UNIVERSITAT POLITÈCNICA DE VALÈNCIA

CASE STUDY 2

Application of GENERA Tools

MOOC 2 - CASE STUDY 2

Case study 2 for the use of GENERA tools: *Energy Planning, Inference Module and Multicriteria Decision Method.*

STEPS

1. Identification of the region and municipality of study
2. Application of the **Energy Planning module** (National Level)
3. Identification of best practices through **GENERA's Database Module** (GENERA's Digital Social Platform)
4. Application of the **Inference module** (Local Level)
5. **Multi-criteria decision Module** and ranking of measures

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MOOC 2 - CASE STUDY 2

Case study 2 for the use of GENERA tools: *Energy Planning, Inference Module and Multicriteria Decision Method*.

- This case study shows an example of application of GENERA tools to study a municipality and proposes the application to another one.
- **Case proposed and analyzed:** The municipality of El Rosario (Tenerife, Spain).
- **The second one can be chosen** by the user or one of those proposed in the exercise or in the GENERA MOOC2.

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MOOC 2 - CASE STUDY 2

Case study in El Rosario (Tenerife, Spain).

1. **National Analysis (Energy Planning Module)**
2. **Identification of Best Practices (Database Module)**
3. **Proposed measures and calculations (Inference Module)**
4. **Ranking of most promising measures (Multicriteria Module)**

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MOOC 2 - CASE STUDY 2

Case study in El Rosario (Tenerife, Spain).

1. Identification of the region and municipality of study

Reference Data

Data entered in the tool take 2022 as the reference year (since 2023 is incomplete for some sectors) (International Energy Agency).

Energy Balance

Oil is the main source in the transport sector and in other sectors such as agriculture, fishing, etc. On the other hand, natural gas is more involved in the industry, residential and service sectors. In addition, in electricity production, natural gas and renewables are the main producers.

Context

The municipality has a total of 17,983 inhabitants and its municipal area covers an area of 39.43 square kilometers. It occupies an intermediate position with respect to the size of the rest of the municipalities of the Island (it is larger than 12 of the 31 municipalities of Tenerife).

Challenges

- The city council of El Rosario (Tenerife) signed on May 15, 2013 the adhesion to the Covenant of Mayors.
- Reduce CO_2 emissions, in their respective territorial areas, by at least 20%, through the implementation of a Sustainable Energy Action Plan.

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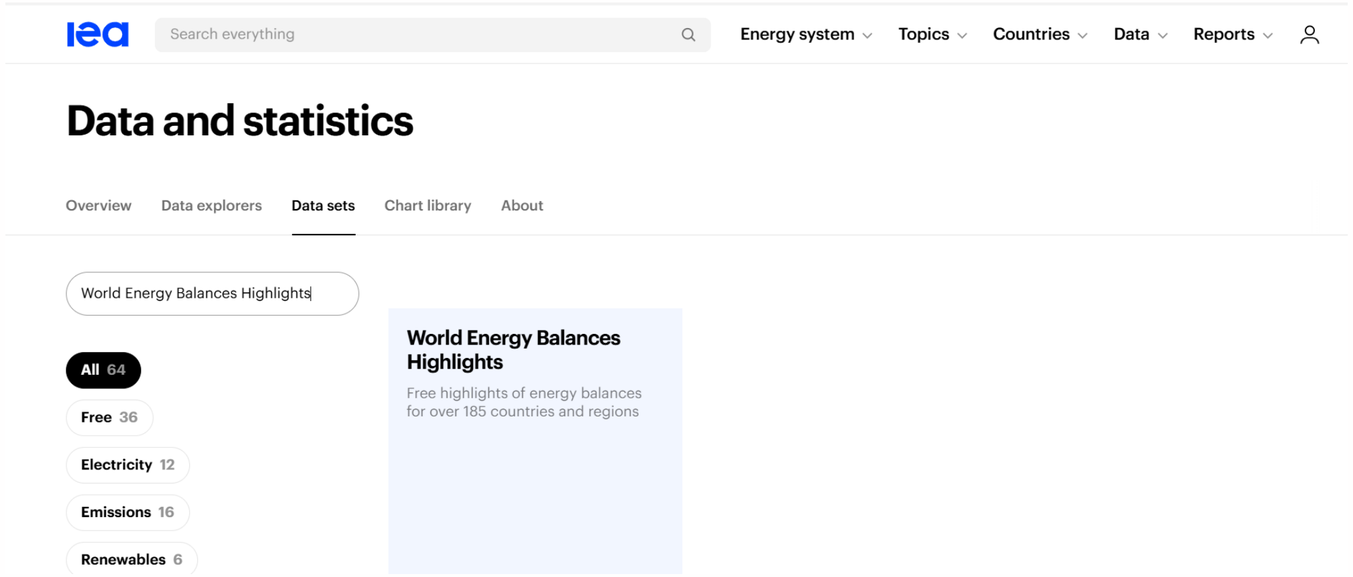
Case study in El Rosario (Tenerife, Spain).

2. Energy Planning Module

Recommended Database

The tool is adapted to use information from the IEA's "World Energy Balances Highlights" database.



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Case study in El Rosario (Tenerife, Spain).

2. Energy Planning Module

World Energy Balances Highlights

A report will be obtained in an excel sheet and filtered by country to obtain the data related to the country of study.

Data Selection

Use the latest year containing the most complete information possible for accurate analysis.

Source: IEA (2024). All rights reserved. (https://www.iea.org/terms)

Country	Product	Flow	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023 Provisional
Spain	Coal, peat and oil shale	Production (PJ)	228	176	160	138	111	103	74	68	52	31	47	37	0	0	0	0	0
Spain	Coal, peat and oil shale	Imports (PJ)	613	525	415	329	398	542	338	399	458	339	467	399	232	124	155	256	176
Spain	Coal, peat and oil shale	Exports (PJ)	-54	-61	-38	-46	-39	-57	-21	-34	-30	-14	-10	-14	-42	-52	-18	-38	-93
Spain	Coal, peat and oil shale	Total energy supply (PJ)	834	578	432	325	522	638	464	479	559	441	536	471	211	123	130	158	112
Spain	Coal, peat and oil shale	Electricity, CHP and heat plants (PJ)	-735	-471	-357	-255	-448	-546	-390	-431	-498	-358	-446	-369	-135	-60	-57	-82	..
Spain	Coal, peat and oil shale	Oil refineries, transformation (PJ)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
Spain	Coal, peat and oil shale	Total final consumption (PJ)	60	55	35	37	46	31	40	26	22	23	37	31	27	27	27	29	..
Spain	Coal, peat and oil shale	Industry (PJ)	45	40	23	26	38	23	35	20	17	16	26	20	20	20	21	23	..
Spain	Coal, peat and oil shale	Transport (PJ)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
Spain	Coal, peat and oil shale	Residential (PJ)	9	9	9	7	5	5	4	4	4	3	3	3	3	2	2	1	..
Spain	Coal, peat and oil shale	Commercial and public services (PJ)	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	..
Spain	Coal, peat and oil shale	Other final consumption (PJ)	5	5	2	2	3	3	2	1	1	4	7	8	5	4	5	5	..
Spain	Crude, NGL and feedstocks	Production (PJ)	6	5	4	5	4	6	16	13	10	6	5	4	2	1	0	0	0
Spain	Crude, NGL and feedstocks	Imports (PJ)	2496	2560	2366	2378	2388	2638	2690	2709	2859	2842	2928	2951	2921	2477	2578	2788	2731
Spain	Crude, NGL and feedstocks	Exports (PJ)	0	0	0	0	0	-103	-159	-141	-114	-145	-169	-109	-122	-133	-126	-118	-141
Spain	Crude, NGL and feedstocks	Total energy supply (PJ)	2501	2551	2405	2386	2368	2578	2549	2566	2761	2723	2769	2859	2762	2373	2487	2655	2604
Spain	Crude, NGL and feedstocks	Electricity, CHP and heat plants (PJ)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
Spain	Crude, NGL and feedstocks	Oil refineries, transformation (PJ)	-2555	-2584	-2443	-2460	-2418	-2618	-2582	-2588	-2778	-2779	-2827	-2907	-2815	-2395	-2498	-2698	..
Spain	Crude, NGL and feedstocks	Total final consumption (PJ)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	..
Spain	Crude, NGL and feedstocks	Industry (PJ)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	..
Spain	Crude, NGL and feedstocks	Transport (PJ)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..

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MOOC 2 - CASE STUDY 2

Case study in El Rosario (Tenerife, Spain).

2. Energy Planning Module

Growth Rate Input

In the Energy Planning Module, the growth ratios are entered first.

Data entering

The data for each of the sectors is obtained from the IEA report, but must be entered into the tool in ktep, so it is important to make the unit conversion considering:

1ktep=	41.87 TJ

	ktep				
Year	Industry	Transport	Services	Domestic	gric. And Fisherie
1990	19,259	21,281	3,413	9,153	1,668
1991	19,713	22,147	3,718	9,664	1,799
1992	18,829	23,373	3,936	9,745	1,920
1993	18,343	23,033	3,828	9,785	1,959
1994	19,315	23,855	4,174	10,252	2,079
1995	19,830	24,134	4,321	9,997	2,193
1996	19,020	25,710	4,703	10,557	2,173
1997	21,084	25,705	5,259	10,740	2,099
1998	21,795	28,137	5,422	11,085	1,944
1999	21,648	29,493	5,886	11,793	2,203
2000	24,641	30,206	6,702	11,985	2,561
2001	26,346	31,550	7,049	12,605	2,387
2002	26,709	32,151	7,246	12,938	2,351
2003	28,761	33,822	7,132	13,881	2,929
2004	29,564	35,216	7,734	14,638	3,325
2005	30,401	36,510	8,403	15,091	3,095
2006	24,860	37,518	8,918	15,529	2,799
2007	26,856	38,595	8,811	15,604	2,928
2008	25,255	36,811	9,289	15,444	2,682
2009	20,710	34,460	9,398	15,866	2,348
2010	20,904	33,889	9,790	16,866	2,229
2011	20,674	32,158	10,196	15,597	2,391
2012	20,134	29,549	10,037	15,489	2,703
2013	19,944	27,975	9,606	14,871	2,839
2014	19,231	28,106	9,838	14,698	2,758
2015	18,044	29,472	10,056	14,864	2,485
2016	18,185	30,630	10,618	15,051	2,634
2017	20,426	31,429	9,815	14,222	2,726
2018	20,562	32,224	9,856	14,988	2,732
2019	20,553	32,638	9,823	14,247	2,881
2020	18,796	25,930	8,891	14,342	2,977
2021	20,014	30,069	9,434	14,521	8,646
2022	20,062	30,069	9,457	14,019	8,072
2023					

Year	Population	GDP (Mil Millones 2010 USD
1,990	39	737
1,991	39	756
1,992	40	763
1,993	40	755
1,994	40	773
1,995	40	795
1,996	40	816
1,997	40	846
1,998	40	883
1,999	40	923
2,000	41	971
2,001	41	1,009
2,002	41	1,037
2,003	42	1,068
2,004	43	1,101
2,005	44	1,141
2,006	44	1,188
2,007	45	1,231
2,008	46	1,242
2,009	46	1,195
2,010	46	1,197
2,011	47	1,187
2,012	47	1,152
2,013	47	1,136
2,014	47	1,152
2,015	46	1,196
2,016	46	1,232
2,017	47	1,269
2,018	47	1,298
2,019	47	1,324
2,020	47	1,174
2,021	47	1,239
2,022	47	1,381
2023		

Country	Product	Flow	19	2020	2021	2022
Spain	Total	Oil refineries, transformation (PJ)	66	-50	-41	-72
Spain	Total	Industry (PJ)	61	787	840	745
Spain	Total	Transport (PJ)	65	1081	1259	1347
Spain	Total	Residential (PJ)	96	600	607	587
Spain	Total	Other final consumption (PJ)	53	378	360	338

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MOOC 2 - CASE STUDY 2

Case study in El Rosario (Tenerife, Spain).

2. Energy Planning Module

Data entering

The rest of the information is entered in PJ in the tool and the conversion to ktep is automatically performed to obtain results.

2022 DATA

	Coal	Crude oil	Oil products	Natural gas	Nuclear	Hydro	Renewables and waste	Biofuels and waste	Electricity	Heat	Total
	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ
Production	0	0	0	1	639		813		0		1454
Imports	256	2788	700	1446	0		68		29		5287
Exports	-38	-118	-727	-221	0		-93		-100		-1297
International marine bunkers											
International aviation bunkers											
Stock changes											
Total energy supply	158	2655	-544	1186	639		792		-71		4815
Transfers											
Statistical differences											
Electricity plants, CHP, Heat Plants	-82	0	-90	-570	-639		-545		1037		-889
Gas works											
Oil refineries	0	-2698	2627	0			0		0		-72
Coal transformation											
Liquefication plants											
Other transformation											
Energy industry own use											
Losses											
Total final consumption	29	0	1777	549			246		808		3409
Industry	23	0	86	295			86		255		745
Transport	0	0	1260	15			57		14		1347
Residential	1	0	102	131			89		264		587
Commercial and public services	0	0	50	78			10		253		391
Other (Agriculture, fishing)	5	0	279	31			3		20		338
Fishing											
Non-specified											
Non-energy use											

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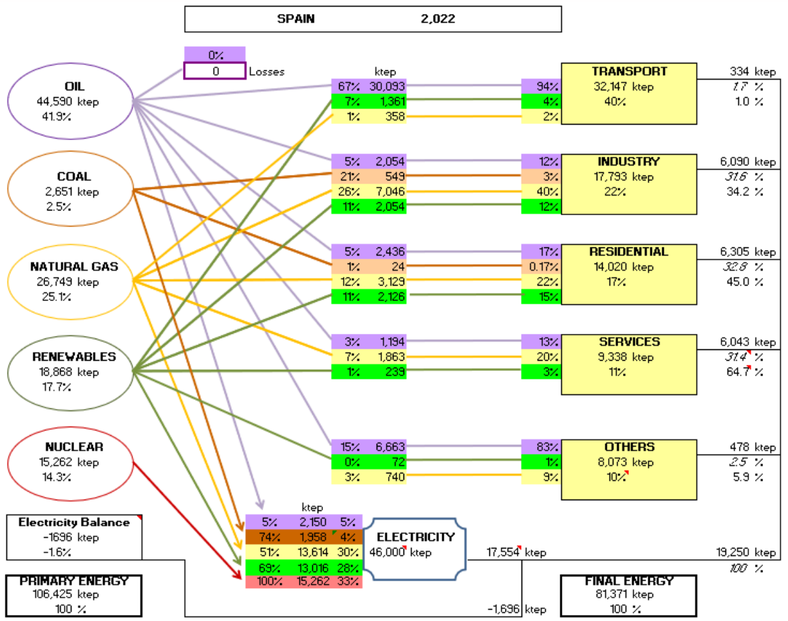
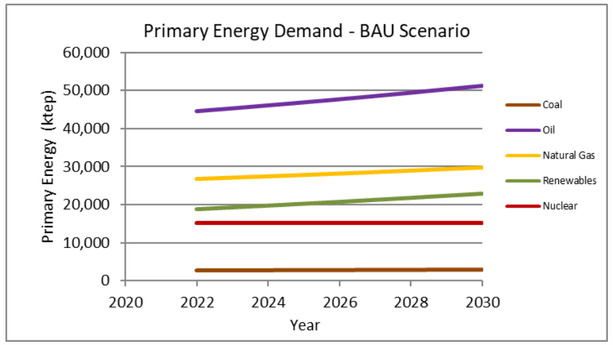
MOOC 2 - CASE STUDY 2

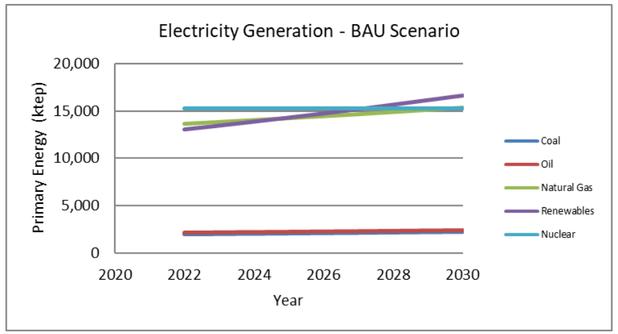
Case study in El Rosario (Tenerife, Spain).

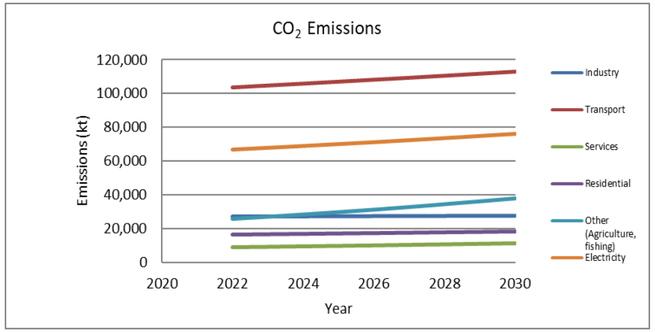
2. Energy Planning Module

Results









MOOC 2: Energy transition measurement and monitoring tools

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Case study in El Rosario (Tenerife, Spain).

2. Energy Planning Module

Conclusions

Spain's energy context is characterized by the use of **oil** mainly for the transport sector, which in turn generates most of the country's emissions. There is a **growing trend** towards the use of **renewable energy**, mainly for electricity production, but also for residential use.

Natural gas also shows a growing trend and greater involvement in the **industrial**, **residential** and **service sectors**.

In terms of **emissions**, the most damaging sector is **transport**, followed by **electricity generation**.

Case study in El Rosario (Tenerife, Spain).

3. Identification of best practices

https://dsp.life-genera.eu/energy-transition

According to GENERA's DSP, some of the most commonly used measures in Spain are as follows:

- Renewal of the municipal fleet with electric or plug-in hybrid vehicles
- Establishment of a network of electric vehicle charging points
- Promoting collective self-consumption and citizen energy communities
- Replacement of existing luminaires with new ones equipped with LED lamps and remote management
- Installation of renewable self-consumption in municipal buildings
- Improvement of Insulation and Air Conditioning Systems
- Campaign for waste reduction and correct waste management

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Case study in El Rosario (Tenerife, Spain).

4. Inference module

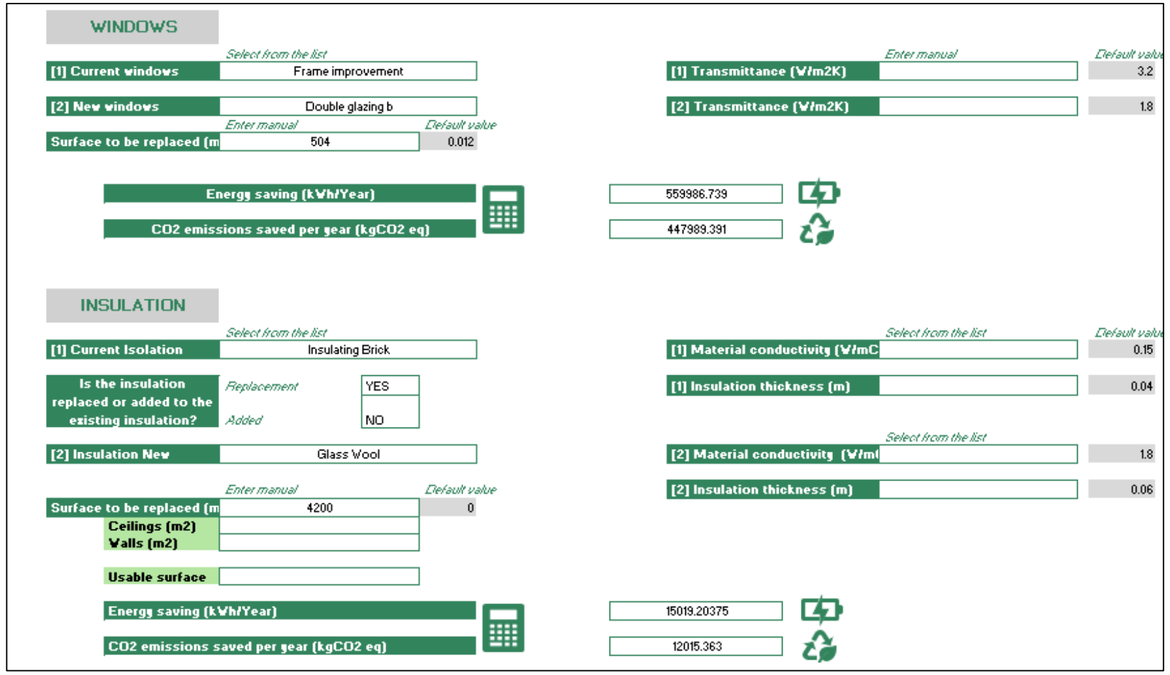
GENERA tool

Application of the GENERA inference module.

Main actions:

- **Improving energy efficiency in municipal buildings**

It is proposed to improve the energy efficiency of buildings, specifically of a total of 7. To this end, the tool allows improving the building envelopes such as windows an insulation. In relation to the windows, a change with double glazing is proposed, which will improve the energy consumption of the buildings. An average of 600 square meters per building is estimated, with 12% of windows. On the other hand, glass wool is added to the insulation on different surfaces.



Case study in El Rosario (Tenerife, Spain).

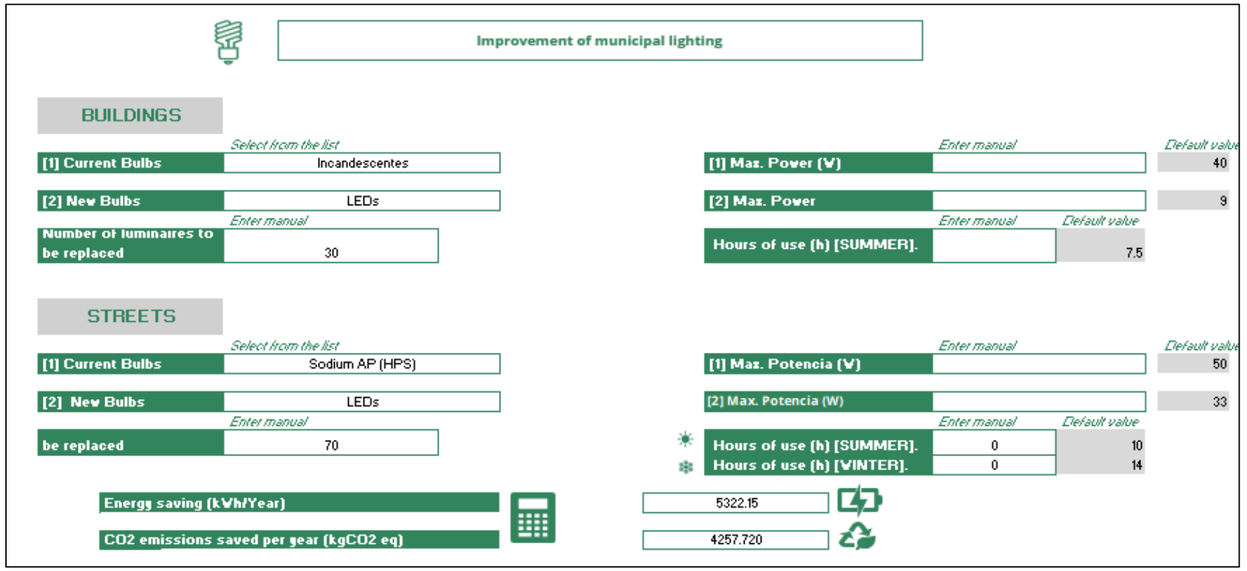
4. Inference module

GENERA tool

Application of the GENERA inference module.

Main actions:

- **Indoor lighting renovation**



Case study in El Rosario (Tenerife, Spain).

4. Inference module

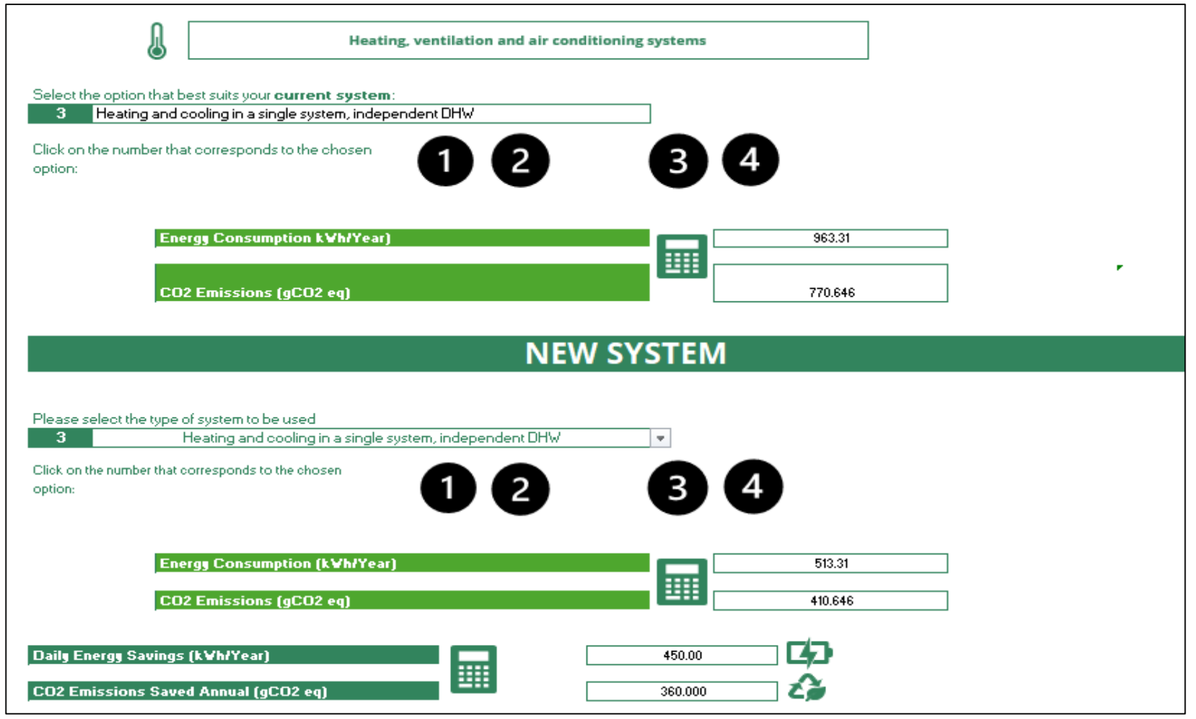
GENERA tool

Application of the GENERA inference module.

Main actions:

- **Improvement of building conditioning**

The same system is then calculated but improving the energy certificate of the air conditioning equipment, as shown in the following figure. It is assumed that the domestic hot water system is independent.



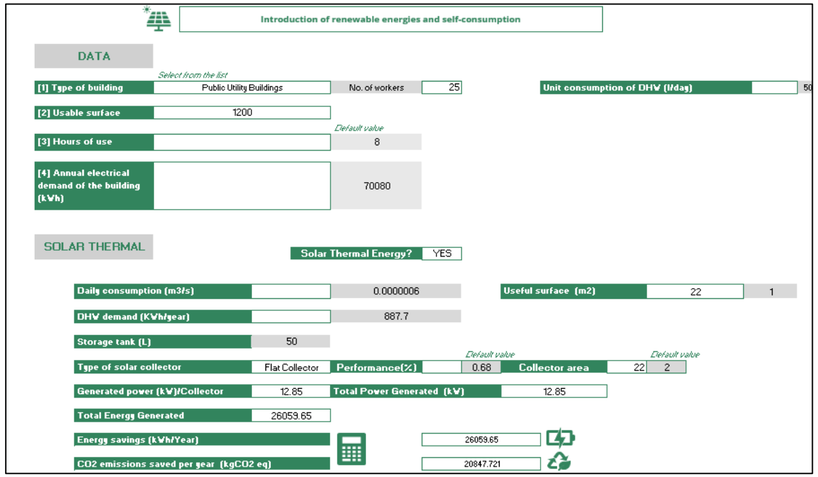
MOOC 2 - CASE STUDY 2

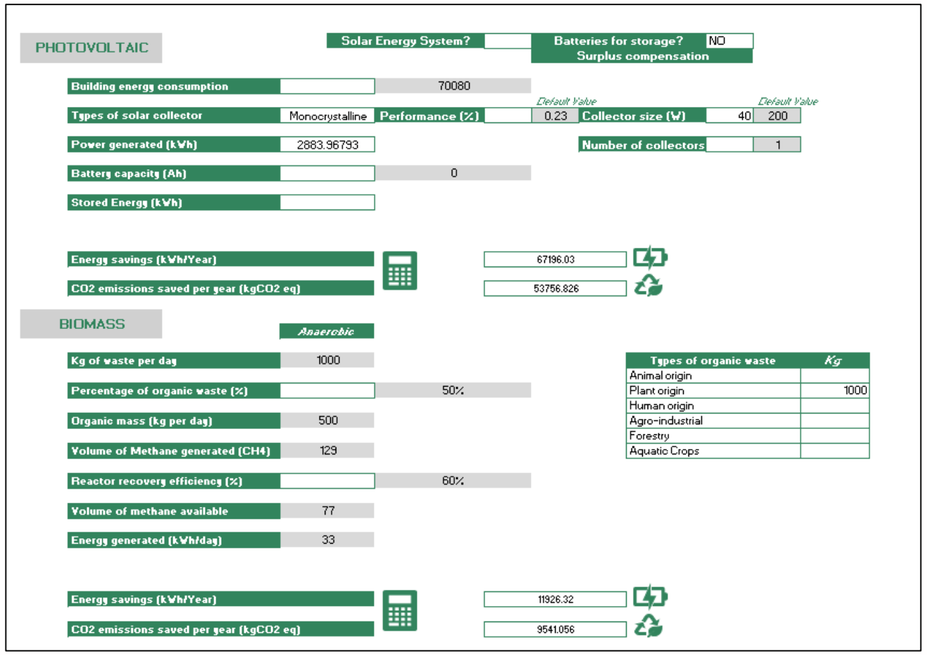
Case study in El Rosario (Tenerife, Spain).

4. Inference module

Main actions:

- **Introduction of renewable energies in public buildings**





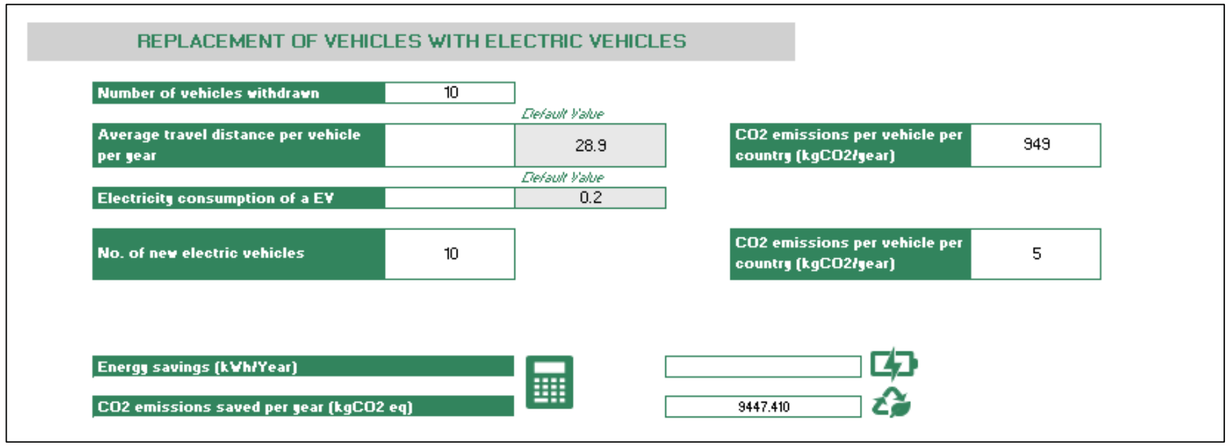
Case study in El Rosario (Tenerife, Spain).

4. Inference module

Main actions:

- **Renewal of municipal fleet of energy efficient vehicles**

Last action considered at the municipal level is to renew the fleet of vehicles for more efficient ones, such as electric vehicles. In this case, all gasoline vehicles (a total of 10 vehicles) will be replaced by electric vehicles.



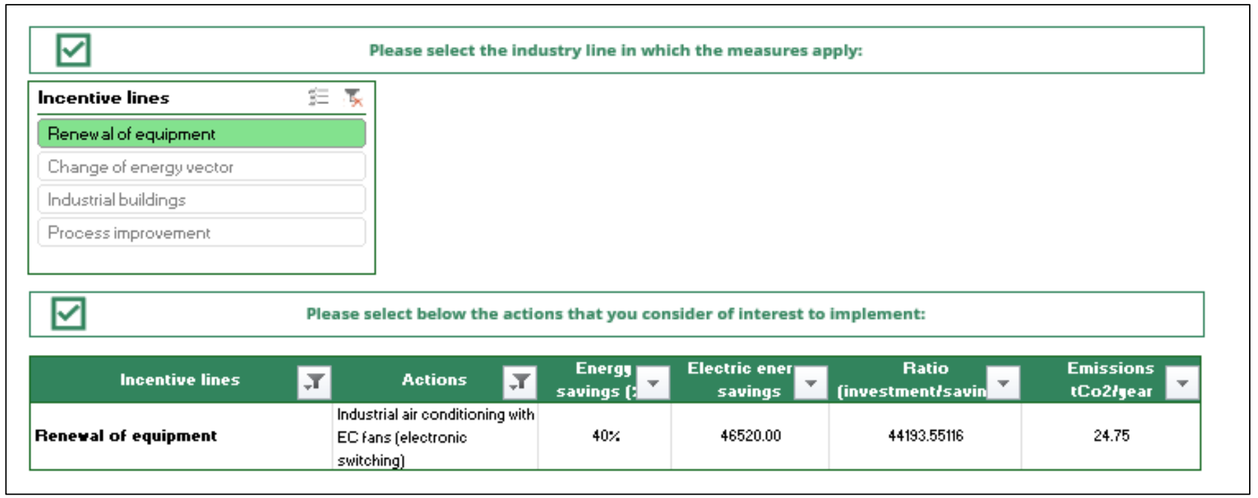
Case study in El Rosario (Tenerife, Spain).

4. Inference module

Main actions:

- **Industry**

Promotion of energy consumption control in companies, e.g. industrial air conditioning with EC (electronically commuted) fans.



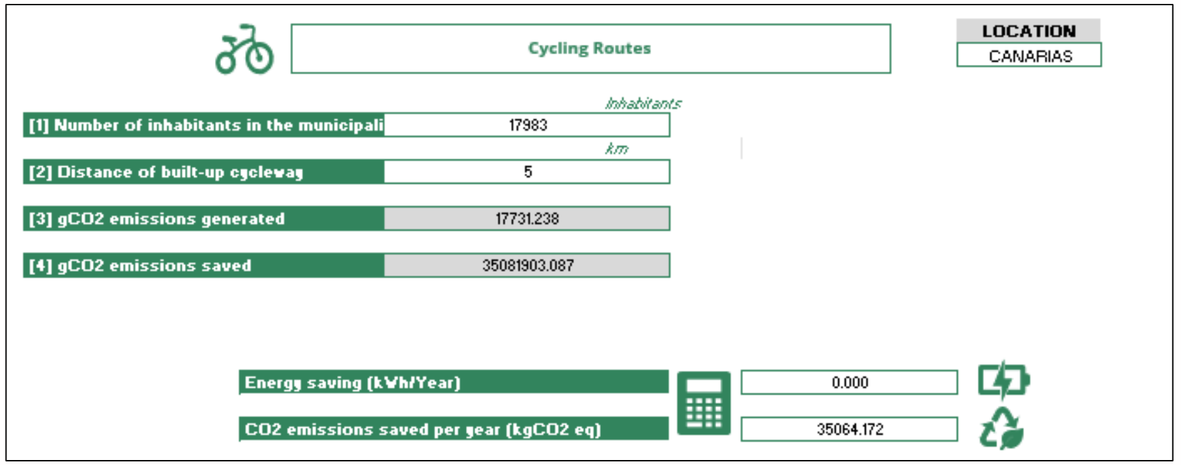
Case study in El Rosario (Tenerife, Spain).

4. Inference module

Main actions:

- **Increased bicycle lane line**

Among the main actions is the creation of a mobility plan for the improvement of municipal transportation. This plan indicates the km of bike lanes to be extended, in this case it is proposed to include 5 km of lanes that will save CO_2 emissions according to the figure below.



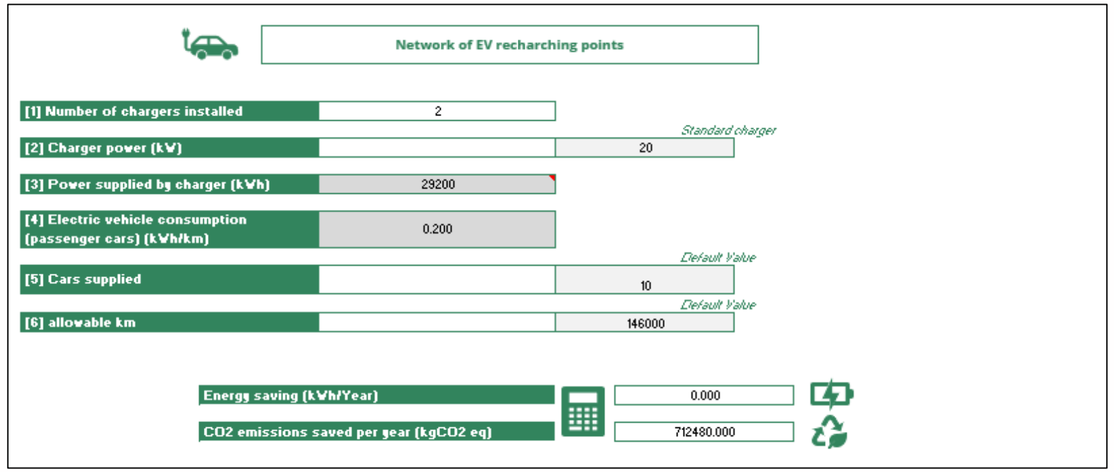
Case study in El Rosario (Tenerife, Spain).

4. Inference module

Main actions:

- **Implementation of alternative recharging points**

Including recharging points to provide alternative options to conventional vehicles is another priority action. In this case, it is proposed to introduce 2 electric vehicle recharging points.



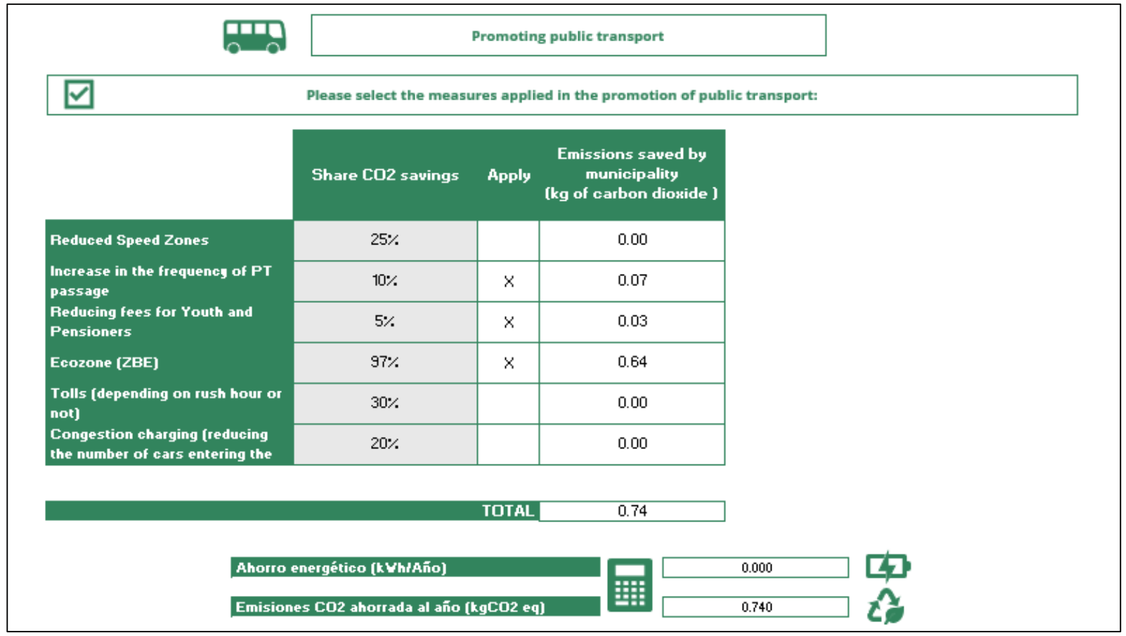
Case study in El Rosario (Tenerife, Spain).

4. Inference module

Main actions:

- **Actions to promote public transport**

Some actions are the improvement of public transport by increasing frequency, reduced rates for young people and adults or the creation of a low emission zone.



Promoting public transport

Please select the measures applied in the promotion of public transport:

	Share CO2 savings	Apply	Emissions saved by municipality (kg of carbon dioxide)
Reduced Speed Zones	25%		0.00
Increase in the frequency of PT passage	10%	X	0.07
Reducing fees for Youth and Pensioners	5%	X	0.03
Ecozone (ZBE)	97%	X	0.64
Tolls (depending on rush hour or not)	30%		0.00
Congestion charging (reducing the number of cars entering the	20%		0.00
		TOTAL	0.74

Ahorro energético (kWh/Año)	0.000
Emisiones CO2 ahorrada al año (kgCO2 eq)	0.740

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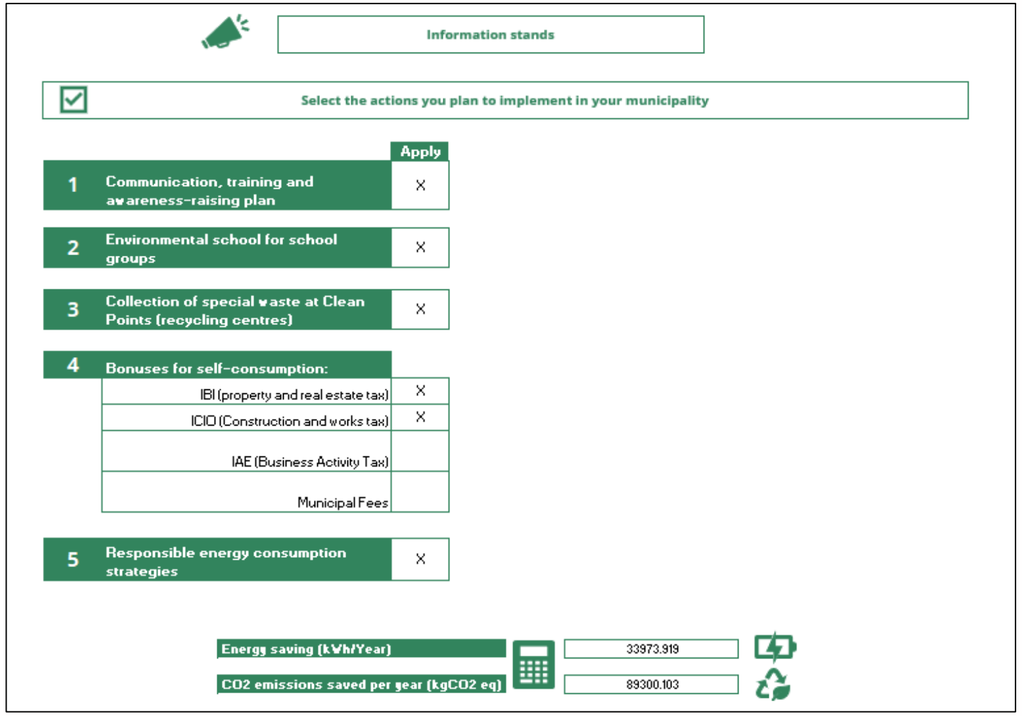
Case study in El Rosario (Tenerife, Spain).

4. Inference module

Main actions:

- **Awareness**

Citizen awareness actions in El Rosario are directly aimed at the creation of a municipal awareness and training plan. They also include training in schools, collection points and training workshops for recycling and energy consumption reduction strategies. In addition, discount rates are also applied for homes with self-consumption or for construction works with bioclimatic solutions.



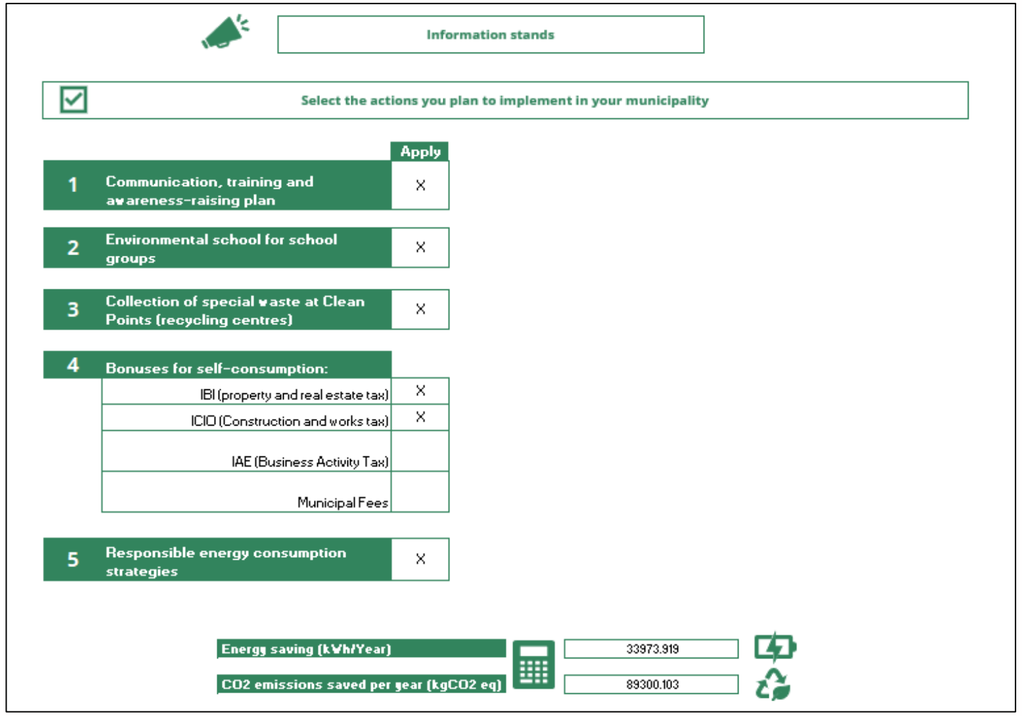
Case study in El Rosario (Tenerife, Spain).

4. Inference module

Main actions:

- **Awareness**

Citizen awareness actions in El Rosario are directly aimed at the creation of a municipal awareness and training plan. They also include training in schools, collection points and training workshops for recycling and energy consumption reduction strategies. In addition, discount rates are also applied for homes with self-consumption or for construction works with bioclimatic solutions.



Case study in El Rosario (Tenerife, Spain).

5. Multi-criteria decision method and ranking of measures

- *Since this module has been described in case study 1, for more information on the use of the tool it is suggested to take a look and review the complete case.*

Municipal Priorities

MUNICIPAL PRIORITIES	
1	Improvements in the equipment and infrastructure of the public lighting network, through the replacement of more efficient switchboards, luminaires and lamps.
2	Municipal tax rebates for the use of renewable energies and energy efficient vehicles.
3	Use of renewable energies: use of biogas energy generated by the contribution of waste at the provincial landfill, installation of photovoltaic plants and solar thermal installations
4	Intention to set up a permanent personalized attention and advice department for individuals and legal entities interested in energy saving and the use of renewable energy sources

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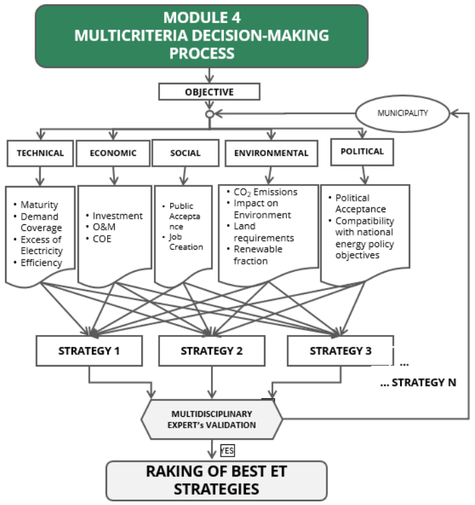
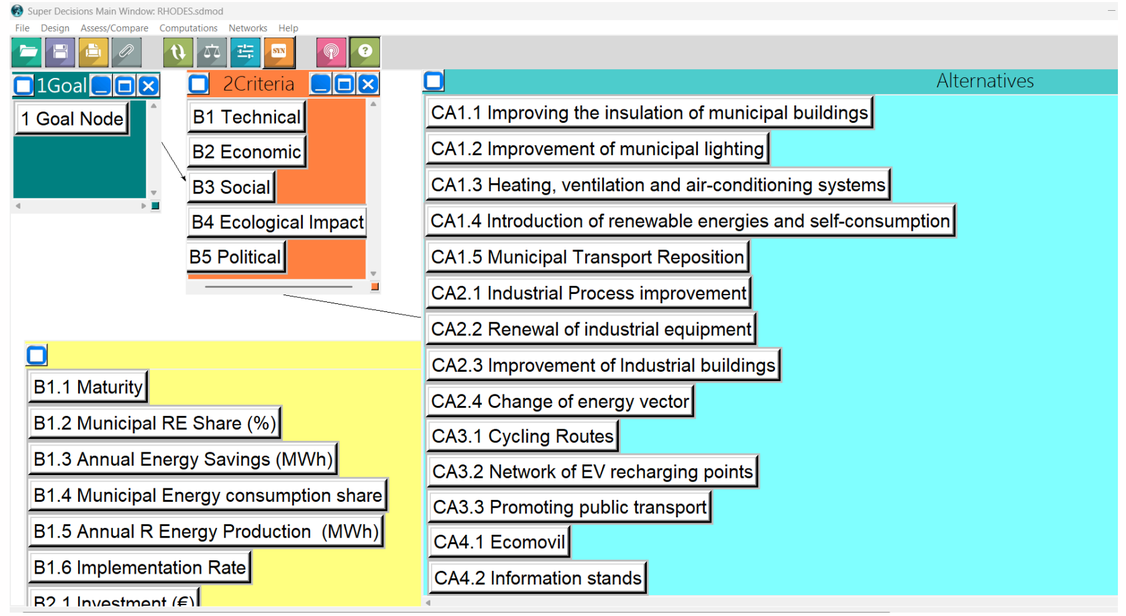
MOOC 2 - CASE STUDY 2

Case study in El Rosario (Tenerife, Spain).

5. Multi-criteria decision method and ranking of measures

Using the SuperDecisions tool





Case study in El Rosario (Tenerife, Spain).

5. Multi-criteria decision method and ranking of measures

Using the SuperDecisions tool

Alternative Rankings

Graphic	Alternatives	Total	Normal	Ideal	Ranking
	CA1.1 Improving the insulation of municipal buildings	0.0183	0.0558	0.2764	8
	CA1.2 Improvement of municipal lighting	0.0262	0.0799	0.3959	6
	CA1.3 Heating, ventilation and air-conditioning systems	0.0342	0.1043	0.5169	4
	CA1.4 Introduction of renewable energies and self-consumption	0.0661	0.2017	1.0000	1
	CA1.5 Municipal Transport Reposition	0.0081	0.0246	0.1220	10
	CA2.1 Industrial Process improvement	0.0035	0.0107	0.0529	14
	CA2.2 Renewal of industrial equipment	0.0039	0.0119	0.0590	12
	CA2.3 Improvement of Industrial buildings	0.0036	0.0109	0.0539	13
	CA2.4 Change of energy vector	0.0082	0.0251	0.1242	9
	CA3.1 Cycling Routes	0.0376	0.1146	0.5683	3
	CA3.2 Network of EV recharching points	0.0230	0.0702	0.3478	7
	CA3.3 Promoting public transport	0.0276	0.0842	0.4174	5
	CA4.1 Ecomovil	0.0057	0.0173	0.0855	11
	CA4.2 Information stands	0.0620	0.1890	0.9371	2

PRIORITY	ACTION	ENERGY SAVINGS (MWh/year)	CO_2 SAVINGS (tCO2e)	CATEGORY
1	Introduction of renewable energies and self-consumption	105.18	84.15	Municipal facilities
2	Information stands	33.94	89.30	Awareness
3	Cycling Routes	-	35.06	Transport
4	Heating, ventilation and air-conditioning systems	0.45	0.36	Municipal facilities
5	Promoting public transport	-	13.30	Transport
6	Improvement of municipal lighting	5.32	4.26	Municipal facilities
7	Network of EV recharging points	-	712.50	Transport
8	Improving the insulation of municipal buildings	567.45	453.96	Municipal facilities
9	Change of energy vector	-	-	Industry
10	Municipal Transport Reposition	-	9.45	Municipal facilities
11	Ecomovil	-	-	Awareness
12	Renewal of industrial equipment	46.52	37.22	Industry
13	Improvement of Industrial buildings	-	-	Industry
14	Industrial Process improvement	-	-	Industry
	TOTAL	758.86	1439.20	

MOOC 2 - CASE STUDY 2

Propose your own case study

- To practice and use the GENERA tools we propose you to create your own case study. You can start from any municipality about which you have information on its objectives and future plans, or start from a municipal action plan with the idea of improving it.

- You can also make use of the cases described in MOOC2:
    - Sant Antoni de Portmany (Ibiza, Spain)
    - Stintino (Sardinia, Italy)
    - Halki (Greece)

- There is also the option of taking a look at GENERA's deliverable *D3.2: Pilot Descriptions and Results*, where you will find more information and case studies.

MOOC 2 - CASE STUDY 2

Energy transition measurement and monitoring tools