Planning Tool for Non–Interconnected Islands

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Abstract—**Strong national and global commitment has supported the efforts towards a cleaner, cheaper and more autonomous energy ecosystem. Series of studies have been made, regarding the operational functionalities and the impact of Hybrid Power Stations (HPSs) at the Electrical System (ES). As the construction of such power plants is an intensive time–consuming activity, mid and long–term horizon planning of energy generation systems is a vital requisition. Especially for small autonomous and isolated ES, like a Non Interconnected Island Power System (NIIPS), it is a decision making problem of high complexity. A series of studies is required, examining various scenarios, in order to decide the most appropriate development plan for each distinct NIIPS. This paper presents a web based application, developed by the Smart grids Research Unit of the Electrical and Computer Engineering School (Smart RUE) of the Energy Systems Laboratory (National Technical University of Athens–NTUA) in collaboration with the Hellenic Electricity Distribution Network Operator (HEDNO), serving as a tool for performing simulations that support this complex decision making process.**

Keywords-component; energy planning, hybrid power stations, storage, non interconnected power systems, renewable hosting capacity, interconnections;

I. INTRODUCTION

During the last years, following the national, European and global principles [1] [2] [3] [4] towards decarbonization, energy secure supply, and improving social welfare, global research has been focused on developing methods and analyzing case studies towards a decarbonized energy mix. All those studies[5] [6] [7] [8], serve mostly operational functionalities for the Day Ahead Scheduling (DAS), or the intraday system operation, implementing all necessary constraints securing system operation and maximizing Renewable Energy Sources (RES) in the energy mix. Mature RES technologies, e.g. Wind Turbines (WTs) and solar Photovoltaics (PVs) or less mature as Hybrid Power Stations (HPSs), are modeled so a study for the available RES capacity margins is performed. In compliance of the aforementioned, HPS, that consists a power plant with combined RES, mostly WTs and PVs, and Energy Storage Systems (ESS) operate as a single entity, aids augmenting the already confined RES integration margins [7] [9] [10] and at some cases even offering ancillary services to the ES [11] [5]. Another trend is the integration of interconnections either between NIIPSs or between a NIIPS and the mainland system, in order to satisfy the aforementioned goals that 've been set.. In all cases, the planning and the implementation of such huge projects, as the construction of a power plant or an interconnection, could require several years, until the moment of its operation.

System Operators (SO) must be able to plan the long and mid-term energy mix of the Electrical System (ES), design precisely any components of an investment plan in order to optimize the benefits from it, assess and give cogent reports as feedback to investors. On the other hand, investors' business proposals have to fit to the unique needs of each ES and at the same time must be economically attractive to them, with legitimate Internal Revenue Rates. In order for that to happen, it is possible that a huge number of scenarios have to be tested so that the optimal plant component dimensioning is achieved. It can be seen that sophisticated tools and methods, as these presented in this paper, have to be designed and integrated so that each player's objective is fulfilled.

In section II, an overview of the status of the greek NIIPS and the greek legal framework are briefly described.

The paper continues in section III, with a technical description of the tool, presenting its features and its capabilities.

A case study is performed and described in section IV, with the island of Anafi serving as a test bed, as well as selected results produced by the tool.

The paper's conclusions are discussed in section V, by explanations of the subdivisions of the tool, proving how important a tool for energy planning is.

II. Greek NIIPS

A. Status of the greek NIIPS

Greece has more than 100 inhabited islands, 57 of which are not interconnected to the mainland grid, forming 29 isolated electrical systems with a total load of 5,88TWh (12,4% of the total annual electricity load of mainland system, according to the official HEDNO's [12] and IPTO's [13] report). Demand curve in greek NIIPS, due to high tourism activity, presents significant fluctuations with daily and annual peaks, during noon and evening, and during summer likewise. Out of the rich renewable potential of the greek NIIPS in 2017 only 1,04 TWh (equivalent to 17,6% of the total electricity production of the Greek NIIPSs) has been exploited. RES units have assisted significantly only in midday peak decrease, though the non-dispatchable installed PVs have led to a more intensive fluctuation on the demand curve. The production system in the NIIPS depends mainly on inflexible expensive fossil fuel (imported heavy fuel and diesel oil) generation units, leading to high operational costs. Moreover, conventional units must be kept at their high technical low, providing spinning reserve, even if they are not actually needed for energy generation. Operating at a low power output could cause severe issues to the machinery (e.g. unburnt fuel condensing in the exhaust system or carbon deposits settling on injectors, valves, etc.), leading to irregular wear which can cause a conventional unit to frequent replacements of engine parts and hence downtime or even damage and premature failure [14]. Some conventional units manufacturers have published specific usage recommendations for low load operation, but since this is not a widespread tactic for all types of units and manufacturers, such instructions cannot be carried out, the technical low is horizontally applied between 30 and 50% of the nominal capacity, depending on the technology (e.g. steam/gas turbines, internal combustion engines) and the age of the unit. [15] Another parameter, concerning the availability of the conventional units, that can alternate significantly the results of such a study is the programmed maintenance periods and the stochastic, due to fault, out of service periods of the conventional units.

Because of the high technical low, the limited RES capacity margins and the stochastic nature of the solar and wind energy, in order to ensure the secure operation of the isolated ES, RES shedding is necessary. Thus, viability of such investments needs to be thoroughly investigated, as they are characterized by a high level of risk and achieving a legitimate Internal Rate of Return (IRR), even under a standard feed – in tariff. Meticulous studies regarding the dimensioning of the components of RES/HPS facilities are an absolute necessity.

B. Legal Framework

European Union (EU) has set environmental goals towards a sustainable model of electricity market, where primary objective is the secure and constant supply of carbon free electric power, while continued growth and competitiveness should be supported in a transparent manner. Active measures towards the decarbonisation are decided in order to reduce the industrial and residential carbon emissions, minimizing the impact on the greenhouse effect. [7] [8]

HEDNO is responsible for the operation and the planning of the greek NIIPS. Planning refers identifying to the deployment plan for new conventional generation units within a horizon of 7 years, determining the RES hosting capacity of each autonomous energy system and assessing the needs for implementing interconnections between NIIPSs or between NIIPSs and the mainland system. In the ES Operation Code for Non-Interconnected Islands (Code) [16], all rules and necessary information for the operation of NIIPSs are described, concerning the Information Provisioning, operation of the energy Control Centre, the energy market operation and rules players are subjected to, the daily solution for the next Dispatch Day, with hourly step, of the Unit Commitment (UC), thus implementing the Rolling DAS, and the intraday Economic Dispatch (ED) problem.

In the framework of the new era of ES, the *smart grids*, it seems that SO needs some sophisticated tools and methods in order to be able to achieve all these complex targets with as less compromises as possible, and market players need advanced methods in order to decide on successful investments.

III. Tool description

The tool is a user friendly web-based application, where each user may create his own unique password-protected account, and once access has been granted could start designing models and run scenarios. Each model may be private or public, so anyone can have access to it. Data regarding the existing generation units per NIIPS, historical load timeseries, as well as normalized RES production timeseries are stored in a database. User can also insert his own timeseries through the Application interface, and both timeseries and models created are also stored in the database, so the user can save the model, even half designed, and come back to it anytime later. Below some screenshots of the Application are provided.

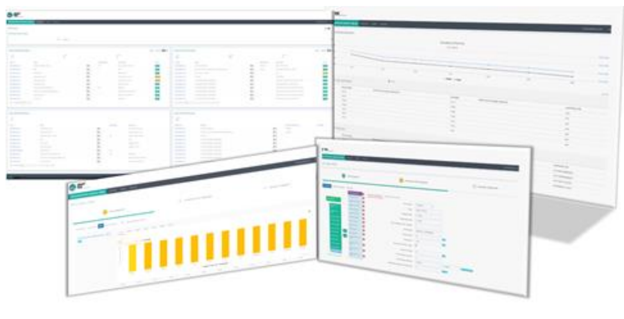

Figure 1: Screenshots from the Application. Upper left: Dashboard. Upper right: Demand/Peak model. Down left: RES (PVs) capacity. Down right: conventional units parameters fields.

The application comes with a well written user manual, with step by step instructions when building models, and explaining everything necessary (e.g. abbreviations, algorithms). The tool enables easy definition of complicated scenarios regarding the electricity demand forecast and the composition of the ES under study. The tool allows performing three types of studies:

a. 7-Year Energy Planning for assessing the deployment plan of new conventional production units,

b. RES Hosting Capacity for assessing the hosting capacity of production units utilizing RES in the ES,

c. Interconnection Study, of a selected non interconnected island either with the mainland or with other NIIPSs.

These types of studies assist the SO who is obliged to securely serve the entire load, and simultaneously maximize the RES penetration and social welfare. On the other hand the tool is very useful to an investor as it quantifies several pointers, and is easy to simulate a series of scenarios, that lead to an easy post-calculation of economic pointers (e.g. Levelised Cost of Energy (LCOE IRR) and evaluation of an investment risk.

The core of the calculations includes a merit order algorithm that decides, on an hourly basis, the commitment and the dispatched quantities of the conventional production unit. Such a hybrid approach between planning and operational study, contributes to the stochasticity of the planning process through RES and load time-series predictions, while at the same time respecting the operational limitations and the rules that contribute to the safe operation of the ES.

User can define various demand/peak and ES models, all stored in the database. The web interface, designed for best user experience, allows downloading a .jpeg or a .pdf of the peak/demand chart and a .pdf of the report.

Designing the ES model, one may simply insert all characteristics of various types of electricity production units, i.e. conventional, WTs, small wind turbines, PV, Concentrated Solar Power stations, HPSs and Biomass-Biogas Stations (BBs). User may as well define all technical and detailed characteristics for CUs management, like specific fuel consumption, commission/decommission dates, rated power, technical minimum, maintenance schedule, merit order, etc. User may select various parameters concerning RES units, like installed capacity, remuneration prices, guaranteed production percentage. Finally, several operational parameters may be set (e.g. spinning reserve requirement, must run units, cost data, etc.).

The combination of a Peak/Demand model and an ES model with the simulation type (7-Year Energy Planning, RES Hosting Capacity or Interconnections) comprises the input of the algorithm and is selected through a "*mix-match*" tab.

Performing an interconnection analysis requires selecting the ESs to be interconnected, a Peak/Demand model and an ES Model per ES, as well as defining the technical characteristics per interconnection, i.e. implementation year, transmission capacity, length. The algorithm uses mathematical graph theory to define if a node, representing an ES, is interconnected with another node and proceeds with the Unit Commitment and Economic Dispatch for each component of the graph. The flows per interconnection line are calculated using the DC load flow equations. In case the line capacity limits are violated rescheduling of the production units situated at the ESs connected through the specific line is performed.

Before the implementation of any interconnecting line, the ESs operate autonomously covering their load by locally installed conventional or RES units. The significant amount of energy available from RES units, imposes restrictions leading to energy shedding, in order to ensure the secure operation of the ES. Furthermore, during low load and high non-dispatchable RES energy injection (e.g. PVs), conventional units might operate below their technical minimum, affecting the wear of the engine parts. The interconnecting lines allow exporting excess energy injected by RES units, thus resulting in reduced RES energy spillage, or benefiting from energy imports in case of energy deficit.

The results of the simulation are exported as .csv files in a zipped folder containing hourly results providing the possibility of a thorough analysis, and in the form of a report loaded in the browser window with a brief overview of the crucial aggregated results.

IV. CASE STUDIES[1]

The three types of studies are all applied on the same ES for the purposes of results comparison by the SO or an investor, in order one can decide the investment that fits best for each particular case. The NIIPS of Anafi serves as a case study.

For 7 year Energy Planning and Interconnection studies, the following elements are common. During 2018 the ES consists of 4 diesel generation units with 0,8MW total capacity, covering load of 1,31 GWh with a peak of 0,495 MW. There is no installed capacity of WTs or PVs. The availability of serving the expected load growth combining RES utilization is taken into account. Concerning the installed PVs and WTs capacity on the NIIPS, a gradually increasing rate is supposed, as shown below, while the remuneration is supposed to be in a feed-in tariff system with 90€/MWh injected both for PVs and WTs.

TABLE I. WTs and PVs installation plan over the 7-year Energy Planning horizon and Interconnection studies for the NIIPS of Anafi.

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

A. 7 – year Energy Planning Study

The results of the simulations indicate the effects of the scenario under study in the operation of the ES. More specifically, the adequacy of the ES is ensured for the entire seven-year horizon, while the share of the conventional generation units reduces in favor of the share of the new RES

[1]The simulations presented in this document are indicative of the appropriateness of the *Energy Planning* tool for performing the relevant types of studies. The results and conclusions contained herein are not intended to be used as a source of advice with respect to the development program of the NIIs under study.

units being installed. The over-dimensioning of the RES capacity components leads in excess RES energy, mainly from the non-dispatchable units, which in turn lead to energy surplus over the demand, in simulation years 2023-2025. As there is no interconnection available so the RES surplus may be exported, the RES units' capacity should be restricted ensuring the secure operation of the ES.

TABLE II. Annually energy results for the NIIPS of Anafi for the 7-year planning horizon.

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

However, due to the increasing trend of the electricity load, and the intermittent nature of the RES units, the number of start-ups, the hours of operation of conventional units and underload hours increase, in order to provide the necessary reserve.

TABLE III. Annually conventional units results for the NIIPS of Anafi for the 7-year planning horizon.

Year	Conventional units on a 7-year Planning horizon				
	Start ups	***Operation hours***	***Underload hours***	***CO_2 emissions (tn)***	***Fuel consumption (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

Although the operational costs, concerning conventional units decrease widely due to conventional generation, the total ES production cost decreases and then increases again, as a result of the increasing load.

TABLE IV. Annually generation costs for the NIIPS of Anafi for the 7-year planning horizon.

Year	Generation costs on a 7-year Planning horizon				
	Diesel cost (th. €)	***CO_2 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

B. Hosting Capacity Study

The RES Hosting Capacity study explores three sets of new RES plants. Firstly, in Set A, PVs, WTs combined with dispatchable BBs are examined, without any ESS, *TABLE V*. In Set B, the concept of Central Storage is introduced, combined with already installed WTs and PVs, in order to reduce the WTs curtailments, *TABLE VI*, and in Set C the concept of HPS is introduced, examining some possible dimensions of its components (*TABLE VII*).

TABLE V. Set A - RES power plant components per scenario for the NIIPS of Anafi.

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

The WTs primarily available capacity factor is equal to 41,3% and the energy efficiency of PVs is 1.604 kWh/kW, while the BBs is considered with 7 months availability. Installed PVs are considered as non-dispatchable while WTs are non-dispatchable with the possibility of set-point.

TABLE VI. Set B - RES power plant components per scenario for the NIIPS of Anafi.

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

A preliminary HPS components dimension analysis is held, proving that a very precision study may be performed, minimizing the risk taken from the investor's point of view.

TABLE VII. Set C - HPS components per scenario for the NIIPS of Anafi.

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

The results are evaluated firstly from the energy point of view, providing the RES penetration levels per scenario. As shown in *Figure 2:*, non dispatchable RES plants affect in an enormous way the share of RES units, yet from *Figure 3* it is deducted that the larger the non dispatchable RES share, the larger the number of underload hours, burdening the machinery.

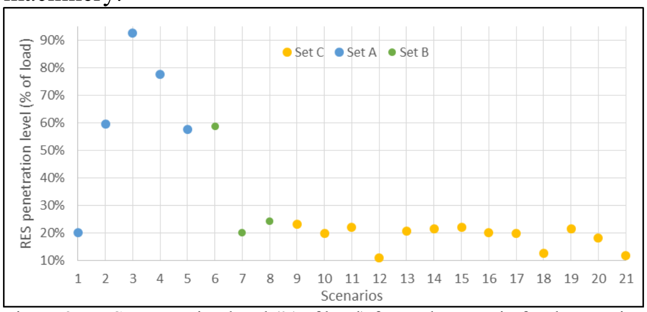

Figure 2: RES penetration level (% of load) for each scenario for the Hosting Capacity Study for the NIIPS of Anafi.

HPS plants contribute to augment the RES share, with no harm on the safe operation of the ES (e.g. no increase of underload hours as shown in *Figure 3*), in contrast with non dispatchable RES. Utilization of an HPS with only component the storage system as a Central Storage, seems to be energy beneficial in specific cases, yet as shown in *Figure 4* and *Figure 6*, the idea is characterized by the maximum rejected energy and the IRR is devastating.

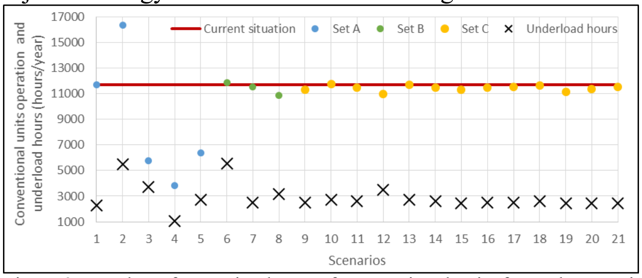

Figure 3: Number of operation hours of conventional units for each scenario for the Hosting Capacity Study for the NIIPS of Anafi.

In *Figure 4* and *Figure 5*, the rejected energy per RES available is displayed. Capacity factor from WTs in Sets A and B get lower as the installed capacity gets bigger. As proven in scenario 4 of Set A, when PVs are not installed in the ES and the WTs capacity is low, the available RES margins augments rendering such investments more sustainable.

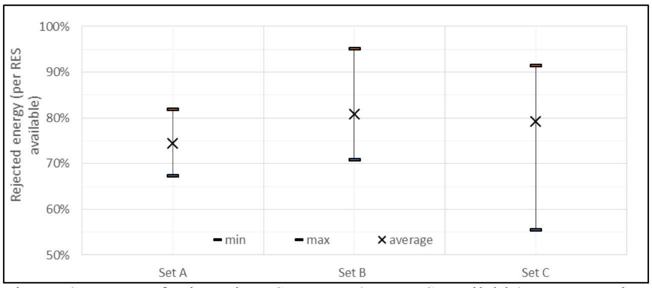

Figure 4: Range of rejected RES energy (per RES available) per scenarios set for the Hosting Capacity Study for the NIIPS of Anafi.

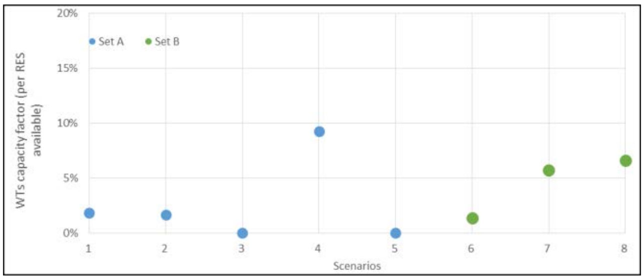

Figure 5: WTs capacity factor (per RES available) for Set A and B for the Hosting Capacity Study for the NIIPS of Anafi.

Concerning the economical aspect of storage plants investments, investment prices that have been taken into account are displayed in *TABLE VIII*, for post–processing and evaluating the sustainability of the under study investment.

TABLE VIII. Cost data and prices for calculating the IRR.

Cost data and Prices				
WTs investment cost (€/kW)	***PVs investment cost (€/kW)***	***Storage investment cost (€/kWh)***	***Inverter investment cost (€/kW)***	***O&M cost (% of investment cost)***
1000	700	300	200	2,5
Interest Rate (%)	***Investment evaluation period (years)***	***Tax Rate (%)***	***Inflation (%)***	***Equity (% of investment cost)***
8	20	29	0	75
Loan duration (years)	***Feed-in remuneration tariff (€/MWh)***			
10	300			

None of the examined scenarios has shown a positive value of the IRR, pointing that more cases must be studied. In Set B, the injected energy from the WFs curtailments has been very confined, so the remuneration of this investment does not seem to become sustainable at all, and actually returns a very negative value. Although, neither Set B nor Set C investment plans are viable, the HPS concept, implementing ESS and new RES units, tends to be a better investment, with less marketable risks, as deducted from *Figure 6*.

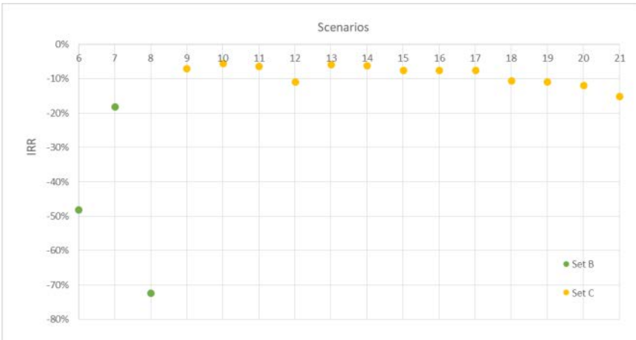

Figure 6: IRR for the ESS scenarios, for the Hosting Capacity Study for the NIIPS of Anafi.

C. *Interconnections Study*

As shown in previous studies, the conventional units are used for half the load of 2025, and the spillage of renewable energy from RES units is tremendous, interconnecting Anafi to Thera in 2024 (located 50 miles from Anafi, a NIIPS of Cyclades with very high demand) for exporting the excess energy is under study. The results of the yearly simulations allow examining the operation of the ESs under study during a seven-year horizon. In *TABLE IX* and *TABLE X*, the annually load, generation and transmitted energy through the interconnecting line, for the islands of Anafi and Thira are displayed. Before the implementation of the interconnection in 2024, RES energy, after the WTs curtailments, exceeded the available RES margin from the conventional units, leading to energy surplus on the energy balance. After the interconnection implementation, in Anafi the WTs capacity was doubled and the RES production as well as the conventional units' generation, increased significantly, exporting the excess energy to Thira.

TABLE IX. Annually energy results for the NIIPS of Anafi for the interconnection planning horizon study.

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

Load forecasts predict low increase for the NIIPS of Anafi, while in Thira the increase is significantly larger. After the interconnection is completed, the available RES and conventional generation from the island of Anafi is used to serve part of Thira's load, ensuring the adequacy of the ES, satisfying the complete load with no need to commission any new units.

TABLE X. Annually energy results for the NIIPS of Thira for the interconnection planning horizon study.

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

Operational costs follow up the energy results, as the suppressed cost of Thira, after the interconnection's implemented, leads to rise of the operational cost in Anafi.

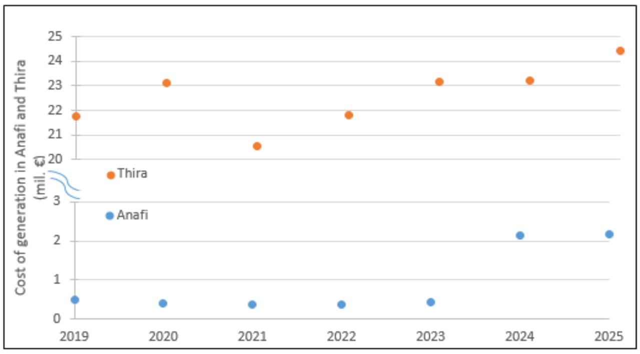

Figure 7: Total generation cost over the Interconnection study horizon, for the ESs of Anafi and Thira.

Interconnection has benefited the conventional units so they are not underloaded, and the tear because of the underload usage is eliminated. Another pros of the interconnection, is that the limited operation hours [8], may now be divided, to the machinery of the two islands.

TABLE XI. Annually conventional units results for the NIIPS of Anafi for the interconnection planning horizon study.

Year	Conventional units in Anafi over Interconnection study horizon				
	Units commited	*Start ups*	*Operation hours*	*Underload hours*	*CO_2 emissions (tn)*
2019	4	736	12.018	4.048	1.149,49
2020	4	623	10.932	6.080	834,63
2021	4	327	9.740	5.525	630,86
2022	4	372	9.839	5.402	648,18
2023	4	415	9.849	5.680	580,17
2024	4	52	33.451	0	3.917,98
2025	4	50	33.459	0	3.944,79

The rise of load in Thira, affects power plant located in Anafi, so the latter take on the load increase of Thira, allowing generators in Thira to maintain almost the same operation hours through the last three years of the simulation.

TABLE XII. Annually conventional units results for the NIIPS of Thira for the interconnection planning horizon study.

Year	Conventional units in Thira over Interconnection study horizon				
	Units commited	*Start ups*	*Operation hours*	*Underload hours*	*CO_2 emissions (tn)*
2019	20	3.816	64.017	0	143.692,91
2020	19	4.094	67.474	0	143.34,94
2021	6	1.076	29.539	0	148.408,84
2022	6	1.115	30.553	0	154.074,75
2023	7	1.213	31.428	0	159.818,02
2024	6	1.183	31.396	0	159.433,86
2025	6	1.185	32.284	0	164.975,27

V. CONCLUSIONS

Energy Planning tool of NIIPSs comprises a robust, deterministic tool, supporting decisions of Electrical System Operator decision making process, incorporating all aspects concerning the polymorphism and the peculiarities of the isolated ESs operation. Simultaneously, it is designed in a way that it can evenly be used for business and corporates in the energy area, supporting and evaluating an investment plan.

Recapitulating, the following district subdivisions are implemented, assisting particular projects:

a. Demand and Peak forecasting procedure, for a 7 year horizon. After the execution, a simple observation on the exported report informs about the adequacy of the generation units per year. A series of Demand/Peak models can be formulated, so the User can approach precisely the unique charasteristics of each ES.
b. Electrical System designing procedure, offering the potentiality of creating a series of models per ES, reflecting both the current status as well as foreseeable future units commissioning/decommissioning.
c. Simulations execution procedure, which offers three types of studies available; 7-Year Energy Planning Study, RES Hosting Capacity Study, Interconnection Study.
d. UC&ED procedure, which respecting the legal framework and the Code rules, takes

over the responsibility of dispatching units in the most financially beneficial way, maximizing the social welfare and the penetration of renewables, while ensuring the secure operation of the ES.

e. Exporting procedure, offering a quick overview of the results through the aggregated report, and simultaneously exporting a zipped folder with monthly and hourly results in .csv files.

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