikaria
	Samos	Samos
		Fournoi
		Thimaina



28 Isolated Electrical Systems (ES)

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Interconnection of Non-Interconnected Islands with Mainland

- **Reduction of Production Cost**
- Increase System reliability
- **Increase RES Penetration**
- Lifting of electrical isolation

- - μείωση περιβαλλοντικού αποτυπώματος increase of the unified electricity market

Reduction of Public Obligation Services

✓ Connected to Mainland

- Andros
- Siros
- Paros >> Antiparos, los, Sikinos,
 - **Folegandros**
- Naxos >> Sxinousa, Iraklia,
- **Mykonos**

To be Connected (on process

- Crete (B Phase)
- Phase D (Cyclades)
- Dodekannise
- **Islands of North East**
 - Aegean

Without Connection

- **Antikithira**
- Gavdos
- Megisti (Kastelorizo)
- **Ereikousa**
- Othonoi



National Energy & Climate Plan for Non Interconnected Islands / Interconnections

The goal of eliminating the operation of thermal units with liquid fuel is the completion of the interconnection of all islands with the interconnected system (Mainland), a goal of the previous NECP that is already successfully implemented and further expanded in the present NECP. The island interconnection project includes:

- Interconnection of Crete with Mainland (Phase II)
- Phace D Interconnection of Cyclades (South and West)
- Interconnection of Dodecanes with Mainland
- Interconnection of North-East with Mainland

Interconnections of Cyclades

Phase D (on process)

Connection Paros (or Naxos) - Thira To be completed in 2023

Naxos to Thira Thira to Folegandros Folegandros to Milos Milos to Serifos Serifos to Attika







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Interconnections of Crete

Interconnections of Crete

To be completed within 2025

The first cable is already in operation since July 2021



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Greece interconnection with Cyprus & Egypt

Grece – Cyprus - Israel / Euroasia Interconnection -

- Kofina (Cyprus) Handera (Israel)
- Kofinou (Cyprus) Korakia (Crete)

Greece – Egypt (GREGY) electrical connection (sort list of PCI Project)

New Scada system by HEDNO (Greece) for the Non Interconnected Islands

The Regulatory framework for Hybrid Stations (implementation in Non Interconnected Islands)

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The first main objective of the notified scheme is to increase the level of RES in the energy mix of the NIIs in Greece, currently estimated to around 20 % of the annual electricity demand to levels of up to 50 % of the annual electrical energy demand on each NII. In this way, the notified scheme will incentivise electricity production from RES in order to contribute to the achievement of the targets set by Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources (the "RED II")21 and Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action (the "Governance Regulation").

According to Greece, the design of the notified scheme for the establishment of HPS projects in the NIIs takes into account the new circumstances in the NIIs (State Aid 58482)

Greece has notified the following types of measures under the notified scheme, broken down as follows:

Measure 1:

Support granted for HPSs in six small NIIs that will not be interconnected (Agios Efstratios, Gavdos, Megisti (Aegean sea) | Ereikousa, Othonoi (Ionian sea);

Measure 2:

Support granted without a call for tenders to HPSs in **Crete;**

Measure 3:

Support granted in calls for tender to HPSs in the remaining 22 NIIs.

Measure 1:

According to the legislation framework there is a competitive procedure for the islands, such as already implemented for the island **Astypalaia**:

- Ministers Decision with the basic parameters
- Announcement of the tender by the Greek Regulator
- Submission of Applications (Folder A technical data | Folder B – Economic proposal)

Results with the best economic proposal.

Measure 2:

Greece submits that there are currently four mature projects in Crete that received their Certification Production and the environmental permits and could apply for immediate support under the notified scheme, once it has been approved by the Commission. The main characteristics of these four mature HPS projects in Crete are:

a) The Amari HPS project combines a 78 MW wind farm with pumped hydro storage of a guaranteed capacity of 50 MW (installed capacity of hydro turbines (2+1)x25 MW). The developer of the pumped-hydro HPS project has already obtained the rights to exploit the existing irrigation and water supply dam (Potamoi Dam) at Amari as the lower reservoir of the pumping station, through a competitive tender procedure held by the Organization for the Development of Crete in 2011. The HPS facilities will utilize the existing Potamoi Dam as a lower water reservoir, along with a purpose-built upper reservoir of 1.15 hm3 total volume, ensuring a nominal energy capacity of 1,236 MWh.

b) The Plakakia HPS project combines a 60.5 MW wind farm with battery storage of 27.5 MW guaranteed capacity /220 MWh installed storage capacity. Initially it was conceived with pumpedhydro storage facilities of larger capacity, now converted to battery storage.

c) The Stavros HPS project combines a 4.725 MW wind farm with battery storage of 1.95 MW guaranteed capacity/16 MWh installed storage capacity.

d) The Kissos HPS project combines a 10.5 MW wind farm with battery energy storage of 5 MW guaranteed capacity/ 40.8 MWh installed storage capacity.

In total, the four projects represent a guaranteed capacity of 84.45 MW.

Island of Crete – 4 Hybrid stations

Measure 3: For the remaining 22 NIIs

	Two step continuous bidding format	Single step- static auction
Participation	In two phases:	Single phase.
& awarding	a) submission of relevant documentation and	Simultaneously electronic
	guarantees	submission of relevant
	after 1-2 month period final list of participants	documents and of the unique
	(codified names) with total participating capacity	economic bid per proposal in
	b) Conduct of a descending continuous electronic	encrypted format.
	bidding process (30 min), where the participants	
	can change their bids to lower prices.	

Case study: The Island of Crete

Island of Crete – 4 Hybrid stations

Island of Crete – Hybrid stations ALL

Total Installed Capacity: 244,2 MW 28 Projects Guarantee Capacity: 127,7 MW

Island of Crete – RES with storage

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Island of Crete – stand alone batteries

Open issues for Discussion

Open issues

After the connection of the Island of Crete a new situation arise up

- What are the main technical and operational challenges for the power system after the interconnection of Crete with the mainland?
- How can energy storage support system stability and flexibility under high RES penetration?
- What types of storage technologies are best suited for Crete's needs (e.g. batteries, pumped hydro, hydrogen)?
- How can we estimate the required storage capacity to maximize benefits for the power system and avoid curtailments of RES?
- How can storage be integrated into long-term energy planning for the island and the national system?

Clean energy for EU islands FORUM 2025

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