Smart Islands networks with very high penetration of RES

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The goal

- Test a new concept: Hybrid station with RES and small size of storage
- Increase the RES penetration beyond 60%
- Sustainable solution
  - Does not increase the total cost in the island
  - Should be an attractive investment
- Ensure the power supply in the island
- Minimize impact on thermal production
- New experiences for the Island Operator in order to replicate the solution in other islands

Challenges

- Technical
  - The system may run only with RES + Storage for several hours
- Regulatory
  - Energy Market framework in the Non-Interconnected Islands (NII)
  - Regulatory framework for Hybrid stations not sufficient
- Operational
  - Too many actors actively involved in the operation of the Hybrid (Hybrid station, PPC, NII Operator - HEDNO, other RES)

Required infrastructure

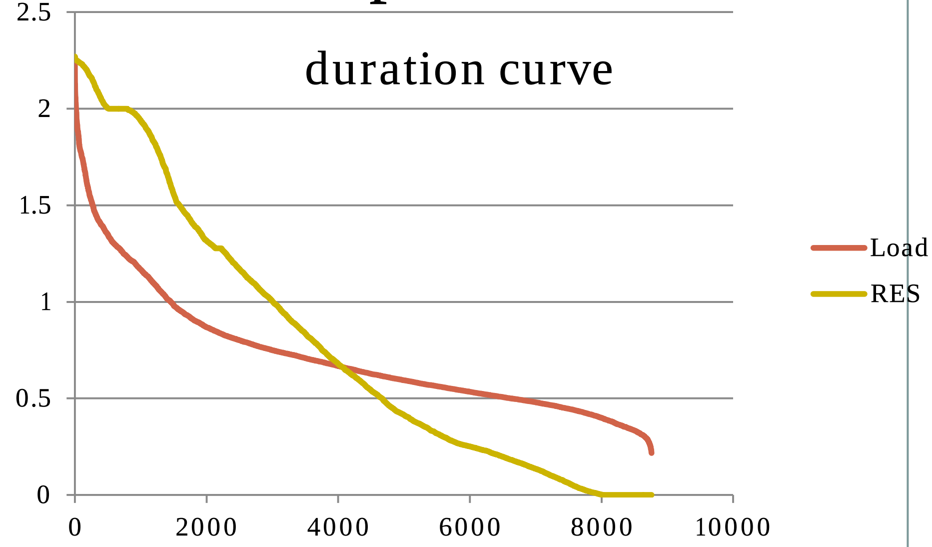
- Hybrid Control Center
  - Local SCADA (monitoring, control and management of RES and Storage)
  - Functionalities for the participation in the island operation
- Local Control Center
  - Real time control
  - Direct connection with other SCADAs (Thermal Station, Hybrid, RES)
- Central Control Center (in Athens)
  - Dispatch schedule
  - Monitor
- Metering infrastructure (for billing)

Island selection

- Main requirements
  - Increased production cost
  - No applications for other RES
- The most suitable island is one with peak load 1-5 MW
- Why not smaller island(<1 MW)?
  - Possibly no replicable solution
  - No sufficient number of operators
- Why not bigger island(>5 MW)?
  - Production cost might be cheaper
  - Huge investment
  - Multiple applications for RES (Wind-PV)

Hybrid Sizing

- Over sizing RES (installed RES capacity close to peak load of the island)
- The increased RES production allows the installation of smaller batteries
- Wind production should be the main production source



Main rules of operation

- 4h scheduling (updated every 15 min)
- The system may run with RES and Storage only
- The Hybrid station provides ancillary services
- The main technical constraint is the technical minimum of the thermal engines
- Assumes the existence of advanced automation (for scheduling, set point to the units etc)
- Start up/ Shut down of units:
  - Hybrid station: should be an automated solution
  - Thermal Units: Under discussion

Simulation – Case of Astypalea

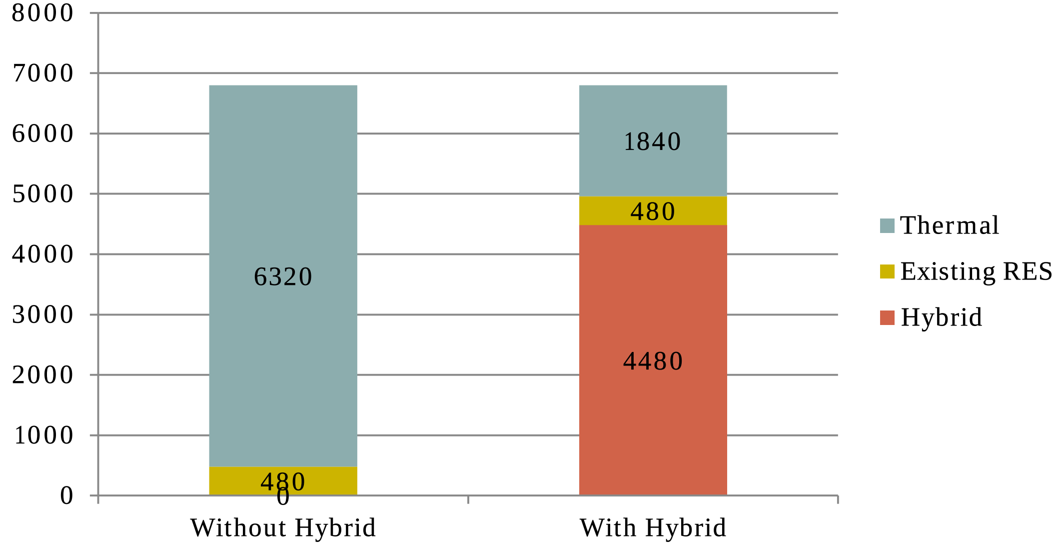
- Typical NII system, peak during summer
- 5 thermal units with total capacity 4,3 MW
- Peak Load: 2,3MW
- Yearly Demand: 6,600MWh
- 4 PV plants (0.32MW) and 7 roof top PVs (0,035 MW)

Main Scenario

- Hybrid: 0,4MW PV,2MW Wind, Storage 2MW/ 8MWh
- Average Variable Cost 250€/MWh
- Pricing (according to the legislation)
  - Energy produced from battery: 312,5 €/MWh
  - Energy from PV feeding the load:69€/MWh-191€/MWh
  - Energy from W/F feeding the load:110€/MWh-211,25€/MWh
- Consideration in IRR
  - Battery cost 550k€/MWh
  - Installation cost for PV 1200€/kW
  - Installation cost for W/F 1500€/kW
  - Other costs 1M€ (SCADA, substation etc)

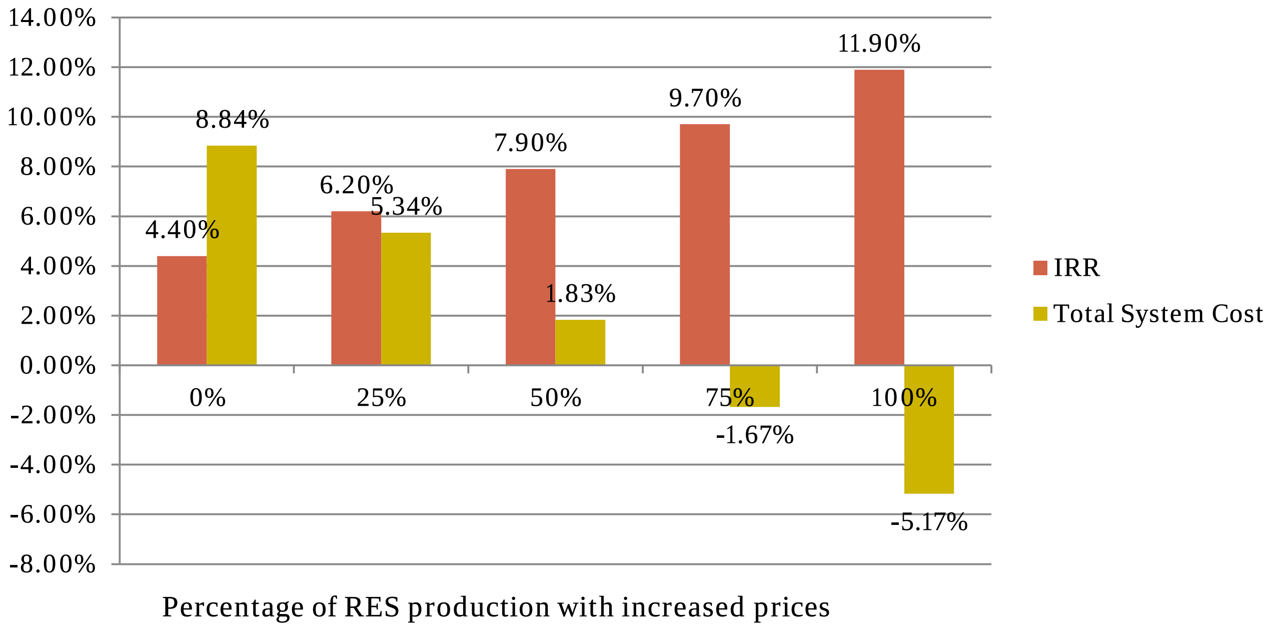
Operation of the Hybrid Station

- 65% of the total demand is covered by the Hybrid station
- If the other PV stations are considered the total RES penetration is 73%.



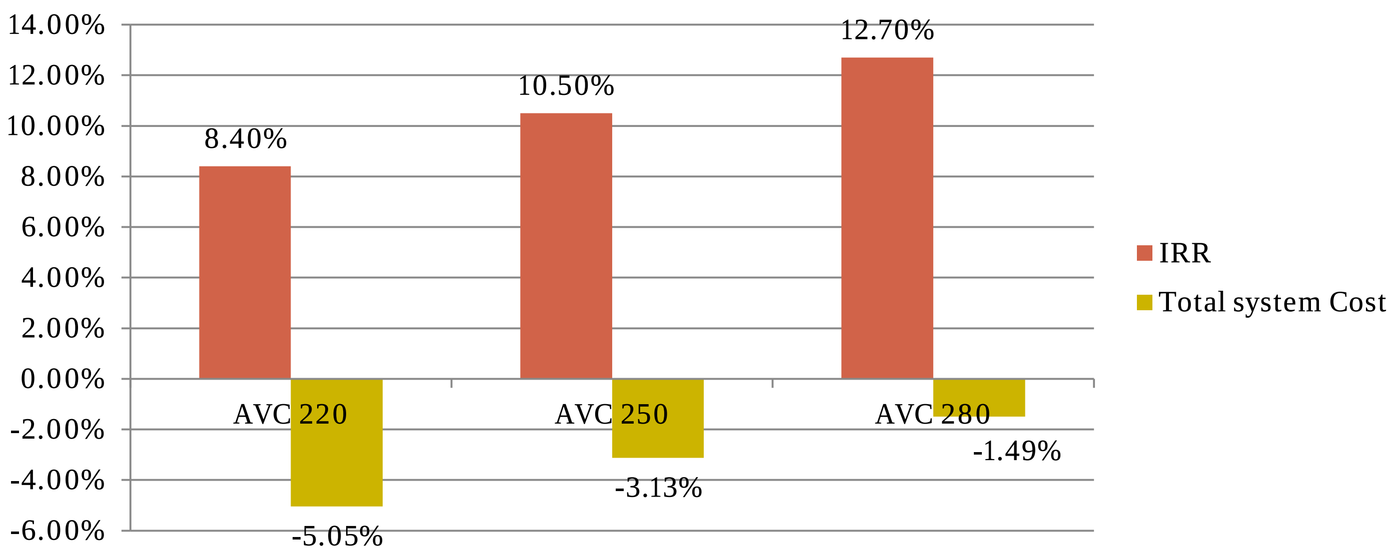
Pricing

- Hybrid pricing affects the IRR and to Total System Cost
- The Total System Cost includes Thermal and RES costs



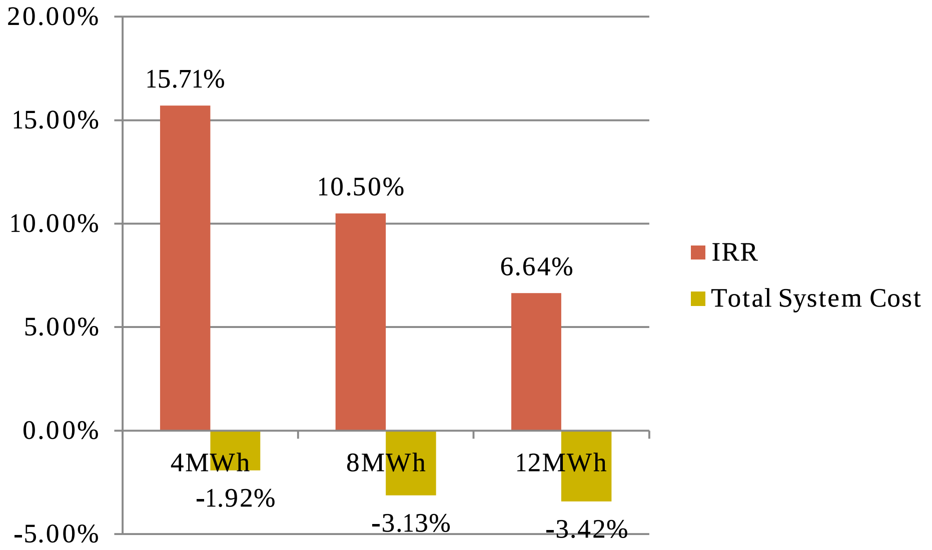
Thermal Production Cost

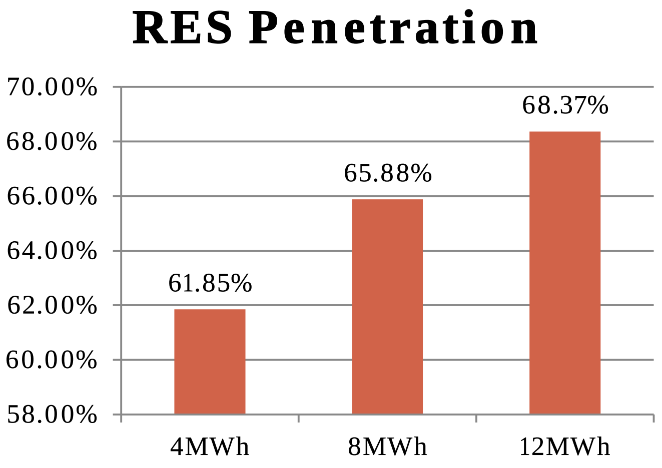
- Thermal production costs affects the investment.
- High Thermal production cost makes the Hybrid attractive for the system.



Storage Size

- Affects the IRR but no equally the RES penetration





Conclusions- Next Steps

- This is a challenging project for the Greek Islands
- We should prove:
  - It is technically feasible
  - The investment is attractive
  - The total system cost is not increased
- Currently HEDNO, RAE, PPC and the Ministry of Environment, Energy and Climate Change are working on the regulatory issues
- Soon the main framework will be ready

Thank you

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