

# Energy Markets and RES

## RE Storage / The case of TILOS Project

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CIrCIE 2019, Challenges for the Islands in the era of the Circular Economy  
Nicosia, March 2019

**Zisimos Mantas**  
Chief Business Development Officer, EUNICE Energy Group

**EUNICE Energy Group** (referred to as “EEG”), operating through its project entities in Greece, is one of the leading independent companies of development, as well as, the owner and operator of renewable energy projects mainly in Greece. EEG was established in 2001.

### Wind Operating Assets

- ▲ 61MW operating
- ▲ 21MW under installation

### Wind Under Development

- ▲ 190MW in Peloponnese
- ▲ 582MW in the SE Aegean

### PV Operating Assets

- 1.2MW in Peloponnese

### ΤΟ ΟΡΑΜΑ ΜΑΣ

Δημιουργούμε τις εξελίξεις στην παροχή ηλεκτρικής ενέργειας στην Ελλάδα και ξεκινάμε μια εθνική εκστρατεία πράσινης συνείδησης με σύμμαχους τις σύγχρονες επιχειρήσεις και τους ιδιώτες που αντιλαμβάνονται το όραμά μας και μας εμπιστεύονται για να δημιουργήσουμε μαζί έναν κόσμο ενεργειακής αυτονομίας για όλους και ένα ευοίωνο μέλλον για το περιβάλλον.





### Wind Measuring Services

- ▲ Certified under ISO 17025.
- ▲ Measuring wind Speed & wind direction (acc. IEC 61400-12)



### Manufacturing of a Small Wind Turbine

- ▲ Nominal capacity: 50kW
- ▲ Rotor diameter: 17m
- ▲ Wind Class: II-A

Hellenic Accreditation System S.A.



Annex F1/3 to the Certificate No. 592-2

SCOPE of ACCREDITATION  
of the  
Laboratory of Wind Measurements  
of  
Eunice Laboratories S.A.

Materials / Products to be tested	Types of test / Properties to be measured	Applied methods / Techniques to be used
Wind Measurements		
Wind potential intended for the estimation of wind turbine generator performance	Wind speed (m/s)	IEC 61400-12-1:2005, §6.2
	Wind direction (Deg)	IEC 61400-12-1:2005, §6.3

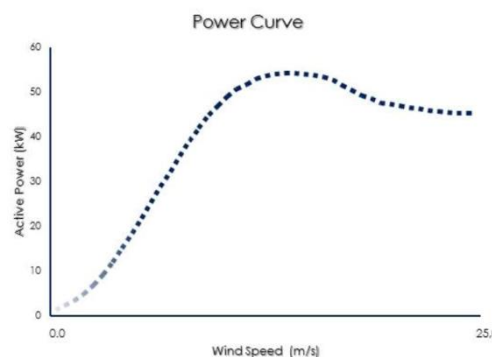
Site of assessment: Permanent Laboratory Pireos, 25, Van Sulfur Str., Athens, Greece and equivalent field of meteorological data  
Approval signature: Theodoros Katsiras, General Supervisor

This Scope of Accreditation replaces the previous one dated 1/9/2009.  
The Accreditation Certificate No. 592, to ELIOT EN ISO/IEC 17025:2005, is valid until 31/8/2013.

Athens, June 26<sup>th</sup>, 2013



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### Energy Trader & Energy Supplier

- ▲ Trading license: 300MW
- ▲ Supply License: 300MW
- ▲ Retail Electricity provider

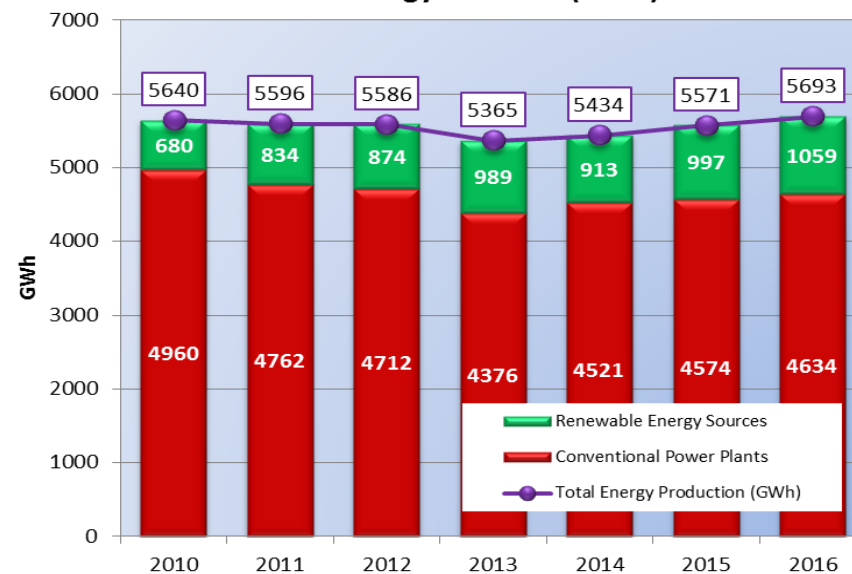


# Non-Interconnected Islands

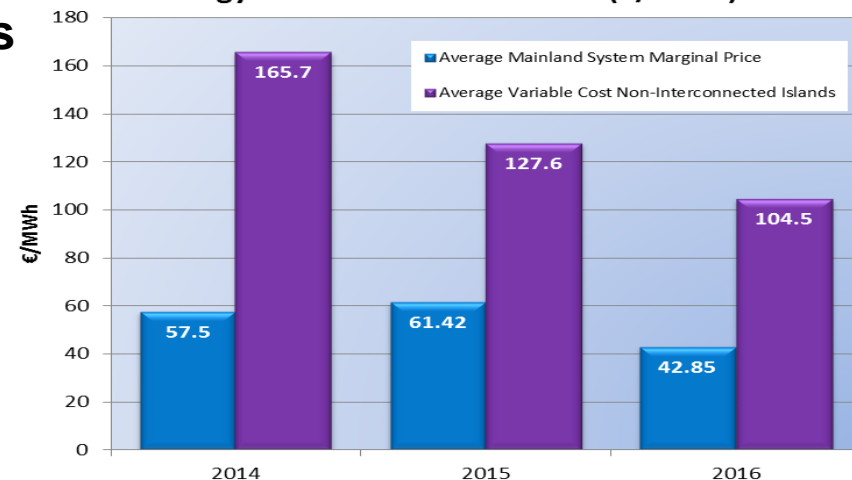
## Energy Production facts

- ⤴ 32 autonomous Electrical Systems (ES)
- ⤴ **High demand variability** on a daily and monthly basis
- ⤴ **High RES potential** e.g. wind, solar, etc.
- ⤴ Interconnection is underway for some of them (planned for 2020)
- ⤴ In total, RES penetration:
  - reaches approx. **18% of the annual energy demand**
  - in **1,100 ktns avoided CO<sub>2</sub> emissions** for 2016
- ⤴ **High RES curtailment** due to limitations
- ⤴ Generation mainly via **diesel-fueled Local Power Stations (LPS)**
- ⤴ **High generation cost** compared to the mainland

Annual Energy Demand (GWh)



Energy Production Variable cost (€/MWh)





# The Greek island of Tilos

## Geography, History & Facts

### Geography / terrain

- ⤴ S-shaped island, with max. width of 8km (5 mi), covering an area of 61sq.km (24sq.mi)
- ⤴ Mountainous limestone interior, volcanic lowlands → Complex terrain

### History

- ⤴ Proofs of human activity in the early Neolithic Period (8000 BC to 7000 BC)
- ⤴ Remnants of dwarf elephants, carbon dated to between 4000 and 7000 BC
- ⤴ Possessed by the Italians (1912) and joined Greece in 1947 (after WWII)

### Facts

- ⤴ 780 inhabitants, increased to approx. 4.000 during summer period
- ⤴ Progressive-minded and environmental friendly community
- ⤴ Tilos island has rich flora and fauna, also part of the Natura 2000 network



# Hybrid Systems with RES & Batteries Configuration

## Wind Turbine

- ▲ Variable speed, pitch controlled
- ▲ Full-scale converter
- ▲ Fault Ride-Through (FRT)

## PV Station

- ▲ PV panels
- ▲ Controllable inverters

## Batteries

- ▲ Flexible characteristics
- ▲ High charging rates
- ▲ Long life-time

## Power inverters

- ▲ P-Q/operation
- ▲ U-f/island mode
- ▲ Grid-forming capability

## Forecasting

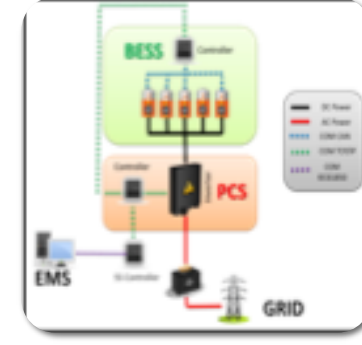
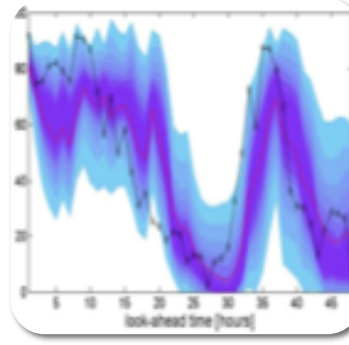
- ▲ Solar power
- ▲ Wind power
- ▲ Local load demand

## Energy Management System (EMS)

- ▲ Consider forecasting (solar, wind, load)
- ▲ Integrate DSM (load shedding, emergencies, etc.)

## Demand-Side Management

- ▲ Smart-metering in PDB
- ▲ Load shedding – Load activation



Demonstration phase  
Real-time operational data

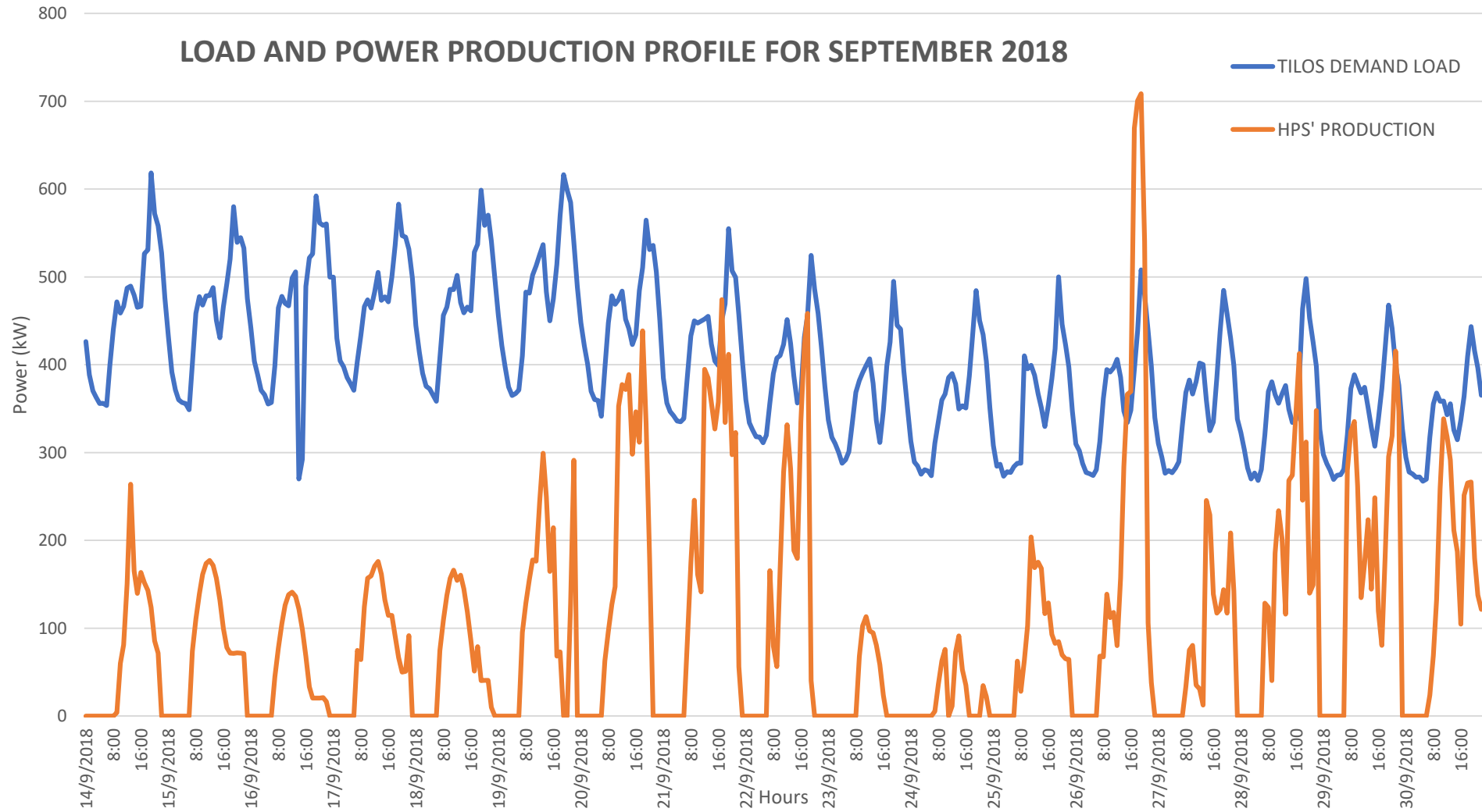


[www.S4s.Eunice.gr](http://www.S4s.Eunice.gr)

# Demonstration phase

## HPS penetration in Tilos' Demand Load

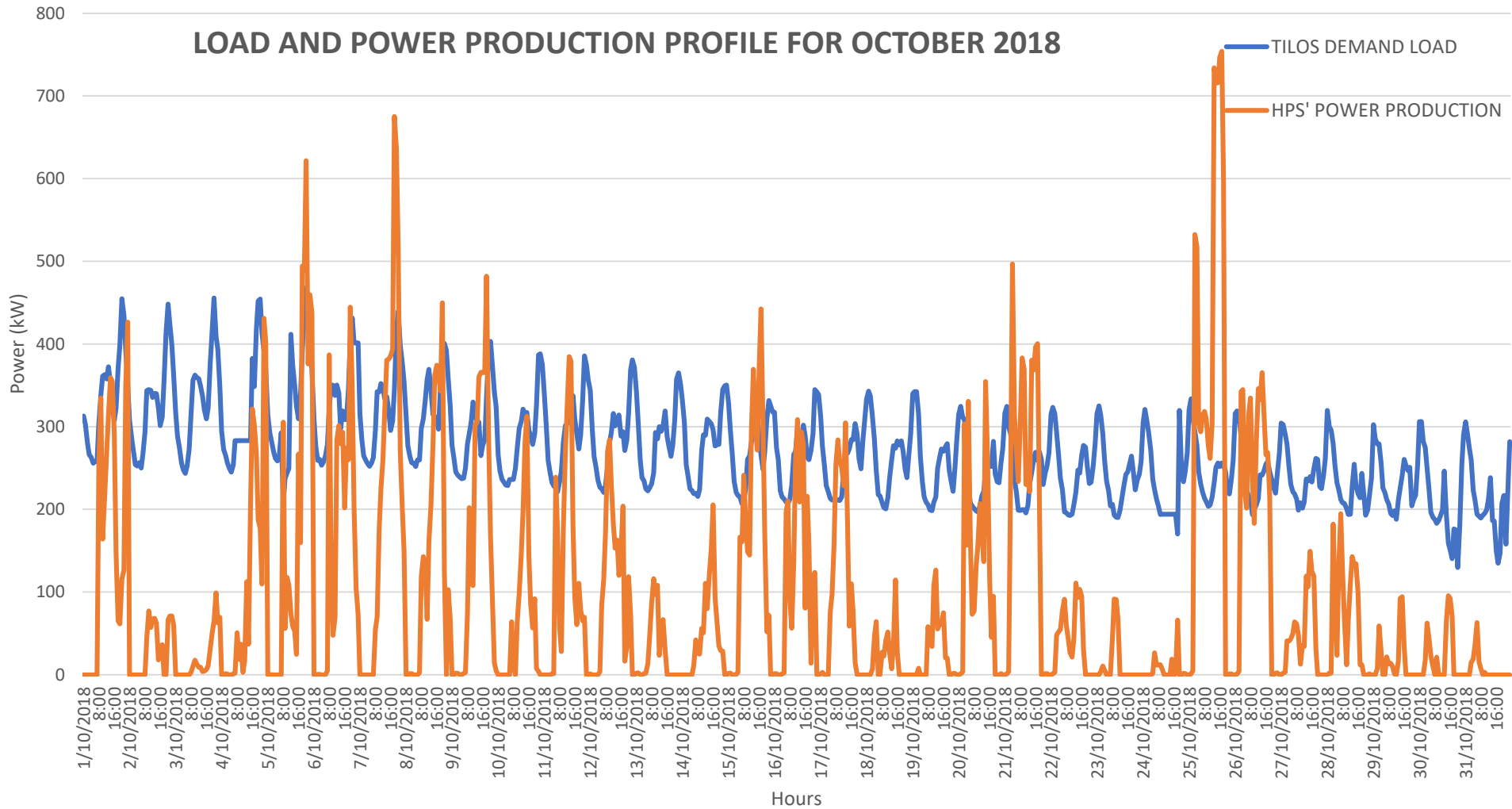
### LOAD AND POWER PRODUCTION PROFILE FOR SEPTEMBER 2018





# Demonstration phase

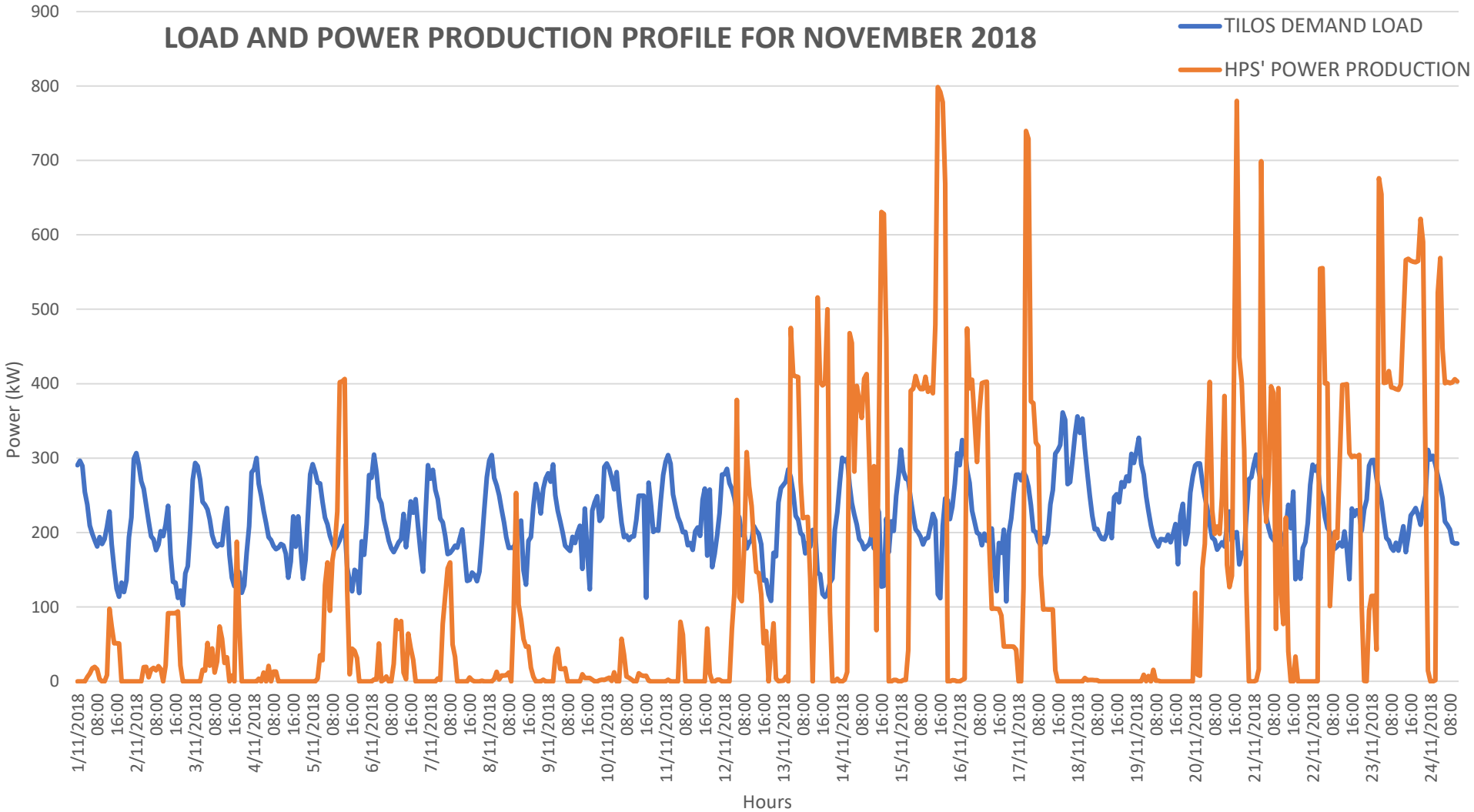
## HPS penetration in Tilos' Demand Load



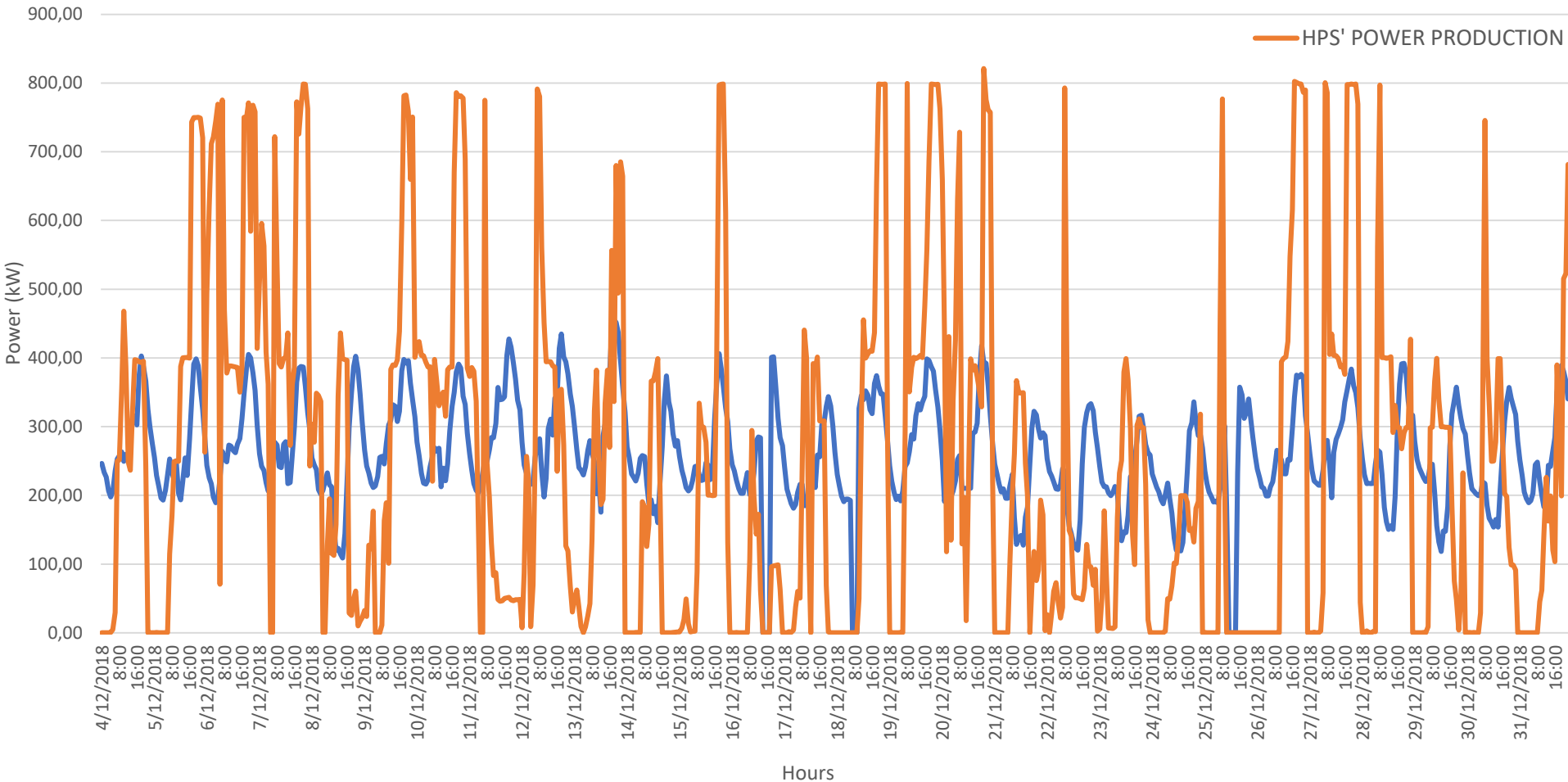
# Demonstration phase

## HPS penetration in Tilos' Demand Load

### LOAD AND POWER PRODUCTION PROFILE FOR NOVEMBER 2018



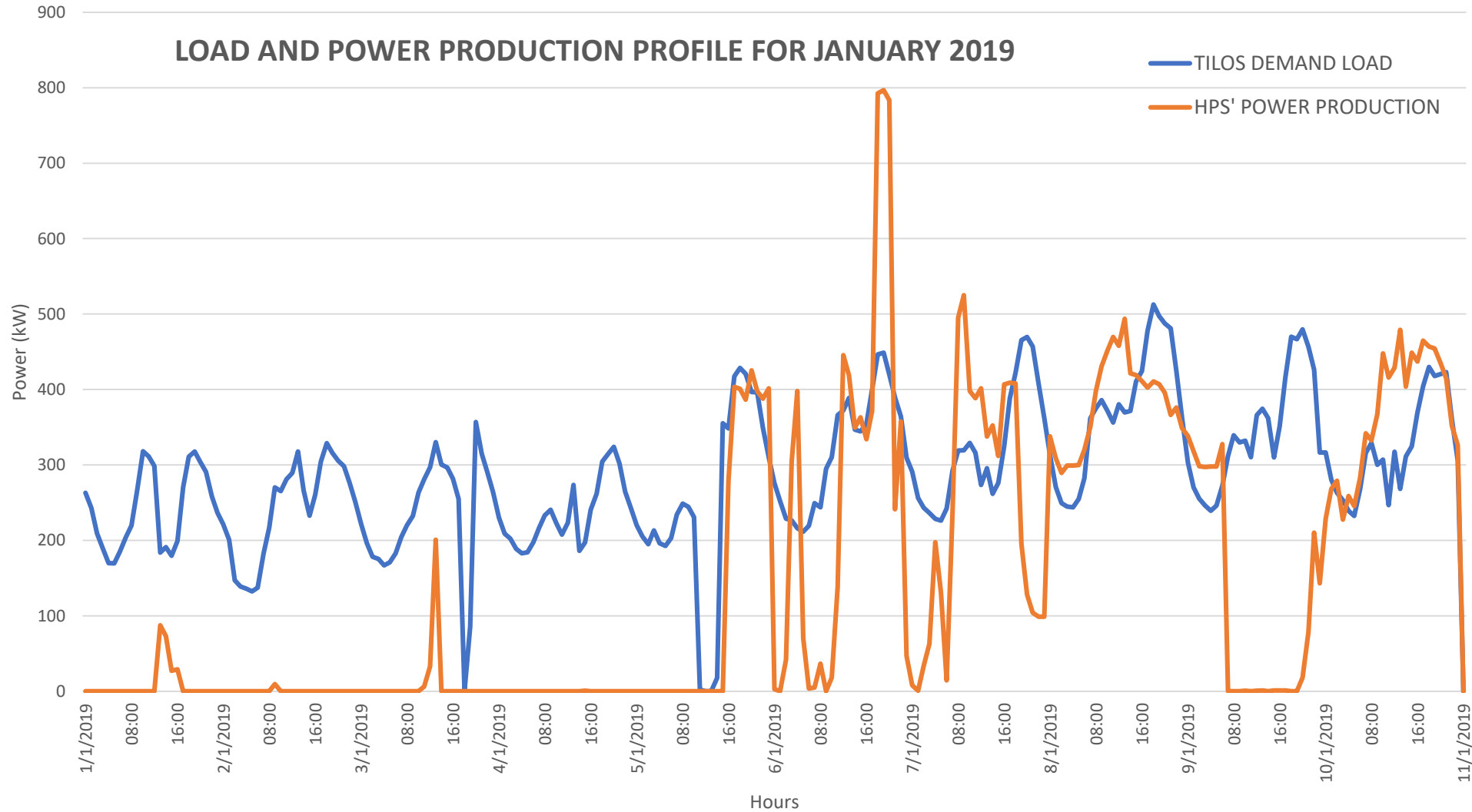
### LOAD AND POWER PRODUCTION PROFILE FOR DECEMBER 2018



# Demonstration phase

## HPS penetration in Tilos' Demand Load

### LOAD AND POWER PRODUCTION PROFILE FOR JANUARY 2019



Month	Load Demand [kWh]	Average Penetration[%]	max. Daily Penetration [%]
<b>September 2018</b> (14.09.2018 – 30.09.2018)	164,600	24.14%	46,14% on 26.09.2018
<b>October 2018</b> (01.10.2018 – 31.10.2018)	203,800	34.53%	132,10% on 25.10.2018
<b>November 2018</b> (01.11.2018 – 24.11.2018)	122,000	59.11%	201,75% on 23.11.2018
<b>December 2018</b> (04.12.2018 – 31.12.2018)	174,263	93,04%	193,58% on 06.12.2018
<b>January 2019</b> (01.01.2019 – 10.01.2019)	68,600	45.19%	105.68% on 08.01.2019

Penetration above 100% indicates energy exports to Nisyros.



- ▲ **Large wind projects including separate interconnections to mainland**
  - ▲ Projects in Andros, Cyclades, Crete, Ikaria, Chios Lesvos, etc. including submarine cable interconnection to mainland
  - ▲ Project in uninhabited islets → onshore installations with challenging offshore conditions!
  - ▲ Private PPAs → option under the target model
- ▲ **Hybrid Power Plants (Non-Interconnected islands, mainland)**
  - ▲ Provide guaranteed amounts of energy to the Grid
  - ▲ Render renewables as dispatchable units
  - ▲ Ancillary services & Active frequency regulation
- ▲ **Holistic energy approach for locally consuming/producing energy**
  - ▲ Retail electricity trading
  - ▲ Net-metering and energy storage → Energy communities
  - ▲ Small wind turbines and PV systems combined with batteries
- ▲ **Eco-mobility and distributed renewable energy production & storage**
  - ▲ Energy exchange schemes
  - ▲ Active management of energy and local billing
- ▲ **Technology innovation integrating Blockchain technology**
  - ▲ Energy exchange schemes
  - ▲ Active management of energy and local billing

Thank you for your attention

