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# Analysis of Spanish energy and environmental strategies with TIMES-Spain

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CIEMAT, Spain


Venice, June 16<sup>th</sup>, 2009

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## RES2020 project

Intelligent Energy  Europe

**OBJECTIVE:** To analyze the dynamics of the RES implementation in EU27, given the 2020 targets as proposed by the Directive on the promotion of the use of energy from renewable sources.

<http://www.res2020.eu>

**FUNDED** by the Intelligent Energy for Europe programme (2006-2009)

**MODEL:** Pan-European TIMES model

*This presentation = only the results for Spain*

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## RES2020 project- Scenarios

	<b>BaU</b>	<b>RES Ref</b>	<b>RES Trade</b>	<b>RES 30%</b>
<b>RES policies or targets</b>	Existing ones in countries (feed-in tariffs, etc.)	As in RES Ref  Directive 12/2008: - <i>RES final energy</i> 20% by 2020 and trajectory towards 2020 - <i>RES transport</i> 5.75% by 2010 and 10% by 2020	As in RES Ref	As in RES Ref
<b>EU Climate policy targets</b>	No quantity limits but CO2 tax in ETS: from 20€ in 2010 to 24€/tCO2 in 2030	As in RES Ref  Directive proposal: 20% reduction by 2020 from 1990 (max 3.6 GtCO2 in 2020)	As in RES Ref	As in RES Ref  30% reduction by 2020
<b>MS Allocation</b>	None	Directive proposal (Spain = -10%. Max 183.6 MtCO2)	As in RES Ref	As in RES Ref
<b>Virtual trade in RES</b>	Not allowed	Not allowed	Allowed	Not allowed
<b>Fossil prices</b>	According to WEO2008 (IEA)			
<b>Other assumptions</b>	Consistent with PRIMES baseline as far as underlying PRIMES data are available			

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## Spanish Energy System

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## Overview of the Spanish energy context

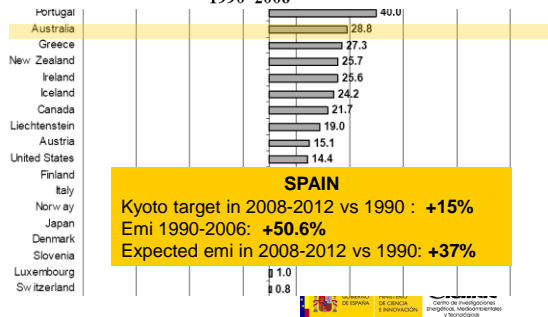
**Spain is strongly dependent on energy imports (79% of primary energy in 2007):** Scarcity in domestic fossil resources, energy security issues

**Uncertain future nuclear policy** (18% of elc in 2007): no nuclear moratorium, promotion of the extension of the technical life of the existing nuclear power plants

### Strong increase of emissions

- Difficulties in complying with the Kyoto target
- Strong reduction effort needed
- Spain started buying permits from Hungary (6 MtCO<sub>2</sub>) and is negotiating with other Eastern European countries

Changes in total aggregate emissions of individual Annex I Parties, 1990–2006



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## Overview of the Spanish Energy context

**Good potential for renewable (solar, wind) with dynamic wind and solar industries**

- At the end of 2008, installed wind capacity 16.6 GW, solar PV 3 GW
- Modification of the feed-in tariff for solar PV in 2008

### Domestic policies

- 1) Fiscal incentives: Feed-in tariffs, investment subsidies
- 2) Renewable Energy Plan 2005-2010
- 3) Plans for Energy Saving and Efficiency 2005-2007, 2008-2012
- 4) Other measures includes in the Climate Change Strategy such as the National

Allocation Plans

### Renewable Energy Plan 2005-2010

- ▶ **RNW = 12%** of the primary energy
- ▶ **30%** of the electricity (hydro excl)
- ▶ **Biofuels = 5.83%** of the gasoline & diesel consumed by transport in 2010 (3.4% in 2009) with minimum levels for gasoline and diesel



**Rapidly changing energy system, dynamic policies**  
 ⇒ **Decision-making challenges, but also modelling challenges !**

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# TIMES-Spain: Examples of data requirement and assumptions

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## Existing and future energy system

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**Initial year for calibration of the energy balance:** 2000 (Eurostat database + domestic data)

**Adjustments to reflect the changes already observed in the energy system :** 2005 (eg. Penetration of CCGT, of wind, etc.)

**Future energy service demands:** Based on POP (Eurostat consistent with INE projections) and macro-economic projections (macro-economic modeling)

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# Existing and future energy system

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## Current Spanish energy policies

**Included:** Fiscal incentives (feed-in tariffs, as modified by the RD of Sept. 2008), investment subsidies. Limit on the overall money spent over 2005-2020.

**Not included (in this project):** Renewable Energy Plan (PER), Plan for Energy Saving and Efficiency, Kyoto target (but carbon tax included for the ETS) and NAP.

**Nuclear:** No new nuclear plant, constant existing capacity (difference with the PRIMES assumptions).

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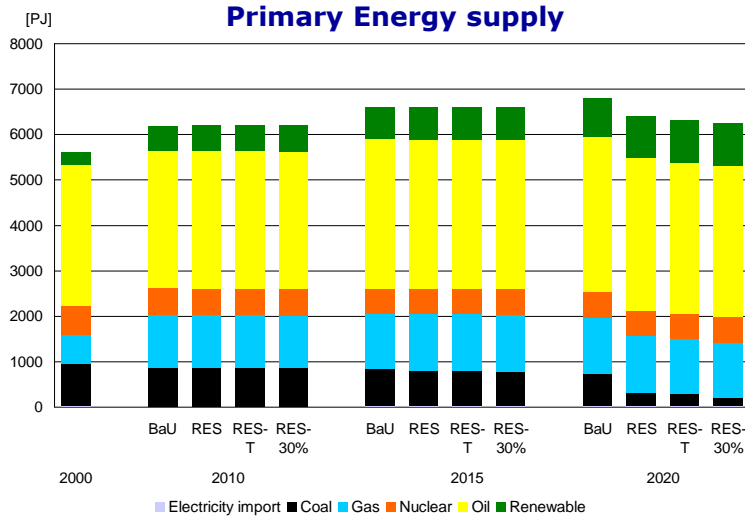
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## Results

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# Results

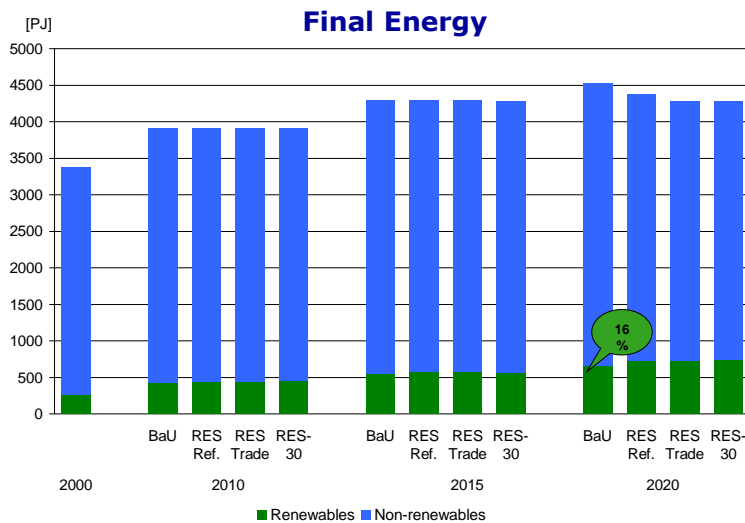


- 2010 PER objectives (12% renewable) not reached, 9% in all scenarios

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# Results



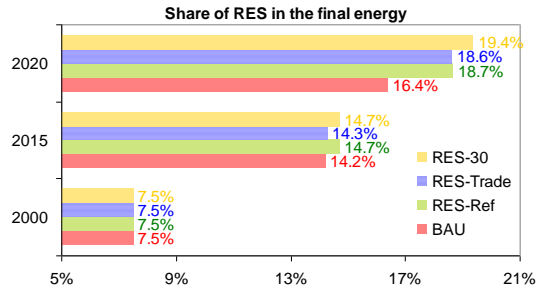
- The establishment of policies leads to a decrease in final energy use in 2020

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# Results

## Share of RES in final energy

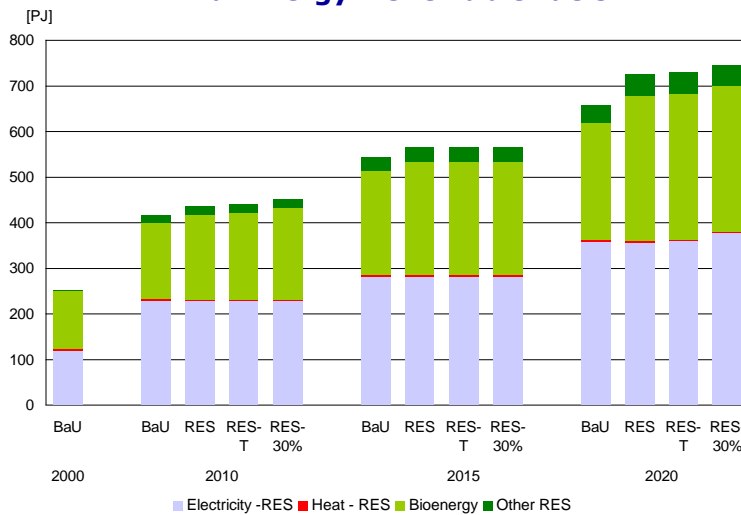


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# Results

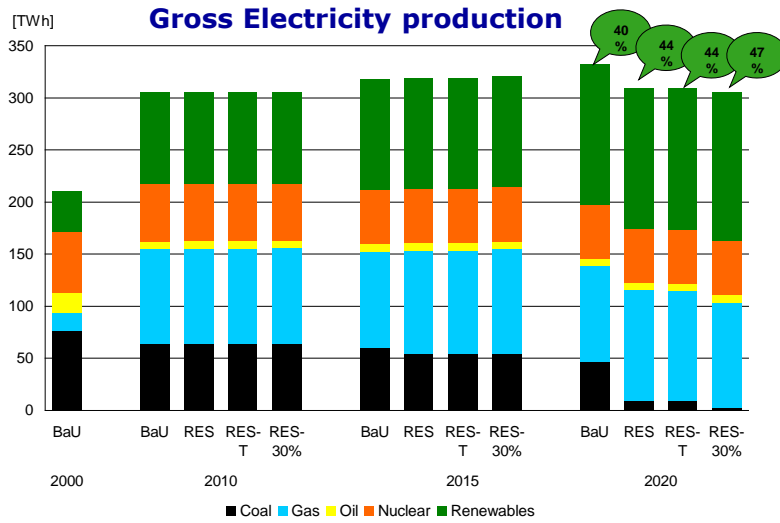
## Final Energy-Renewable fuels



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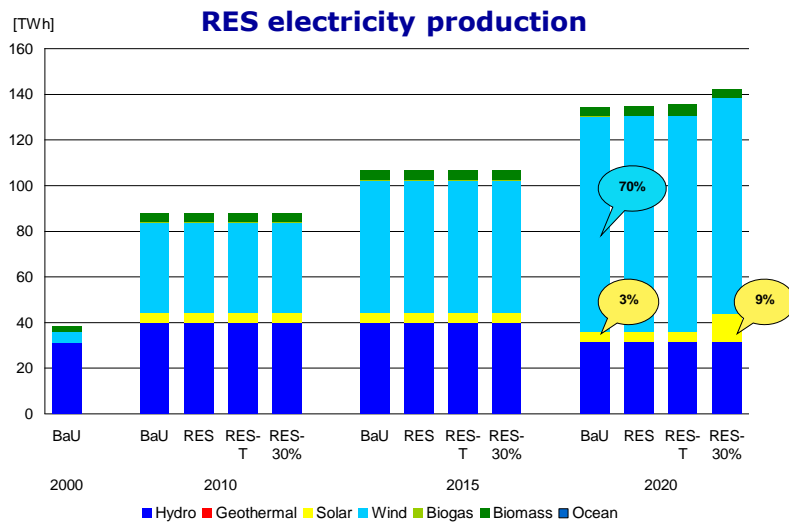
## Results



- 2010 PER objectives (30% renewable without hydro) not reached, 16% in all scenarios
- ETSAP Workshop, June 2009**



## Results



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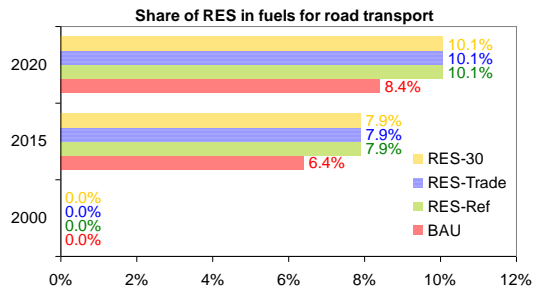
# Results

## Transport fuels

In road transport, non-fossil fuels:

	2010	2020
BAU	4.5%	8.4%
RES	5.8%	10.1%

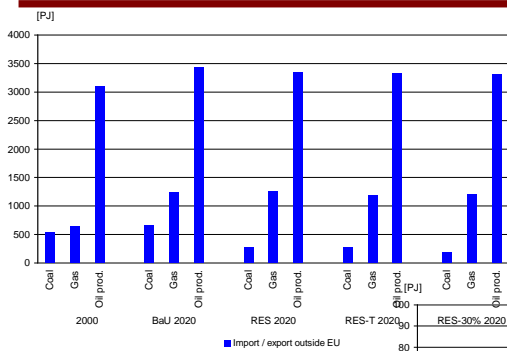
- Climate targets and green certificates trade do not promote the use of biofuels beyond the targets of the Directive



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# Results

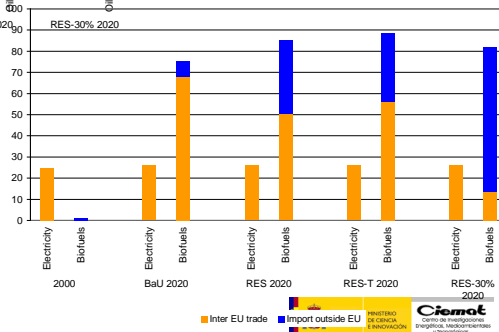


## Trade

- No reduction in energy dependence

## Inter-EU trade and imports

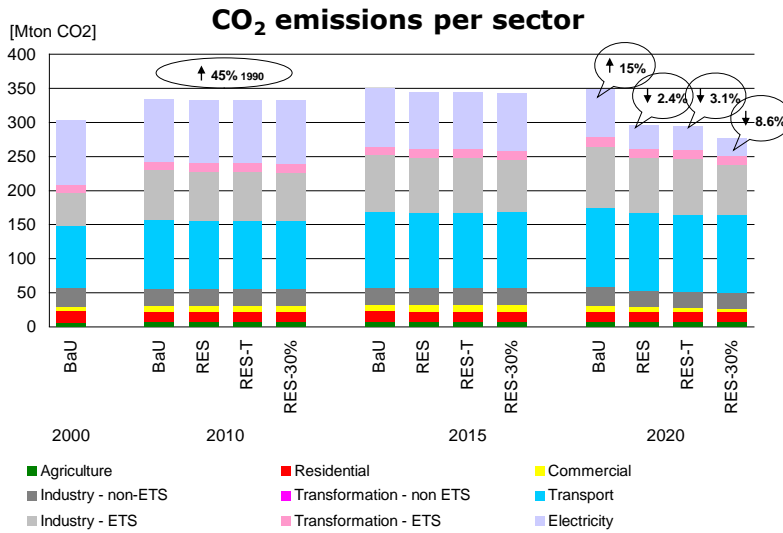
- More dependence on biofuels imports



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# Results



• Kyoto targets are far from be reached. Need to buy permits

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# Conclusions

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## Conclusions 1/3

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- **RES targets lead to:**
  - A reduction in the final energy consumption (conservation)
  - Renewable supplying more than 44% of total power generation by 2020. But the total installed capacity does not increase
  - Close to 20% of total heat production
  - 10% of road transport fuels. Not more than the target.
  - These figures are similar to those for the EU27 results in RES2020, but higher for renewables in power generation (around 35% in EU27)
  - Only the stricter climate target of RES-30% scenario drives up the renewable electricity, substituting coal power plants
- **The existing policies** as modeled in the BaU (feed-in tariff, CO2 tax on the ETS) **almost reach the REN target**, but at the contrary, **not the biofuel target in transport**.

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## Conclusions 2/3

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- **So, the RES target in 2020 can be met in Spain mainly by:**
  - Reduction of the final energy consumption (conservation, energy efficiency)
  - Maintaining the electricity production from RES (with a dominant role by wind) as observed in the base case
  - Heat production from bioenergy, and
  - Biofuels in transport (but the latter are driven by the specific constraint of the Directive, not by the CO2 target)
- Both, current measures and RES climate and energy targets, lead mainly to a **reduction of coal consumption, higher in RES scenarios**
- Spain is a seller of **green certificates** when allowed

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## Conclusions 3/3

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- **Regarding the Spanish PER target in 2010, it is not reached:**
  - 16% RES (no hydro) in total power generation against the 30% objective
  - 9% RES in total primary energy against the 12% objective
- **Renewable and climate policies do not reduce energy dependence on imports.** Moreover, stricter CO2 targets increase the dependence on biofuel imports
- **The Kyoto target is not satisfied, need to buy permits**
- **RES scenarios do not represent higher costs for renewable technologies until 2020.** RES-30% costs are still lower than in BaU
- **Further possible analyses:** Nuclear policies? Potentials for energy crops, solar and wind?

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## Thank you !

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Questions or comments  
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### References

- RES2020 project: <http://www.res2020.eu>
- Maryse Labriet, Helena Cabal y Yolanda Lechón. 2009. "Country Report. Spain". RES2020 project. June 2009.
- Maryse Labriet, Helena Cabal y Yolanda Lechón. 2008. "Enhancement of the NEEDS-TIMES model: Data for Spain on Biomass Resources and Renewable Electricity". Informes Técnicos Ciemat nº 1148. Abril 2008.
- Maryse Labriet, María Laguna, Helena Cabal, Yolanda Lechón. 2008. "Review of the Renewable Energy Policies of Spain". Informes Técnicos Ciemat nº 1149. Marzo 2008.

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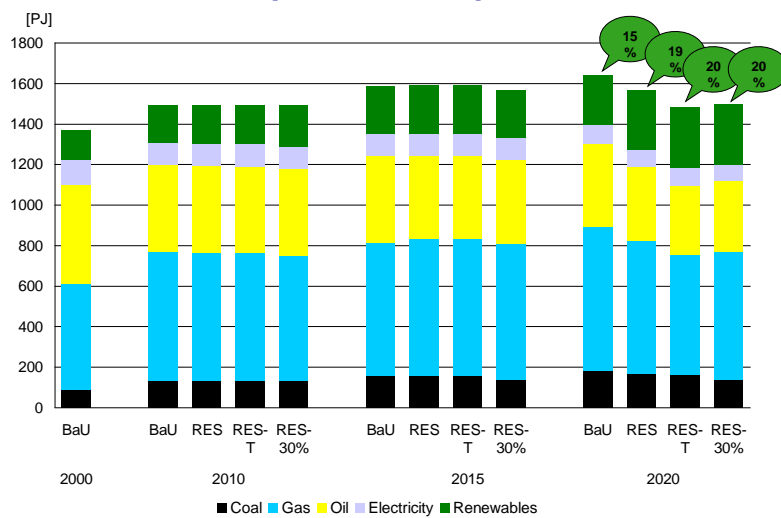
## Appendix

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## Results

### Fuel inputs for heat production

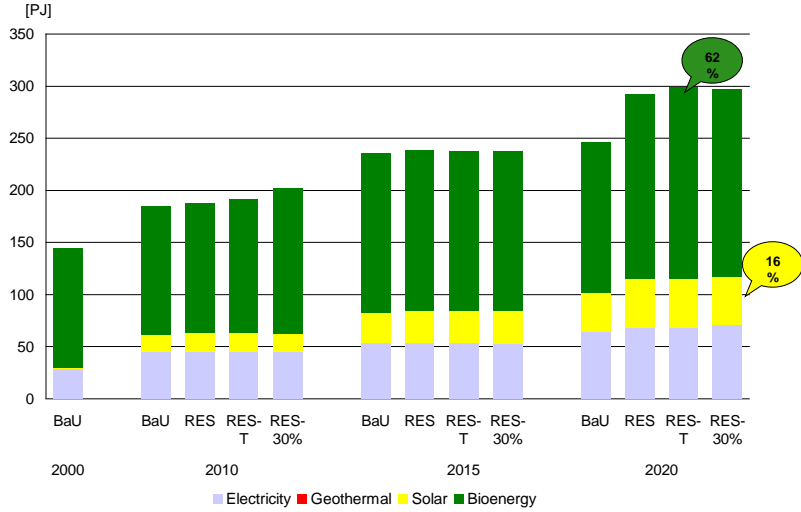


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# Results

## RES Heat production



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Annual growth rates	2005	2010	2015	2020	2025	2030
POP	1.40%	1.60%	1.10%	0.70%	0.40%	0.20%
GDP	2.80%	3.60%	3.30%	3.00%	2.80%	2.70%

To remove, even from the appendix. The GDP growths are not the ones used in the model

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## PER 2010

PLAN DE ENERGÍAS RENOVABLES EN ESPAÑA 2005-2010							
Electricity generation	2004 situation			Goal for 2010			% INCREASE
	POWER (MW)	PRODUC (GWh)	KTEP	POWER (MW)	PRODUC (GWh)	KTEP	
Hydraulic (>50Mw)	13521	25014	1979	13521	25014	1979	0%
Hydraulic (10-50 Mw)	2897	5794	498	3257	6480	557	12%
Hydraulic (<10 Mw)	1749	5421	466	2199	6692	575	26%
Biomass	344	2193	680	2039	14015	5138	593%
Biomass centrals	344	2193	680	1317	8980	3586	
Co-combustion	0	0	0	722	5036	1552	
SUR	189	1223	395	189	1223	395	0%
Wind	8155	19571	1683	20155	45511	3914	249%
Solar P.V.	37	56	5	400	609	52	1081%
Bio-gas	141	825	267	235	1417	455	167%
Thermosolar				500	1298	509	500%
<b>TOTAL</b>	<b>27032</b>	<b>60096</b>	<b>5973</b>	<b>42494</b>	<b>102259</b>	<b>13574</b>	<b>157%</b>

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## Structure of TIMES-Spain: end-use demands

Table 10. Residential and commercial end-use demands

Residential segment	Code	Unit
Space heating		PJ
Rsd.Space Heat.Single.Rural.Existing.	RHRE	
Rsd.Space Heat.Single.Urban.Existing.	RHUE	
Rsd.Space Heat.Multi.All.Existing.	RHME	
Space cooling		PJ
Rsd.Space Cool.Single.Rural.Existing.	RWRE	
Rsd.Space Cool.Single.Urban.Existing.	RWUE	
Rsd.Space Cool.Multi.All.Existing.	RWME	
Water heating		PJ
Rsd.Water Heat.Single.Rural.Existing.	RCRE	
Rsd.Water Heat.Single.Urban.Existing.	RCUE	
Rsd.Water Heat.Multi.All.Existing.	RCME	
Rsd.Cooking.Existing.	RCKO	PJ
Rsd.Refrigeration.Existing.	RREF	PJ
Rsd.Cloth Washing.Existing.	RCWA	PJ
Rsd.Dish Washing.Existing.	RDWA	PJ
Rsd.Cloth Drying.Existing.	RCDR	PJ
Rsd.Lighting.Existing.	RLIG	PJ
Rsd.Other Electric.Existing.	ROEL	PJ
Rsd.Other Energy.Existing.	ROEN	PJ
Commercial segment		PJ
Space heating		PJ
Com.Space Heat.Small.Existing.	CHSE	
Com.Space Heat.Large.Existing.	CHLE	
Space cooling		PJ
Com.Space Cool.Small.Existing.	CWSE	
Com.Space Cool.Large.Existing.	CWLE	
Water heating		PJ
Com.Water Heat.Small.Existing.	CCSE	
Com.Water Heat.Large.Existing.	CCLE	
Com.Cooking.Existing.	CCOK	PJ
Com.Refrigeration.Existing.	CRFP	PJ
Com.Lighting.Existing.	CLIG	PJ
Com.Public Lighting.Existing.	CPLI	PJ
Com.Other Electric.Existing.	COEL	PJ
Com.Other Energy.Existing.	COEN	PJ
Other sector consumption	ONE	PJ
Agriculture segment		PJ
Agriculture useful energy demand	AGR	PJ

Table 11. Industry end-use demands.

Description	Code	Unit	Marked by:
Iron and steel Demand	IS	Mt of Steel	Process
Aluminium Demand	IAL	Mt of Aluminium	Process
Copper Demand	ICU	Mt of Copper	Process
Other Non Ferrous Metals Demand	INF	PJ	End-use
Ammonia Demand	IAM	Mt	Process
Chlorine Demand	ICL	Mt	Process
Other Chemicals Demand	ICH	PJ	End-use
High Quality Paper Demand	IPH	Mt of High Quality Paper	Process
Low Quality Paper Demand	IPL	Mt of Low Quality Paper	Process
Cement Demand	ICM	Mt of Cement	Process
Glass Flat Demand	IGF	Mt of Glass Flat	Process
Glass Hollow Demand	IGH	Mt of Glass Hollow	Process
Lime Demand	ILM	Mt of Lime	Process
Other Non Metal Minerals Demand	INM	PJ	End-use
Other Industries and Adjustment	IOI	PJ	End-use
Non Energy Uses - Chemicals	NEC	PJ	Fuel
Non Energy Uses - Others	NEO	PJ	Fuel

Table 14. Transport end-use demands

Description	Code	Unit
Cars, short distance	TCS	10E9 passenger-r-kms
Cars, long distance	TCL	10E9 passenger-r-kms
Freight (long distance)	TFR	10E9 ton-kms
Buses, Urban	TBU	10E9 passenger-r-kms
Buses, Intercity	TBI	10E9 passenger-r-kms
Motors, Three wheelers, Off road	TMO	10E9 passenger-r-kms
Rail Freight	TRF	10E9 ton-km
Rail Passengers Light	TRL	10E9 passenger-r-kms
Rail Passengers Heavy	TRH	10E9 passenger-r-kms
Generic aviation	TAV	PJ
Generic navigation	TNA	PJ