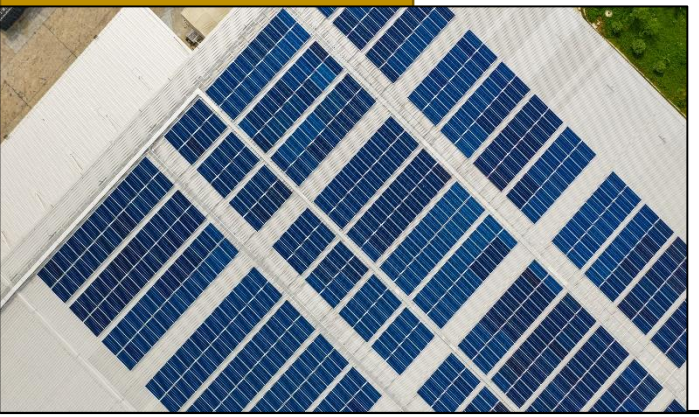
CANARIAS

Por la transición energética

Plan de Transición Energética de Canarias

Canary Islands Energy Transition Plan



COP27
SHARM EL-SHEIKH
EGYPT 2022

Gobierno de Canarias

Consejería de Transición Ecológica, Lucha contra el Cambio Climático y Planificación Territorial

Dirección General de Energía

Canary Islands energy system

COP27 SHARM EL-SHEIKH EGYPT 2022

CANARIAS Por la transición energética | Plan de Transición Energética de Canarias

Canary Islands energy system | Year 2021

Load demand: 8.055 GWh/year
Load demand coverage with RES: 19,5%

La Palma

Peak power:	44,5 MW
Load demand:	246 GWh
Load demand coverage with RES:	10,3 %

Tenerife

Peak power:	529 MW
Load demand:	3.225 GWh
Load demand coverage with RES:	21,0 %

Projected Subsea Interconnection

2x50 MW – 66 kV AC

La Gomera

Peak power:	11,9 MW
Load demand:	68 GWh
Load demand coverage with RES:	0,2 %

El Hierro

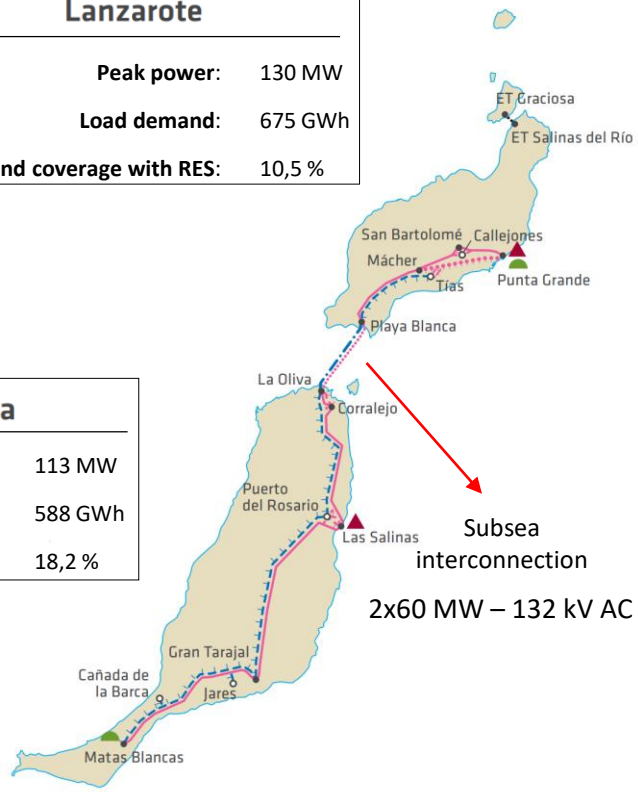
Peak power:	8,6 MW
Load demand:	48 GWh
Load demand coverage with RES:	56,1 %

Lanzarote

Peak power:	130 MW
Load demand:	675 GWh
Load demand coverage with RES:	10,5 %

Fuerteventura

Peak power:	113 MW
Load demand:	588 GWh
Load demand coverage with RES:	18,2 %

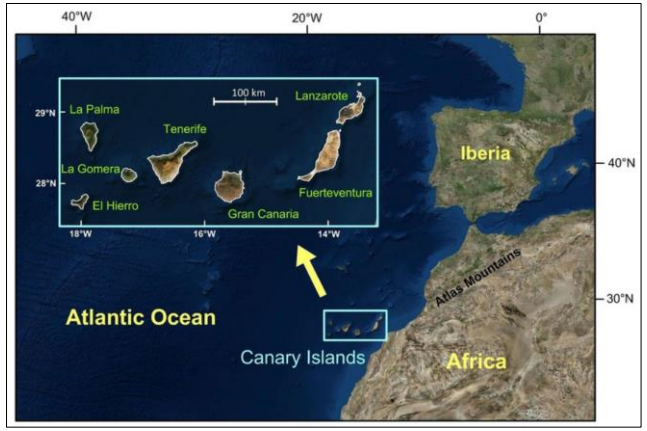


Subsea interconnection

2x60 MW – 132 kV AC

Gran Canaria

Peak power:	529 MW
Load demand:	3.204 GWh
Load demand coverage with RES:	20,6 %



General structure of PTECan

COP27 SHARM EL-SHEIKH EGYPT 2022

CANARIAS Por la transición energética | Plan de Transición Energética de Canarias

1 – PV self-consumption strategy

2 – Energy storage strategy

3 – Electric Vehicle strategy

4 - Geothermal energy strategy

5 – Marine Energy strategy

6-Manageable Energy strategy

7 – Green hydrogen strategy

8 – Demand Side Management and Smart-Grid

OBJECTIVE

Decarbonisation of the Canarian energy system

CANARIAS Por la transición energética | Plan de Transición Energética de Canarias

ENERGY DEMAND

Time evolution according to:

- Gross Domestic Product
- Population
- Price of fuels
- Right Emission Prices
- Climate Change IPCC

ECONOMIC DIMENSION

- Self-consumption
- Decarbonisation of the economy
- Blue economy: promotion of marine renewable energy
- Low carbon economy: promotion of RES and the electrification of heat demand and mobility
- Circular economy: energy recovery from waste

Alternative 0
Trend

Alternative 1
100% RES
0 % CO_2
2040
2030 2040

Alternative 2
100% RES
0 % CO_2
2040
2030 2040

DIAGNOSIS
- SWOT
- Specific objectives

ACTION PLAN
- Insularized
- Anualized

ECONOMIC ANALYSIS
- Financing
- Positive externalities

ENVIRONMENTAL DIMENSION:

- Conservation of landscape wealth
- Reduction of environmental pollution
- Mitigation of climate change
- Biodiversity Conservation

Strategic Environmental Assessment

DIMENSION SOCIAL

- Exploit new sources of green employment
- Fair Energy Transition
- Fight against energy poverty
- Promotion of energy communities
- Energy democratization

ANNUAL OBJECTIVES

INVESTMENT

ZONIFICATION

1040 *DECRETO 9/2021, de 18 de febrero, por el que se encomienda a la Consejería de Transición Ecológica, Lucha contra el Cambio Climático y Planificación Territorial la elaboración de un plan de transición energética para la Comunidad Autónoma de Canarias.*

PROYECTOS DE LEY

EN TRÁMITE
10L/PL-0018 De Cambio Climático y Transición Energética de Canarias. Página 1

General structure of PTECan

+

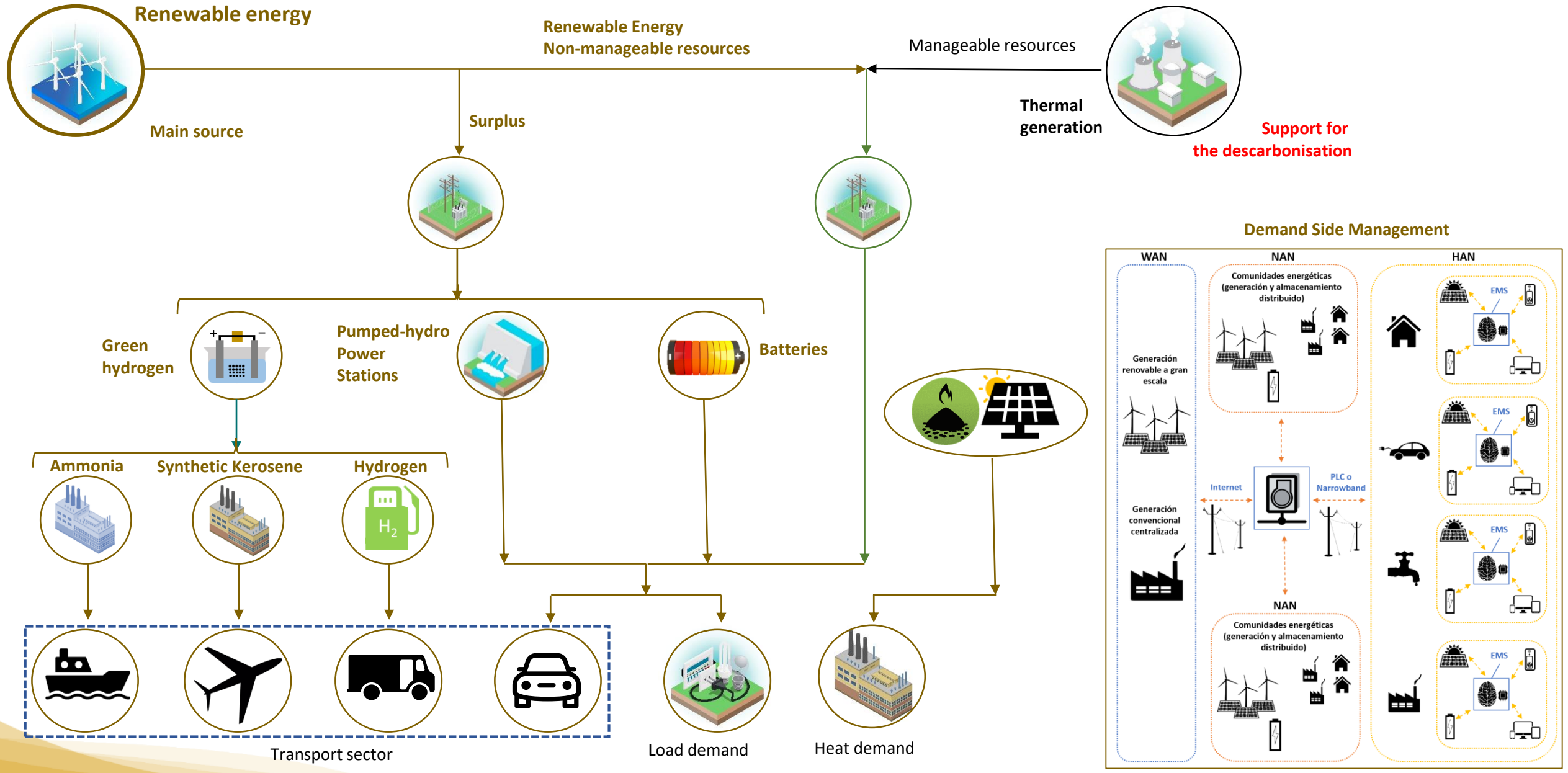
Chapter 1. Executive summary → **Chapter 2.** PTECan development process → **Chapter 3.** Planning alternatives → **Chapter 4.** Electric power production

Chapter 5. Energy storage → **Chapter 6.** Transport and distribution of electricity → **Chapter 7.** Sustainable mobility and demand side management → **Chapter 8.** Sectoral Policies, Energy Saving and Efficiency

Chapter 9. Consumer protection and energy poverty → **Chapter 10.** Externalities of the energy sector of the Canary Islands → **Chapter 11.** Canary energy model. Selected alternative → **Chapter 12.** Action plan and governance system

Chapter 13. Social impact and job creation + Strategic Initial Document | Economic report | Cartography and annexes

Basic scheme of the proposed energy system



Key solutions for maximizing renewable energy

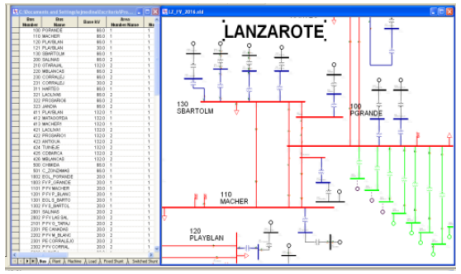
COP27 SHARM EL-SHEIKH EGYPT 2022

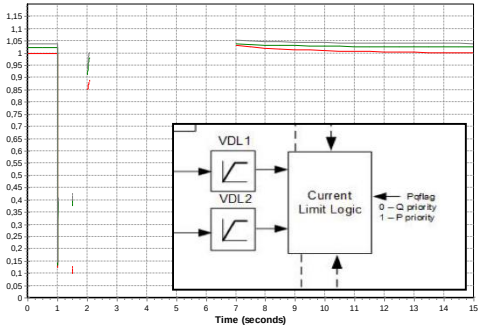
CANARIAS Por la transición energética | Plan de Transición Energética de Canarias

Electrical system

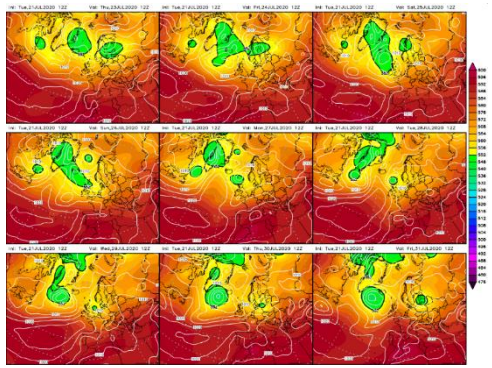
Approaches for maximizing renewable energy

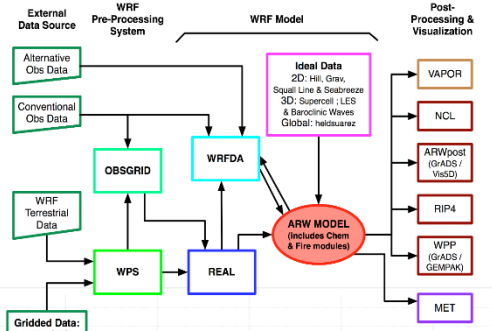
Grid stability analysis



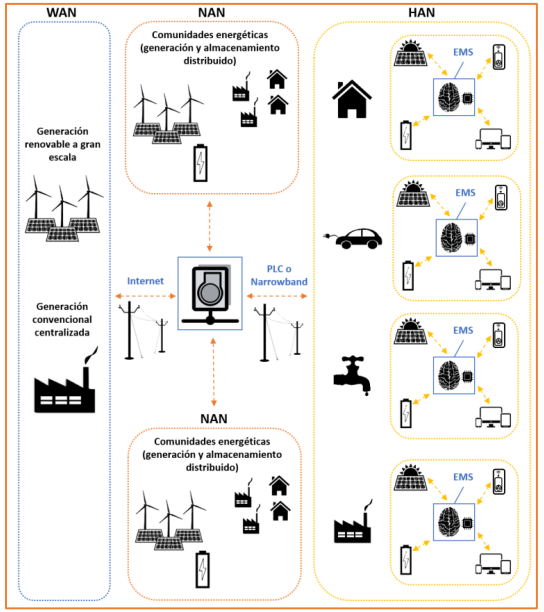


Energy forecasting

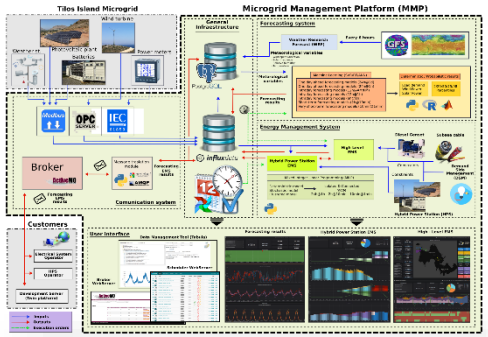




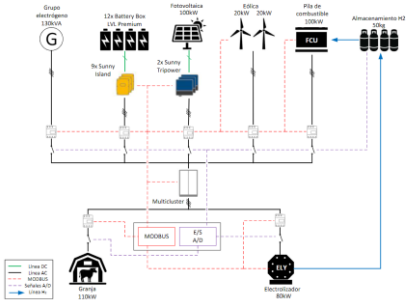
Demand Side Management



Energy Storage

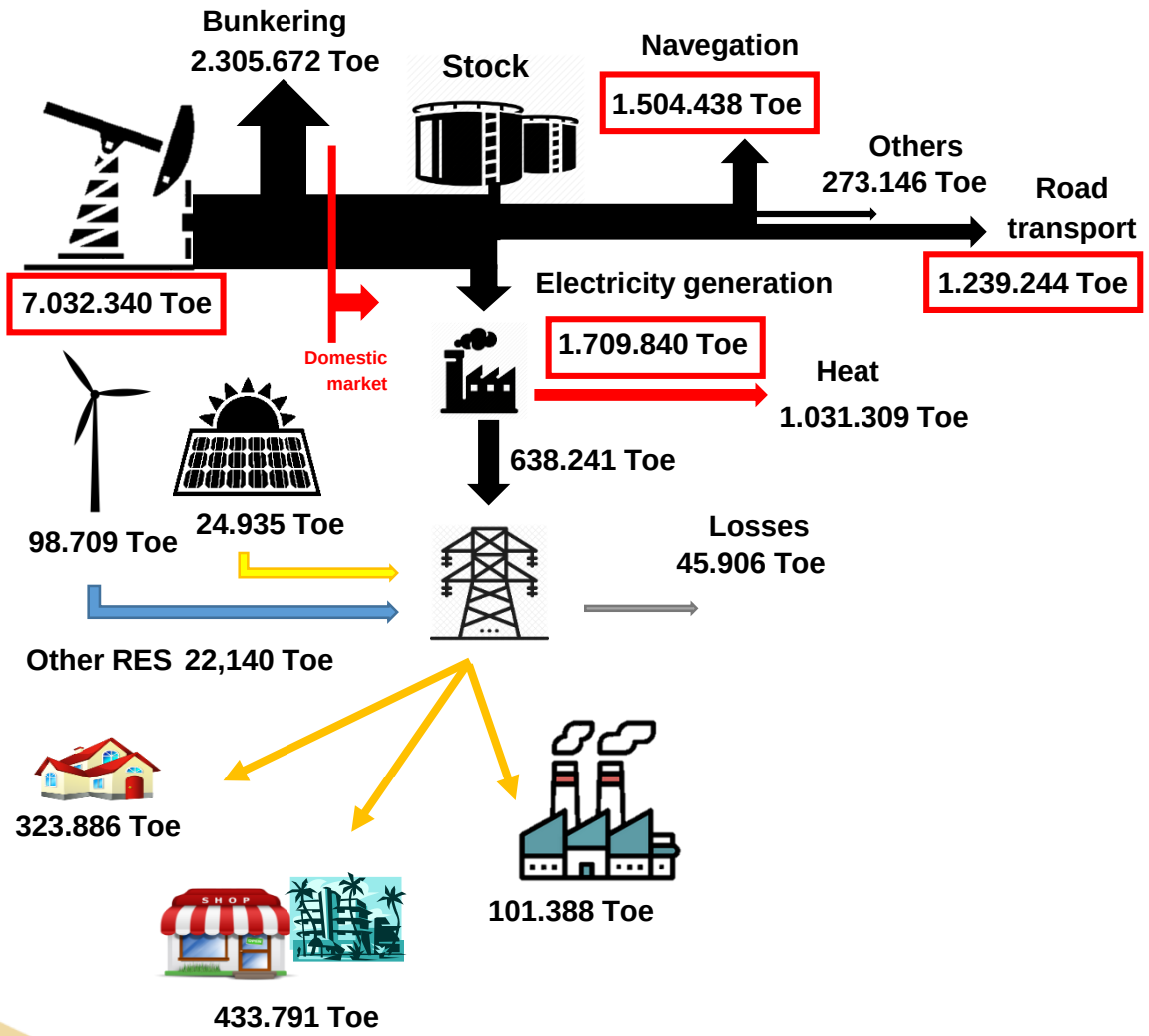


Distributed generation



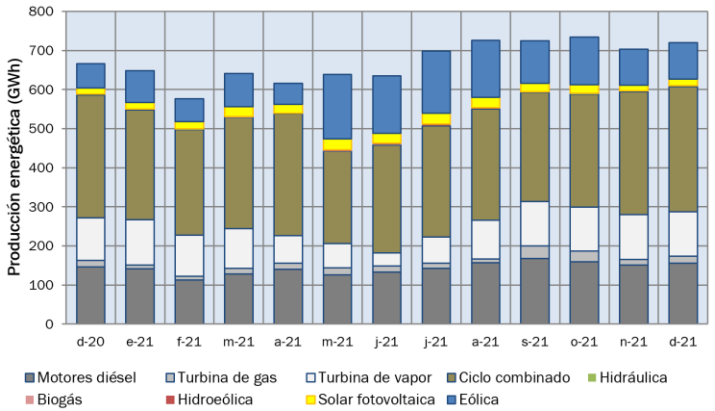
Energy balance of the Canary Islands

Energy balance (Pre-pandemic 2019)



Sector	Domestic market		Domestic market + Bunkering	
Electricity generation	1.709.840 Toe	**36,2%**	1.709.840 Toe	24,3%
Road transport sector	1.239.244 Toe	**26,2%**	1.239.244 Toe	17,6%
Marine and air navigation	1.504.438 Toe	**31,8%**	1.504.438 Toe	21,4%
Bunkering	-	-	2.305.672 Toe	32,8%
Others	273.146 Toe	**5,8%**	273.146 Toe	3,9%

Electricity production (GWh) - 2021



- Wind: **17,02%**
- PV: **3,65%**
- Wind Pumped-hydro: **0,29%**
- Biomass: **0,10%**
- Hydro: **0,04%**

Load demand coverage with Renewable Energy Sources (RES)

RES	RES	RES	RES
16,4%	17,0%	19,5%	21,7%
Year 2019	**Year 2020**	**Year 2021**	**Year 2022**

(01/01/2022 – 26/10/2022)

Initial situation (2019)

Fuel demand	5.900 kTm	Electrical power demand	9.336 GWh	Thermal energy demand	166 kTep	Number of vehicles	1.737.027

Renewable power generation

Renewable power generation	Power
Onshore wind	419,5 MW
Offshore wind	5,2 MW
PV	181,7 MW
PV Off-shore	0,0 MW
PV self-consumption	12,4 MW
Biomass	3,7 MW
Wave energy	0,0 MW
High entalphy geothermal	0,0 MW
Solar thermal	0,0 MW
Small scale hydro	2,0 MW

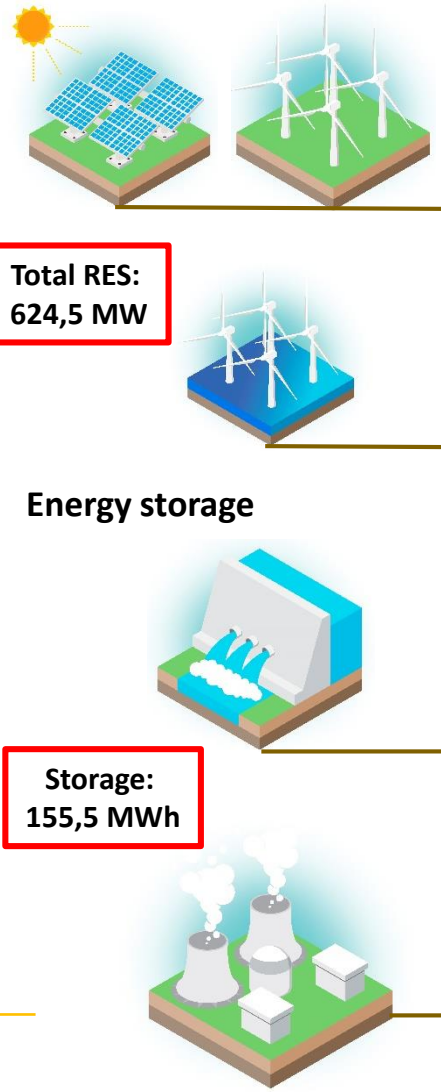
Total RES: 624,5 MW

Energy storage

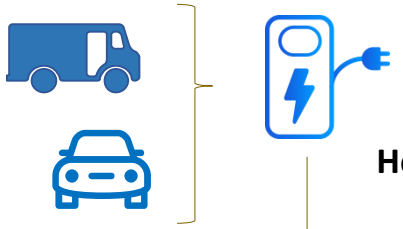
Storage	Ratio
Consumer storage	- MWh
Grid storage	5,5 MWh
Large scale storage	150 MWh

Storage: 155,5 MWh

Conventional thermal generation	Ratio
Conventional Thermal	2.357 MW
Hydrogen engines/turbines	0 MW

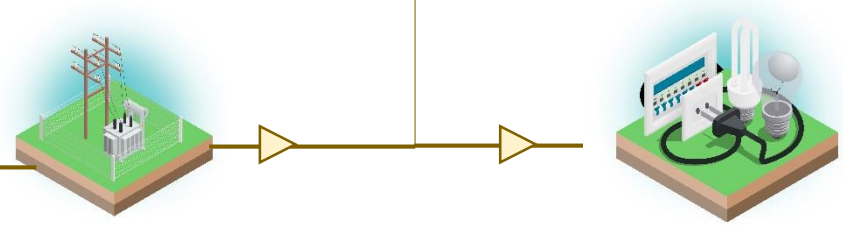


Sustainable mobility



Zero-emissions vehicles: 2.578 Vehicles

Heat/cold production with renewables



Conventional thermal generation

Distribution and transport of electrical energy

Energy efficiency and demand management

Mobility	Ratio
Promoting public transport	0,85 Veh./hab.
Electric vehicle	2.578 Veh.
Slow charging stations	156 Puntos
Fast charging stations	75 Puntos
Rapid charging stations	81 Puntos
Hydrogen vehicles	5 Veh.
Hidrogen stations	0
Other zero emissions alternatives	0 Veh.
Maritime transport e-solutions	0 GWh
Maritime transport hydrogen	0 tH2

Heat sector	Ratio
Solar thermal	123.719 m^2
Low entalphy geothermal	32 MW
Biomass	- toe/year
Cogeneration	89,98 MW

Communities and buildings	Ratio
Energy efficiency	-
Demand management	No

Initial situation (2020)

Fuel demand	3.531 kTm	Electrical power demand	8.355 GWh	Thermal energy demand	158 KTep	Number of vehicles	1.745.742

Renewable power generation

Renewable power generation	Power
Onshore wind	463,4 MW
Offshore wind	5,2 MW
PV	182,3 MW
PV Off-shore	0,0 MW
PV self-consumption	24,4 MW
Biomass	3,7 MW
Wave energy	0,0 MW
High entalphy geothermal	0,0 MW
Solar thermal	0,0 MW
Small scale hydro	2,0 MW

Total RES: 681,0 MW

Energy storage

Storage	Energy
Consumer storage	- MWh
Grid storage	5,5 MWh
Large scale storage	150 MWh

Storage: 155,5 MWh

Conventional thermal generation	Power
Conventional Thermal	2.357 MW
Hydrrogen engines/turbines	0 MW

Conventional thermal generation

Distribution and transport of electrical energy

Sustainable mobility

Zero-emissions vehicles: 3.806 Vehicles

Heat/cold production with renewables

Energy efficiency and demand management

Mobility	Ratio
Promoting public transport	0,81Veh./citizen.
Electric vehicle	3.806
Slow charging stations	156
Fast charging stations	75
Rapid charging stations	81
Hydrogen vehicles	7
Hidrogen stations	0
Other zero emissions alternatives	0
Maritime transport e-solutions	0 GWh
Maritime transport hydrogen	0 tH2

Heat sector	Ratio
Solar thermal	125.019 m^2
Low entalphy geothermal	32 MW
Biomass	- toe/year
Cogeneration	89,98 MW

Communities and buildings	Ratio
Energy efficiency	-
Demand management	No

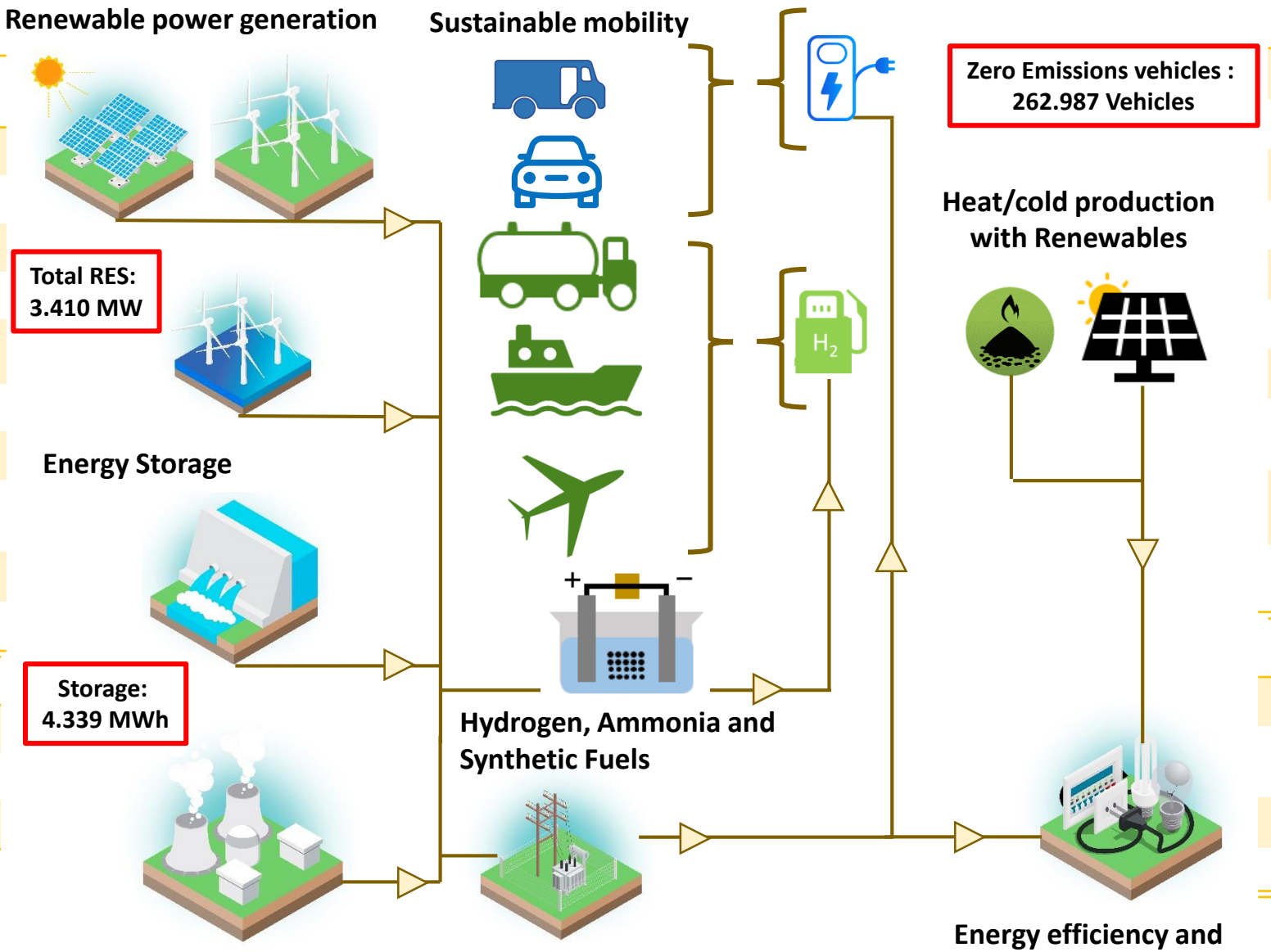
Objective 2030

Fuel demand	5.426 kTm	Electr. power demand	8.692 GWh	Thermal energy demand	130 kTep	Number of vehicles	1.669.825

Renewable power generation	Power
Oshore wind	1.706 MW
Offshore wind	330 MW
PV	759 MW
Floating PV	31 MW
PV self-consumption	524 MW
Biomass	18 MW
Wave energy	4 MW
High enthalpy geothermal	30 MW
Solar thermal	6 MW
Small scale hydro	2 MW

Storage	Energy
Consumer storage	827 MWh
Grid storage	162 MWh
Large scale storage	3.350 MWh

Conventional power generation	Power
Conventional thermal	1.440 MW
Hydrogen turbines/engines	45 MW



Mobility	Ratio
Promoting public transport	0,717 Veh./citiz.
Electric vehicle	225.424 .
Slow charging stations	249.765
Fast charging stations	5.692
Rapid charging stations	1.700
Hydrogen vehicles	7.183
Hydrogen stations	17
Other zero emissions alternatives	13.847 veh.
Maritime electrical transport	168 GWh
Maritime hydrogen transport	6.834 tH_2

Heat sector	Ratio
Solar thermal	456.272 m^2
Low enthalpy geothermal energy	59 MW
Biomass	15.423 Toe/year
Cogeneration	8 MW

Communities and buildings	Ratio
Energy efficiency	38% increase from year 2005
Demand management	VE

Global objectives of PTECan

CANARIAS
Por la transición energética
Plan de Transición Energética de Canarias

Improving energy efficiency

27%

Greenhouse Gas Emissions compared to 1990

+2,6%

-37%

Greenhouse gases emissions compared to 2010 (ref. PNIEC)

Renewable energy in electricity generation

62%

Renewable on the end use of energy

29%

CANARIAS
Por la transición energética
Plan de Transición Energética de Canarias

Economic indicators

Total investment (2021 – 2030)	6.248 M€
Total investment (2021 – 2040)	39.170 M€
Savings in operating cost for energy systems of the Canary Islands	937 M€/año

Comparison 2019 - 2030

CANARIAS Por la transición energética | Plan de Transición Energética de Canarias

	Wind On-shore	PV	PV Self-Consumption	Total SP	Wind Off-shore	PV Off-shore	Wave converter	Total Off-shore
2019	419,5 MW	181,7 MW	12,4 MW	194,1 MW	5,5 MW	0 MW	0 MW	5,5 MW
2022 October Current situation	576,8 MW	205,4 MW	56,3 MW	261,7 MW				
2030	1.706,5 MW	758,7 MW	524,3 MW	1.283 MW	330,0 MW	30,8 MW	4,0 MW	364,8 MW

	Pumped-Hydro
2019	150 MWh
2030	3.350 MWh

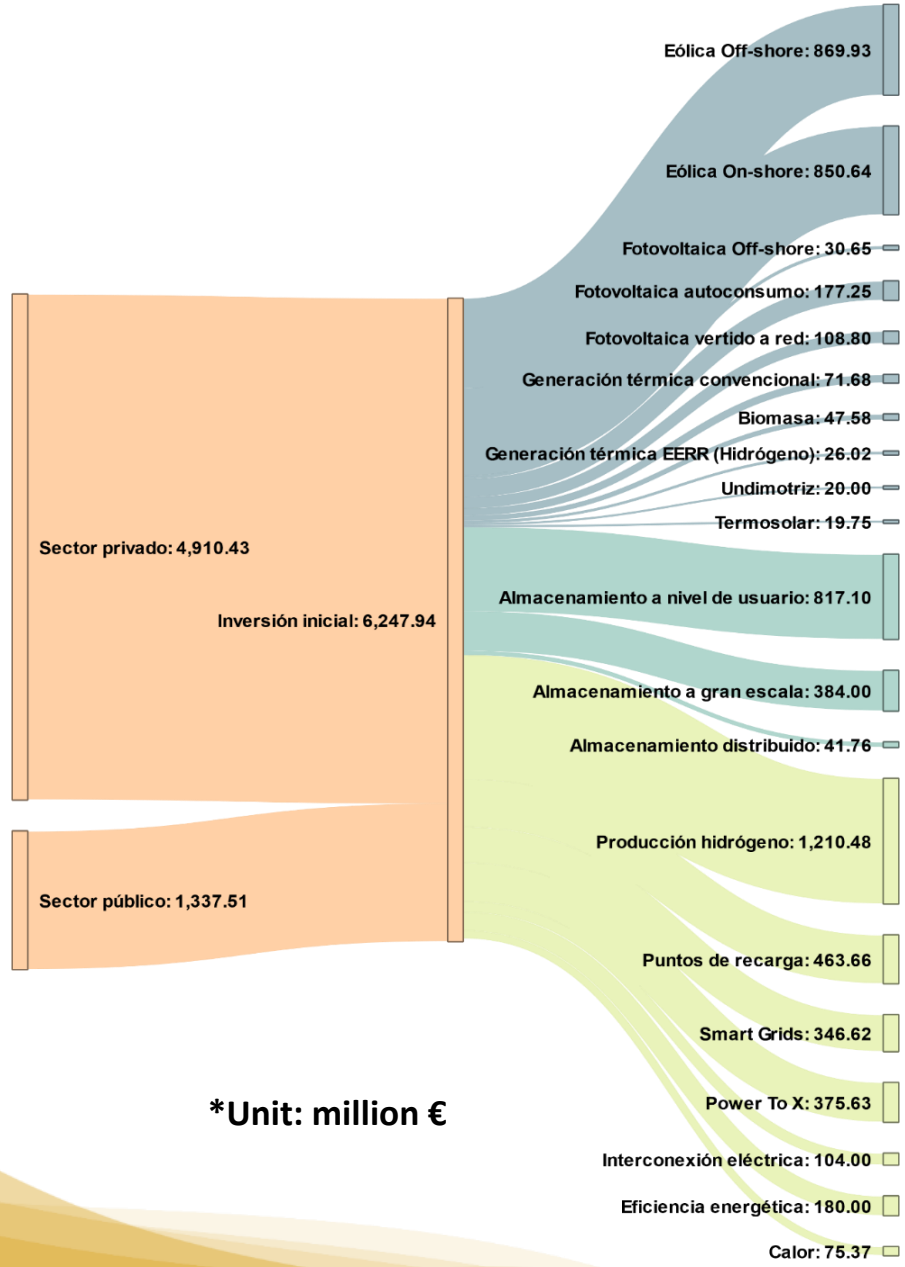
	Thermal generation	Hydrogen turbines	Geothermal	Small scale hydro	Biomass	Solar thermal
2019	2.357 MW	0 MW	0 MW	2 MW	3,70 MW	0 MW
2030	1.440 MW	45 MW	30 MW	2,6 MW	18,2 MW	5,6 MW

	Zero Emission vehicles
2019	2.578
2030	262.987

	Charging stations (chargers)	Hydrogen stations
2019	312	0
2030	257.157	17

	Biomass	Solar thermal	Low Enthalpy Geothermal
2019		123.719 m²	32 MWt
2030	15.423 t/year	456.272 m²	59 MWt

Source of funding



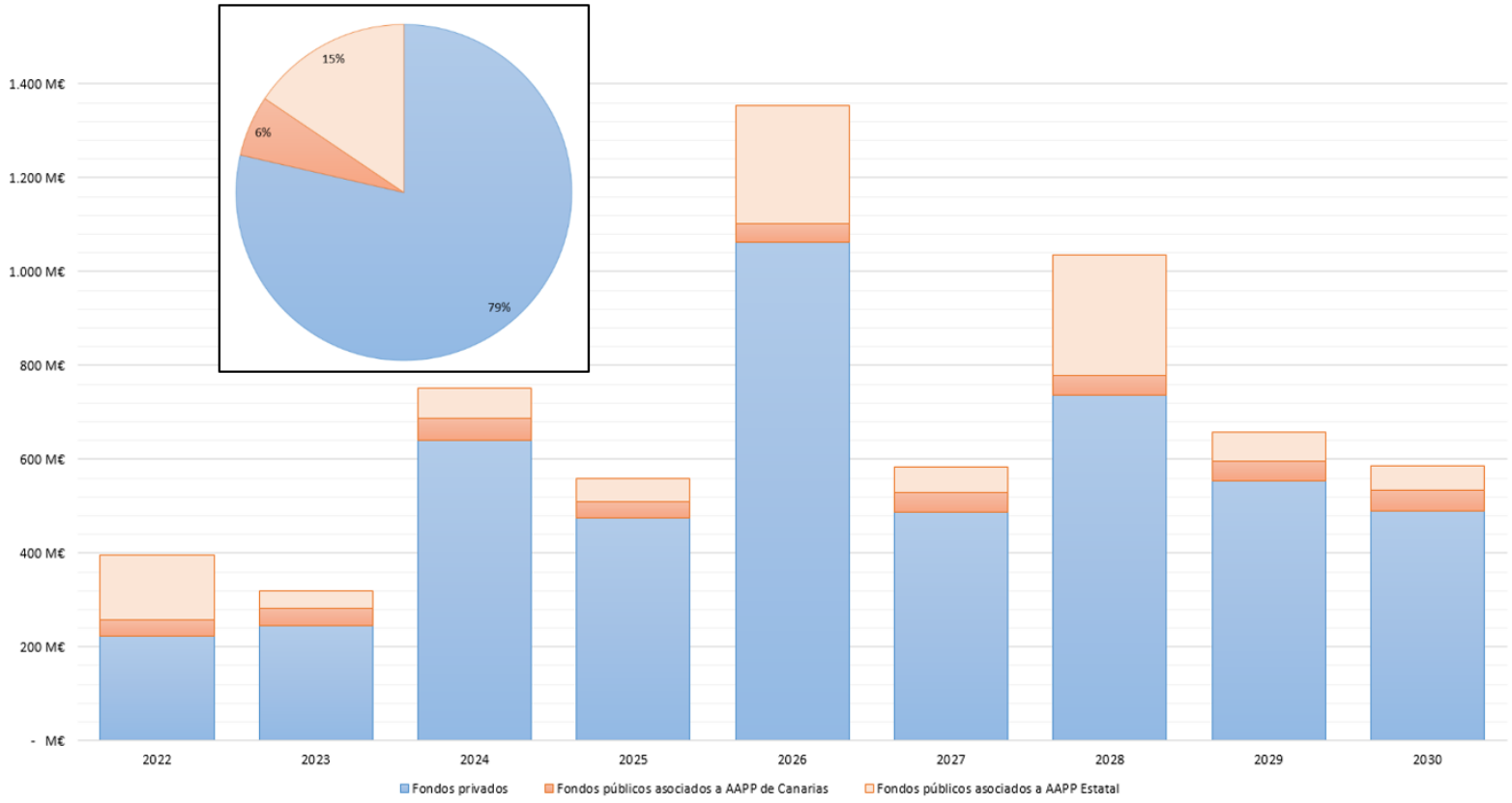
*Unit: million €

Investment PTECan [2022 – 2030] | Canary Islands → 6.248 million €

Investment PNIEC [2022 – 2030] | Spain → 241.000 million €

2,59% of the National Budget

The GDP of the Canary Islands (47.164.165 thousand €) is 3,8% of the National GDP (1.244.772.000 thousand €)



Spatial planning

Draft Law on Climate Change and Energy Transition of the Canary Islands.

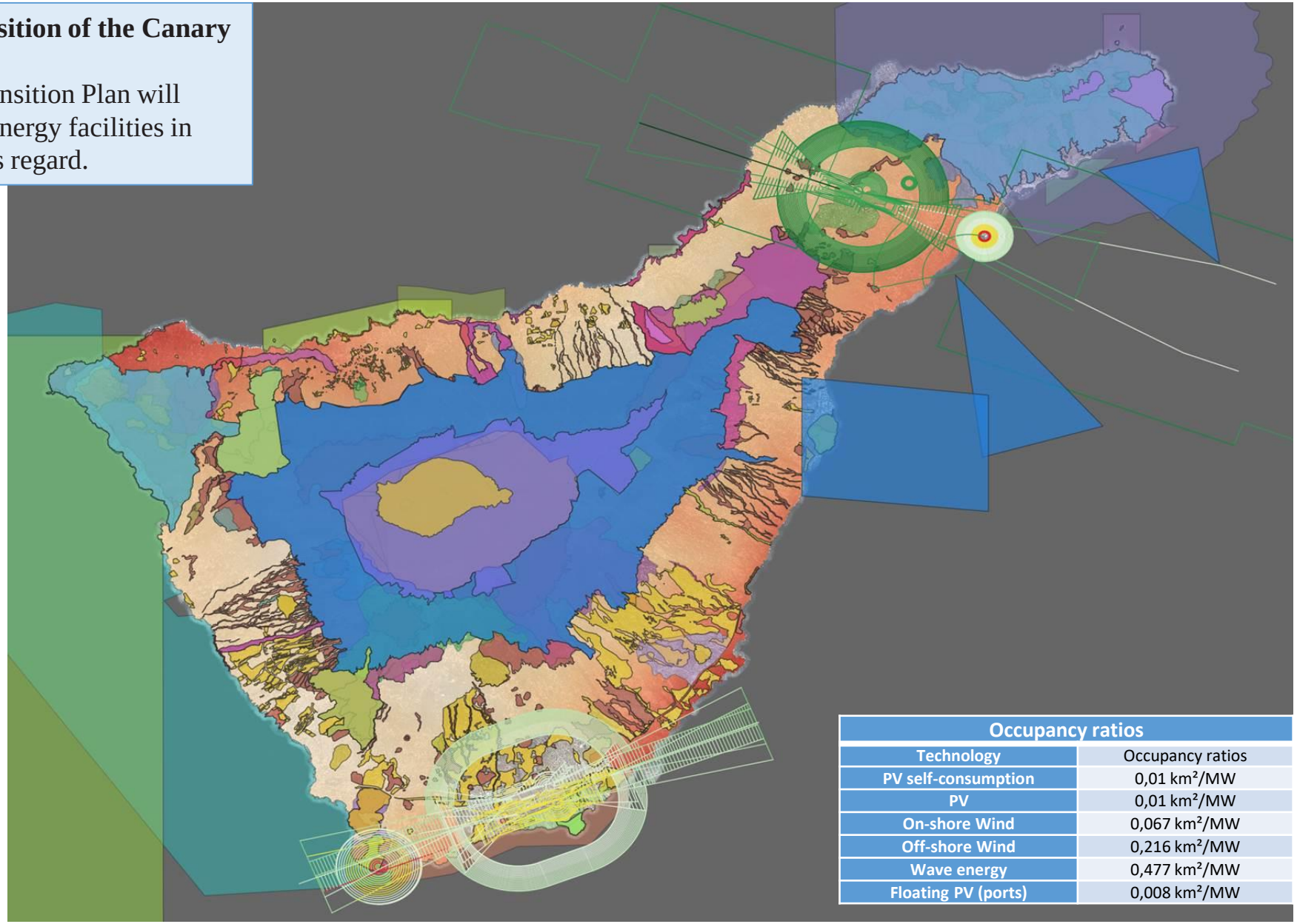
Article 18: 2. The Canary Islands Energy Transition Plan will establish the criteria for locating renewable energy facilities in accordance with the forecasts foreseen in this regard.

Approach:

Identifies areas that comply with:

- Environmental protection.
- Territorial protection.
- Proximity to population.
- Air and sea traffic regulations.
- Exclusion zones.
- Areas pending to other technologies. Complementary uses.
- Restrictions based on legislative frameworks.
- Renewable resource.

Color maps are generated marking the areas of greatest interest. Suggest the areas of greatest potential.



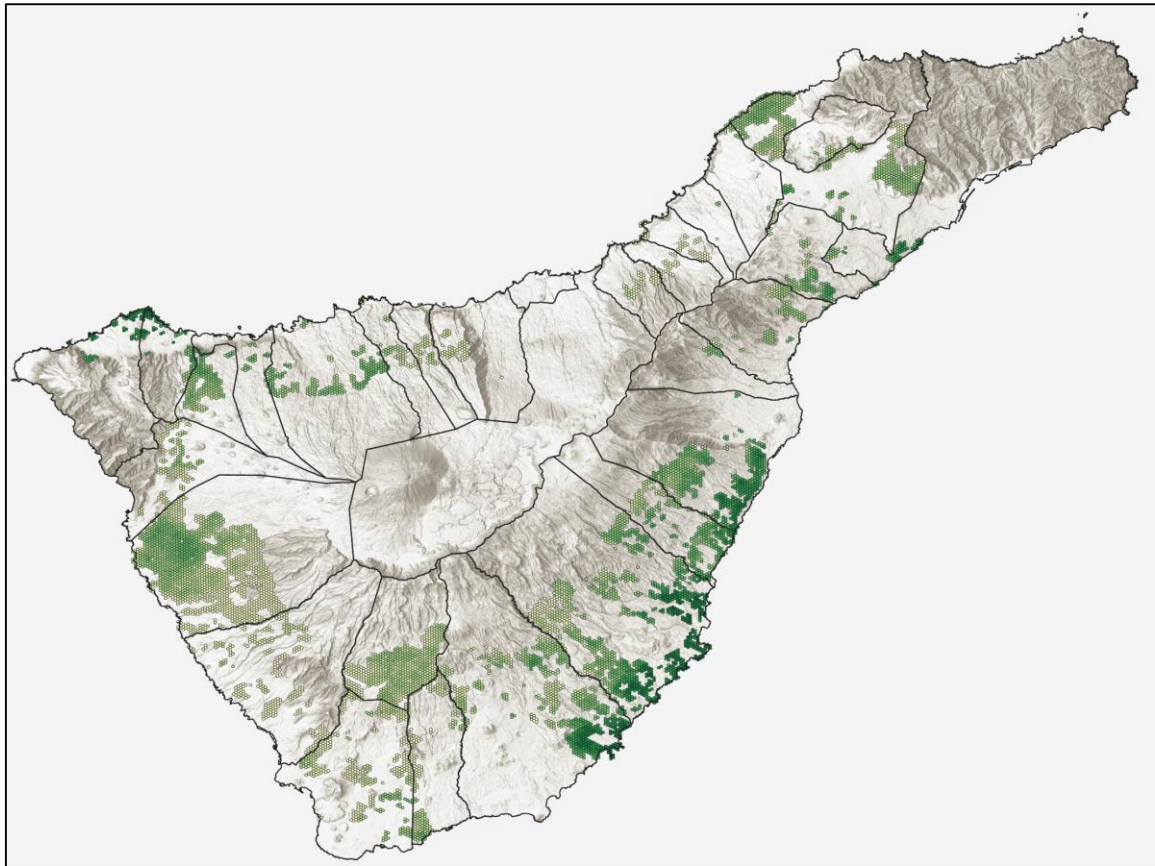
Occupancy ratios	
Technology	Occupancy ratios
PV self-consumption	0,01 km²/MW
PV	0,01 km²/MW
On-shore Wind	0,067 km²/MW
Off-shore Wind	0,216 km²/MW
Wave energy	0,477 km²/MW
Floating PV (ports)	0,008 km²/MW

Example: Spatial planning Tenerife

Technology	Area 2030	Power 2030	Area 2040	Power 2040	Available Area	Capacity
PV self-consumption	2,32 km²	230,7 MW	8,35 km²	829 MW	50,3 km²	4.995 MW
PV	3,43 km²	343 MW	16,50 km²	1.650 MW	129 km²	12.900 MW
On-shore wind energy	38,12 km²	569 MW	114 km²	1.700 MW	125 km²	1.866 MW
Off-shore wind energy	27,51 km²	130 MW	190,44 km²	900 MW	205 km²	969 MW
Thermal solar power	0,2 km²	15,6 ktoe	8,35 km²	649 ktoe	45 km²	782 ktoe
Wave energy	0,95 m²	2 MW	200 m²	2 MW	116 km²	243 MW
Floating PV (ports)	0,10 km²	10 MW	0,23 km²	27 MW	0,23 km²	27 MW

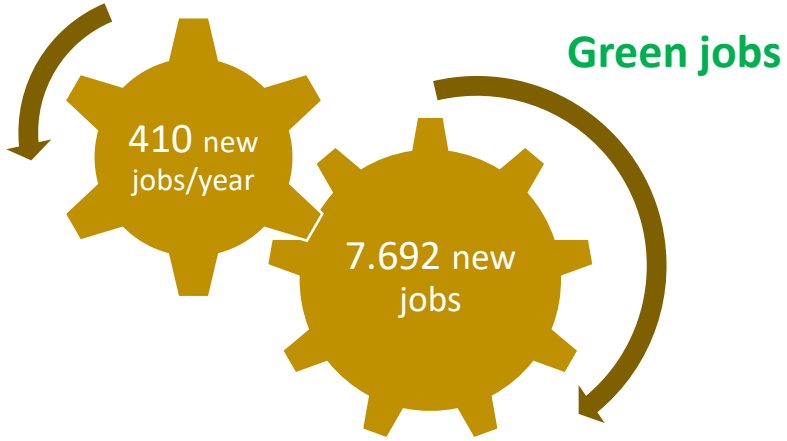
Main conclusions

- The objectives proposed in PTECan for 2030 and the scenario of total decarbonisation proposed are viable from a land use perspective.
- Onshore wind is at the limit of compliance by 2040 but it is vital as it is the renewable technology with the lowest cost and the highest capacity factor (h_{eq}).
- Positions with lower renewable potential will have to be exploited progressively. The alternative is to analyze in detail the distancing limits that currently apply.
- It is essential apply technologies with high integration capacity. Energy community concepts to optimize space needs.

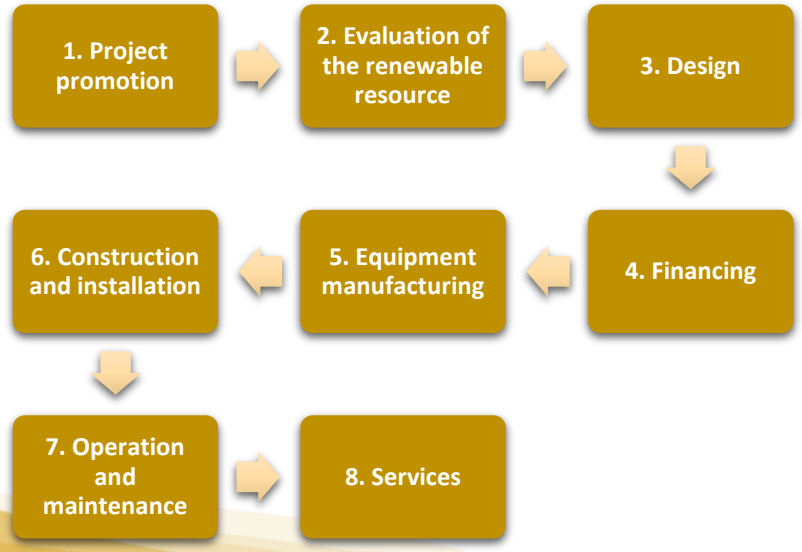


Social impact

1. Total number of jobs that would be created by the energy transition.



2. Consolidation of current business models and creation of new companies.



3. Protection of consumers against energy poverty.

Early detection of energy poverty

- Support to local authorities (municipalities).

Special measurements

- **Energy efficiency**
- **PV self-consumption**
- **Demand side management**
- **Sustainable mobility**

Communication

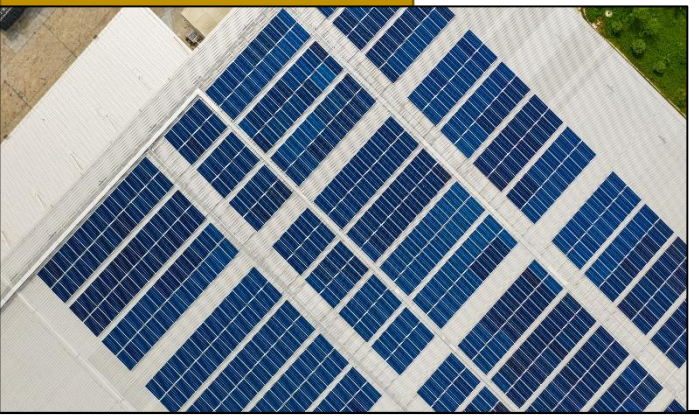
4. Consolidation of Canary Islands as a Living Lab for innovative renewable technologies.

CANARIAS

Por la transición energética

Plan de Transición Energética de Canarias

Canary Islands Energy Planning



COP27
SHARM EL-SHEIKH
EGYPT 2022

Gobierno de Canarias

Consejería de Transición Ecológica, Lucha contra el Cambio Climático y Planificación Territorial

Dirección General de Energía