



Sophia-Antipolis, 15 December 2008



EC-RES2020 project: preliminary results; the TIMES-UK model

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RES2020 and the Pan European TIMES Model



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1. RES2020 and the Pan European TIMES (PET) Model
2. The TIMES-UK Model
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Objectives

- RES2020 (Renewable Energy Sources – “Monitoring and Evaluation of the RES directives implementation in EU27 and policy recommendations for 2020) aims at analysing the present situation in the RES implementation, defining future options for policies and measures, calculating concrete targets for the RES contribution that can be achieved by the implementation of these options and finally examining the implications of the achievement of these targets to the European Economy.

Direct Outcomes

- An independent monitoring of RES policies in EU27.
- A detailed energy model covering the Pan European Times model, which includes detailed modelling of RES on a country level basis.



Important Aspects of the Model

- Open-Transparent model
- Country models are build by country modelers with local insight
- Input is requested by National energy experts through the project – on the level of data and the results analysis





Pan European TIMES Model Description



The Pan European Times Model is a multi-regional model built with TIMES for the EU27.

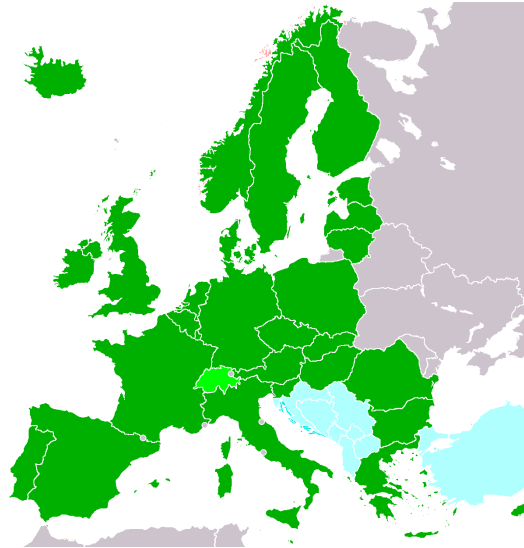
- The PET has been originally developed in the
 - NEEDS project (Integrated Project on New Energy Externalities – Developments for Sustainability) and
 - Recalibrated/improved in RES2020 adding:
 - new demand projection from country modellers
 - new and more detailed technologies and processes in the supply and demand chain of the renewable energy sources
 - more detailed representation of technologies for electricity production from RES and
 - constraints related to their availability.



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Pan European TIMES Model Description



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Pan European TIMES Model Wind Availability



Wind availability factor by country used in the PET model

	AT	BG	BE	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IT	LT
Onshore																
Spring	0.167	0.257	0.210	0.257	0.167	0.167	0.202	0.21	0.252	0.21	0.206	0.257	0.167	0.099	0.204	0.21
Summer	0.103	0.333	0.126	0.333	0.103	0.103	0.107	0.16	0.182	0.16	0.149	0.333	0.103	0.057	0.164	0.16
Fall	0.178	0.238	0.202	0.238	0.178	0.178	0.199	0.27	0.200	0.27	0.187	0.238	0.178	0.060	0.144	0.27
Winter	0.272	0.341	0.265	0.341	0.272	0.272	0.296	0.30	0.259	0.30	0.256	0.341	0.272	0.138	0.217	0.30
Offshore																
Spring		0.343	0.41	0.343	0.356	0.36	0.39	0.31	0.45	0.31	0.40	0.34		0.427	0.44	0.31
Summer		0.445	0.24	0.445	0.218	0.22	0.25	0.23	0.32	0.23	0.29	0.44		0.247	0.35	0.23
Fall		0.318	0.39	0.318	0.380	0.38	0.39	0.39	0.35	0.39	0.37	0.32		0.257	0.31	0.39
Winter		0.455	0.52	0.455	0.579	0.58	0.53	0.42	0.46	0.42	0.50	0.46		0.591	0.47	0.42

	LU	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK	UK
Onshore												
Spring	0.167	0.21	0.257	0.214	0.192	0.252	0.232	0.167	0.182	0.204	0.167	0.199
Summer	0.103	0.16	0.333	0.121	0.180	0.151	0.187	0.103	0.128	0.164	0.103	0.115
Fall	0.178	0.27	0.238	0.191	0.284	0.193	0.253	0.178	0.223	0.144	0.178	0.120
Winter	0.272	0.30	0.341	0.283	0.322	0.281	0.276	0.272	0.284	0.217	0.272	0.275
Offshore												
Spring		0.31	0.343	0.41	0.31	0.39	0.39	0.356	0.35	0.441		0.43
Summer		0.23	0.445	0.23	0.29	0.23	0.31	0.218	0.24	0.353		0.25
Fall		0.39	0.318	0.37	0.45	0.30	0.42	0.390	0.42	0.311		0.26
Winter		0.42	0.455	0.54	0.51	0.43	0.46	0.579	0.54	0.467		0.59



Pan European TIMES Model Biofuels and Biomass



- The basic enhancements are:
 - Differentiation of potentials of energy crops with different costs, taking into account land-use competition between different crops.
 - Rape oil as an intermediate product that also can be imported or traded.
 - Ethanol production from sugar as well as from starch crops
 - the available potential of bioenergy, taking in mind sustainability issues. The main sources of data for bioenergy are a number of studies contacted by ECN.
 - Biofuels and biomass trade (land and sea trading)





Pan European TIMES Model Land Availability



Competing land use requirements for Europe's food and livestock sector as well as land use conversion from agriculture to other uses, in particular built-up and associated land areas, will determine future availability of land for energy crop production.

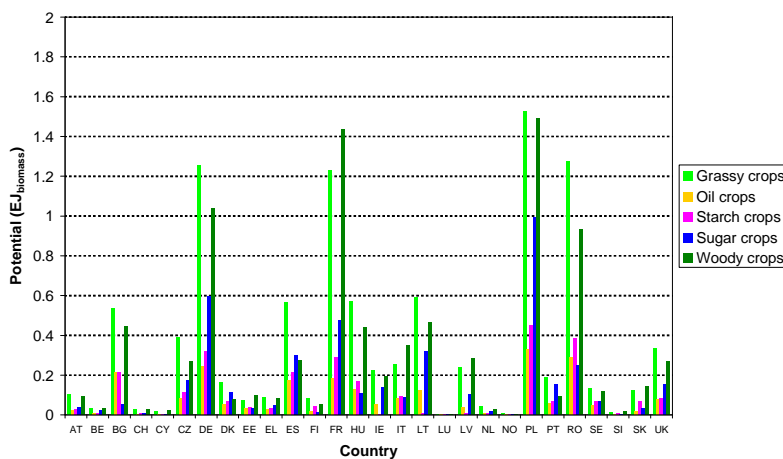
Future food and feed area requirements are the result of developments in food demand combined with changes in production intensity and trade of agricultural products. Moreover, areas of high nature conservation value are excluded from the potential biofuel crop area. All these data were adopted from the REFUEL project (www.refuel.eu).



Pan European TIMES Model Potential bio-energy crops EU

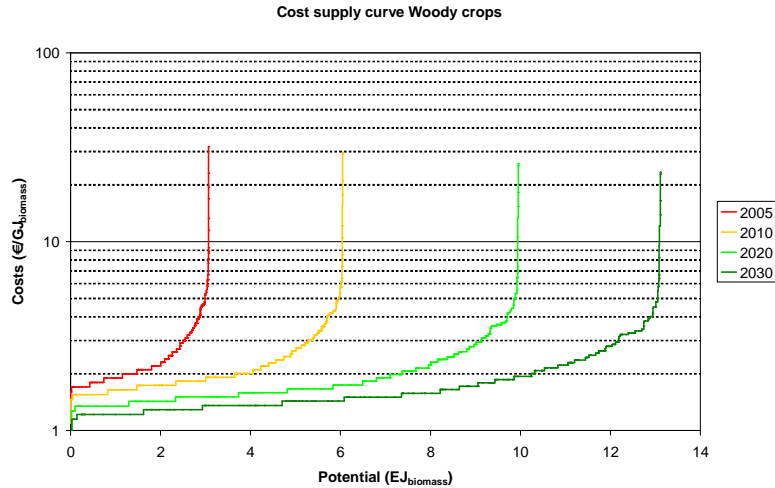


Crop potential in 2030





Pan European TIMES Model Cost supply curve woody crops EU



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The TIMES-UK Model White Paper on Energy



Meeting the Energy Challenge (a White Paper on Energy) May 2007

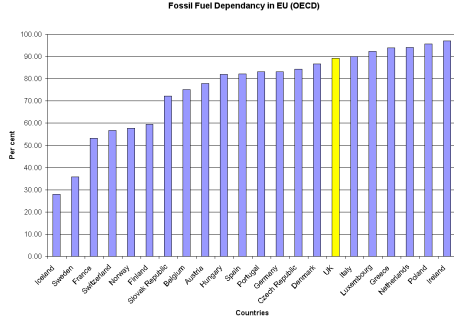
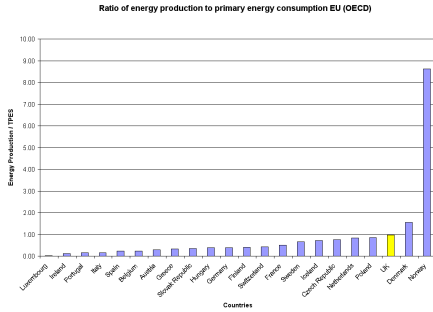
- the current share of renewables in the UK's total energy mix is around 2% and for the EU as a whole around 6%. Projections indicate that by 2020, on the basis of existing policies, renewables would contribute around 5% of the UK's consumption and are unlikely to exceed 10% of the EU's.
- there is uncertainty as to the size and nature of the UK's contribution to the EU greenhouse gas and renewables targets (as for other EU countries)
- expected decline in nuclear generating capacity



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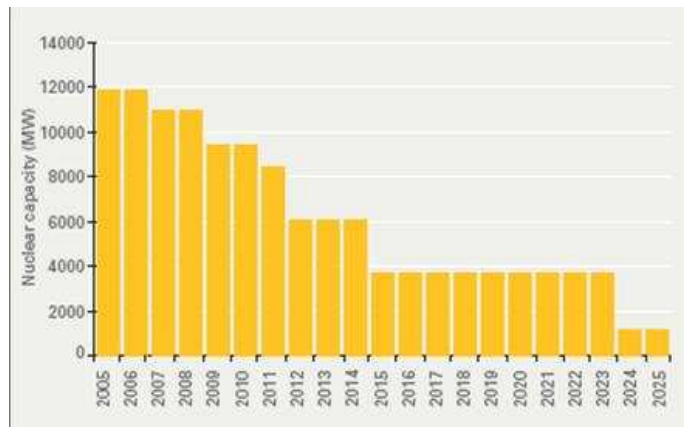
The UK Energy Situation



The UK Energy Situation



Expected decline in nuclear generating capacity



Source: DTI





The TIMES-UK Model



The UK's contribution to the EU greenhouse gas and renewables targets (as for other EU countries) can be evaluated in the PET model.

The PET model give the possibility to analyse:

- the contribution from each of the EU27 countries
- the full implications of local proposals on the overall energy mix and
- the wider implications for energy policy including electricity, bio-energy and green certificates trade.



The TIMES-UK Model Methodology



The core of work has been to describe:

- the UK energy system: searching, elaborating, adjusting and putting in the input file all the description data required according to the detail level built (the same for all countries) from the defined Reference Energy System, in order to reproduce the EUROSTAT energy balance for the base year, sector by sector and sub-sector by sub-sector.
- scenarios definition and implementation in the PET model.





The TIMES-UK Model Data Source



Books, articles and other sources

- Department for Transport, " The Future of Transport", 2004.
- Department for Transport, "Transport Statistics Bulletin", 2003.
- DTI, "Energy white paper – Our energy future – creating a low carbon economy", 2003.
- DTI, "Digest of United Kingdom Energy Statistics", 2005
- DTI, "National Statistics, "Energy Consumption in the United Kingdom", 2002.
- DTI, "Renewable innovation review", 2004.
- DTI, "The Energy Challenge - Energy Review report 2006"
- DTI, "UK Coal Production", 2004
- Office of the Deputy Prime Minister, "Commercial and Industrial Floorspace and Rateable Value Statistics 1998-2004", 2005.
- Shorrock L. D. , Utley J.D. - BRE -, "Domestic Energy fact file", 2003.
- Screse I., - The Association for the Conservation of Energy -, "White collar CO2 : Energy consumption in the service sectors", 2000.
- Walker A. , Maher J. , Coulthard M. , Goddard E. , Thomas M. , - National Statistics - , "Living in Britain", 2001.



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Scenarios



Contents

1. Reference - BaU
2. RES Reference
3. RES Trade

December 12, 2008
Decision of the EU Council about RES2020 Directive



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BaU Scenario Basic Assumptions

Discussion with DGTREN concluded that the BaU scenario should use the same background assumptions as the Baseline Scenario in the:

"European energy and transport: Trends to 2030 – Update 2007"
as published by DGTREN.



- **Nuclear energy assumptions**
 - Early decommissioning of nuclear in new MS before 2010
 - Firm decisions about new nuclear plants
- **Renewables**
 - Support mechanisms per country
- **Biofuels directive**
 - No target for 2005 and 2010 in the BaU scenario
- **New Energy Carriers**
 - No subsidies (e.g. hydrogen, CCS, etc.)
- **Discount rate**
 - By sector (e.g. Households 17.5%)
- **CO2 Tax**
 - No bound
 - ETS scheme operates at a clearing price of 20€(2005)/tonCO₂ in 2010. For the post-Kyoto period carbon prices increase smoothly to 24€(2005)/tonCO₂ in 2030 and this price applies to the current ETS sectors.





Scenario Assumptions



- **Demographic Assumptions**
 - Eurostat data
- **Macroeconomic Outlook**
 - GEM-E3 data (e.g. GDP)
- **Useful Energy Demand Projection based on**
 - the macroeconomic and demographic assumptions
 - country modellers projection (if available)
- **Renewable Energy Potential and Prices**
 - Different sources
- **Endogenous Trading**
 - Electricity and bio-energy



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Scenario Assumptions



Scenario RES Reference

Renewable Energy Sources Target per Member State

The target for renewable energy sources in 2020 is imposed per country, following the path as given in the directive proposal.

The path is used as a lower bound in the solution of the model.



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Scenario Assumptions



RES target and path per country

According to the proposed Directive

	Country	Share 2005	Share average 2011-2012	Share average 2013-2014	Share average 2015-2016	Share average 2017-2018	Share 2020
BE	Belgium	2.2%	5%	6%	7%	9%	13%
BG	Bulgaria	9.4%	11%	12%	12%	14%	16%
CZ	Czech	6.1%	8%	9%	9%	11%	13%
DK	Denmark	17.0%	20%	22%	23%	25%	30%
DE	Germany	5.8%	9%	10%	11%	14%	18%
EE	Estonia	18.0%	20%	20%	21%	23%	25%
IE	Ireland	3.1%	6%	8%	9%	11%	16%
GR	Greece	6.9%	10%	11%	12%	14%	18%
ES	Spain	8.7%	12%	13%	14%	16%	20%
FR	France	10.3%	13%	15%	16%	19%	23%
IT	Italy	5.2%	8%	9%	11%	13%	17%
CY	Cyprus	2.9%	5%	6%	7%	9%	13%
LV	Latvia	34.9%	37%	37%	38%	40%	42%
LT	Lithuania	15.0%	17%	18%	19%	20%	23%
LU	Luxembourg	0.9%	3%	4%	5%	7%	11%
HU	Hungary	4.3%	6%	7%	8%	10%	13%
MT	Malta	0.0%	3%	4%	5%	7%	10%
NL	Netherlands	2.4%	5%	6%	8%	10%	14%
AT	Austria	23.3%	26%	27%	28%	30%	34%
PL	Poland	7.2%	9%	10%	11%	12%	15%
PT	Portugal	20.5%	23%	24%	25%	27%	31%
RO	Romania	17.8%	19%	20%	21%	22%	24%
SI	Slovenia	16.0%	18%	19%	20%	22%	25%
SK	Slovak Republic	6.7%	9%	9%	10%	11%	14%
FI	Finland	28.5%	31%	32%	33%	35%	38%
SE	Sweden	39.8%	42%	43%	44%	46%	49%
UK	United Kingdom	1.3%	5%	6%	7%	10%	15%



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Scenario Assumptions



Biofuels

The biofuels target is imposed as a lower bound for all the Member states, to be 5.75% in 2010 and 10% in 2020.

Endogenous trade

Trade of electricity and bioenergy is endogenous in the scenario run.

Certificates trade

There is no virtual trade in renewable energy sources certificates in this scenario

Emissions

- Only CO2 emissions (following the same approach as PRIMES) although the model has all the other GHG emissions included.

- The total CO2 both from the ETS and non-ETS sectors, has the upper bound of 3591Mtons in EU27 for 2020. This value comes from GAINS, where the 20% reduction of the GHG emissions from the 1990 level, by 2020 is translated into a 18% reduction of CO2 only in the same year.

ETS Sectors: Full trade of CO2 from the ETS sectors with in EU27.

Non-ETS Sectors: An upper bound in the emissions of CO2 from the non-ETS sectors is imposed for 2020. The values in this table comes from GAINS and is what is used in the PRIMES runs as well.

Non-ETS

	CO ₂ Mtons
AT	43.2
BE	55.2
BG	15.8
CY	3.9
CZ	50.5
DE	359.7
DK	21.2
EE	4.3
ES	183.6
FI	21.3
FR	244.3
GR	44.8
HU	34.6
IE	27
IT	242.5
LT	7.5
LU	8.7
LV	6.1
MT	1.4
NL	90.5
PL	117
PT	34.1
RO	50.6
SE	30.3
SI	8.6
SK	16.5
UK	281.9
EU-27	2065.1



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Scenario Assumptions



Scenario RES Trade

All the other assumptions hold as in the Scenario RES Reference.

In this scenario a Green Certificate is allocated for each unit of Renewable Electricity that is being generated and each unit of a renewable energy carrier that is being used in the final energy consumption.

This Certificate can be used either for fulfilling the country's obligation for the 2020 target or it can be used for trading with the other countries.

So there is physical trade of electricity, bioenergy and at the same time there is trading of green certificates.



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Preliminary Results



Preliminary Results for the EU27 and UK



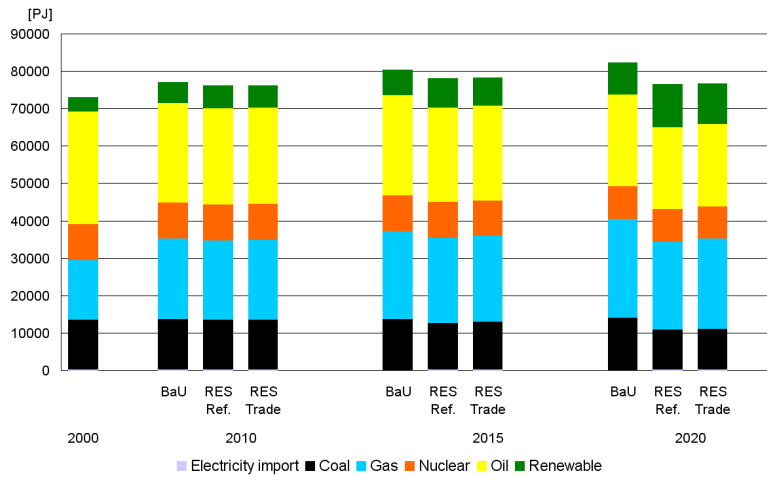
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Preliminary Results EU27



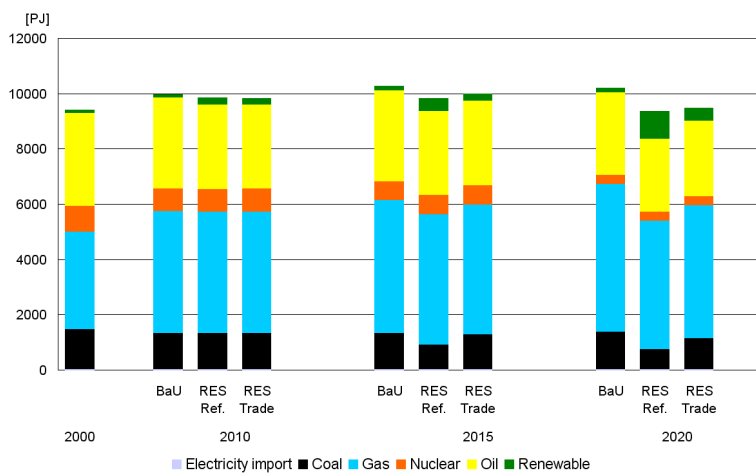
Total Primary Energy Supply



Preliminary Results UK



Total Primary Energy Supply

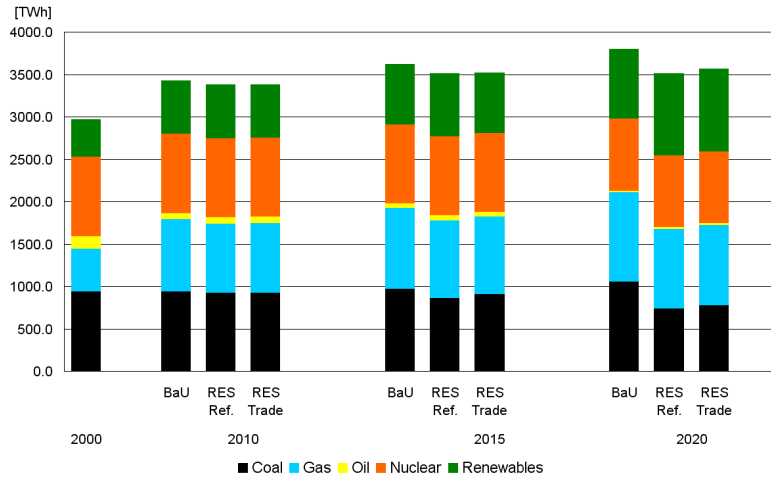




Preliminary Results EU27



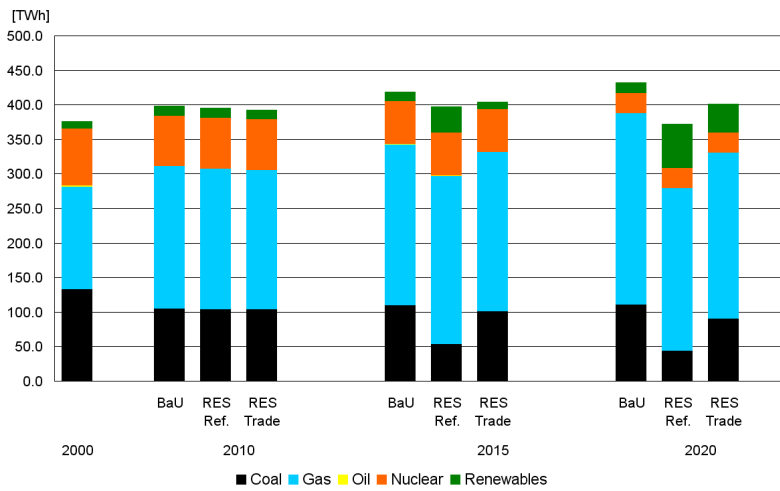
Electricity Production



Preliminary Results UK



Electricity Production

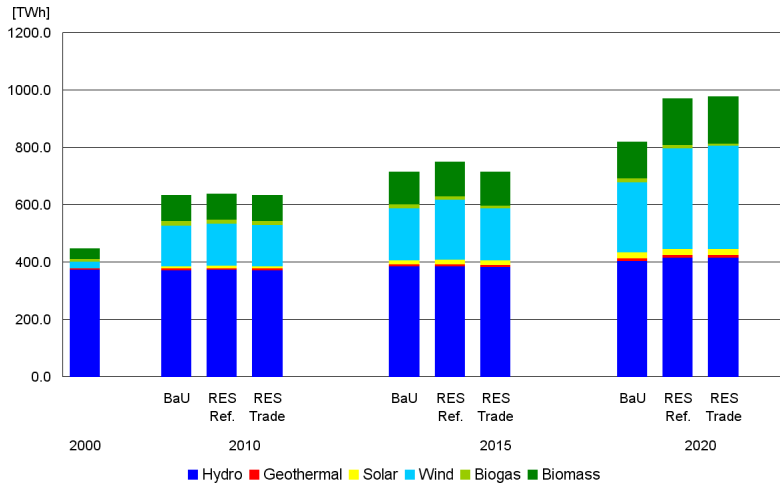




Preliminary Results EU27



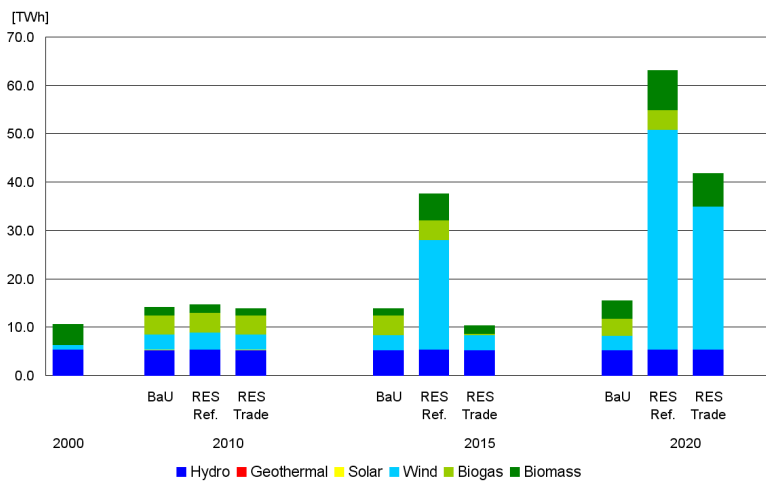
RES Electricity Production



Preliminary Results UK



RES Electricity Production

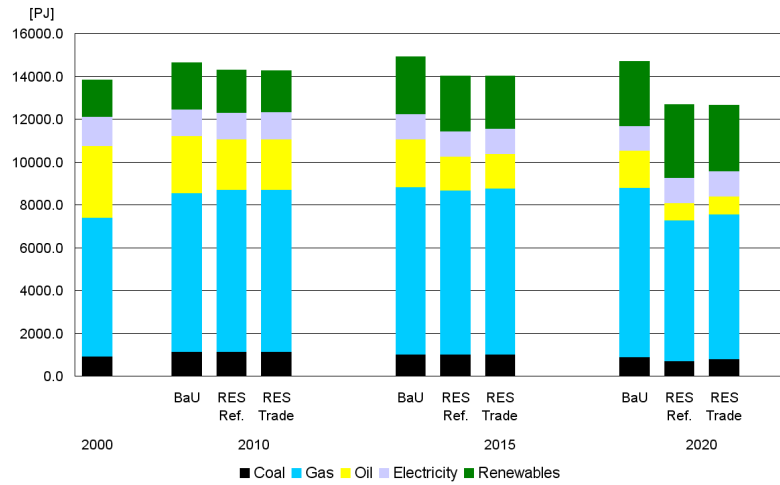




Preliminary Results EU27



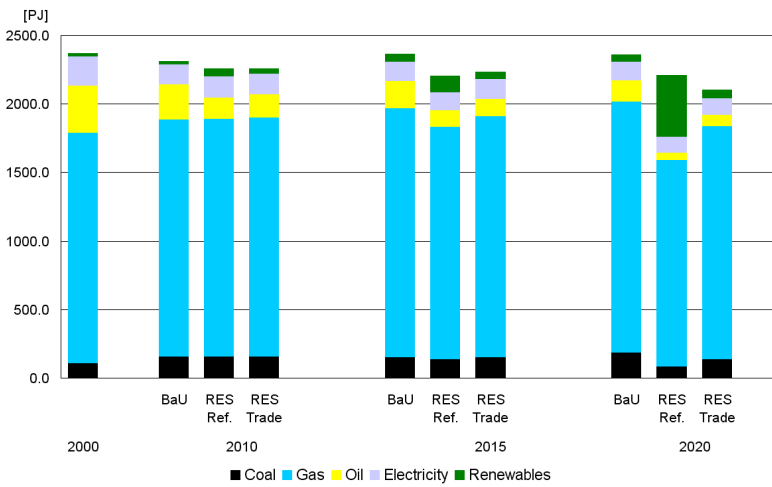
Consumption for Heat Production



Preliminary Results UK



Consumption for Heat Production

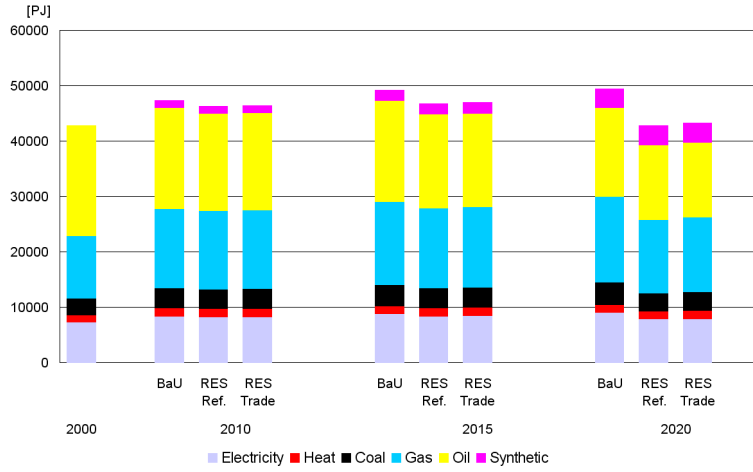




Preliminary Results EU27



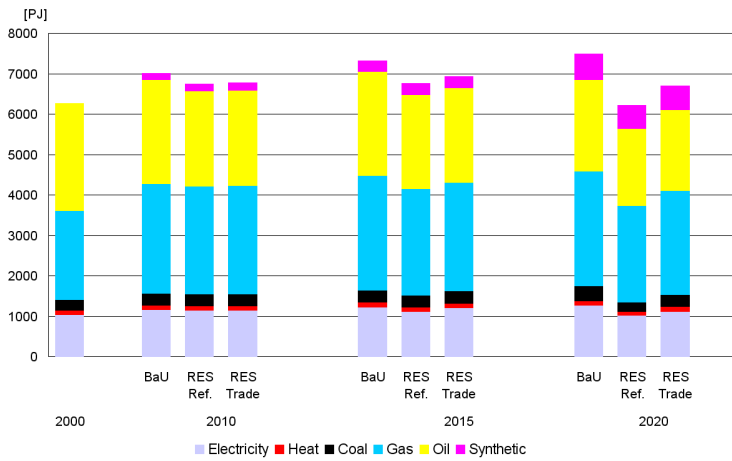
Final Energy Consumption – Non Renewable fuels



Preliminary Results UK



Final Energy Consumption – Non Renewable fuels

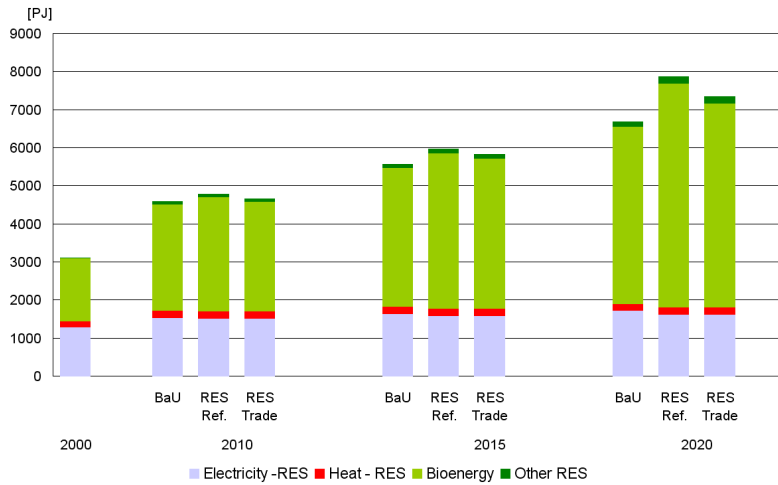




Preliminary Results EU27



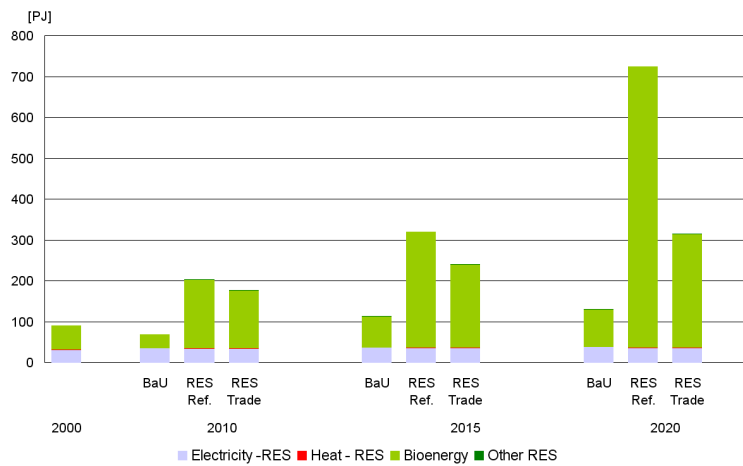
Final Energy Consumption – Renewable Energy



Preliminary Results UK



Final Energy Consumption – Renewable Energy

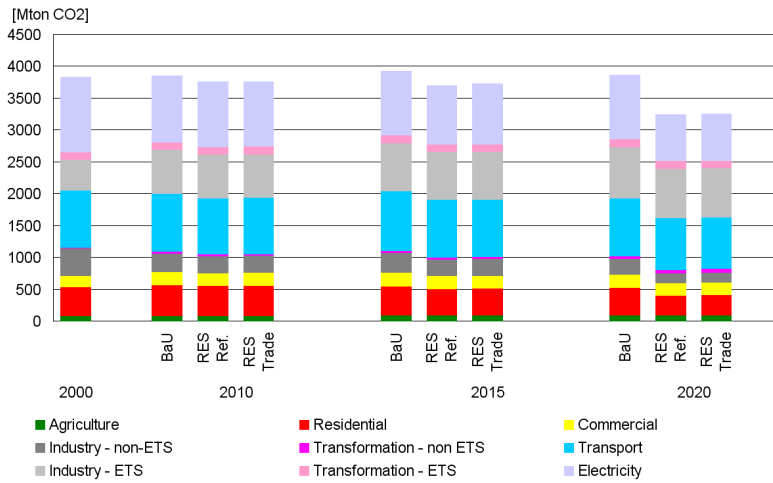




Preliminary Results EU27



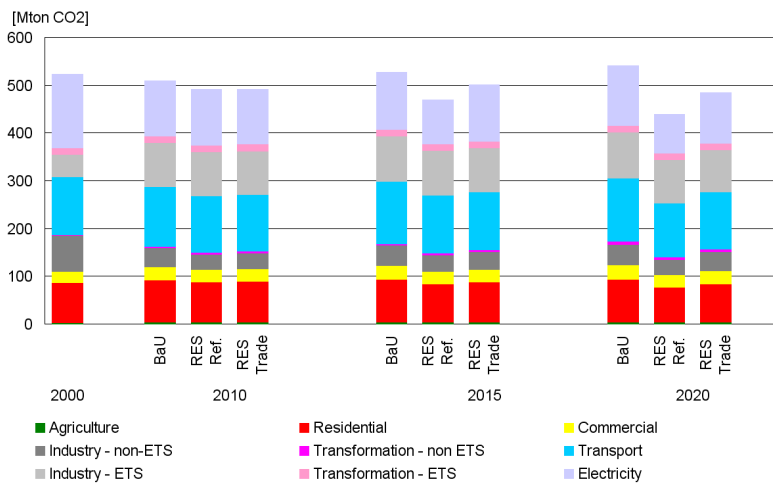
CO2 emissions per sector



Preliminary Results UK



CO2 emissions per sector

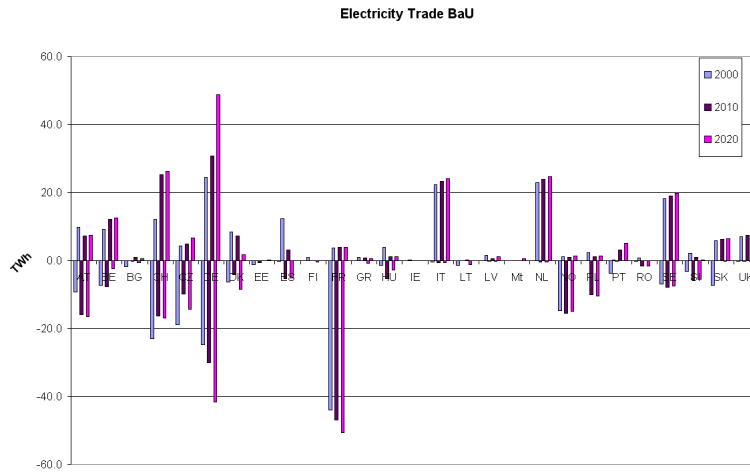




Preliminary Results EU27



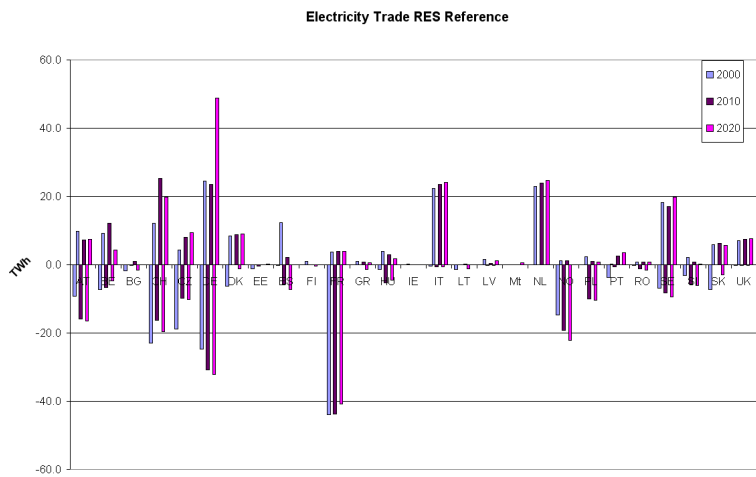
Inter- EU Electricity Trade BaU



Preliminary Results EU27



Inter- EU Electricity Trade RES Reference



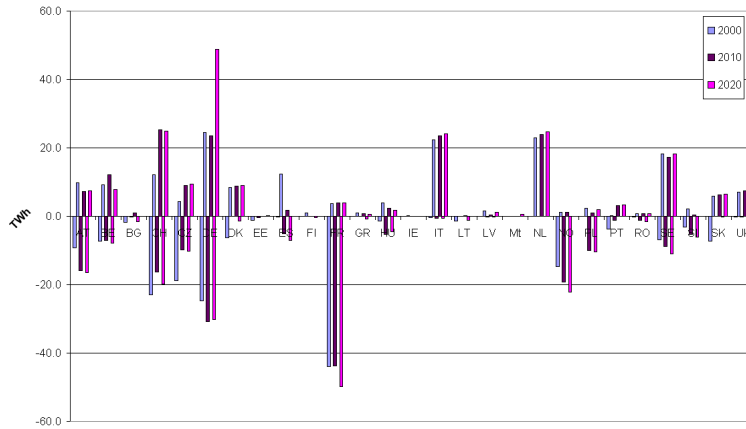


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Inter- EU Electricity Trade RES Trade

Electricity Trade RES Trade



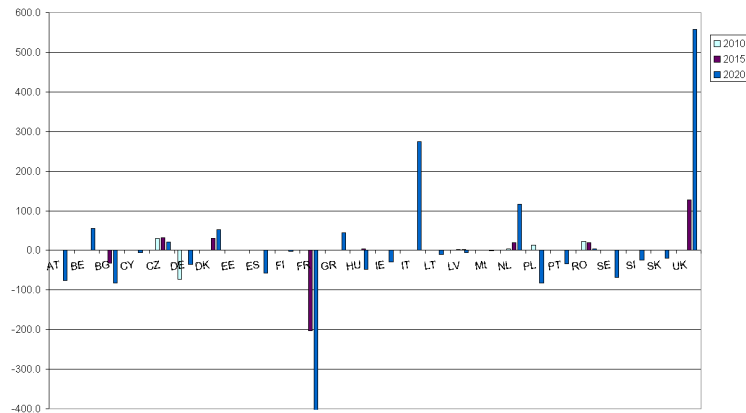
Preliminary Results EU27



Green Certificate trading – RES Trade scenario

The possibility of Trading of Green Certificates, reduces the physical trade of Biofuels and Biomass

Green Certificate trading - Non Electricity

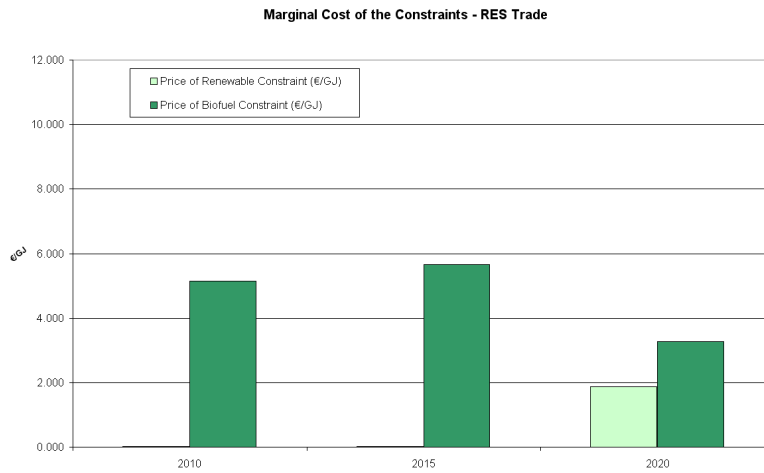




Preliminary Results EU27



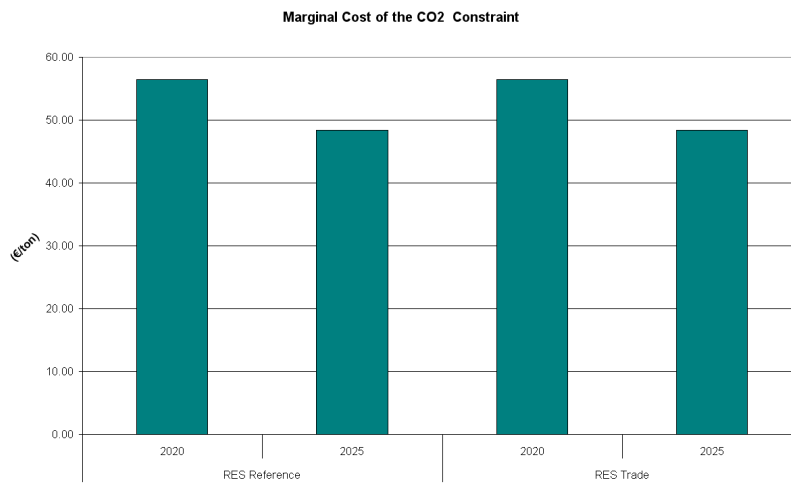
Marginal Price of the RES Constraint - RES Trade Scenario



Preliminary Results EU27



Marginal Price of the CO2 Constraint





Preliminary Results EU27



General Remarks

- Bioenergy use is preferred in the final energy consumption because of the way the target is imposed
- Electricity production is dominated by Wind and Hydro
- The cost of the CO2 constraint relative to the Renewables constraint shows that it is the GHG reduction target, that seems to "pull" the Renewable target
- In the case of GC trading, physical trade of bioenergy is reduced



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- Modelling Distributed Generation and Variable Loads from RES
- Technology Characterisation For Biofuels and Renewable Heating Cooling
- Proposal for Scenarios and Policy Packages

Presentations from the international workshop in Amsterdam 22 / 10 / 2007

- Project Description
- EU Policy and Market Development
- Modelling Biomass in TIMES
- Distributed Generation Modelling
- Wind Modelling
- Country and Policy Profiles



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THANK YOU!

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