

# Planning Tool for Non – Interconnected Islands





# Hello!



*I am **George Milionis***

I am presenting the *Energy Planning* application, designed and integrated by **Smart RUE– ICCS/NTUA** with the power of **HEDNO**.

You can find more about the team at **[www.smartrue.gr](http://www.smartrue.gr)**

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# Electrical Systems Transition

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*In the framework of smart grids, Electrical Systems need to be optimally re-designed, so new more sophisticated tools and methods are required by their Operators.*

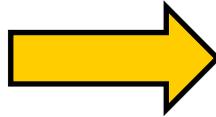




## Why are such tools required?

### Facts

- Climate change
- Legal Framework
- Status of greek NIIPSSs



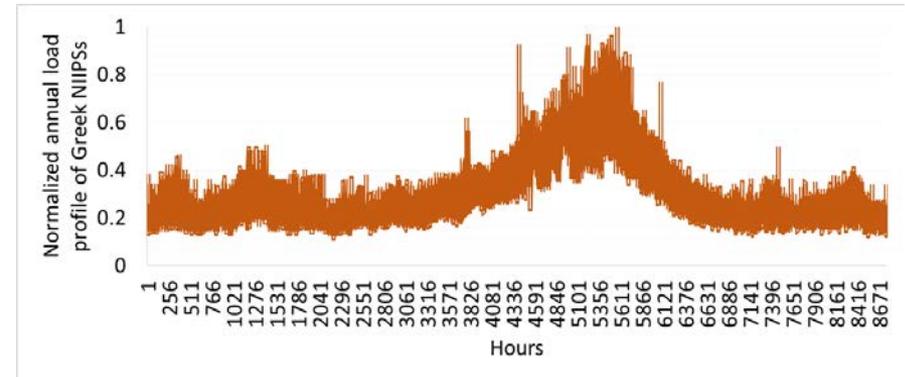
### Targets

- Decarbonization
- Energy secure supply
- Maximizing social welfare



Why are such tools required?

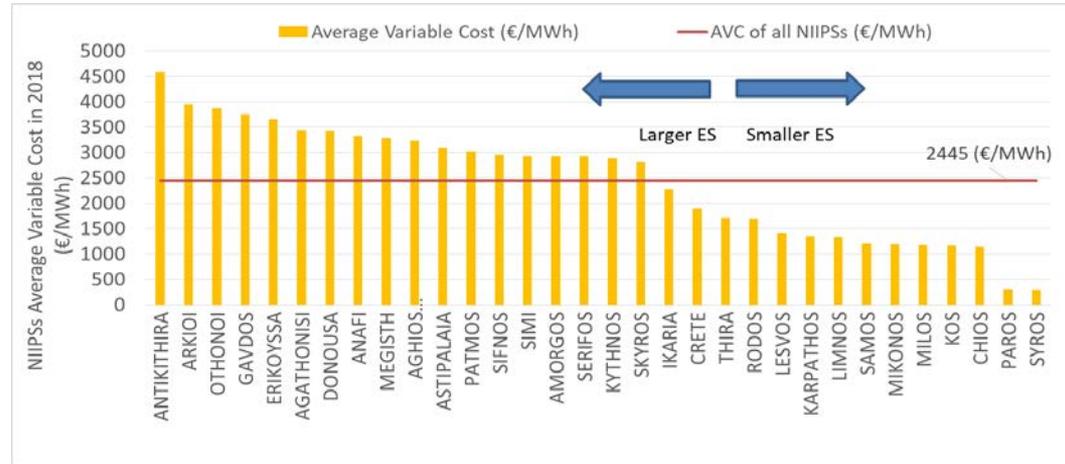
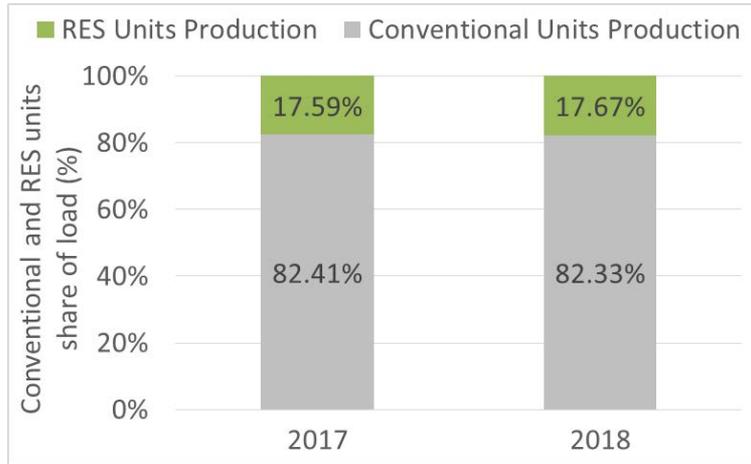
## Greek NIIPS status





# Why are such tools required?

## Greek NIIPS status





# Energy Planning



## Instructions provided

### User's Manual

The tool is provided with a detailed User's Manual (English and Greek), explaining all algorithms used, the output files being exported and fully documented screenshots of each screen of the application.

### Step by step videos

Series of screen recording videos explaining each functionality in separated videos is available on our site, or more easily, you can use the QR code below!

More info on how to use the tool at [www.smartrue.gr/en/laboratory/laboratory-equipment-and-capabilities/energy-planning-software](http://www.smartrue.gr/en/laboratory/laboratory-equipment-and-capabilities/energy-planning-software)

Or you can scan with your mobile





## Simulations that support the decision making process

### Units deployment

The deployment of new electricity generation units (conventional and renewable) on the Non-Interconnected Island Power Systems(NIIPSs) and

### Interconnection deployment

The deployment of a new interconnection line between NIIPSs.



## Types of studies

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### **7-Year Energy Planning**

Assessing the deployment plan of new conventional production units.

### **RES Hosting Capacity**

Assessing the hosting capacity of production units utilizing Renewable Energy Sources (RES) in the ES.

### **Interconnections**

Assessing the implementation of interconnections between NIIPs or NIIPs and the mainland.



## Electricity markets integration

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**Energy and  
ancillary  
services  
market**

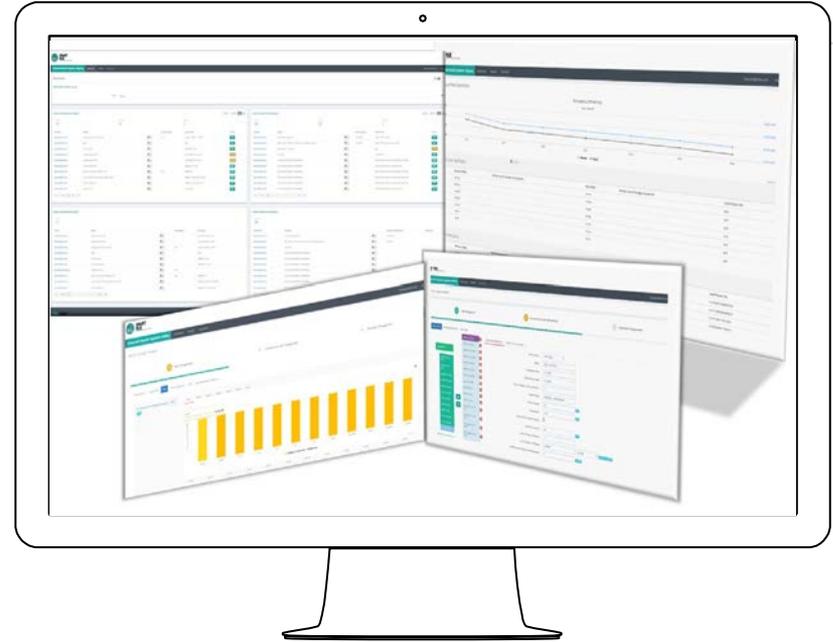
**Energy  
Planning**

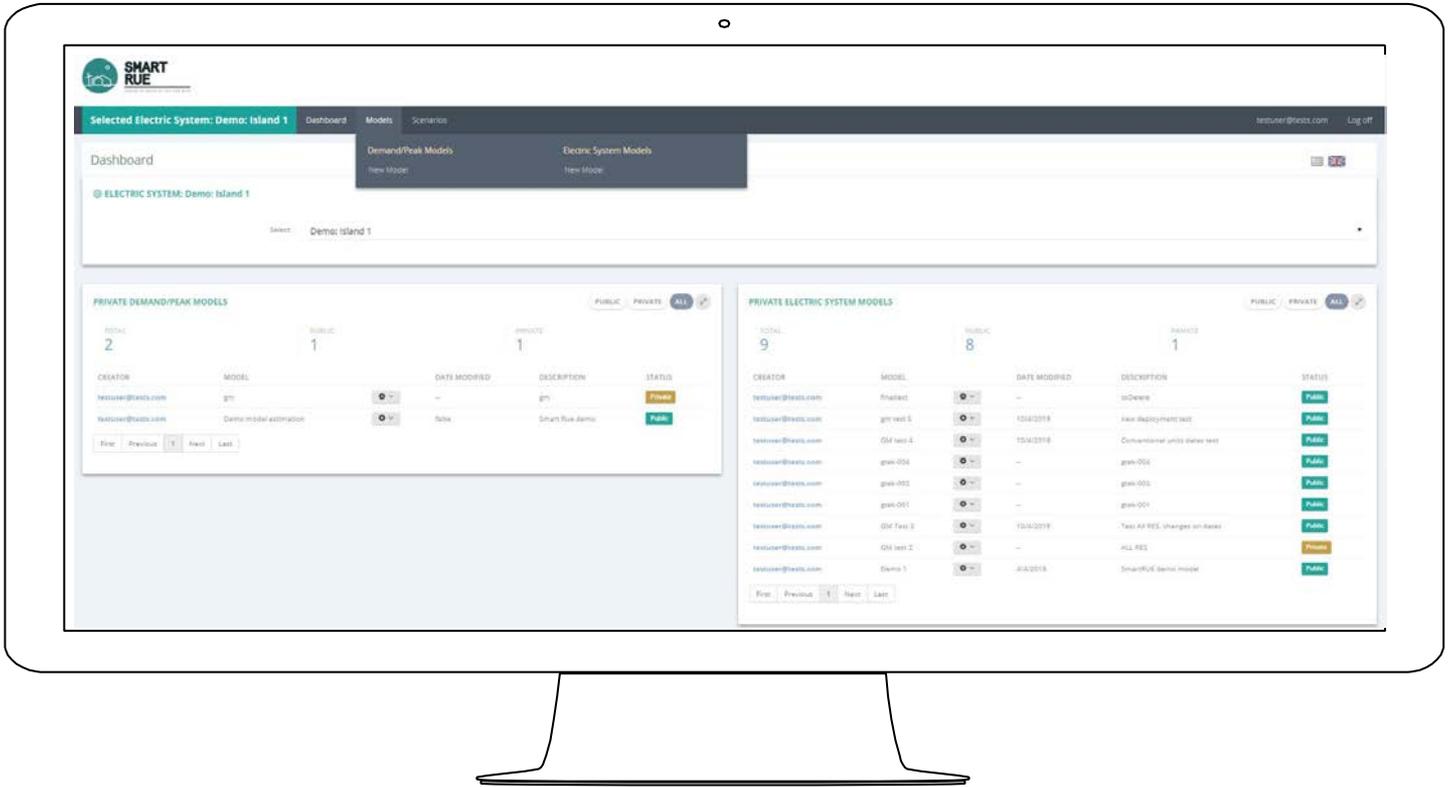
**Capacity  
market**

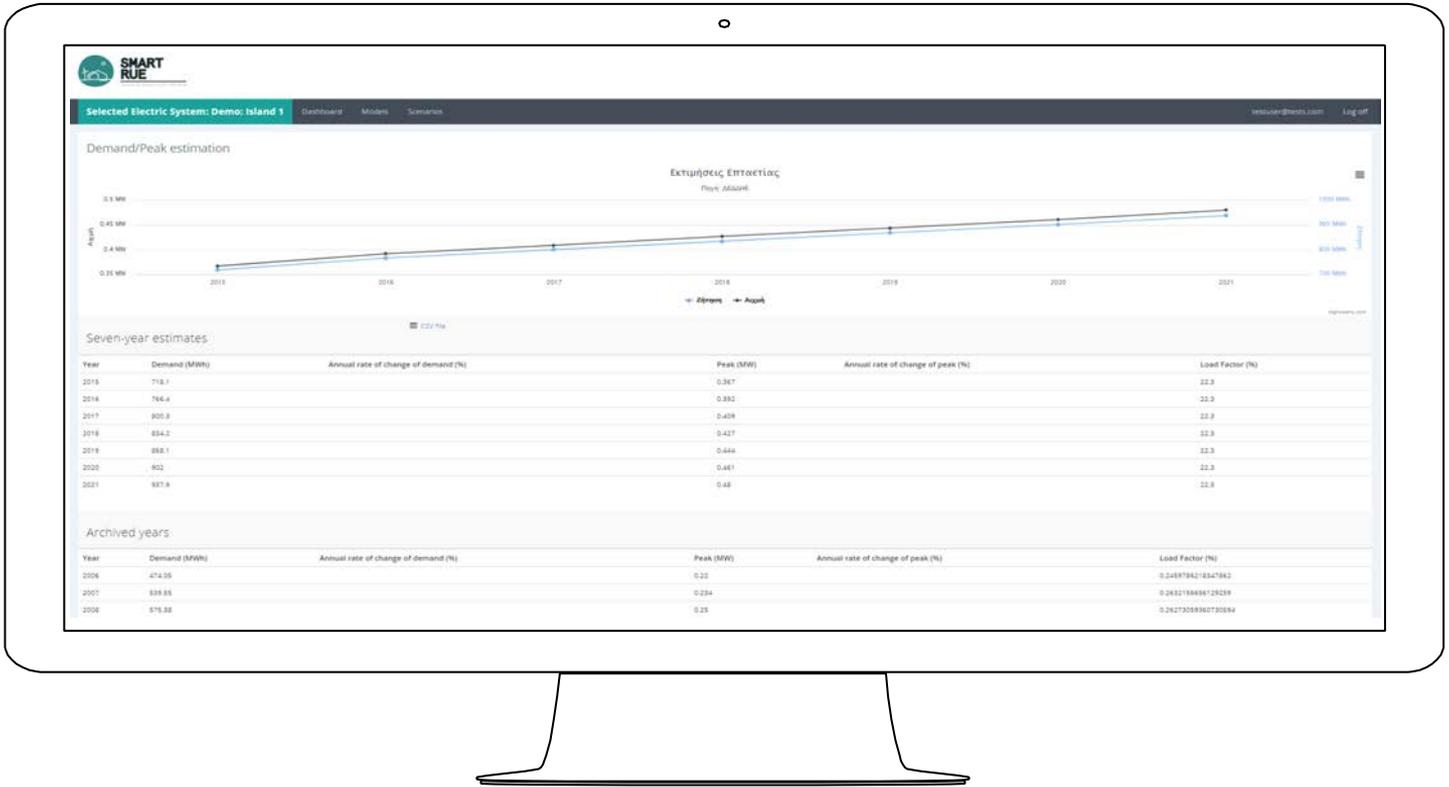


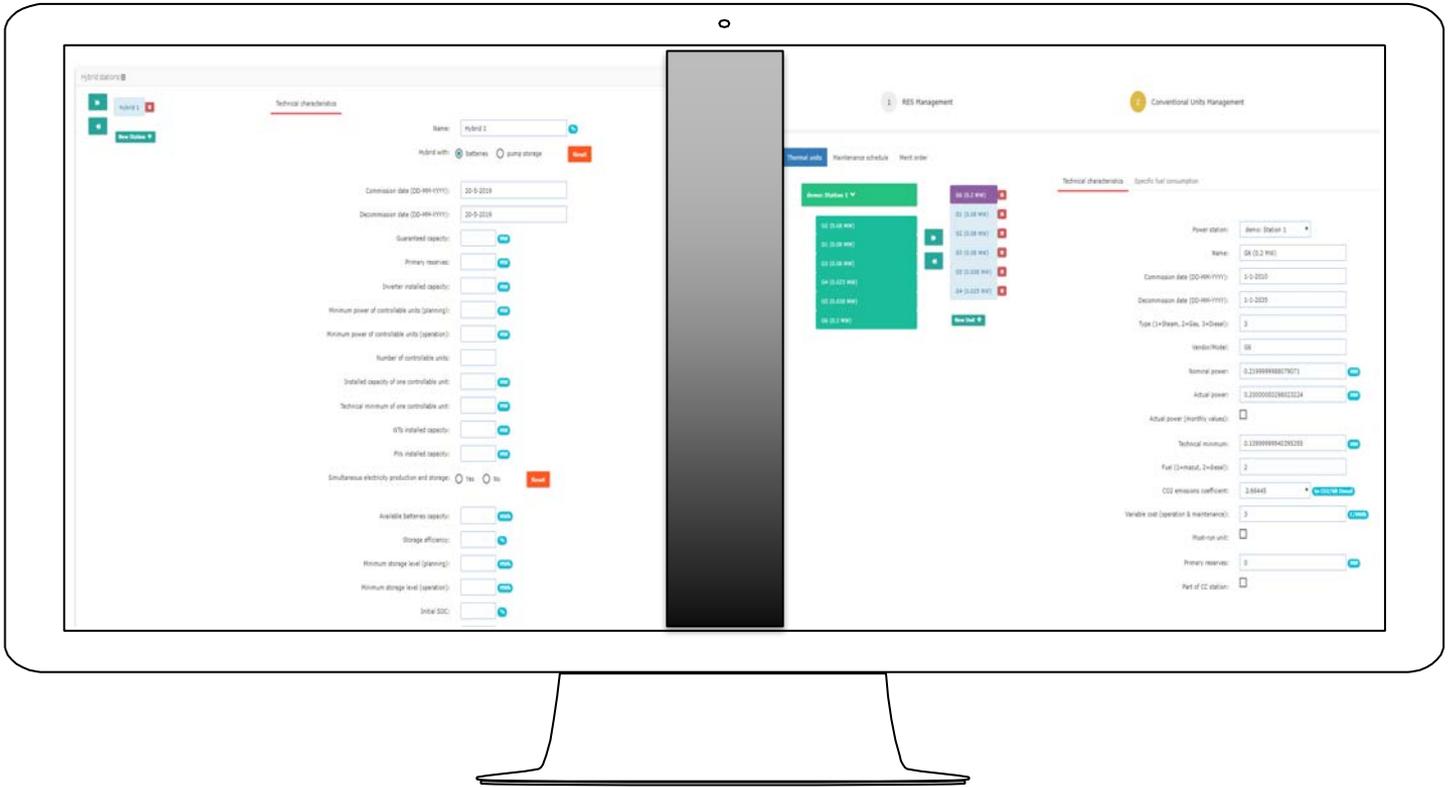
## Desktop project

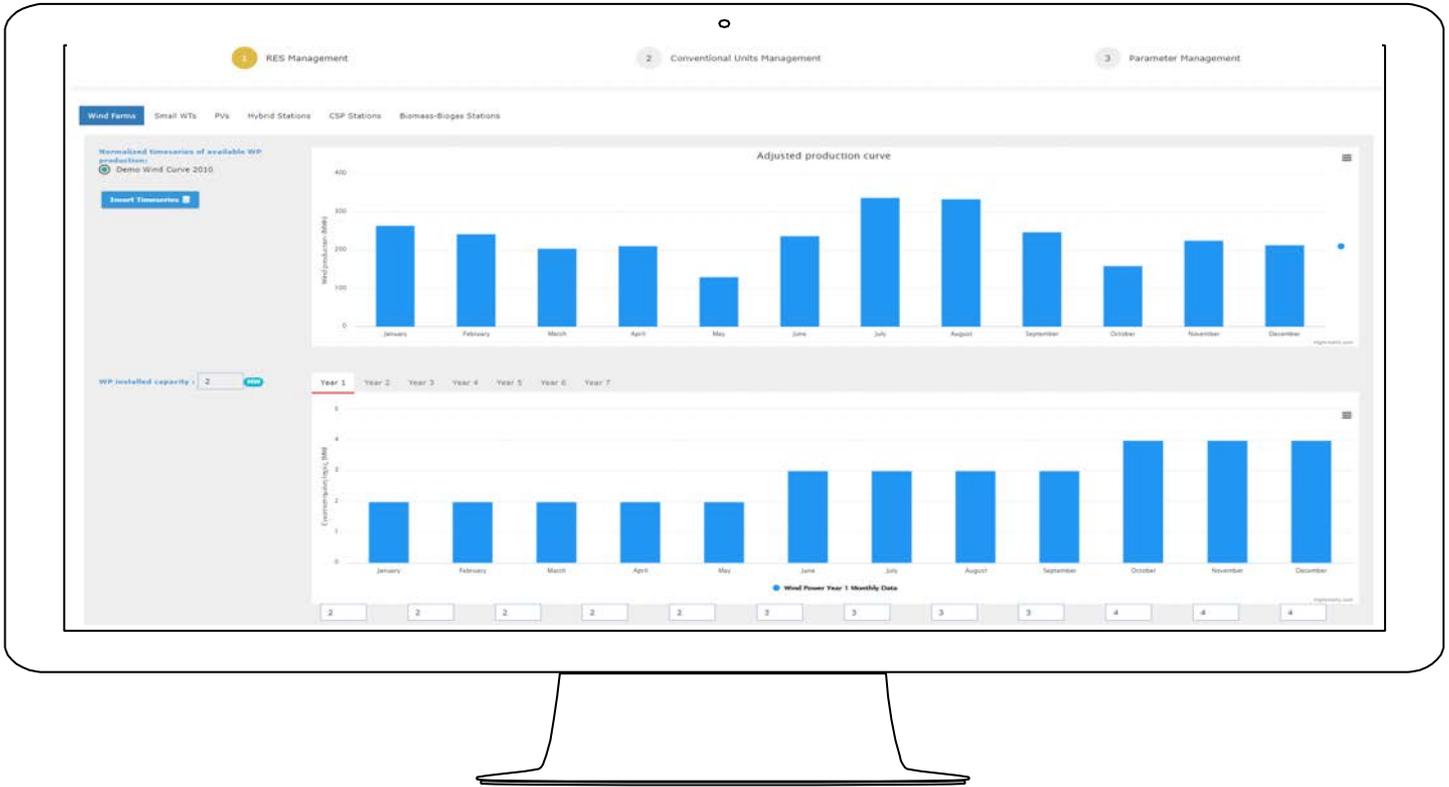
Dashboard, Demand-Peak estimation, RES management, Conventional Units management screenshots.



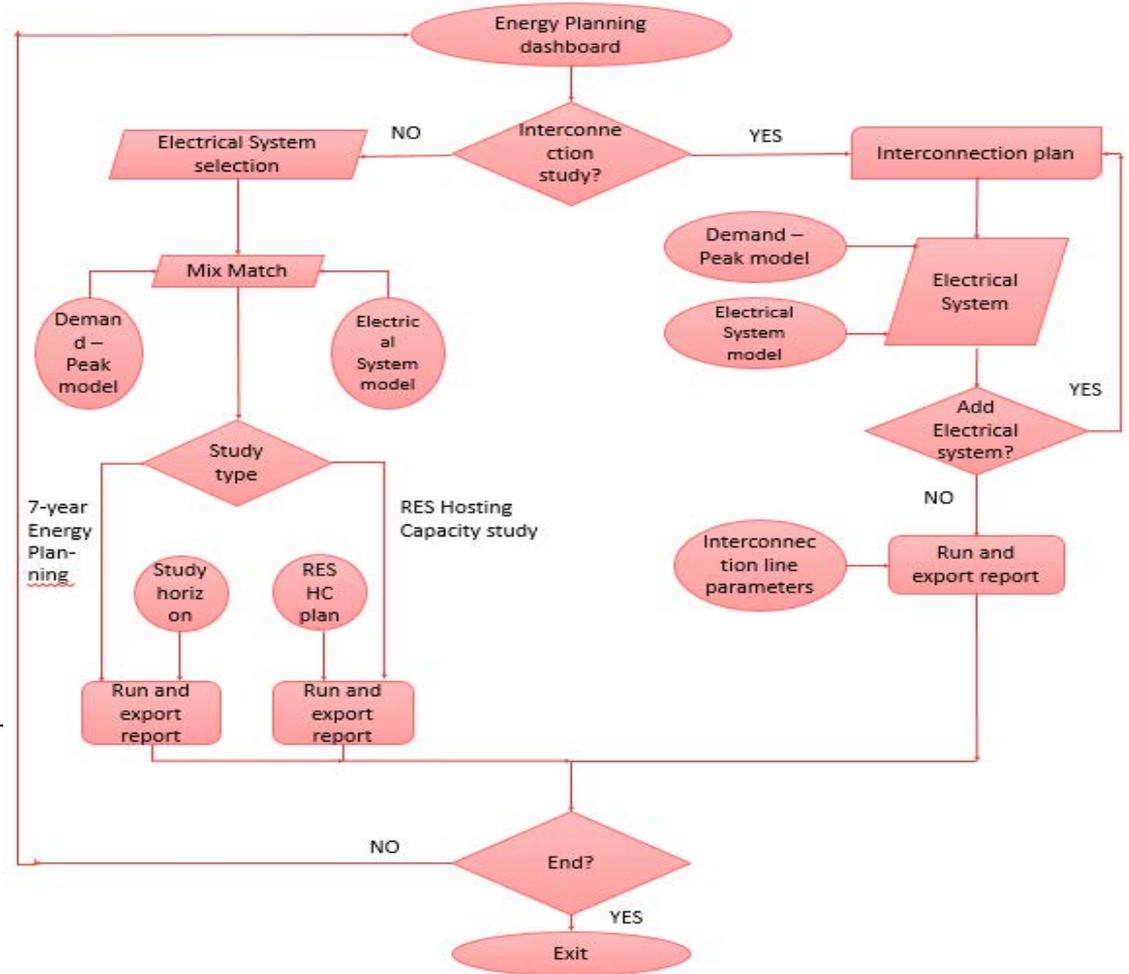








# Energy Planning user's flow chart





## Example: Anafi test - bed

### Why Anafi?

Belongs in small ADP category, low existing RES penetration level, average cost of energy, not expected to be interconnected until 2028.

### Targets

The target was to explore the tool functionalities on the best deployment plan for the NIIPS of Anafi, among new RES units installation and interconnection plan with Thira.

### Technologies examined

- Photovoltaics, Wind turbines, dispatchable Biomass Biogas stations
- Central Storage supporting the wind turbines curtailments
- Hybrid Power Stations
- Interconnection lines



## Example: Anafi test - bed

### Results

High RES penetration levels, high energy spillage, operating cost reduction, no new conventional units,  $CO_2$  reduction, no sustainable IRR.

### Evaluation

Units of Anafi support the demand of Thira, postponing the installation of new conventional units. Anafi's load is totally served, and total operating cost is being restrained.

### Solution?

This preliminary report required a minimum of 21 scenarios. Assume the number of the necessary scenarios for a real planning deployment study...!



## Credits

Team behind the scenes:

- Prof. Nikos Hatziargyriou
- Dr. Aris Dimeas
- Dr. Georgia Asimakopoulou
- George Millionis
- George Tekelis
- Nick Korres



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Unit  
ECE  
NTUA



## Credits

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Special thanks to HEDNO for supporting and evaluating the project throughout the implementation.





# Thanks!

*Any questions ?*

You can find me at

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# Appendix

Year	Installed RES capacity per year	
	WTs (MW)	PVs (MW)
2019	0	0
2020	0	0.3
2021	0.5	0.5
2022	0.5	0.5
2023	0.5	1
2024	1	1
2025	1	1

Year	Generation components on a 7-year Planning horizon				
	Load (GWh)	Conv. Gen. (GWh)	WTs (GWh)	PVs (GWh)	RES penetration (% per load)
2019	1,38	1,38	0,00	0,00	0,00
2020	1,42	0,99	0,00	0,48	33,97
2021	1,45	0,76	0,12	0,80	63,22
2022	1,49	0,79	0,12	0,80	62,10
2023	1,52	0,70	0,12	1,60	113,44
2024	1,56	0,71	0,14	1,60	111,75
2025	1,59	0,73	0,14	1,60	109,59



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# Appendix

Year	Conventional units on a 7-year Planning horizon				
	Start ups	Operati on hours	Underlo ad hours	CO <sub>2</sub> emission s (tn)	Fuel consump tion (mil. lt)
2019	7.140	11.852	3.793	1.119,93	420,32
2020	1.030	14.011	6.110	819,17	307,44
2021	1.031	16.180	5.916	634,72	238,22
2022	1.035	16.265	5.805	651,85	244,65
2023	1.133	19.090	5.912	577,44	216,72
2024	1.128	19.163	5.864	584,36	219,32
2025	1.153	19.245	5.753	597,89	224,40

Year	Generation costs on a 7-year Planning horizon				
	Diesel cost (th. €)	CO <sub>2</sub> emissions allowance cost (th. €)	O&M cost (th. €)	WTs remuneration cost (th. €)	PVs remuneration cost (th. €)
2019	462,35	23,52	4,14	0,00	0,00
2020	338,19	17,20	2,97	0,00	43,32
2021	262,04	13,33	2,29	10,43	72,19
2022	269,11	13,69	2,36	10,94	72,19
2023	238,39	12,13	2,10	11,08	144,38
2024	241,25	12,27	2,13	12,33	144,38
2025	246,83	12,56	2,18	12,77	144,38



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Set A	Installed capacity per RES technology		
	PVs (MW)	WTs (MW)	BBs (MW)
Scen1	0	2	0
Scen2	0,5	1	0
Scen3	0,5	0	0,5
Scen4	0	0,5	0,5
Scen5	0	0	1

Set B	Installed capacity per RES technology		
	PVs (MW)	WTs (MW)	Central Storage (MWh)
Scen6	0,5	0	4
Scen7	1	0,5	8
Scen8	4	8	16

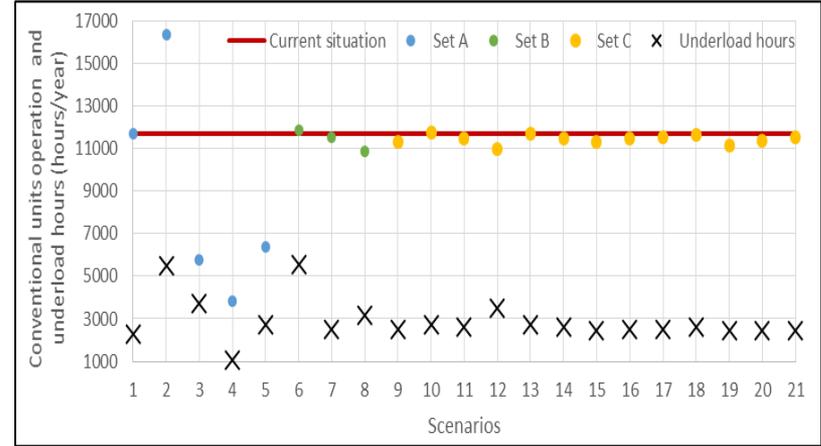
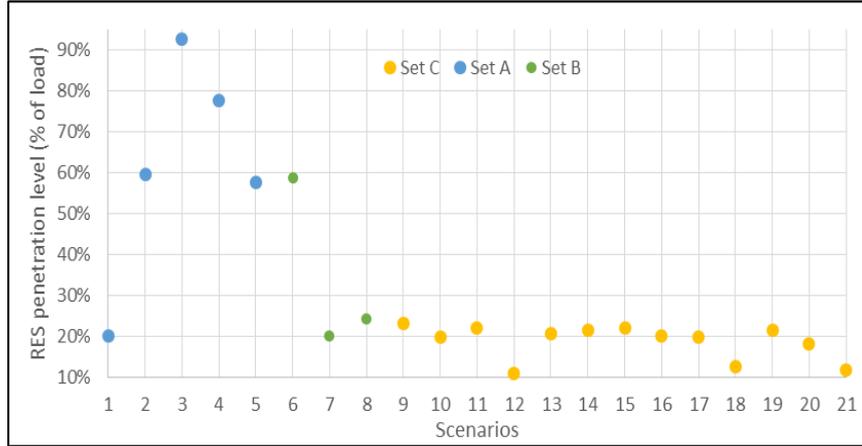
Set C	Installed capacity per RES technology		
	PVs (MW)	WTs (MW)	Storage (MWh)
Scen9	1	1	2
Scen10	0,5	0,5	2
Scen11	1	0,5	2
Scen12	0	1	2
Scen13	1	0	2
Scen14	0,5	1	2
Scen15	0,5	0,5	4
Scen16	0,3	0,3	4
Scen17	0,5	0	4
Scen18	0	0,5	4
Scen19	0,3	0,3	8
Scen20	0,3	0	8
Scen21	0	0,3	8



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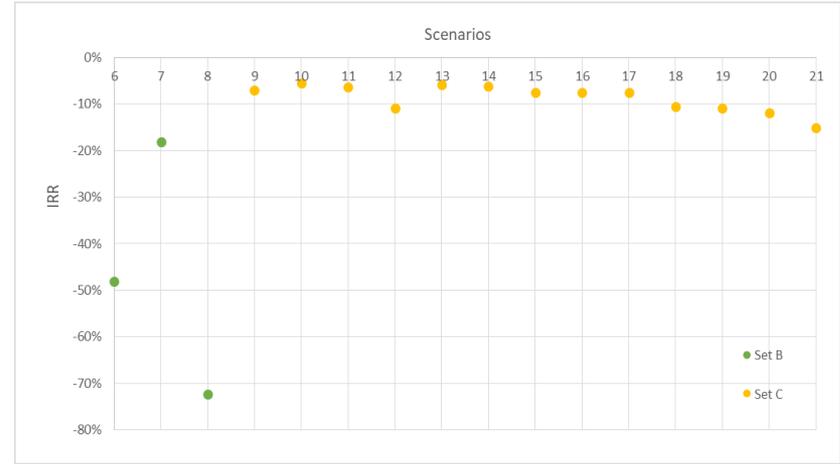
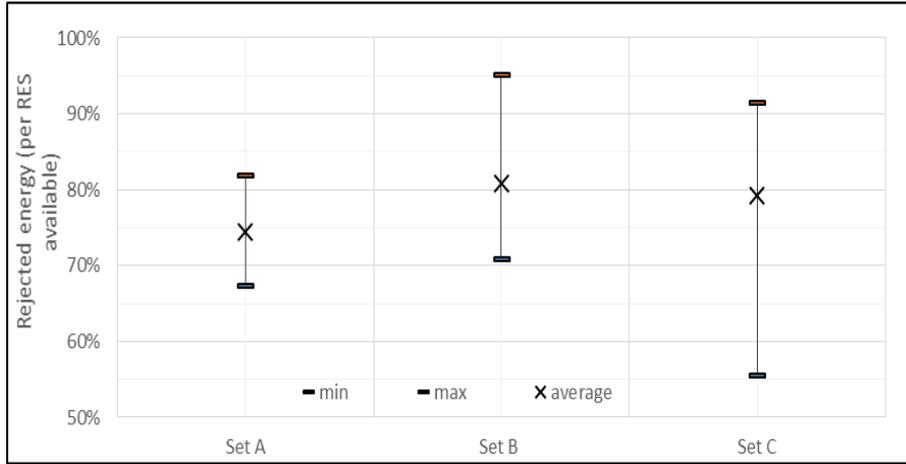
# Appendix



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Year	Generation in Anafi over Interconnection study horizon				
	Load (GWh)	Conv. Gen. (GWh)	Reserve not observed (MWh)	RES Production (MWh)	Interconnection flow (GWh)
2019	1,38	1,38	0,02	0,00	0,00
2020	1,42	0,99	0,07	0,48	0,00
2021	1,45	0,75	0,00	0,93	0,00
2022	1,49	0,77	0,00	0,94	0,00
2023	1,52	0,69	0,00	1,74	0,00
2024	1,56	4,82	0,00	4,41	7,68
2025	1,59	4,86	0,00	4,41	7,68

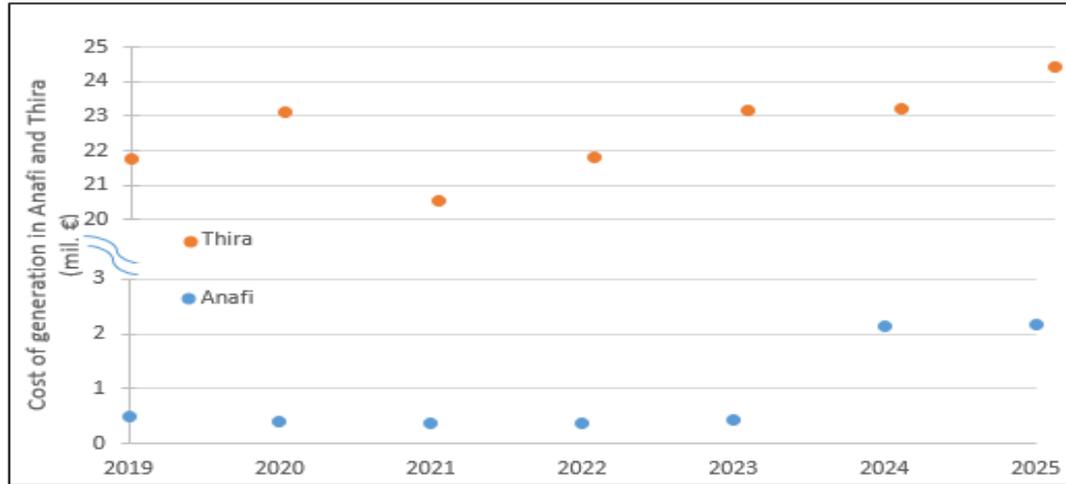
Year	Generation in Thira over Interconnection study horizon				
	Load (GWh)	Conv. Gen. (GWh)	Energy Deficit (MWh)	RES Production (MWh)	Energy imports (MWh)
2019	200,37	199,97	14,19	0,40	0,00
2020	207,65	207,01	61,04	0,64	0,00
2021	214,92	213,96	29,37	0,96	0,00
2022	222,20	220,91	22,80	1,28	0,00
2023	229,47	227,87	37,81	1,60	0,00
2024	236,75	227,14	0,00	1,93	7,68
2025	244,02	234,08	0,00	2,27	7,68



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