The Pan European TIMES model for **RES2020**

Model description and definitions of Scenarios

Project no: EIE/06/170/SI2.442662

Background

The RES2020[1] project 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.

In the framework of the RES2020 project, in order to develop a model for analysing the renewable energy targets set by the European Union for 2020, the *TIMES* model generator is used.

TIMES is one of the tools developed and used by the Energy Technology Systems Analysis Programme (ETSAP)[2], an implementing agreement of the International Energy Agency.

The *TIMES* (**T**he **I**ntegrated **M**ARKAL-**E**FOM **S**ystem) is an economic model generator for local, national or multi-regional energy systems which provides a technology rich basis for estimating the development of the energy system over a long-term time horizon[3].

Some definitions are necessary at this point in order to make things clear:
The *TIMES* Model Generator is the computer programme, which processes a given set of data files (which constitute the model) and generates a matrix with all the coefficients that specify the economic equilibrium model of the energy system as a mathematical programming problem.
The model is a set of data files, which fully describe the energy system (technologies, commodities, resources, demands of energy services, in one or more regions) in a format compatible with the model generator.

[1] The RES2020 project is funded under the Intelligent Energy for Europe programme. More information at www.res2020.eu
[2] http://www.etsap.org
[3] "Documentation of the TIMES Model, Part I", April 2005.

TIMES is defined as a bottom-up technology rich optimisation model generator, with exogenously defined energy services demands.

What this means is:

Estimates of end-use energy service demands (e.g., car road travel; residential lighting; steam heat requirements in the paper industry; etc.) are provided by the modeller. In order to get these estimates the modeller must consult other models (e.g. economic, specialised models for transport etc) and use estimations about the future development of parameters like population, number of persons per households etc.

Estimates of the existing stock of energy related equipment in all sectors of economic activity are also provided by the modeller, as well as the characteristics of possible future technologies. The modeller must also provide estimates of the present and future sources of primary energy supply and their potentials.

Using these estimates as inputs, the *TIMES* model finds the optimal solution in order to satisfy the energy services demand at a minimum total cost, by simultaneously making decisions on equipment investment and operation, primary energy supply and energy commodities trade. Energy and environmental policies can be represented and analysed with accuracy, due to the explicit representation of technologies, fuels, energy related emissions and materials use, in all sectors of economic activity.

In *TIMES*, the quantities and prices of the various commodities are in equilibrium, i.e. their prices and quantities are such that the suppliers produce exactly the quantities demanded by the consumers.

The NEEDS - TIMES Pan European Model.

NEEDS[4] is a project funded by the 6th Framework Programme and in its framework a model for EU-27, Iceland Norway and Switzerland was developed, using the *TIMES* model generator. In this model the energy systems of each one of the thirty countries are modelled separately in detail. The Pan European Model is then synthesized by allowing trade of energy commodities among the countries. This model has been used as a starting point for building the *RES2020* model.

The level of analysis per sector of economic activity in each country, in the NEEDS-Pan European model, is rather detailed[5]. On the energy demand side the residential, commercial, agricultural, industrial, and transport sectors are analysed as described below.

- **Residential Sector**

The energy service demands that are being considered in the residential sector are very detailed. These are Space heating, Space Cooling, Water heating Cooking, Lighting, Refrigeration, Cloth washing, Cloth drying, Dish Washing, Other electric uses (equipment) and Other energy uses. Furthermore three building categories are used for the demands for space heating, space cooling and water heating, namely Multi apartment building, single house in urban areas and single house in rural areas.

- **Commercial Sector**

The energy service demands considered in the commercial sector are quite similar to the residential sector and include Space heating, Space Cooling, Water heating, Cooking, Refrigeration, Lighting, Public Lighting, Other electric uses (equipment), Other Energy Uses. Furthermore the energy service demands for space heating, space cooling and water heating are divided into two building categories, namely small and large commercial buildings.

[4] http://www.needs-project.org/
[5] "Draft common structure of the National country models" Deliverable D1.4, NEEDS project, August 2005

- **Agriculture**

Agriculture is not analysed in detail, but is represented as a single energy service demand satisfied by a single technology that consumes a mixture of fuels.

- **Transportation**

The transportation sector is analysed to road and rail transport of passengers and freight, domestic and international navigation as well as domestic and international aviation.

Passengers' road transport is further divided to Short and Long distance car transport, urban busses, intercity busses and motorcycles. Passenger's rail transport is further divided into Urban Metro transport and intercity train transport.

Freight transport is divided into road transport by trucks and intercity rail transport.

The aviation and navigation are split to domestic and international, without further analysis of alternative technologies.

- **Industry**

The industrial sector is analysed in detail following an initial division in to energy intensive industries and other industries.

The energy intensive industries are: Iron and Steel (see Figure 1), Aluminium, Copper, Ammonia, Chlorine, Cement, Lime, Glass, Paper. For each one of these industrial branches a detailed description of the production processes is being used in the model.

The industrial branches of other non-ferrous metals, other chemicals, other non-metallic minerals, and the remaining industries are not modelled in detail on a process basis but they are represented using the same generic structure with the energy uses of steam, process heat, machine drive, electrochemical processes and other processes.

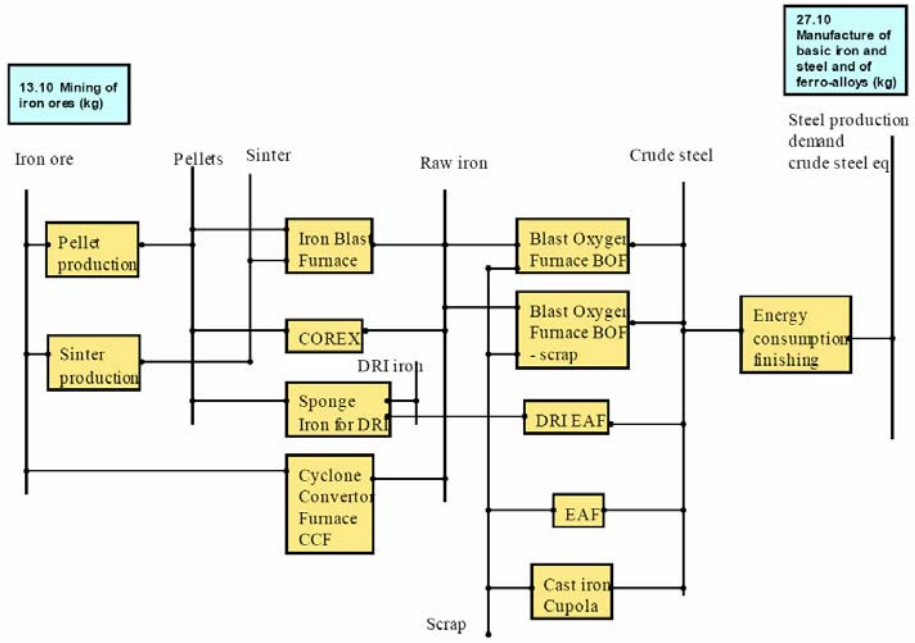

Figure 1: Production processes in the Iron and steel industry[6]

On the energy supply side, the electricity and heat production is analysed in detail, the refineries are modelled using a generic refinery structure and the mining and extraction of primary energy resources are modelled using a cost-supply curve.

- **Electricity and Heat production**

The electricity production sector is divided into public power plants and CHP plants, and auto production electricity power plants and CHP plants in the industrial and commercial sector. Nuclear power plants are modelled separately as well as discrete heating installations.

The high, medium and low voltage grids are included in the model, with different type of technologies being able to produce at different voltage, modelling **distributed generation** in this way. There are also two separated heat grids for high temperature and low temperature heat.

[6] "Draft common structure of the National country models" Deliverable D1.4, NEEDS project, August 2005

- **Primary resources**

The mining of each primary energy resource is modelled using a supply curve with three cost steps. Biomass is modelled, but not in detail regarding the production processes.

- **Emissions**

Emissions are also calculated in the model. These include Carbon Dioxide (CO_2), Carbon Monoxide (CO), Methane (CH_4), Sulphur dioxide (SO_2), Nitrogen Oxides (NO_x), Nitrous Oxide (NO), Particulate (PM 2.5 and PM 10), Volatile Organic Compounds (VOC), Sulphur hexafluorides (SF_6) and Fluor Carbons (C_xF_y).

The RES2020 Pan European TIMES model

In framework of the RES2020 project, the NEEDS-TIMES Pan-European model has been enhanced in the representation of Renewable Energy Sources.

A more detailed analysis of the availability factors for wind turbines has been performed using data from the production of the existing wind parks in the countries participating in the project. Monthly data for wind power are available from UCTE and Nordel for most countries from 2005. These data are easily converted to seasonal data following the time slices used in the model. For all countries with a significant capacity of wind power there is a common pattern of seasonal variation. Winter: 20-30 %, Fall: 20-25 % , Spring 15-25 %, and Summer: 10-20 %. Statistics for diurnal variations are available from few countries only (Denmark and Greece). Although the average daytime availability tends to be slightly higher than night-time availability, it is not recommended to consider this variation in the model.

Data for installed capacities by the end of the year are available from EWEA since 2004. At the end of 2006, offshore wind farm installations represented 1.8% of total installed wind power capacity, generating 3.3% of Europe's wind power (press release from EWEA 9 Oct. 2007). The largest share of offshore wind capacity is 13% in Denmark. For countries with coasts to the Atlantic Ocean, the North Sea the annual availability factor is set as 40 % with seasonal variations similar to onshore wind power. For countries in the Baltic Sea the Finnish assumption at 34 % is used (for more details see the "Modelling Distributed generation and Variable Loads from RES" document on the project website www.res2020.eu).

New decentralised electricity production technologies have been included in the technology database of the model. These include CHP power plants and IGCC power plants using Black Liquor in the Pulp and Paper Industry, wave power plants and tidal power plants, small CHP power plants using biomass as a fuel.

Further enhancements were made in the representation of biomass and biofuels in the model. The use of bioenergy per sector in the model is presented in the table that follows.

Table 1: Bioenergy use per sector in the model

Type	Industry	Residential and C&S	Agriculture	Transport	Biogas production	Biofuels production	Electricity production
Oil crops						X	
Starch crops					X	X	
Sugar crops					X	X	
Grassy crops	X	X	X		X	X	X
Woody crops	X	X	X		X	X	X
Forestry residues	X	X	X		X	X	X
Agricultural residues	X	X	X		X	X	X
Wood process. residues	X	X	X		X	X	X
Black Liquor	X				X	X	
Municipal waste	X	X					X
Industrial waste	X	X			X		X
Biogas	X	X	X	X			X
Biofuels	X		X	X			

Regarding biofuels most of the enhancements within RES2020 are made on the supply side, for instance on the differentiation of crop types and waste and residues sources to be used for the production of biofuels. Figure 2 gives an overview of the chains for biofuels and biogas production. The parts of the production chain that are yellow coloured are new. 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.

One of the most important issues regarding bioenergy is the available potential, especially taking in mind sustainability issues. The main sources of data for bioenergy are a number of studies contacted by ECN. The references are presented in detail in the next section on Data Sources.

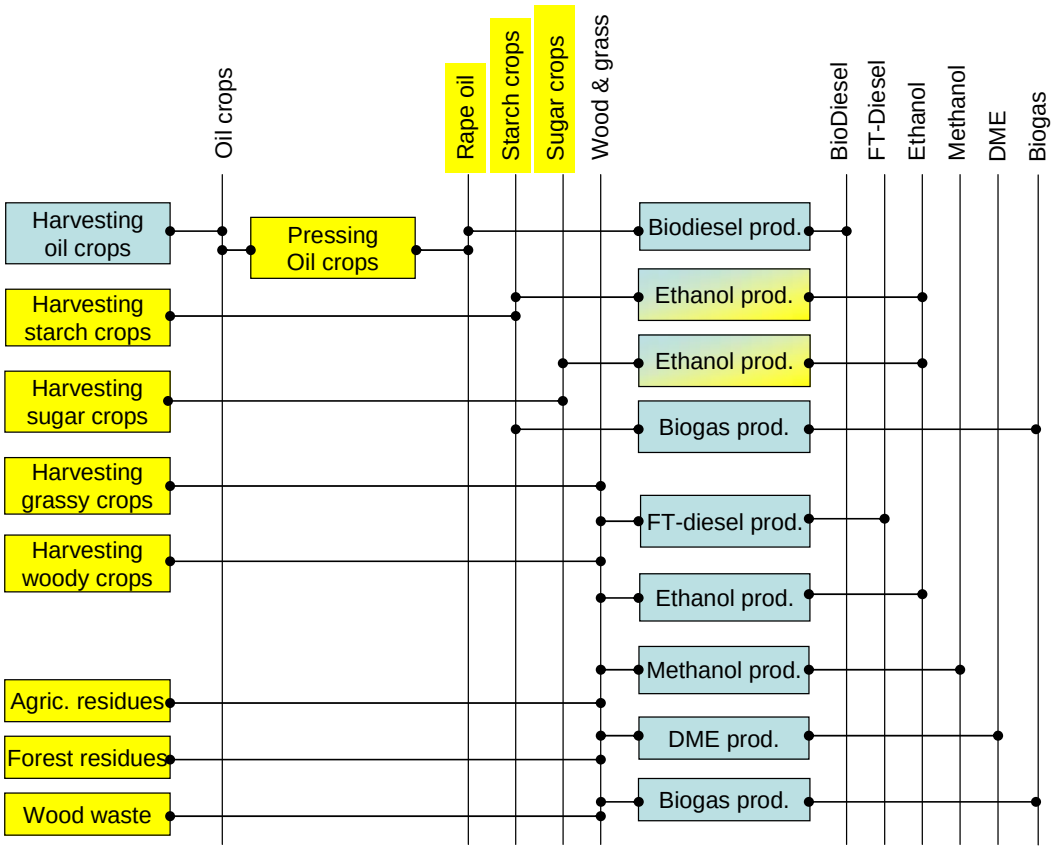

Figure 2: Representation biomass, waste and residues for biofuels and biogas production RES2020

Data sources:

The Eurostat energy balance:

The main source for the base-year energy balances of all countries of the model is the Eurostat database provided by the Statistical Office of the European Communities.

The Eurostat database covers the European Union, its Member States and its partners, and is organised under a variety of Themes and Collections, all accessible free of charge. The section 'Energy and Environment' of this database provides all the energy flows (production, transformation, consumption, trade) for the base-year (2000), as well as the net installed capacities for power plants, several technological parameters for nuclear plants (efficiency, availability, etc.) and import/export figures. The Eurostat values for 2005 where used to calibrate the model.

Other data sources

The table shows in brief the main common data sources used in the templates to build the country models. These sources provided either the official statistics (e.g. Eurostat), or in some cases provided the defaults values (e.g. the MATTER database) which were then adopted by the country modellers to their country situation, based on country specific data.

Sector	Data sources
Residential and Commercial	'Trends in Europe and North America". The statistical Yearbook of the Economic Commission for Europe 2003. http://www.unece.org/stats/trends/register.htm UN-Demography and Social Housing and its environment Compendium on Human Settlements Statistics 2001. http://unstats.un.org/unsd/demographic/sconcerns/housing/housing2.htm
Electricity and Heat	International Energy Agency Electric Information 2005. Renewable Information 2005. Eurostat Data on Installed capacities, http://ec.europa.eu/eurostat/ Euroelectric http://public.eurelectirc.org EuroHeat&Power www.euroheat.org EIA – Energy Information Administration (www.eia.doe.gov), electricity and CHP technology capacities by type (public/auto-production) and by fuel for all countries.
Industry	ECN- The Western European MATTER database, for the default inputs and outputs of energy intensive technologies.
Transport	Eurostat – Transport data PRIM model of MEET projects (1995 data)
Mining data	World Energy Council

Bioenergy Potential

The technology characterisation, the estimation of potentials for biofuels on the level of individual technologies, and the renewable heating/cooling is based on the BRED study (Biomass strategies for greenhouse gas emission reduction) and ECN's BIOTRANS model (REFUEL project - www.refuel.eu).

The data on bioenergy potentials and costs originate from the European IEE project REFUEL. In the REFUEL project three scenarios are considered. A reference scenario ('baseline') that describes 'most likely' developments under current policy settings. Baseline essentially reflects effects of ongoing trends in food consumption patterns on the one hand and technological progress in food production on the other hand, and it assumes a continuation of current self-reliance levels in Europe's aggregate food and feed commodities. An extended description of the assumptions driving the Baseline scenario can be find in the REFUEL project reports (www.refuel.eu). In the other two scenarios, the focus is more on difference in land area becoming available in the future for bio-fuel feedstock production (scenario *'high'* and scenario *'low'*). Agricultural production intensity, depends on agricultural and environmental policies as well as technological progress, and may vary significantly in different scenarios. In first instance the potentials from the Baseline scenario is used in RES2020

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).

Other Renewable Energy Sources data

The sources used for the RES technology characterisation and corresponding potential are:

- Data for Hydropower is an EURELECTRIC forecast which can be found in: “EURELECTRIC (2006): Statistics and prospects for the European electricity sector, EURPROG 2006”
- Wind data is an EWEA forecast (with good policies implemented) from the TRADEWIND project. The reference document is “Wind Power capacity data collection”, April 2007, http://www.trade-wind.eu/
- Data for the potential of Geothermal, PV, Biogas and Ocean power (Wave and Tidal technologies) come from the OPTRES forecast. The reference document “OPTRES - Potential and cost for renewable electricity in Europe”, EEG, ISI, LEI, Vienna, February 2006, can be found at http://www.optres.fhg.de/
- Data for the potential of Concentrated Solar Power come from the EREC/Greenpeace scenario with good policy implemented.

The RES2020 Scenario Definitions

In the framework of the RES2020 project, it was decided to run four alternative scenarios in order to examine the achievement of the renewable targets set by the European Union for 2020. The scenarios that were elaborated are:

Reference Scenario: where there is no enforcement of the targets for renewable energy sources in 2020.

RES Reference Scenario: where the target for renewable energy sources per Member State and the corresponding targets for CO_2 emission in 2020 are enforced.

RES Statistical Transfer Scenario: where the target for renewable energy sources per Member State and the corresponding targets for CO_2 emission in 2020 are enforced as in the RES Reference scenario, and the statistical transfer mechanism proposed in the Directive is also modeled.

RES-30 Scenario: with the same assumptions as the RES Reference Scenario, but enforcing a 30% reduction target for CO_2 emissions over the whole of the European Union.

The model runs for the period 2000-2025 in five year intervals, and is calibrated for 2000 and 2005. A brief description of the assumptions for each of these scenarios follows:

Basic Assumptions for the Reference Scenario

The basic assumptions used for the Reference Scenario are in accordance with the Baseline Scenario published by the DG TREN[7].

Nuclear energy assumptions:

- No Nuclear for: Austria, Cyprus, Denmark, Estonia, Greece, Italy, Ireland, Latvia, Luxembourg, Malta, Portugal
- Nuclear Phase out after the decided extension of lifetime for: Belgium, Germany, Sweden, Spain.

[7] "European energy and transport: Trends to 2030 – Update 2007" Capros P., Mantzos L., Papandreou V., Tasios N., DGTREN 2008

- Possible New Nuclear-no lifetime extension: Bulgaria, Czech Republic, France, Finland, Hungary, Lithuania, Poland, Romania, Slovakia, Slovenia, UK.

Renewables

The support mechanisms that are modeled are investment subsidies and feed-in tariffs in the Member States that employ them. A detailed description of these mechanisms can be found in "Reference Document on Renewable Energy Sources Policy and Potential" on the RES2020 project website[8].

Biofuels directive

In the Reference Scenario the target for Biofuels for 2005 and 2010 is not imposed as a bound.

CO_2 Tax

In the Reference Scenario the Kyoto targets or the post-Kyoto targets set by the 2007 European Spring Council are not imposed as a bound. It is assumed that the current Emissions Trading Scheme (ETS) operates at a clearing price of 20€(2005)/tonCO_2 in 2010. For the post-Kyoto period carbon prices increase smoothly to 24€(2005)/tonCO_2 in 2030 and this price applies to the current ETS sectors.

Prices of Fossil Fuels

The prices used in the Reference scenario are those used in the Reference Scenario of the World Energy Outlook 2008[9], published by the IEA in November 2008. These prices correspond to an oil price of 100$(2007)/barrel in 2010.

€2000/GJ					
	2005	**2010**	**2015**	**2020**	**2025**
Oil	6.89	12.016	12.016	13.218	13.939
Gas	4.37	7.394	7.626	8.428	8.919
Coal	1.87	2.864	2.864	2.785	2.705

Demographic Assumptions

The population projection is according to Eurostat. The projection states that the population of EU-27 will remain rather stable, peaking at 2020 to about

[8] www.res2020.eu
[9] World Energy Outlook, November 2008, IEA, http://www.worldenergyoutlook.org/

496.4 million people, while the population of New Member states (NM-12) will decline by 7.2% between 2005 and 2030. The average household size in the EU27 will decline from 2.4 persons in 2005 to 2.1 persons in 2030 according to UN-HABITAT (Human Settlement statistical database version 4).

Macroeconomic Outlook

The GEM-E3 model was used to quantify the National sectoral figures of economic growth and GDP growth. In this way there is a consistent forecast of the GDP growth over the EU27.

Renewable Energy potential and Prices

The potential and prices for RES electricity technologies and biomass production can be found in the "Reference Document on Renewable Energy Sources Policy and Potential", on the RES2020 project website. A brief description is given in the Appendix.

Endogenous trading

The endogenous trade of Electricity and Bioenergy (1st and 2nd Generation Biofuels and Biomass) is allowed between the country models in the PanEuropean model run. This means that the physical trade of Electricity and Bioenergy between Member States is done based on the least cost optimization procedure of the model.

Basic Assumptions for the RES Reference

The basic assumptions of the RES Reference Scenario are:

RES Target

The target for renewable energy sources in 2020 is imposed per country, following the path as given in the Directive proposal. The path is implemented as a lower bound in the model solution.

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.

Other assumptions

Nuclear energy, Fuel prices, and all the other assumptions are the same as in the Reference Scenario. The useful energy demand in this scenario is considered to be elastic.

Emissions

Only CO_2 emissions are taken in mind in the implementation of the emissions limits.

The approach taken in the modelling is the following:

- ETS Sectors: Full trade of CO_2 emitted from the ETS sectors between the EU27.
- Non-ETS Sectors: An upper bound in the emissions of CO_2 from the non-ETS sectors is imposed according the Directive proposal for non-ETS emissions, per Member State.
- The total CO_2 both from the ETS and non-ETS sectors, has a reduction, of 18% from the 1990 level (following the results from GAINS).

Basic Assumptions for the RES Statistical Tranfers (RES-T)

All the assumptions of the RES Reference Scenario hold in the RES-T scenario. On top of them there is the possibility statistical transfers between the Member States. So this scenario models in a least cost approach how the statistical transfers mechanism can be used in order to achieve the renewable energy target.

Basic Assumptions for the RES-30 Scenario

All the assumptions of the RES Reference Scenario hold in the RES-30 scenario. The only difference is that the overall reduction of CO_2 emissions in the whole of EU27 is forced to be 30% less than the 1990 level.

Project Partners:

Participant name	Country	Website	Contact
CENTER FOR RENEWABLE ENERGY SOURCES	GREECE	www.cres.gr	George Giannakidis
NATIONAL TECHNICAL UNIVERSITY OF ATHENS	GREECE	www.ntua.gr	Arthouros Zervos
EUROPEAN RENEWABLE ENERGY COUNCIL	BELGIUM	www.erec-renewables.org	Christine Lins
POLITECNICO DI TORINO	ITALY	www.polito.it	Evasio Lavagno
RISOE NATIONAL LABORATORY	DENMARK	www.risoe.dk	Poul Erik Grohnheit
CHALMERS TEKNISKA HOEGSKOLA AKTIEBOLAG	SWEDEN	www.chalmers.se	Erik Ahlgren
ENERGY RESEARCH CENTRE OF THE NETHERLANDS	NETHERLANDS	www.ecn.nl	Hilke Rosler
CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS	SPAIN	www.ciemat.es	Yolanda Lechon
CENTRUL PENTRU PROMOVAREA ENERGIEI CURATE SI EFICIENTE IN ROMANIA (CENTER FOR PROMOTION OF CLEAN AND EFFICIENT ENERGY IN ROMANIA)	ROMANIA	www.enero.ro	Christian Tantareanu
CONSIGLIO NAZIONALE DELLE RICERCHE – INSTITUTODI METODOLOGIE PER L'ANALISI AMBIENTALE	ITALY	www.imaa.cnr.it	Lina Cosmi
UNIVERSITAET STUTTGART	GERMANY	www.ier.uni-stuttgart.de	Markus Blesl
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Project Website: www.res2020.eu

Appendix

RES Maximum Potential Assumptions

Table 1: Maximum Wind Onshore Capacity (GW)

Year	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IT	LT	LU	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK	UK
2005	0.83	0.17	0.00	0.00	0.00	0.00	18.43	3.13	0.01	8.30	0.08	0.72	0.49	0.00	0.49	1.64	0.01	0.07	0.00	0.00	0.44	0.27	0.00	1.06	0.00	0.45	0.00	0.01	1.56
2010	2.78	0.78	0.25	0.10	0.11	0.58	19.08	3.20	0.01	22.17	0.28	9.68	2.00	0.77	2.86	10.00	0.25	0.07	0.14	0.00	2.70		0.69	5.70	0.38	1.60	0.13	0.77	5.08
2015	3.40	1.16	0.65	0.30	0.20	1.15	23.34	3.25	0.10		0.50	22.77	3.50	0.85	4.44	15.50	0.42	0.10	0.32	0.10	3.70	3.42	1.84	5.95	1.40	3.00	0.34	0.85	11.16
2020	4.02	1.53	1.15	0.60	0.25	1.72	25.11	3.28	0.30	33.19	0.90	36.63	5.50	0.93	5.34	19.00	0.70	0.13	0.43	0.20	4.10	4.77	2.99	7.60	2.50	4.50	0.56	0.93	18.27

Table 2: Maximum Wind Offshore Capacity (GW)

Year	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IS	IT	LT	LU	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK	UK
2005		0.00					0.00	0.00	0.00	0.00	0.00		0.00		0.00			0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.02			0.21
2010		0.34					6.37	1.03	0.30	0.00	0.22				0.03			0.00		0.00		0.70		0.14	0.00	0.04	0.55			3.82
2015		0.79					6.96	1.50	0.50	0.00	1.10	0.23			0.65			0.08		0.08		3.00	0.65	0.41	0.00	0.16	2.60			5.82
2020		1.50					14.81	2.10	0.70	7.00	2.10	0.37	5.00		0.75			0.10		0.12		6.00	1.89	0.68	1.00	0.60	5.50			7.82

Table 3: Maximum solar PV Electricity Production (PJ)

Year	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IS	IT	LT	LU	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK	UK
2005	0.04	0.002	0.00		0.00	1.44	4.67	0.00		0.29	0.00	0.02	0.00	0.00	0.00		0.01	0.00	0.03	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
2010	5.59					1.73	14.87	0.00						0.86	0.00					0.00				1.08	1.08	0.00	0.00	0.00	0.36	
2015	14.45					2.02	19.42							1.73										2.16		0.00			0.72	
2020	23.3	2.09	2.5		0.1	2.3	24	1.8		124.41	2.2	21	4.54	2.6	1.1		13	0.1	0.1	0.1	0	4.3	8.8	3.2	59	0.2	4.6	0.1	1.1	16

Table 4: Maximum Solar Thermal Capacity (GW)

Year	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IS	IT	LT	LU	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK	UK
2005										0.00			0.00				0.00								0.00					
2010										0.01			0.00												0.25					
2015													0.00																	
2020										5.597			0.9				2.6								2.4					

Table 5: Maximum Conventional Hydro Capacity (GW)

Year	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IT	LT	LU	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK	UK
2005	2.96		1.34			0.82	1.15	0.01		13.93	3.00	20.88	2.40		0.22	9.77	0.12	0.02				26.16	0.41	1.84	6.01	16.14		0.82	1.46
2010	2.96		1.42			0.82	1.15	0.01		12.39	3.14	20.20	2.54		0.22	9.98	0.13	0.02				27.81	0.41	1.91		16.20		0.82	1.46
2015	2.96		1.42			0.82	1.15	0.01					2.54										0.41		6.62			0.86	
2020	2.96		1.63			0.82	1.15	0.01		12.97	3.44	20.20	2.54		0.22	10.10	0.14	0.02				28.20	0.41	2.19	6.66	16.40		0.90	1.46

Table 6: Maximum Hydro run of river Capacity (GW)

Year	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IT	LT	LU	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK	UK
2005	5.34	0.11	0.04	3.72		0.15	2.94		0.01	1.79		6.16	0.05	0.05	0.25	4.02		0.02	1.57		0.04	6.03	0.43	2.16		8.05	0.86	0.73	
2010	6.15	0.11	0.05	3.72		0.15	2.96		0.01	1.82			0.15	0.08	0.25	4.35		0.02	1.58		0.04		0.44	2.24			0.99	0.74	
2015	6.28					0.17	3.07							0.09									0.44					0.77	
2020	7.10	0.12	0.06	3.72		0.20	3.30		0.02	1.94			0.35	0.10	0.25	4.65		0.02	1.58		0.04		0.44	2.73			0.99	0.80	

Table 7: Maximum Pumped Storage Capacity (GW)

Year	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IT	LT	LU	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK	UK
2005	3.57	1.39	0.57	9.60		1.15	5.71			2.73	0.00	4.30	0.70		0.29	6.96	0.90	1.10				1.27	1.37	0.78	0.00			0.87	2.79
2010	4.16	1.39	0.57	10.30		1.15	5.71			4.90		4.30	0.70		0.29	6.99	0.90	1.10				1.27	1.37	0.81	0.00			0.87	2.83
2015	4.85					1.15																	1.37		0.00			0.87	
2020	4.85	1.39	0.78	10.30						5.90		4.30	0.70		0.29	7.16	0.90	1.10				1.27	1.37	2.04	0.95				2.83

Table 8: Maximum Geothermal Hot Dry Rock Capacity (GW)

Year	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IT	LT	LU	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK	UK
2010						0.19				0.00				0.07									0.18					0.01	
2015						0.26				0.00				0.07									0.25					0.01	
2020						0.41				0.8				0.07									0.32					0.01	

Table 9: Maximum Geothermal Dry Steam & Flash Power Plants (>180°C) (GW)

Year	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IT	LT	LU	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK	UK
2005			0																					0.02					
2010	0.00	0.00		0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	791.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00
2015							0.26																	0.03	0.01				
2020			0.09				0.407						0.12			810								0.05	0.03				

Table 10: Maximum Geothermal Electricity Production (PJ)

Year	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IT	LT	LU	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK	UK
2005			0													19.8													
2010	0.00	0.00		0.00	0.00	5.00	4.27	0.00	0.00	0.00	0.00	0.00	0.00	2.16	0.00		0.00	0.00	0.00	0.00	0.00	0.00	4.84	0.40	0.00	0.00	0.00	0.14	0.00
2015						7.00	6.97			0.00			0.00	2.16									6.74					0.16	
2020			2.52			11	10.91			20.84				2.16		26.17							8.63	1.08				0.17	

Table 11: Maximum Wave & Tide Electricity Production (PJ)

Year	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IT	LT	LU	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK	UK
2005		0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2010		0.00			0.00			0.00		0.00	0.00		0.00			0.00	0.00			0.00	0.00	0.00	4.68	5.40	0.00	0.00			0.00
2015													0.00							0.00		0.00	9.36		0.00	0.00			
2020		0.5			0.9			9.3		48	5.5	47	14		12	12	0.1			0.2	3.7	76	14	27	0	11			212

Table 12: Maximum Biomass (conventional+CHP) Electricity Production (PJ)

Year	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IT	LT	LU	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK	UK
2005	6.92	0.00	0.00	0.11	0.00	2.22	16.12	4.68	0.00	10.04	35.40	6.34	0.00	5.67	0.00	1.91	0.00	0.00	0.00	0.00	3.74	0.00	5.04	0.36	0.00	13.00	0.25	0.01	5.76
2010	20.05					7.77	103.09		0.00					8.51								1.80	7.56	3.96	4.73			4.16	
2015	28.25					13.33	192.85							16.69									32.14		13.25			5.87	
2020	36.44	22	20	2.1	0.7	18.9	282.1	19	3.4	195.5	73.8	246	22	24.9	14	96	15	1.3	3.4	0.1	14	32	56.7	22	26.5	56.4	3.9	7.6	29

Table 13: Maximum Biogas (conventional+CHP) Electricity Production(PJ)

Year	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IT	LT	LU	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK	UK
2005	1.13	0.02	0.00	0.60	0.00	0.58	9.08	0.72	0.00	4.32	0.06	2.45	0.72	0.09	0.40	4.46	0.11	0.07	0.11	0.00	1.19	0.00	0.40	0.36	0.00	0.40	0.11	0.01	16.92
2010	6.00					0.83	37.52							0.11									0.59	2.52	1.70			0.01	
2015	6.38					4.38	41.83							4.05									7.63		3.78			0.91	
2020	6.768	11	5	9.3	0.5	7.92	46.14	6.8	0.1	47.48	4.5	82	5.8	7.99	12	38	27	0.6	1.8	0.2	16	7.6	14.7	8.3	6.05	6.73	2.7	1.8	58.8

Table 14: Maximum Bio Waste (CHP) Electricity Production(PJ)

Year	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IT	LT	LU	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK	UK
2005	1.16	0.00	0.00	3.15	0.00	0.04	30.65	2.52	0.00	7.42	0.23	8.78	0.00	0.22	0.00	6.01	0.00	0.07	0.00	0.00	4.86	0.36	1.19	1.08	0.00	1.80	0.00	0.05	3.60
2010	2.40					1.63	32.90							2.14									2.14		0.57			2.14	
2015	2.84					1.70	38.20							2.23									2.23		3.03			2.23	
2020	3.269	26	10	5.6	0.2	1.77	43.8	3.7	0.3	20.34	2.56	22	1.6	2.32	1.9	17	0.4	0.1	0.1	0.1	8.7	1.8	2.32	25	4.73	7.2	1.4	2.3	14.7

Table 15: Biomass Production Cost (€/GJ)

Costs [€/GJ]	Year	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IT	LT	LU	LV	NL	NO	PL	PT	RO	SE	SI	SK	UK
Rape seed	**2005**	9.80	8.37	5.41	9.91	8.76	6.24	9.54	15.13	6.29	10.92	9.62	8.14	13.29	6.16	5.48	11.44	5.11	8.81	5.79	12.15	11.38	5.31	8.72	6.02	8.92	8.59	8.52	10.44
	2010	9.51	8.12	5.25	9.59	8.46	6.05	9.26	14.68	6.09	10.59	9.34	7.90	12.89	5.97	5.33	11.10	4.92	8.54	5.62	11.77	11.03	5.14	8.46	5.83	8.66	8.32	8.25	10.13
	2015	9.25	7.89	5.12	9.29	8.19	5.90	9.00	14.28	5.93	10.28	9.07	7.67	12.52	5.81	5.19	10.78	4.77	8.30	5.47	11.44	10.72	5.01	8.23	5.68	8.42	8.08	8.02	9.84
	2020	9.00	7.68	5.02	9.03	7.95	5.77	8.76	13.91	5.81	10.00	8.84	7.46	12.19	5.68	5.07	10.50	4.66	8.08	5.36	11.13	10.44	4.90	8.01	5.56	8.20	7.87	7.83	9.58
	2025	8.78	7.48	4.95	8.78	7.74	5.66	8.54	13.58	5.71	9.75	8.62	7.27	11.88	5.59	4.96	10.24	4.58	7.88	5.28	10.85	10.17	4.83	7.81	5.47	8.00	7.69	7.66	9.34
	2030	8.58	7.31	4.91	8.56	7.54	5.59	8.34	13.27	5.66	9.51	8.42	7.09	11.60	5.53	4.86	9.99	4.54	7.69	5.24	10.59	9.93	4.80	7.63	5.41	7.82	7.54	7.54	9.12
Starch crops	**2005**	8.67	8.47	7.19	9.03	8.27	6.90	8.87	10.97	8.23	13.96	13.52	8.71	14.92	6.35	8.16	13.91	7.87	10.30	7.87	9.80	42.74	7.04	9.94	6.08	8.87	6.30	6.18	11.03
	2010	8.19	8.00	6.91	8.50	7.92	6.64	8.37	10.37	7.91	13.15	12.75	8.22	14.76	6.11	7.73	13.11	7.56	9.72	7.56	9.25	39.20	6.76	9.38	5.85	8.38	6.07	5.95	10.41
	2015	7.79	7.60	6.69	8.05	7.62	6.43	7.96	9.87	7.64	12.48	12.11	7.81	14.00	5.92	7.36	12.44	7.31	9.24	7.31	8.79	37.10	6.55	8.91	5.67	7.97	5.87	5.77	9.89
	2020	7.45	7.26	6.52	7.67	7.35	6.27	7.61	9.45	7.44	11.91	11.57	7.45	13.36	5.78	7.06	11.88	7.11	8.82	7.11	8.39	35.35	6.38	8.52	5.54	7.63	5.72	5.63	9.45
	2025	7.16	6.98	6.40	7.34	7.12	6.15	7.31	9.10	7.29	11.42	11.10	7.15	12.89	5.68	6.81	11.40	6.98	8.47	6.98	8.06	33.77	6.27	8.18	5.46	7.33	5.59	5.53	9.07
	2030	6.91	6.73	6.34	7.05	6.91	6.07	7.05	8.80	7.21	10.99	10.70	6.89	12.46	5.65	6.59	10.98	6.91	8.16	6.91	7.77	32.43	6.22	7.89	5.43	7.08	5.49	5.48	8.74
Sugar crops	**2005**	9.10	8.23	6.33	9.97	8.84	6.49	9.04	10.91	8.21	9.37	12.39	8.76	11.05	4.96	7.57	10.04	6.14	9.18	6.71	10.03	10.47	5.49	8.27	5.18	10.13	7.75	7.32	9.69
	2010	8.80	7.95	6.36	9.48	8.68	6.53	8.72	10.59	8.18	9.01	11.93	8.43	10.66	5.03	7.39	9.69	6.16	8.85	6.72	9.67	10.07	5.54	7.99	5.24	9.78	7.75	7.34	9.34
	2015	8.54	7.70	6.46	9.05	8.53	6.63	8.45	10.33	8.24	8.69	11.54	8.13	10.31	5.16	7.25	9.39	6.27	8.56	6.81	9.34	9.75	5.66	7.75	5.37	9.49	7.78	7.42	9.05
	2020	8.32	7.48	6.65	8.66	8.39	6.79	8.21	10.13	8.39	8.40	11.20	7.87	10.01	5.38	7.15	9.12	6.47	8.31	7.00	9.06	9.46	5.87	7.54	5.59	9.23	7.86	7.56	8.78
	2025	8.12	7.28	6.96	8.31	8.26	7.05	8.00	9.97	8.67	8.15	10.90	7.64	9.74	5.72	7.08	8.89	6.79	8.08	7.31	8.81	9.20	6.21	7.35	5.92	9.01	7.98	7.80	8.55
	2030	7.95	7.10	7.42	7.98	8.14	7.41	7.81	9.84	9.13	7.92	10.63	7.42	9.51	6.21	7.03	8.68	7.29	7.88	7.80	8.58	8.97	6.72	7.19	6.40	8.81	8.14	8.14	8.35
Grassy crops	**2005**	5.97	5.81	3.21	8.06	4.44	9.20	6.02	8.00	16.93	5.85	18.62	5.29	5.52	3.11	4.48	4.98	3.75	5.91	5.28	11.00	9.44	3.31	4.56	3.80	15.25	4.14	4.02	10.85
	2010	6.00	5.36	2.99	7.38	4.11	8.42	5.61	7.37	15.51	5.39	17.05	5.01	5.11	2.90	4.16	4.61	3.48	5.45	4.88	10.09	8.65	3.08	4.22	3.56	13.97	3.85	3.74	11.45
	2015	5.82	5.05	2.86	6.86	3.86	7.86	5.27	6.90	14.46	5.06	15.86	4.73	4.78	2.77	3.92	4.32	3.31	5.09	4.60	10.62	8.05	2.94	3.96	3.39	12.99	3.65	3.55	11.30
	2020	5.63	4.79	2.78	6.44	3.66	7.46	4.99	6.54	13.66	4.78	14.91	4.49	4.53	2.71	3.73	4.09	3.21	4.81	4.42	10.39	7.59	2.86	3.75	3.29	12.23	3.51	3.43	11.05
	2025	5.48	4.60	2.77	6.09	3.50	7.17	4.77	6.25	13.07	4.56	14.15	4.29	4.32	2.70	3.59	3.91	3.17	4.59	4.33	12.05	7.21	2.85	3.58	3.26	11.61	3.42	3.37	10.86
	2030	5.34	4.43	2.82	5.80	3.37	6.98	4.58	6.02	12.65	4.37	13.53	4.12	4.15	2.76	3.48	3.76	3.21	4.40	4.31	12.19	6.90	2.91	3.45	3.30	11.10	3.37	3.37	10.65
Woody crops	**2005**	4.47	3.74	2.01	5.65	3.55	2.82	4.77	5.75	2.60	2.98	4.09	3.40	4.46	2.01	2.57	3.10	1.99	3.58	2.78	8.46	3.69	2.25	2.67	2.38	3.08	3.27	3.16	5.52
	2010	4.44	3.46	1.89	5.18	3.29	2.85	4.47	5.31	2.43	2.76	3.79	3.23	4.20	1.89	2.41	2.88	1.87	3.32	2.60	7.77	3.41	2.11	2.49	2.24	2.87	3.05	2.95	5.80
	2015	4.29	3.25	1.83	4.81	3.09	2.82	4.21	4.98	2.32	2.62	3.56	3.06	3.96	1.83	2.29	2.72	1.80	3.11	2.48	8.02	3.21	2.03	2.35	2.16	2.71	2.90	2.81	5.73
	2020	4.14	3.08	1.81	4.52	2.94	2.79	4.00	4.73	2.27	2.50	3.37	2.91	3.76	1.81	2.21	2.58	1.79	2.95	2.42	7.81	3.04	2.00	2.24	2.13	2.58	2.80	2.73	5.62
	2025	4.03	2.95	1.84	4.28	2.82	2.81	3.83	4.54	2.28	2.40	3.23	2.79	3.59	1.84	2.14	2.48	1.82	2.82	2.42	8.84	2.91	2.02	2.15	2.14	2.48	2.74	2.70	5.53
	2030	3.92	2.83	1.92	4.07	2.71	2.85	3.68	4.39	2.35	2.31	3.11	2.69	3.46	1.92	2.10	2.39	1.91	2.71	2.48	8.90	2.80	2.10	2.08	2.21	2.40	2.71	2.71	5.44
Agricultural waste	**2005**	4.90	3.90	1.10	3.40	1.50	1.10	3.40	3.50	1.10	1.40	2.40	3.80	1.50	1.10	4.10	2.00	1.10	3.90	1.10	3.90	3.50	1.10	1.40	1.10	3.50	1.50	1.10	3.00
Forestry residues	**2005**	3.90	4.10	5.80	6.20	2.80	3.40	3.70	4.50	2.20	3.50	3.40	4.40	2.80	3.10	3.80	4.10	3.50	4.10	1.60	5.70	5.30	3.30	2.60	2.20	2.90	2.20	3.30	4.50
Wood waste	**2005**	2.78	2.94	2.20	3.30	1.90	2.20	2.83	3.75	1.50	7.10	2.20	2.00	1.90	6.00	3.25	13.90	2.20	2.20	1.00	6.80	2.90	6.00	6.10	5.00	3.40	3.70	2.00	6.70

Table 16: Biomass Production Potential (PJ/yr)

Potentials [PJ/yr]	Year	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IT	LT	LU	LV	NL	NO	PL	PT	RO	SE	SI	SK	UK
Rape seed																													
	2005	8.00	2.00	59.00	1.00	1.00	19.00	83.00	19.00	8.00	26.00	6.00	61.00	3.00	29.00	4.00	10.00	36.00	0.00	11.00	0.00	0.00	76.00	8.00	67.00	19.00	0.00	4.00	34.00
	2010	12.00	4.00	112.00	2.00	1.00	41.00	122.00	28.00	17.00	51.00	10.00	91.00	8.00	61.00	17.00	24.00	71.00	0.00	21.00	1.00	1.00	158.00	20.00	141.00	28.00	0.00	8.00	45.00
	2015	15.00	5.00	143.00	3.00	1.00	54.00	152.00	35.00	22.00	81.00	13.00	114.00	13.00	82.00	26.00	39.00	88.00	0.00	27.00	2.00	1.00	209.00	30.00	185.00	33.00	1.00	11.00	52.00
	2020	18.00	6.00	174.00	4.00	2.00	68.00	182.00	41.00	26.00	111.00	15.00	136.00	18.00	102.00	34.00	53.00	106.00	0.00	33.00	3.00	1.00	260.00	39.00	229.00	39.00	1.00	13.00	60.00
	2025	21.00	7.00	193.00	5.00	2.00	77.00	215.00	48.00	29.00	142.00	17.00	159.00	23.00	116.00	44.00	68.00	115.00	0.00	36.00	5.00	1.00	294.00	49.00	258.00	43.00	1.00	15.00	68.00
	2030	24.00	8.00	213.00	6.00	2.00	86.00	247.00	54.00	31.00	174.00	19.00	182.00	29.00	130.00	54.00	84.00	125.00	1.00	39.00	7.00	2.00	329.00	58.00	288.00	47.00	1.00	17.00	76.00
Starch crops																													
	2005	10.00	3.00	59.00	1.00	1.00	24.00	107.00	23.00	10.00	32.00	14.00	98.00	5.00	38.00	0.00	12.00	2.00	0.00	2.00	1.00	0.00	104.00	9.00	90.00	28.00	1.00	16.00	38.00
	2010	15.00	5.00	113.00	2.00	1.00	52.00	158.00	34.00	20.00	64.00	23.00	146.00	10.00	81.00	2.00	28.00	5.00	0.00	4.00	2.00	1.00	218.00	24.00	189.00	40.00	3.00	34.00	51.00
	2015	19.00	6.00	144.00	3.00	1.00	70.00	196.00	43.00	25.00	101.00	28.00	182.00	16.00	108.00	2.00	44.00	6.00	0.00	5.00	3.00	1.00	287.00	35.00	248.00	48.00	4.00	44.00	59.00
	2020	23.00	7.00	175.00	4.00	1.00	87.00	235.00	52.00	30.00	138.00	34.00	218.00	22.00	135.00	3.00	60.00	7.00	0.00	6.00	4.00	2.00	357.00	46.00	307.00	55.00	5.00	55.00	68.00
	2025	26.00	9.00	194.00	5.00	1.00	100.00	277.00	59.00	33.00	176.00	38.00	255.00	28.00	153.00	4.00	78.00	7.00	1.00	7.00	6.00	2.00	404.00	57.00	347.00	61.00	7.00	62.00	77.00
	2030	30.00	10.00	214.00	6.00	1.00	112.00	318.00	67.00	36.00	215.00	42.00	292.00	35.00	171.00	5.00	96.00	8.00	1.00	7.00	8.00	2.00	452.00	68.00	387.00	68.00	8.00	69.00	86.00
Sugar crops																													
	2005	13.00	6.00	15.00	1.00	1.00	37.00	201.00	40.00	8.00	45.00	5.00	159.00	5.00	24.00	9.00	11.00	93.00	0.00	29.00	1.00	0.00	229.00	22.00	58.00	29.00	0.00	8.00	68.00
	2010	19.00	10.00	28.00	3.00	2.00	81.00	295.00	59.00	16.00	89.00	8.00	237.00	13.00	51.00	44.00	27.00	180.00	0.00	57.00	4.00	1.00	479.00	54.00	122.00	42.00	1.00	16.00	90.00
	2015	24.00	12.00	35.00	4.00	3.00	108.00	368.00	74.00	21.00	141.00	10.00	295.00	21.00	67.00	66.00	42.00	225.00	1.00	72.00	6.00	1.00	632.00	80.00	160.00	49.00	1.00	21.00	105.00
	2020	29.00	15.00	43.00	6.00	3.00	135.00	440.00	89.00	25.00	192.00	12.00	354.00	28.00	84.00	88.00	57.00	269.00	1.00	87.00	9.00	1.00	786.00	106.00	199.00	57.00	2.00	27.00	120.00
	2025	33.00	18.00	48.00	7.00	4.00	153.00	518.00	102.00	28.00	246.00	13.00	414.00	38.00	96.00	113.00	74.00	293.00	1.00	96.00	13.00	1.00	890.00	131.00	224.00	64.00	2.00	30.00	136.00
	2030	38.00	21.00	53.00	9.00	4.00	172.00	595.00	115.00	30.00	300.00	15.00	473.00	47.00	107.00	139.00	91.00	318.00	1.00	106.00	17.00	1.00	995.00	156.00	250.00	70.00	3.00	34.00	152.00
Grassy crops																													
	2005	32.00	8.00	140.00	3.00	6.00	78.00	323.00	56.00	19.00	80.00	27.00	264.00	9.00	112.00	15.00	30.00	152.00	0.00	44.00	1.00	1.00	335.00	26.00	252.00	54.00	2.00	18.00	115.00
	2010	49.88	12.47	272.00	9.00	9.35	121.59	503.49	87.29	29.62	124.70	42.09	411.52	14.03	174.59	23.38	46.76	236.94	0.00	68.59	1.56	3.00	522.20	40.53	392.82	84.17	3.12	28.06	179.26
	2015	53.50	13.91	352.00	14.00	9.63	186.18	573.51	90.95	40.66	171.20	48.15	514.66	25.68	269.63	75.97	79.18	331.69	1.07	110.21	5.35	4.00	763.96	68.48	603.46	84.53	4.28	51.36	180.83
	2020	62.85	16.96	431.00	19.00	11.97	235.44	709.33	105.75	48.88	258.39	54.87	664.43	37.91	343.19	105.75	116.72	396.07	1.00	140.67	8.98	5.00	949.76	95.77	766.19	93.78	6.98	68.84	207.51
	2025	72.60	21.02	485.00	24.00	13.37	284.66	847.29	121.32	57.31	341.97	62.09	811.95	49.67	416.48	134.69	152.84	462.33	0.96	171.94	13.37	6.00	1136.73	121.32	928.49	104.12	9.55	85.97	235.94
	2030	85.20	26.51	538.00	28.00	15.15	324.70	1013.87	138.21	63.43	438.30	70.05	984.52	65.32	476.17	172.29	196.90	509.30	1.89	197.85	26.51	6.00	1284.61	149.57	1063.09	115.49	12.31	102.24	274.53

(continued Table 21)

Potentials [PJ/yr]	Year	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IT	LT	LU	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK	UK
Woody crops																														
	2005	29.00	8.00	116.00	3.00	7.00	51.00	258.00	26.00	25.00	38.00	19.00	319.00	9.00	85.00	13.00	41.00	119.00	0.00	51.00	0.00	1.00	1.00	325.00	13.00	181.00	48.00	2.00	21.00	97.00
	2010	47.67	13.15	225.00	9.00	11.51	83.84	424.13	42.74	41.10	62.47	31.23	524.40	14.80	139.73	21.37	67.40	195.62	0.00	83.84	0.00	1.64	2.00	534.27	21.37	297.55	78.91	3.29	34.52	159.46
	2015	50.80	15.01	291.00	15.00	12.70	135.08	503.39	46.18	60.04	87.75	34.64	659.26	26.55	221.68	71.58	115.46	280.56	1.15	138.55	0.00	3.46	3.00	802.42	38.10	469.91	80.82	5.77	63.50	161.64
	2020	61.05	18.53	357.00	20.00	14.17	174.42	635.56	54.51	73.04	135.18	40.34	853.59	40.34	286.71	101.38	173.33	339.04	1.09	180.97	0.00	7.63	4.00	1011.66	53.42	608.30	90.48	8.72	86.12	186.42
	2025	71.58	22.10	401.00	25.00	16.84	213.67	768.38	63.15	86.31	181.04	46.31	1046.26	52.63	351.56	129.47	229.46	399.98	1.05	224.20	0.00	10.53	5.00	1223.10	68.42	745.23	102.10	11.58	109.47	211.57
	2030	83.88	27.26	445.00	30.00	18.87	247.46	927.98	72.35	96.47	234.88	52.43	1272.95	70.25	404.74	166.72	296.74	442.49	2.10	260.04	0.00	20.97	5.00	1390.39	83.88	859.82	113.24	14.68	130.02	245.36
Agricultural waste																														
	2005	12.85	0.80	0.00	1.00	0.19	0.63	115.00	18.48	1.29	37.60	0.63	11.30	16.57	1.34	2.09	71.79	0.06	0.00	20.93	0.00	0.14	0.00	2.01	0.00	20.43	18.40	0.00	0.30	5.44
	2010	14.47	4.16	5.00	4.00	0.20	12.10	158.30	22.09	1.84	106.50	12.14	108.86	16.57	15.20	7.36	71.79	9.20	0.00	20.93	0.00	5.52	7.19	110.44	3.68	70.00	18.41	4.19	8.37	25.00
	2020	17.70	11.80	24.00	10.00	0.20	16.00	169.17	23.60	1.97	270.20	14.40	180.00	17.70	28.50	7.87	76.72	9.84	0.00	41.87	0.00	5.90	14.40	118.02	3.93	135.00	19.67	4.19	25.12	63.80
	2030	18.84	12.56	48.00	18.00	0.20	29.31	180.03	25.12	2.09	434.00	16.75	251.21	18.84	41.87	8.37	81.64	10.47	0.00	62.80	0.00	6.28	21.60	125.60	4.19	200.92	20.93	4.19	50.24	102.58
Forestry residues																														
	2005	62.34	8.04	18.00	19.00	0.38	37.89	129.09	24.42	12.00	70.89	103.19	316.56	8.40	36.72	3.39	122.23	29.63	0.63	37.01	0.00	19.71	44.64	95.98	83.07	47.44	57.75	19.64	6.87	17.43
	2010	97.14	8.40	23.00	24.00	0.20	33.50	159.40	30.00	12.00	76.03	103.19	330.00	8.40	40.00	5.81	122.23	29.63	1.84	37.90	0.00	19.71	63.31	89.68	83.07	49.80	92.00	64.00	19.60	20.00
	2020	93.86	8.40	33.00	36.00	0.20	33.50	180.20	35.00	12.00	70.00	103.19	355.00	8.40	40.00	5.81	122.23	29.63	1.97	37.90	0.00	19.71	67.66	89.68	83.07	49.80	114.50	64.00	25.00	30.00
	2030	100.09	8.40	44.36	48.46	0.20	37.70	191.50	35.00	12.00	70.00	103.19	380.00	8.40	40.00	5.81	122.23	29.63	2.09	37.90	0.00	19.71	72.00	89.68	83.07	49.80	137.50	64.00	30.40	40.00
Wood waste																														
	2005	41.11	7.45	0.00	0.00	0.00	11.35	50.00	6.70	16.07	62.00	40.00	48.11	11.25	3.68	1.84	12.89	0.10	0.00	1.84	0.00	1.75	0.00	65.31	30.52	20.39	106.64	0.00	9.50	14.10
	2010	47.86	9.20	1.00	1.50	0.00	9.20	88.36	6.70	31.29	62.00	40.50	99.40	11.40	3.68	1.84	12.89	1.17	0.00	1.84	0.00	3.68	10.00	65.52	30.52	49.80	107.50	3.68	11.60	29.45
	2020	51.14	9.84	3.00	3.00	0.00	9.84	94.42	6.70	33.44	62.00	43.28	106.22	12.40	3.93	1.97	13.77	2.54	0.00	1.97	0.00	3.93	22.50	65.52	30.52	49.80	109.20	3.93	14.00	31.47
	2030	54.43	10.47	3.56	5.00	0.00	10.47	100.48	6.70	35.59	62.00	46.05	113.04	13.40	4.19	2.09	14.65	3.90	0.00	2.09	0.00	4.19	54.00	65.52	30.52	49.80	110.95	4.19	16.40	33.49

More information on the Project Website:
www.res2020.eu