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ASSESSMENT OF RENEWABLE ENERGY IN PORTUGAL POWER SYSTEMS

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ABSTRACT: *Increasing concerns about the changes Climate Security of supply is available to significantly investment in the exploitation of RES (renewable energy sources) to generate electricity, the possibility of reaching 100 % RES is debatable, but concerned. Storage costs and capabilities Backup is still valid, this paper focuses on renewable energy scenario for the electricity sector, the analysis of future strategy. In contrast It is possible for Portugal, one of these strategies, each person will tried with the expected amount of electricity and replacement parts with the objective analysis of the situation RES 100 % chance Energy PLAN tools to analyze the system . energy used for each simulation scenario RES 100 % for one year will find that it is possible in theory , but increased significantly with the total capacity of the system is required to . Make sure that there is a shortage in the summer result is significant overcapacity in the winter and a significant increase of the total cost of the system, importance. Interconnection is the stabilization and consolidation of storage systems has been discussed for high system dependent on renewable energy sources.*

KEYWORDS: *Renewable energy sources ,Electricity system, Portugal*

INTRODUCTION

Development of the system has been very supportive in RES (renewable energy sources) can be attributed to the economic and political environment is clear . Especially in Europe, with a final document for this strategy to control the force RES sector support for investment purposes to have a positive economic development impact to reduce the negative impact on the environment. Often associated with power generation sector - TRICITY and contribute to the reduction of the trade deficit in Europe. In the energy commodity markets [1] While acknowledging the relevance of RES for electricity sustainability . It is important to acknowledge that the RES projects have a major impact in the management of the grid and the electricity costs for consumers, even as the cost of funds often requires high motivation enough for Investment [2, 3] In addition, the wind, the sun or even the rain can be difficult to predict and storage , creating additional complexity to meet the electricity needs and supply one of the major obstacles faced . the production of electricity from RES as variable nature or which creates the need will increase. Reliable storage systems and Shows A challenge security of supply [4] However, the importance of RES has been improved . The possibility of access to energy systems rely completely on these sources currently being explored in various countries and by different authors. Cosmic B. et al [5] For example , as stated in a 100 % renewable energy sector in Macedonia Lund and Mathiesen [6] concluded that 100 % renewable energy supply based on domestic resources possible . body Denmark in 2030 , but the design of this system is a very complex process , as well as in Denmark , the method proposed by Mathiesen et al [7] in the context of policy action to reduce greenhouse gas (GHG) EMIS . - The need to offer Technical Analysis For self development for the prosperity of the country , Mason et al [8] propose and analyze system

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capacity replacement Zealand and the recent cost is less than 100 % Options for the RES . supplying electricity market in Australia is presented [9] .

Topics renewable energy systems are also fully debated in Europe in past studies [10e14] Trainer [10] concluded that the supply of 100 % renewable for European unreachable . Storage and backup key version defined in the production of renewable energy continues a major concern for this system RES [12e14] Despite these shortcomings Institute network of global energy report shows the situation . optimism increases the chances of having several electric powered with 100 % renewable energy future then ear (http://www.geni.org/globalenergy/research/index . shtml , consulted in February 2014) .

Portugal remains one of the EU countries with the highest level of dependence on imported energy, but obviously there is the growing importance of new energy sources, especially outside. On the study of electricity REN (Rede Elétrica of) [15] and DGEG (Direção Geral de Energia e Geologia) [16] establishes that the production - tion in the years ahead will depend on the expansion . The installed capacity of hydropower plants and wind are combined with a special focus on energy development. Solar and RES, such as biomass, biogas, geothermal and wave energy even national plan published recently for renewable energy [17] is still considered the biggest increase in RES near DGEG [16] , but moderate . of REN [15] Kraja_ci_c Ji et al [18] , presented the application of the model . Computer Power Pro Portugal for the production of RES into effect 100 % " indicates that the solution to 100 % hydropower and renewable wind energy "although the latter should be used in combination with "capacity .Electric and pumping water back. "

In general , the complexity of the system under analysis is clear both from the data and from other forms of effort required , the system must be able to simulate possible future scenarios through the application of the model -based planning . Model calculations used in the analysis are often supported on the calculation of electricity costs , CO2 emissions and costs . And external benefits of this study has been a comet assisted by computer tools that assist in the decision making process and can Used for analyzing the integration of renewable energy. [19]This paper aims to investigate the use of renewable energy, SCE narios different for electricity supply in Portugal research from the reference scenario in 2010 and the results of improvement. RES is analyzed for analysis, this article is based on the use of EnergyPLAN one of the best known local energy planning [20, 21] this model has been adapted to the case of Portu - Guese and the end goal is electrolyte simulation TRICITY 100 % renewable.

Renewable energies within the Portuguese electricity system

Powered Portuguese electrical system, especially in the heat plant electrical, water and wind power in what concerns the majority of heat energy comes from electricity. Natural gas and coal, and to a lesser extent, biomass, and dedicated biomass RES represents about 6 % of the total electricity in 2012, as wind power contri - . Bution approximately 23.5 % of the total electricity production and parts with 13 % [22] However , the value of the electricity generated by RES and especially the water is very clear , some depending on the weather each year , for example , in 2010, representing 54.6 % of the RES . Total electricity production in Portugal, but in 2012 the value was only 43.2 % [22, 23] only connection with Spain Portugal with limited capacity to import and export markets under the IBA. Maria For analysis of power systems for different RES. Portugal free in addition to the reference scenario is established as follows. Form of Examination 1, 2010 as the reference year based on reference Situation 2 Scenario 1 in 2020, which was presented in 2011 by the National Renewable Energy Action Plan [16].Situation 3 Scenario 2 in 2022 ,

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according to the proposed development and investment plan to the national electricity network 2012e2017 (2022) [15] . 4 3.3 % with the replacement of fossil fuels with renewable energy by 2020, assuming (Scenario 1) predict consumers; this situation has been described by the author .Energy PLAN models used for the analysis . For a period of one year for the model inputs are set by the estimated hours of consumption, RES and combined cycle configuration and manufacturing hour's dam inflow, thermal power plant and the ability to import and export per hour . Results showed interconnect per hour to produce heat energy , fuel consumption , imports / exports and total system costs for each scenario , the technical analysis has been done for import and export their analysis goes much beyond a purely technical perspective Depending on the strategic behavior of operators. Electricity under market conditions and the price of such the focus of this research is mainly to analyze the impact of different situations under the RES process optimization .Economical purely technical dimension and market connectivity and flexibility that are not included in the form of optimization. Marginal cost of each scenario are calculated and analyzed in accordance with the results of the technical format

Table 1: Results is the model validation.

	Technical data 2010 (REN) (TWh/year)	Model output (EnergyPLAN) (TWh/year)	Difference (%)
Demand	52.3	52.3	_0.09
Wind	9.04	9.04	_0.04
Photovoltaic	0.21	0.2	2.1
Run-of-the-river	9.97	9.8	1.7
Dams	6.52	6.49	0.4
Thermo power plants	17.61	17.52	0.52
Cogeneration and biomass	7.33	7.33	0.0

Aware of the limitations of this form will be considered as valid for the main purpose of this analysis is to compare different scenarios and RES to study the technical feasibility and effects of 100% RES electricity in Portugal for profit. Simplicity import / export fixed hourly rate then considered by the REN 2010, but some additional flexibility to optimize for size RES by first determining interconnection capabilities. But for maximum optimization drain connection as import, export and query. It is currently interconnection is largely dependent on exports and consumption of RES in every hour of planning.

RES analysis

After checking the model according to the reference scenario for the simulation of three scenarios for the RES .Scenario 1 is designed for 2020 and the numbers are based on the revised national action plan for renewable Energies [16] has been assumed and the main objective associated with PRIN - principles such as reducing energy dependence Countries and the need for a sustainable electricity system. This situation tends to evolve Char marked increase in the average level of overall electricity consumption and more wind, water and solar power plants. Scenario 2 presents estimates of electricity in Portugal for the year 2022 based on a strategy to build up the investment plan, National network [15] this situation, depending on the power consumption and higher estimates still higher than the strength of RES than in Scenario 1 for

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all technologies. The scenario has been designed the purpose of the observation is still open to the possibility of a connection, but now targeting 100 % RES electricity in Portugal all the production of energy from fossil fuels has been replaced by RES technology Electricity projected demand Scenario 2 , a more conservative assumed that this situation three support increasing the installed capacity of wind power (onshore and offshore) a total of 9970 MW remain in the situation. This would be considered high in the folds of the production and integration of photovoltaic energy spectrum as proposed by Ji et al Kraja . [18]For all scenarios is limited interconnection is an additional 3000 MW of electric power distribution system storage is not projected and existing hydro schemes to be included .Table A1 in the Appendix shows the conditions for the use and thinking . Although every situation is mainly technical optimization of the skeletal system short of costs every situation is also described the data used for the analysis. These costs are described in Table A2 in the Appendix.

Analysis of the results

Figure 1 presents the total amount of electricity produced from RES in a year, and the increasing trend is clear. Values obtained for scenario 3 (100% RES) showed that the total amount of electricity that is expected to exceed the situation consumption of power which has been designed in such a conservative, which aims to ensure the problem. There is no shortage of power during the peak. This result in a higher value of installed RES power, which causes excess production of pro-consumption, is reduced. As a result, the share of RES in electricity production and 55% to the reference scenario, up to 68% and 82% in Scenario 1 Scenario 2 Scenario 3 to 100% under the expected conditions.

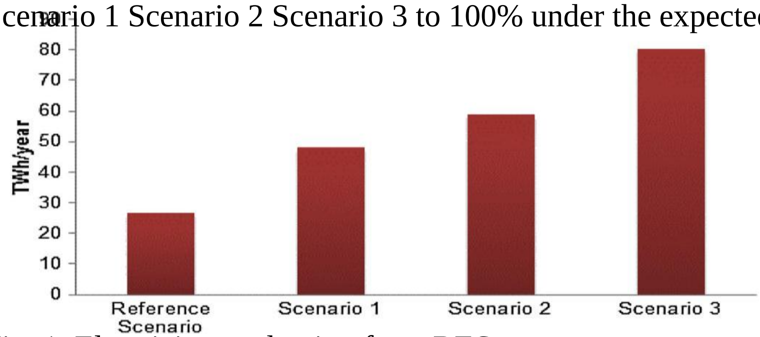

Fig. 1. Electricity production from RES.

As the model is based on a one-year simulation hour to no avail two weeks simplicity involved. Appointed For detailed information about the results to be representative of the general winter (February) and summer (August) Sunday This method allows the recognition of annual chest renewable resources should also take into account seasonal variability per hour of both supply and demanding a situation where the value of the underlying recording impressions . In winter the high Dam and operation of water production will also winter at higher wind energy to succeed numbers into summer Proof “dry “with a very low value for the production of hydroelectric power in the winter , the possibility of exports can be observed otherwise in this summer . Tend to be higher to compensate for the lack of wind and water imports a great time in the summer, all of which are highly Vance during peak demand at Figure 2 and 3. Distribution for hourly electricity needs and supply situation of reference received from replication for winter and summer weeks. Figs 4 and 5 present the distribution of electricity per hour de command and supplies received from the wind and a simulation model for the situation -week summer RES 100 % , and assuming that the 2020 demand forecast is usually the result pointer . RES lap to export technology both in winter and summer, as expected in the summer is solar power with higher numbers during the day , compared to weeks of winter for a while reduce water and wind power are considered early winter showed that the RES output will come

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to a surplus of electricity demand and the most superior . It is assumed interconnection capability is driven primarily by demand. Summer requires a high level of installed RES power to ensure that no eggs during the dry season, so that even imports are still necessary to compensate for the shortage of RES in the summer. It is 100 % RES situation of fossil fuels to generate heat from fossil fuels cannot be predicted.

5. Importation and exportation analysis for RES

This model is based on the optimization of technical systems. Therefore, the main objective is not to assess the economy out of the import or export. However, in analyzing the impact of increasing the share of RES may request for the duration of the shortage of supply or export of electricity in a given period of time. Energy PLAN Excess inventory model allows to analyze the results of this long associated with excess or deficit of electricity production throughout the year

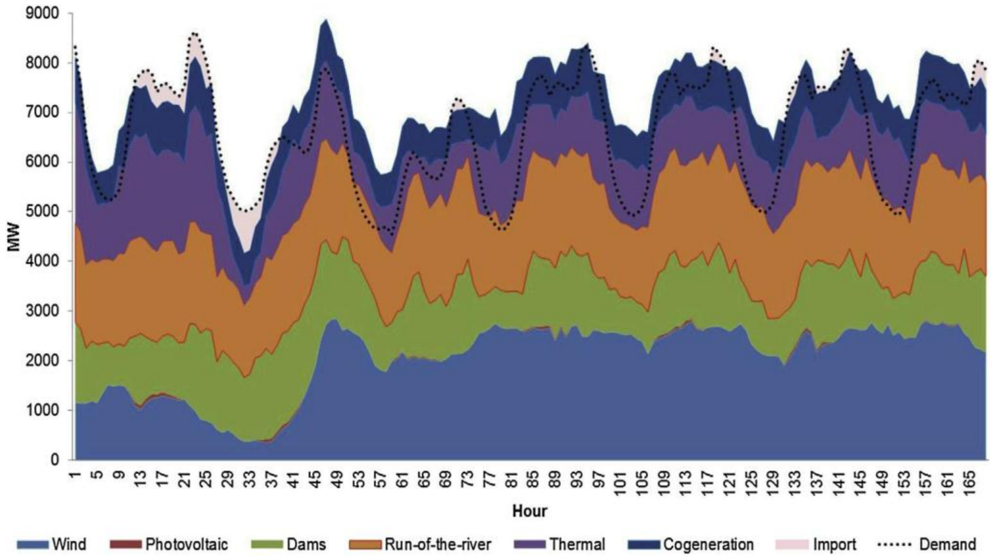

Fig. 2. Hourly distribution is consumption and production of electricity for the Reference Scenario on a winter week.

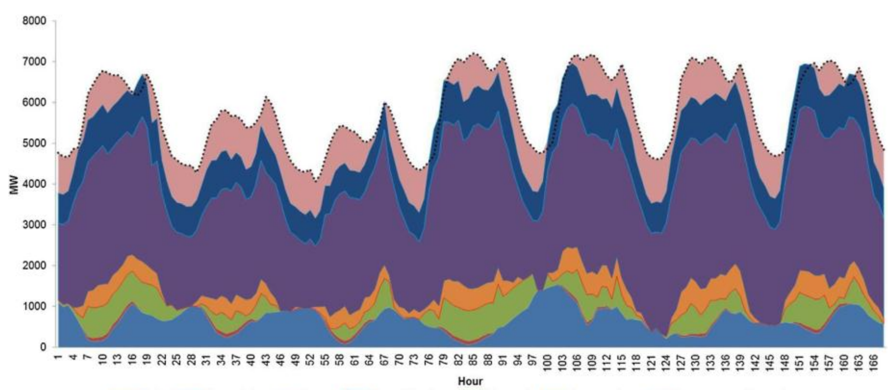

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Fig. 3. Hourly distribution is consumption and production of electricity for the Reference Scenario on a summer week.

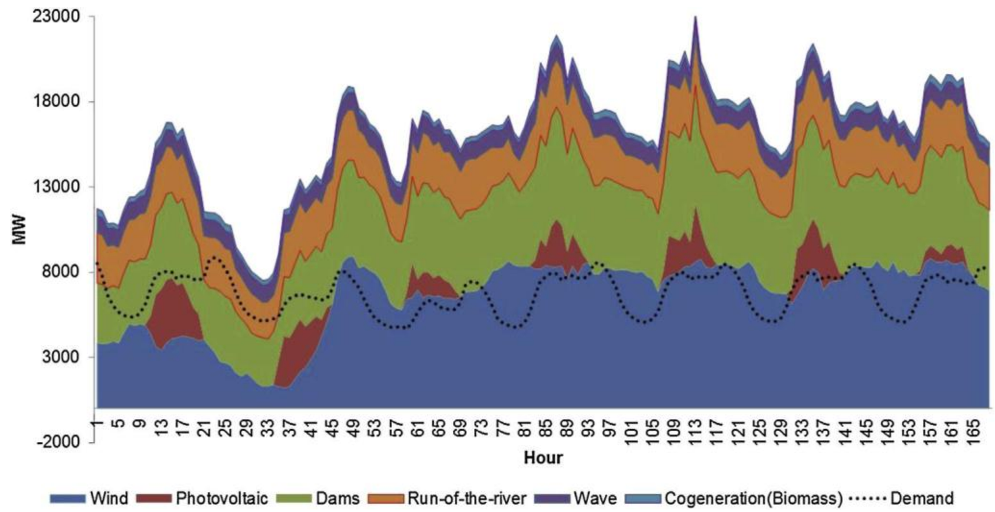

Fig. 4. Hourly distribution is demand and production of electricity for Scenario 3 on a winter week.

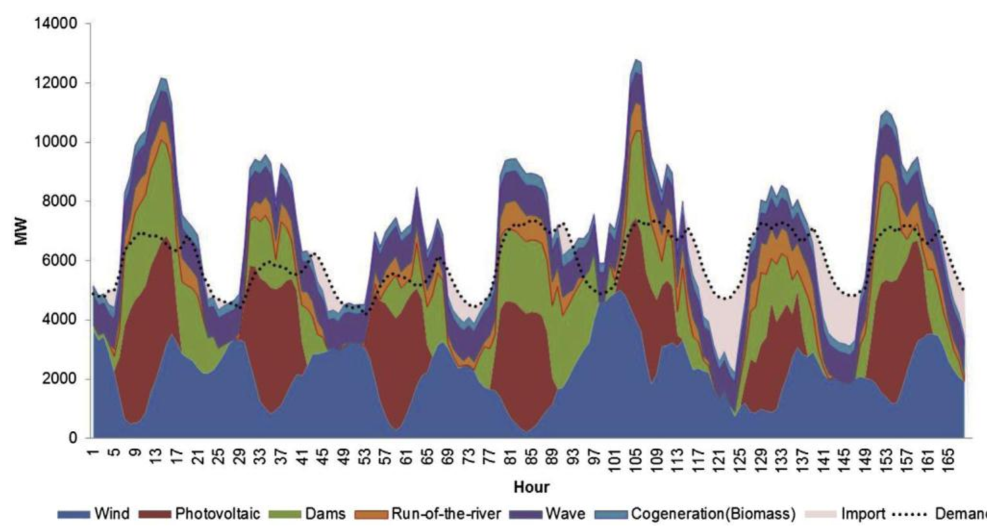

Fig. 5. Hourly distribution is demand and production of electricity for Scenario 3 on a summer week.

Figure 6 presents a balanced import / export under. For technical predicted for each scenario refers to the output and electricity - TRICITY excess demand forecast CEEP (electricity surplus) means the full amount of electric power that exceeds the needs and capabilities . Interconnect for EEEP (export surplus electricity) and the value of imports related to the amount of electricity that can be exported or imported efficiently respectively .According to Figure 6 , it is possible to receive it . The tremendous growth of RES will affect the value of exports and imports increased public EEEP CEEP mostly occurs during the summer, with a decrease in the RES electricity. CEEP timing for this to happen in a week during the winter , usually when

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both wind and water power they reach the top , with the highest potential for electricity production exceeds demand , the need for it to be noted , however , that although the ability to . Interconnection is not limited to the export and efficient. The economic value will depend on market interest and costs and strategic behavior of operators.

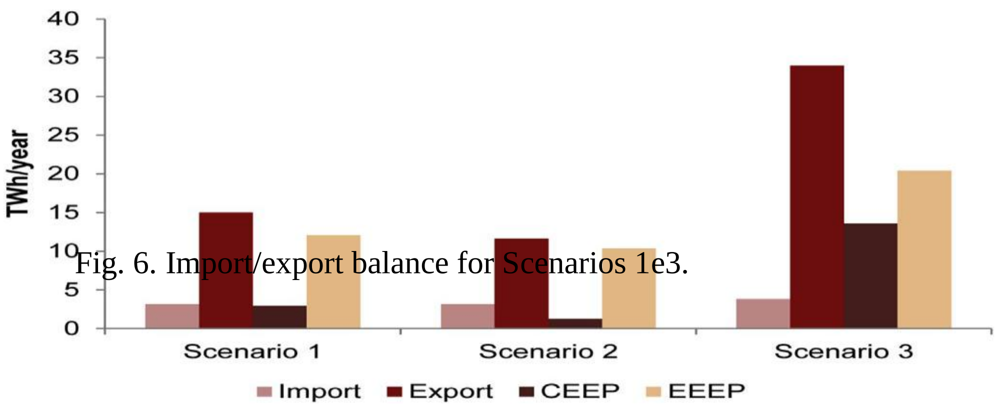

Fig. 6. Import/export balance for Scenarios 1e3.

Although Scenario 1 and 2 currently interconnecting the same situation 2 presents CEEP decrease this difference is justified by the lower than expected electricity consumption and lower installed by RES. expected to be more conservative scenario 1 EEEP whole situation with imports this year. Expected to show how the increase in RES will increase the potential for exports to specific systems during off peak hours and to reduce the country's dependence on external energy by reducing electricity and fossil fuel imports.

Cost analysis of RES

Calculate the total cost for one. Each scenario is based on the total cost. Estimated power generation technology , with the assumption that the increase in relation to the reference to the new power system for calculating the cost of clothing is the uniform distribution costs . Investment costs for the life of the plant, it is calculated as the number of operations and the cost of maintenance costs and fuel emissions allowance costs, CO2 .The results enabled to conclude that the calculations presented decreased costs of scenario 1 to scenario 3 . Reduce costs, this can be explained by a combination of factors that caused the First varied. Operation and maintenance, low cost of RES electricity generation compared with thermal power plants for fossil fuels. Secondly, it is because the cost of avoided fuel costs and CO2 emissions as a result of the stock . Increased RES power plants .For Scenario 1, the cost is calculated as 28.2 V / MWh decreased to 21.2 V / MWh for Scenario 2. Finally, Scenario 3 is presented very low numbers at the cost of increased (14.3 V / MWh) due to the change from fossil fuels to RES . Value of costs described in Figure 7 .But when it comes to the total cost of each situation, the investment cost is the total opposite of becoming a presence in shown in Figure 8. , As part of the increasing trend of increasing RES. This fee can be observed up to the maximum value for the total cost of 100 % of the RES scenario 3 is 45 % higher than scenario 2, but the increase in production costs is 49 % down. Indicate that the RES investment projects with high capital intensity, it should be noted, however, that the typical values used in the calculations. This is a definite investment costs

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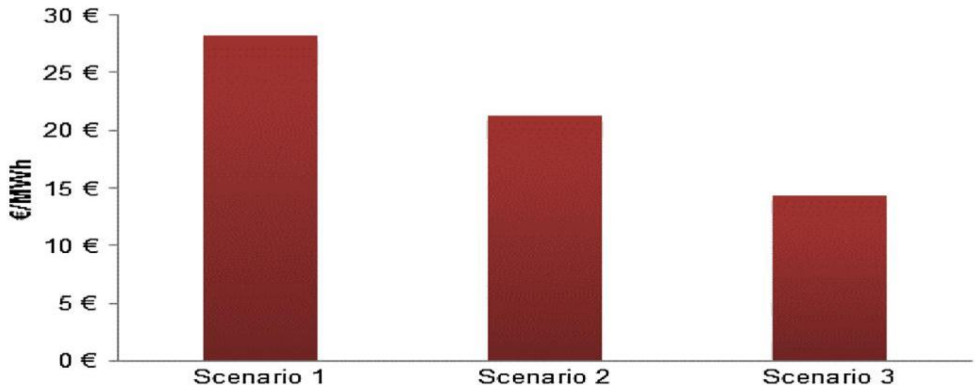

Fig. 7. Marginal costs for Scenarios 1e3.

and results of experimental curves ence can lead to decreased costs of energy technologies. Ogies-included in this model, such as wave, solar panels or wind power installations.

CONCLUSIONS

The New World Order is currently happening about energy consumption and the pursuit of price increases and fuel independence. A growing concern for the environment has stimulated interest in the use of RES electricity Portugal , but still presents itself as a country is significantly dependent on imported energy , and rely heavily on fossil fuels , but in the last few years . there has been increased support for RES wind , water and biomass estimates especially for this sector showed a decrease in this trend is increasing , but the goal for the future continue to underline the importance of this strategy RES power [17 .]This work is intended to lead to a new ability to analyze the situation in future power plants in Portugal , Energy PLAN replication results demonstrate the importance of water resources and wind power for all situations can cause major problems in the management of system resources , either because of the season but the associated increase in solar , biomass and wave it sees complementary questions . Among the resources is a problem that must be taken into account in the design of 100 % RES scenario and needs. Explore More capacity to reduce installation costs , but also to ensure that . Supply shortages

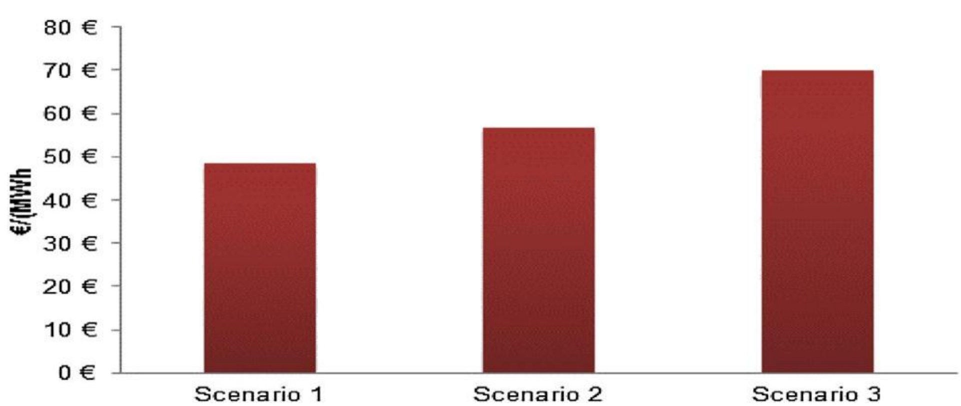

Fig. 8. Average cost for Scenarios 1e3.

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This study focuses on the optimization of technical systems, even though the economic value of import and export in any situation is not considered the question of how to increase RES will affect exports and importa . This has improved the results obtained under optimization techniques have been allowed to conclude that the success of the system will power 100 % RES theoretically possible and warranty are expected to meet . However, consumer demand will lead to an increase. Significantly with the total capacity of the system to ensure that there is a shortage in the winter with low RES sources, again in turn , this strategy will create excess 100 % renewable . Significantly from electricity production - tion for high potential source of RES , because this result is the presence of a significant excess electricity pro - production and also greatly increase the cost of the system .Cost analysis is included . Evaluation of investment - the cost of government . Total operating costs and management costs, fuel costs and the cost of CO2 emission scenarios with high penetration of renewable energy to the total cost of the proposed higher although there is a lower cost than the actual cost of RES investments. A major obstacle to the implementation of 100 % renewable scenario , but the cost difference that should be considered when exploring these circumstances . Shows long-term benefits of this technology .The results put in evidence the need to explore further optimization. Energy PLAN economic model is importa - tion and export potential, suggesting that it is a fundamental aspect that must be considered in the evaluation system, RES also complementary. Maybe between the resources and the integration of storage systems is an important component of the system is 100 % RES and needs to be explored further. Even the 100 % RES target cannot meet the needs. Without a large number of storage and interconnection capacity , in recognizing the importance of the investment cost for the analysis of RES technologies have the potential to reduce costs in the future to be recognized correctly is also available in PDF format plan.

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Appendix Table A1

Main data used for the four scenarios under analysis.

	Reference Scenario	Scenario 1	Scenario 2	Scenario 3
Electricity consumption (TWh/year)	52.3 [24]	53.6 [16]	66.43 [15]	53.6 [16]
Imports/exports balance (TWh/year)	_2.6 [24]	_1.9[a]	_1.9[a]	_1.9[a]
Coal (TWh/year)	6.6 [24]	2.26[a]	6.6[a]	0
Fuel oil (TWh/year)	0.047 [24]	0.014[a]	0[a]	0
Natural gas (TWh/year)	10.7 [24]	16.20[a]	15.3[a]	0
Biomass (TWh/year)	1.2 [25]	2[a]	3.1[a]	3.1[a]
Thermopower plants (MW)	7407 [24]	6900 [16]	7245 [15]	
Wind (MW)	3225 [24]	5300 [16]	7350 [15]	9970 [18]
Photovoltaic (MW)	100 [24]	500 [16]	1600 [15]	4500 [18]
Run-of-the-river (MW)	2380 [24,25]	4750 [16]	3389 [15]	3389 [15]
Waves (MW)	0	6 [16]	275 [15]	1000 [18]
Dams (MW)	2117 [24,25]	4250 [16]	6971 [15]	6971 [15]
Cogeneration (TWh/year)	7.33 [24]	8.84[a]	9.72[a]	3.24[a]
Cogeneration (fossil fuel) (TWh/year)	5.74[a]	6.66[a]	6.48[a]	
Cogeneration (biomass)	1.59 [25]	2.18[a]	3.24[a]	3.24[a]

Table A2

Technical and economic data used for the electricity generation technologies.

	Investment costs (V/kW) [a]	O&M cost (V/MWh)[a]	Lifetime[a]	Fuel costs (V/MWh)[a]	Efficiency (%)[a]	CO_2 (ton/MWh)[a]	Cost CO_2 (V/ton)[b]

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Coal	1647	4.65	40	23.38	37.5	0.900	7.33
Natural gas	825	3.46	30	54.43	55.9	0.370	
Fuel	e	2.2	e	114.22	45.7	0.800	
Water e dam	1443	8.32	50	0	e	0	
Run-of-the-river water	1662	3.87	50	0	e	0	
Water e minihydro	2037	4.33	50	0	e	0	
Wind	1813	16.92	24	0	e	0	
Photovoltaic	4635	23.12	25	0	e	0	
Waves	5000	30	60	0	e	0	
Biomass	2500	4	20	9	27.7	0.022	7.33
Cogeneration (natural gas)	700	4.5	20	54.43	75	0.289	7.33
Cogeneration (fuel oil)	1050	9	20	114.22	78	0.695	7.33
Cogeneration (biomass)	800	3	35	9	75	0.022	7.33

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