Supporting the implementation by NRAs of renewable energy technologies in the road infrastructure

Deliverable 4.2

Methodology for the economic and financial assessment

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1 INTRODUCTION

This document responds to the development of Task 4.2 of the ENROAD Project, methodology for financial and environmental assessment. It attaches the spreadsheet-based model with ten applications of RET (six mini wind – Hawt, Darrieus H-type, Savonious and Darrieus helicals-, two large wind -Vestas and Norwin, and two PVs -monocrystalline and polycrystalline).

The objective of the ENROAD project is to provide the NRAs with accurate and easy-to-use tools that help with the implementation of RE technologies along the road infrastructure with the highest possible benefit from the economic and environmental point of view, supporting them in finding cost-effective paths for their decarbonization goals. This spreadsheet and its business model are the basis to provide NRAs with several business cases that can be applied to the different technologies, assets, and regulatory conditions (as it is defined in WP 4). It consists of the design of the RETs business models with their related Capex, Opex, and revenue streams to make it possible the comparison and recommendations based on the calculation of significant aspects like emission reductions, NPV, IRR, AARR, and payback time, as part of the economic context and the macroeconomic variables. Specifically, the Business Model (BM) provides a deep insight into the economic and financial feasibility of the production of electricity from RETs for different locations, efficiency losses, and macroeconomic forecasts (interest rates and consumer price indexes). This model will be incorporated into the GIS-based Multi-Criteria Decision-Making methodology in WP5.

Since the facility's location is provided by the ENROAD GIS-based tool (including solar and wind data), this is only an example of the Business Model design and use, and outcomes are limited. Note that further revisions of the ENROAD GIS-based tool might result in changes in the Excel file hosting the BM scheme, but not in the philosophy nor the general structure of the BM.

Disclaimer

End User acknowledges and agrees with the Data and Calculations regarded as the first approach, merely descriptive for future planning and resource level information, generated specifically for use within the NRAs' entity geographic information systems. By acceptance of any Data, End User acknowledges the above limitations and that such Data and Calculations are not subject to updating. NO WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, ARE PROVIDED, INCLUDING USAGE, CONTENT, INTERPRETATION, SEQUENCE, ACCURACY, CURRENCY, OR TIMELINESS. End User accepts the Data and Calculations as they are, with any and all defects. ENROAD DOES NOT WARRANT IN ANY WAY THAT THE DATA WILL MEET END USER'S REQUIREMENTS, THE DATA WILL BE COMPLETE, ACCURATE, UNINTERRUPTED, OR ERROR-FREE, OR THAT ANY DEFECTS WILL BE CORRECTED. End User accepts and assumes all risk regarding quality, performance, accuracy, completeness, and usefulness of the Data and Calculations.

2. ANALYSIS OF THE FINANCIAL VIABILITY OF A PROJECT OF RE FACILITY IN ROADS

As other tools or software available in the market, the Business Model (BM) helps to estimate the power and quantity of yearly electricity produced and its average cost per hour in different locations for a RETs list. **What makes the ENROAD tool different from others and gives it added value is the analysis of the long term effects in the financial result, individually or as a whole, of the loss of RET technical efficiency, as well as of the macroeconomic variables (interest rates and inflation).**

For this, a financial dashboard is provided with four Key Performance Indicators (KPIs):

- Energy Average Prices (2023-2057).
- First Year Total Cost (FYTC): mean cost EU/MWh of each RET in the first year, the most efficient being highlighted.
- Levelized Cost Of Energy (LCOE): mean cost EU/MWh of the energy produced by each RET for the setup period, the most efficient being highlighted.
- Cost Gap (LCOE – FYTC): effect of the efficiency loss, the interest rates (general of the economy and specific of the potential debt of the project funding), and the inflation (above OPEX) in the increase of the long term cost. The Cost Gap is presented both in absolute value (difference between LCOE and FYT) and as a percentage (Cost Gap divided into FYTC).

The model is designed to, in an automatic and recurrent manner:

1. Determine the **peak power and quantity of energy produced in the first FYTC year**, based on the **location of a road/highway**, the solar and wind characteristics at that location, and the number of units that can be installed, for a given list of RETs.

2. Determine the yearly productions along the facility life based on an estimation of **performance losses**.

3. Estimate the **mean cost of the standard MWh produced for the first year of operation, FYTC, as well as the LCOE for each RET**. This is done according to the data introduced of **real or estimated costs** of the facility (CAPEX), of the operations (OPEX) and of the engineering and development (DEC).

4. Finally, with the information provided and the necessary calculations made, the BM offers estimations of the Starting Total Investment, Total Energy Revenues, Debt over Investment, Payback Period (in years), Net Present Value (NPV), Internal Rate of Return (IRR), and Average Anual Net Margin After DEC (ARR). These financial ratios are further explained in Deliverable 4.1.

3. BUSINESS MODEL SCHEME AND SPREADSHEET STRUCTURE

The BM is designed as the Figure 1 shows, which comprises the numbers of the groups of sheets in which the Excel spreadsheet is organised.

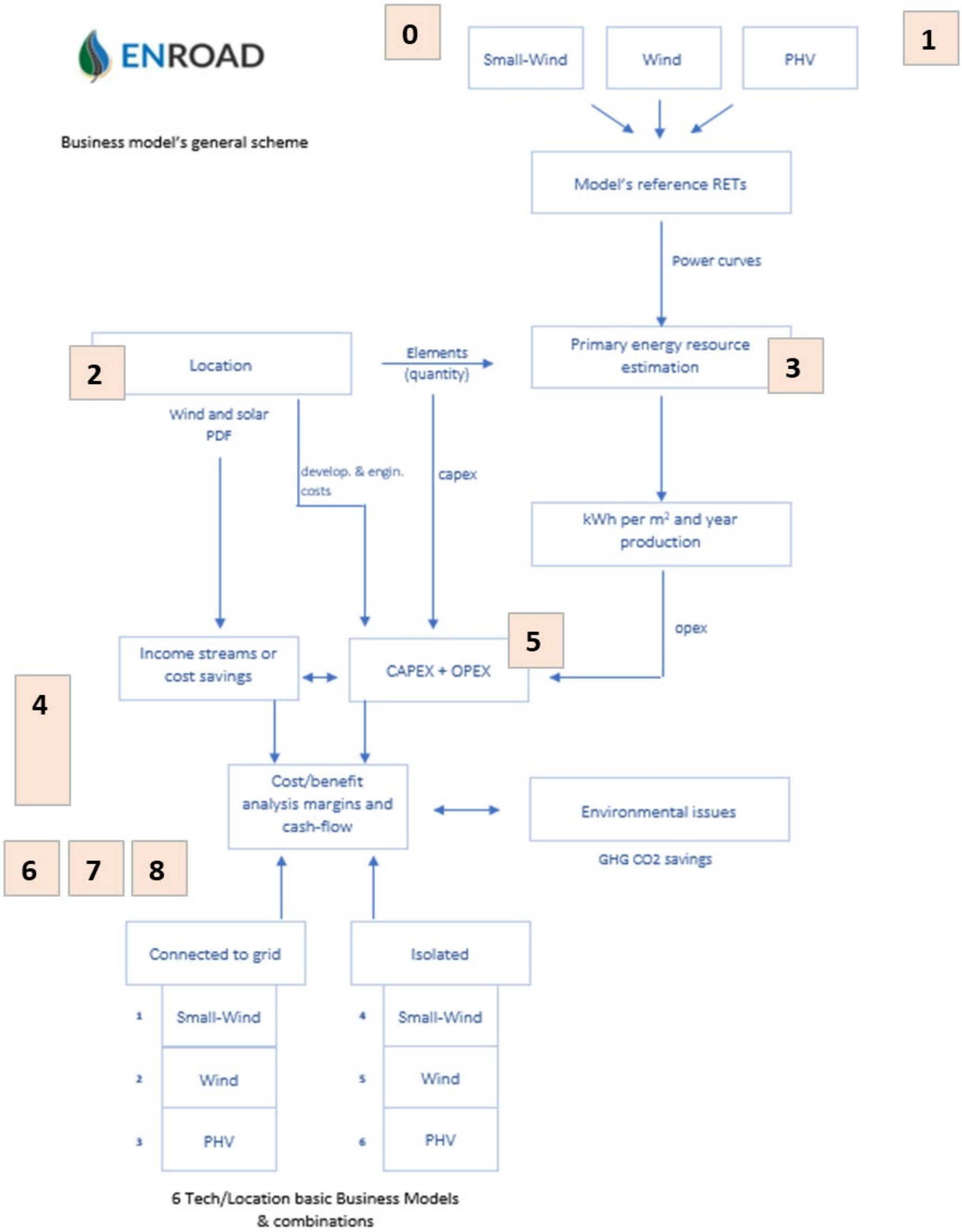


Figure 1. BM general scheme.

The BM is designed to include a double approach:

- Supply model: the BM is applied to a business consisting of the production and sale of energy to an electric operator.
- Demand model: starting from the supply model, the needs of energy of the NRA are gathered and the percentage of coverage is estimated. This model is not fully developed because in the current version neither the curves of electricity consumption of potential uses nor the cost of purchase of energy to the energy trading company are incorporated.

Additionally, according to the connection or not to the electrical network, two scenarios are presented: connected and isolated. In the second scenario, energy storage systems (ESS) technologies and their costs are incorporated into the model even for large wind turbine installations, since the ESS is considered as a complementary electricity supply system.

The description of the dataset conforming the Excel file structure with their respective sheets and, in due case, the referenced numbers in Figure 1, is the following:

Table 1. Description of the organization of the Excel file in sheets or datasets.

Reference number & Type of dataset (group)	**Dataset (Excel file)**	**Brief description**
General presentation	Aim_Disclaimer	BM objective and disclaimer.
General description	Gen_Scheme_Results	Helps categorise the model (connected or isolated) and introduce parameters of general reference: NRAs equity, demand of energy by NRA, interest rates, government subsidies, inflation and date of analysis. Offers the information relative to the BM location and outcomes.
0: General arrangement	0.Config_TechList	List of RETs used as reference in the basic BM. Includes the URLs with the technical information and the purchase price coming from Sheet 1.Config_TechEquipment. The information relative to the **batteries does not consider their renovation** at the end of their useful life, which is below the facility´s, so it is advisable to use a multiple

		to adjust the estimation.
1: General configuration	1.Config_TechEquipment	Technical data coming from the technical datasheets by producers for each RET. Includes a chart with the Wind Power Curves of the following dataset (sheet 1.1.Config_WindNominalPower). ESS are also considered with different configurations in 1.5_Config_ESS. In this section, the costs per component (CAPEX) are included and the engineering and development costs (DEC) for each RET.
1: General arrangement	1.1.Config_WindNominalPower	Data with the wind speed in metres per second and power in kW for small and large wind.
2: Location	2.Input_Location	Input from GIS databases of data for location (Longitude, Latitude and Altitude), area and project starting date. The First Year of Exploitation is the second year of Project, since the first year, totally or partially in months, is for installation operations.
2: Location	2.1.Out_WeibullPDF	Input from the GIS-based tool of data for the location and area to perform the intermediate calculations of Pew PDF.
2: Location	2.3.Out_DailyRadiation	Input from the GIS-based tool of data for the location and area to perform the intermediate calculations of Pout PV.
3: Datos de producción	3.Out_Production_Costs	Starting from the number of RETs units estimated by the GIS-based tool for the selected area, the losses are introduced according to the prices in 0.Config_TechList. Provisionally, in this BM version the number of wind turbines and PV panels is included as a parameter externally calculated, but these

		data will be eventually loaded through the GIS-based tool.
4: Income Streams and Cost Savings	4.Config_PricesInterests	The Energy Forward Prices, included for the term 2023 - 2057, are recommended to be purchased from consultants specialised in this market. 6-month interest rates from Reuters and IR-USA are included as a reference. A performance chart is included to facilitate the simulations in the LCOE determination and further analysis.
5: CAPEX + OPEX	5.Out_CAPEXOPEXDEC	Determination of the tables 4, 5 and 6 of Deliverable 4.1: estimations for the first year of exploitation of each RET with CAPEX, OPEX and DEC costs.
6: Cost/benefit analysis, Margins	6.Out_Margins	An **Analytical Profit and Looses Statement** for each RET is offered. The net margins before DEC, after DEC and the net yearly margin after DEC per kilowatt hour are shown. Besides, the initial total costs are gathered per kWh as well as the total initial CAPEX and per KWh.
6: Cost/benefit analysis, Margins	6.B.Selection	The financial analysis for each RET is carried out in blocks 7 and 8. In order to optimise the BM in the spreadsheet, these analyses are performed in each individual case, so that this sheet changes for each RET and forms the results table that is presented in the Gen_Scheme_Results. If it is required to analyse sections 7 and 8 of a RET in particular, it must be pasted as a value in cell B2.

7: Cash Flow	7.Out_CashBudget	**Cash Budget Statement** (Table 8 in Deliverable 4.1) for a RET. In case government subsidies are available, these are deducted from the payments for Property, Plant & Equipment (PP&E) in the first year, the one of the installation. The Cash Flow Statement is accompanied by the yearly data, for the whole project term, of the energy prices, costs of energy production and the production itself.
7: Cash Flow	7.1.Out_Debt	The difference between NRAs equity and the total of the investment is completed by a bank loan with an amortization period equivalent to the length of the project applying the French amortization method.
8: Performance	8.Out_FinancialAssessment	A chart with the revenues, costs and net margins is offered. In this section, the Payback Period, NPV, IRR and AARR are determined. Similarly, the LCOE is determined for the RET.

The LCOE is estimated based on the following formula:

$$LCOE = \frac{\sum_{t=0}^{T} \frac{C_t + M_t}{(1+r)^t}}{\sum_{t=0}^{T} \frac{Q_t}{(1+r)^t}}$$

where C_t are the yearly costs of Facility Depreciation, End-of-cycle Depreciation and Dismantling, and DCE Depreciation (all of them are CAPEX); M_t are the yearly operation costs (OPEX); Q_t is the yearly energy production; *t* is the year; *r* is the interest rate (IR); and *T* is the length of the project as a whole.

4. OPERATING PROCEDURE

In its current version, for a basic user, the BM helps to simulate the effect in the production cost, in the margins, in the Cash Flow variation and in the performance and profitability indicators of changes in:

- Energy Forward Prices.
- Instalation type (connected / non connected): incorporates in due case the ESS cost.
- NRAs Equity.
- Interest rate (IR).
- Government subsidy.
- Period Average Harmonised Index of Consumer Prices
- Debt Interest Rate.
- Component prices.
- Yearly efficiency looses.

For this, a location in the North of Spain has been selected as a study case since it is an area of average sun and wind exposure. In this way, little modifications of the previous variables have direct effect on the positive or negative profitability of the RET. The location could be changed; however, it would imply updating all the values related to it.

1. LOCATION, TERRAIN AND EXPLOITATION STARTING YEAR

LATITUDE	43,341510	LONGITUDE	-4,14447	ALTITUDE	50
	43.34151		-4.14447		

LAT 43.34151 LONG -4.14447

Area	30231,30 m2	Length	m	264,683
	3,0231298 ha	Width	m	114,217

Price per square meter	€/m2	181,2
Mean wind speed at reference height	m/s	6,4
Project starting year		2023

Once accepted the example location, the procedure to follow is the next:

1. In **Gen_Scheme_Results**: Identify the installation and select type of installation. Change, in due case, the values of: Installation type (connected / non connected), and incorporate in due case the batteries cost; NRAs Equity; Government subsidy; Period Average Harmonised Index of Consumer Prices; and Debt Interest Rate.

Instalation ID		EXAMPLE 02
Installation type ¿connected to the grid?* * Large Wind and PV are always connected		Yes
NRAs Renewable energy demand	MWh/day	0,60
Financing (NRAs equity).	EUR	€ 100.000.000,00
Government subsidy	EUR	€ 0,00
Period Average Harmonised Index of Consumer Prices (H	%	1,00%
Debt Interest Rate (fixed)	%	3,00%

2. In **1.Config_TechEquipment**, in due case, updte the prices of components, of the DEC costs and the annual efficiency losses.

Type		Monopole	Monopole	Monopole	Monopole	Pylon	Monopole				
Length	m	12	9	12	9	5,85	12	80	65		
Cost	EUR	€2.496,11	€989,63	€2.376,89	€2.212,41	€4.150,00	€4.886,56	€199.401,43	€84.949,71		
reference turbine weight	kg	106	27	106	500						
Detailed Feasibility Study (DFS)	EUR	€1.500,00	€1.500,00	€1.500,00	€1.500,00	€1.500,00	€1.500,00	€1.500,00	€1.500,00	€1.500,00	€1.500,00
Development costs (DS)	EUR	€1.000,00	€1.000,00	€1.000,00	€1.000,00	€1.000,00	€1.000,00	€1.000,00	€1.000,00	€1.000,00	€1.000,00
Engineering expenditures (EE)	EUR	€1.201,00	€1.202,00	€1.203,00	€1.204,00	€1.205,00	€1.206,00	€1.207,00	€1.208,00	€1.209,00	€1.210,00
Yearly efficiency looses	%	2,00%	2,00%	2,00%	2,00%	2,00%	2,00%	2,00%	2,00%	0,25%	0,25%

3. In **1.5.Config_ESS** different options of energy storage systems are detailed with different capacities for medium and large installations that ranges among 194 kWh and 2 MWh.

ESS CONFIGURATION PARAMETERS

			** Up to 800 kWh*			
		(2 modules pack)	*(1 module pack)*	*(1 module pack)*	*(2 modules pack)*	*(1 module pack)*
BATTERY TECHNOLOGIES		**BYD LVL 15.4**	**HUAWEI LUNA2000-200**	**CEGASA EBICK 280 pro**	**BYD LVL 15.4**	**HUAWEI LUNA2000-2M**
Cell Material	-	**LFP**	**LFP**	**LFP**	**LFP**	**LFP**
Module(s) nominal capacity	kWh	15,36	16,13	13,44	15,36	16,38
Nominal rated voltage	V	51,20	57,60	48,00	51,20	51,20
Maximum rated current	A	250,00	200,00	175,00	250,00	200,00
Maximum capacity ESS	kWh	983,00	193,50	2000,00	983,00	2064,00
Maximum no. modules	no.	64	12	149	64	126
INVERTER SYSTEM TECHNOLOGIES		**SMA STS 110-60**	**SUN2000 100KTL-M1**	**FRONIUS Tauro D ECO**	**SUN2000 330KTL-H1**	**SMA SCS 3450 UP**
Rated power	kW	110,00	100,00	100,00	300,00	3450,00
Maximum rated current	A	160,00	260,00	175,00	390,00	4750,00
Operating voltage range	V	500-800	200-1000	580-1000	500-1500	880-1500
COST OF TECHNOLOGIES						
Module cost	EUR	8.500,00	9.500,00	8.500,00	8.500,00	9.500,00
Inverter cost	EUR	7.500,00	6.500,00	11.500,00	11.800,00	100.000,00
ESS unit cost	EUR	3.000,00	3.000,00	3.000,00	3.000,00	3.000,00

ESS DEMAND				
NRAs Renewable energy demand for storage		kWh/day	800,00	
NRAs Renewable peak power demand for using energy stored		kW	200,00	Ok

ESS DESIGN AND COSTS

ESS SOLUTION CAPEX		1	2	3	4	5
Number of modules	no.	53,0	50,0	60,0	53,0	49,0
Number of ESS units	no.	1	5	1	1	1
Available ESS capacity	kWh/day	814	807	806	814	803
Number of inverter systems	no.	7	6	6	3	1
Maximum peak power ESS	kW	678,40	576,00	504,00	678,40	501,76
ESS SOLUTION CAPEX	**EUR**	**506.000,00**	**529.000,00**	**582.000,00**	**488.900,00**	**568.500,00**
Years	Yr	15,00	15,00	15,00	15,00	15,00
ESS Depreciation	**EUR**	**33.733,33**	**35.266,67**	**38.800,00**	**32.593,33**	**37.900,00**

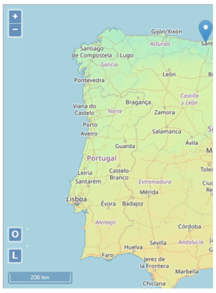
ESS SOLUTION					**4**	
ESS SOLUTION CAPEX	**EUR**				**488.900,00**	
ESS Depreciation	**EUR**				**32.593,33**	
					678,40	

4. In **4.Config_PricesInterests**, the Forward prices and the interest rates for all the period or part of it (in red in the following table, for example). As reference, the data from the EUR6MT-REUTERS are provided.

Prices		Interest Rate (IR)			
		EUR6MT-REUTERS			
Year	Energy Prices Forward		31/12/2021	01/06/2022	Model IR
2014		01/01/2022	-0,5813%		
2015		02/01/2022	-0,5624%		
2016		07/01/2022	-0,5265%		
2017		31/01/2022	-0,5358%		
2018		28/02/2022	-0,5556%		
2019		31/03/2022	-0,5700%		
2020		30/06/2022	-0,5540%	-0,3400%	1,7500%
2021		30/09/2022	-0,5206%	-0,3065%	2,2500%
2022		31/12/2022	-0,4879%	-0,2739%	3,4000%
2023	138,545	31/12/2023	-0,2920%	-0,0780%	4,5000%
2024	94,771	31/12/2024	-0,1355%	0,0785%	4,7000%
2025	64,563	31/12/2025	-0,0517%	0,1623%	5,0000%
2026	52,833	31/12/2026	0,0162%	0,2302%	5,3000%
2027	49,158	31/12/2027	0,0731%	0,2871%	5,4000%
2028	45,123	31/12/2028	0,1281%	0,3421%	5,3000%
2029	52,000	31/12/2029	0,1842%	0,3982%	5,1000%
2030	58,667	31/12/2030	0,2440%	0,4580%	4,8000%
2031	57,493	31/12/2031	0,3021%	0,5161%	4,6000%
2032	56,343	31/12/2032	0,3532%	0,5572%	4,4000%
2033	55,217	31/12/2033	0,3984%	0,6124%	4,2000%
2034	54,112	31/12/2034	0,4375%	0,6515%	3,9000%
2035	53,030	31/12/2035	0,4695%	0,6835%	3,6000%
2036	51,969	31/12/2036	0,4964%	0,7104%	3,3000%
2037	50,930	31/12/2037		0,7223%	3,1000%
2038	49,911	31/12/2038		0,7340%	2,9000%
2039	48,913	31/12/2039		0,7456%	2,6000%
2040	47,935	31/12/2040		0,7510%	2,2000%
2041	46,976	31/12/2041	0,5535%	0,7675%	1,8000%
2042	46,037	31/12/2042		0,7754%	1,4000%
2043	45,116	31/12/2043		0,7611%	1,2000%
2044	44,214	31/12/2044		0,7564%	1,1000%
2045	43,329	31/12/2045		0,7540%	0,9000%
2046	42,463	31/12/2046	0,5271%	0,7411%	0,8000%
2047	41,614	31/12/2047	0,7580%	0,7602%	0,7602%
2048	40,781	31/12/2048		0,8202%	0,8202%
2049	39,966	31/12/2049		0,8002%	0,8002%
2050	39,166	31/12/2050		0,7202%	0,7202%
2051	38,383	31/12/2051		0,6402%	0,6402%
2052	37,615	31/12/2052	0,7427%	0,7449%	0,7449%
2053	36,863	31/12/2053			0,7500%
2054	36,126	31/12/2054			
2055	35,403	31/12/2055			
2056	34,695	31/12/2056			
2057	34,001	31/12/2057			

5. In **Gen_Scheme_Results**, the values of Cash Flow and Financial Assessment (Payback period, NPV, IRR, AARR, Bank Loan, Project duration, Energy revenues , LCOE, and Total Investment) are presented for each RET.

Period Average Harmonised Index of Consumer Prices (HIC %		2,00%
Debt Interest Rate (fixed)	%	3,00%
Period Average interest rate EUR6MT-REUTERS	%	0,57%
Mean wind speed at reference high	m/s	6,4
Starting year		2023
Date of analysis		27/09/2022



Technologies	6.B.Selection		HAWT-Bornay 6000	HAWT-Aeolos-H 1kW	Darrieus-Aeolos-V 3kW
Total Annual Energy Production		MWh/year	861,8	168,1	426,2
Covered demand for energy		%	394%	77%	195%
Total installed peak capacity		MWh	28,1	72,3	83,9

The result of each RET is shown in columns in the 6.B.Selection sheet.

	A	B	C	D	E	F	G	H	I	J	K
1	x		Payback period	NPV	IRR	AARR	Bank Loan	Project duration	Energy revenues	LCOE	Total Investment
2	x	Polycrystalline-LX-330P/156-72+	34	-1.310.603,87	negativo	-3,12%	795.664,97	30	1.530.223,02	97,85	889.615,03
3	x	Technology	Payback period	NPV	IRR	AARR	Bank Loan	Project duration	Energy revenues		Total Investment
4	x	HAWT-Bornay 6000	34	-2.468.130,10	negativo	-8,24%	1.091.823,54	20,00	767.017,73	239,57	1.120.010,52
5	x	HAWT-Aeolos-H 1kW	34	-2.105.478,32	negativo	-10,64%	755.317,71	20,00	149.605,09	921,56	821.064,75
6	x	Darrieus-Aeolos-V 3kW	34	-4.951.994,79	negativo	-9,64%	2.093.957,73	20,00	379.300,00	816,42	2.019.380,37
7	x	Savonious-S594	34	-188.416.186,31	negativo	-8,95%	75.331.213,84	30,00	1.613.912,74	7.440,86	67.532.575,80
8	x	Savonious-LS Helix 3.0	34	-97.018.743,72	negativo	-9,95%	42.705.872,78	20,00	215.558,82	25.917,14	38.319.034,89
9	x	Darrieus-V20000	34	-13.037.337,61	negativo	-9,22%	5.892.389,06	20,00	1.178.320,77	684,15	5.412.007,08
10	x	HAWT-V90-2.0 MW	4	1.632.170,93	0,212417329	11,45%	1.830.728,50	20,00	10.243.171,53	33,39	1.727.728,41
11	x	HAWT-NWB 54-750	34	-791.375,28	negativo	-1,50%	742.767,30	20,00	3.223.480,92	63,46	751.936,45
12	x	Monocrystalline-LG370Q1C-V5	34	-3.053.848,03	negativo	-5,31%	1.534.475,37	30,00	1.860.092,93	148,72	1.545.884,66
13	x	Polycrystalline-LX-330P/156-72+	34	-1.310.603,87	negativo	-3,12%	795.664,97	30,00	1.530.223,02	97,85	889.615,03
14											
15		FOR THE SELECTION OF A LISTED RET (B4:B13), COPY AND PASTE TEXT IN B3.									
16		PARA SELECCIONAR UN ELEMENTO DEL RANGO B4:B13, COPIARLO Y PEGARLO COMO TEXTO EN B3.									

Also in Gen_Scheme_Results, as shown next:

Technologies	6.B.Selection	HAWT-Bornay 6000	HAWT-Aeolos-H 1kW	Darrieus-Aeolos-V 3kW	Savonious-S594	Savonious-LS Helix 3.0	Darrieus-V20000	HAWT-V90-2.0 MW	HAWT-NWB 54-750	Monocrystalline-LG370Q1C-V5	Polycrystalline-LX-330P/156-72+	Promedio
		Small Wind	Small Wind	Small Wind	Small Wind	Small Wind	Small Wind	Large Wind	Large Wind	PV	PV	
Total Annual Energy Production	MWh/year	861,8	168,1	426,2	1.470,4	242,2	1.323,9	11.509,0	3.621,8	1.294,4	1.064,9	
Covered demand for energy	%	394%	77%	195%	671%	111%	605%	5255%	1654%	591%	486%	
Total installed peak capacity	MWh	28,1	72,3	83,9	16.171,1	2.997,0	95,1	2,0	0,8	260,2	272,0	
Yearly efficiency looses	%	0,25%	0,25%	0,25%	0,25%	0,25%	0,25%	0,25%	0,25%	0,25%	0,25%	
First Year Total Cost (FYTC)	EUR/MWh	97,08	370,54	332,54	2.316,22	10.804,61	280,61	12,48	33,24	60,39	38,94	1.780,92
LCOE	EUR/MWh	124,01	473,15	429,20	3.230,06	14.015,72	362,84	15,80	39,66	83,48	54,13	2.336,31
LCOE's best technology (LCOE)	EUR/MWh							15,80				
Starting total Investment	EUR	1.084.308,28	803.213,63	1.989.628,51	67.312.412,04	38.182.176,34	5.292.999,64	1.727.728,41	751.936,45	1.420.926,85	782.508,33	14.643.050,41
Total Energy Revenues	EUR	8.413.394,87	1.641.013,78	4.160.530,47	21.256.518,25	2.364.458,37	12.924.965,71	112.357.046,01	35.358.267,06	18.712.496,55	15.394.012,04	24.809.524,31
Project Duration (and loan repayment)	YR	20	20	20	30	20	20	20	20	30	30	
Debt (bank loan) over Investment	EUR	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Payback period	Years	3	14	12	34	34	10	0	0	3	2	
NPV	EUR	4.715.490,39	60.759,46	434.554,29	-79.489.656,98	-47.693.463,04	2.640.494,51	81.179.172,90	24.284.048,91	10.675.354,33	9.400.857,39	
IRR	%	36,56%	3,84%	5,32%	negativo	negativo	8,01%	328,66%	228,11%	43,06%	65,78%	
AARR	%	30,06%	2,14%	3,05%	-4,17%	-6,55%	4,88%	308,81%	212,71%	37,98%	59,84%	

PRICE SENSITIVITY ANALYSIS OVER ACCOUNTING RATE OF RETURN (ARR)

Finally, this sheet offers a summary of the main results:

- Total Annual Energy Production
- Covered demand for energy

- Total installed peak capacity
- Yearly efficiency looses
- First Year Total Cost (FYTC)

The most efficient RET is identified and the Financial Dashboard is provided:

Energy average price 2023-2057	FINANCIAL DASHBOARD
300,00	HAWT-V90-2.0 MW
EUR/MWh	
First Year Total Cost (FYTC)	COST GAP (LCOE - FYTC)
12,48	3,31
EUR/MWh	EUR/MWh
LCOE for selected RET (LCOE)	COST GAP (LCOE - FYTC)/ FYTC
15,80	27%
EUR/MWh	

In the example shown in the BM there are some initial values of efficiency losses, interest rates and inflation. If they are excluded from the BM analysis using zero values, the final effect is that the LCOE is equal to FYTC, what makes the Cost Gap disappear, as shown next:

Energy average price 2023-2057	FINANCIAL DASHBOARD
300,00	HAWT-V90-2.0 MW
EUR/MWh	
First Year Total Cost (FYTC)	COST GAP (LCOE - FYTC)
12,48	0,00
EUR/MWh	EUR/MWh
LCOE for selected RET (LCOE)	COST GAP (LCOE - FYTC)/ FYTC
12,48	0%
EUR/MWh	

5. FINAL COMMENTS

The situation in 2022 is conditioned by a complex macroeconomic scenario, in which the decarbonization commitments of Europe demand important investments in RETs. For this reason, a spreadsheet has been designed that supports the BM that will be eventually included in the ENROAD tool-based GIS.

This deliverable 4.2 accompanies the BM spreadsheet and describes its use so that it can be used by the NRAs and, with the right improvements or amendments, it can be incorporated to the GIS-based tool (in progress). Thus, as a location and an area are selected by the end user, the NRAs can analyse the income streams and profitability given the effect of the Forward prices of the electricity, the RET components and facilities, the interest rates and the inflation. In this way, the NRA will achieve a first estimation of a likely facility in order to select the best of the locations.

The model explains the relationship between the cost of the first year (FYCT) and the Levelized Cost Of Energy (LCOE) according to the variations in the yearly performances, the interest rates, and the inflation.