

Project No 213744

SECURE
Security of Energy Considering its Uncertainty, Risk and Economic implications

SP1 – Cooperation
 Collaborative project
 Small or medium-scale focused research project

JOINT DELIVERABLES No 3.2 and 4.1

Long term storylines for energy scenarios in Europe
&
Four quantitative scenarios up to 2030 and 2050

- SECURE scenarios preliminary description -

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SECURE

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Joint Deliverable 3.2 & 4.1

SECURE scenarios preliminary description

CEPS

CNRS (UG2)

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SECURE scenarios preliminary description

According to the SECURE Milano meeting outcome, five scenarios have been developed on top of the model's Reference case, with the state of the art version of the POLES model and revised economic growth hypothesis:

1. LTS (Liberalisation -Technology based - Smooth prices),
2. LTR (Liberalisation -Technology based - Rough prices),
3. LCS (Liberalisation –Cap on emissions - Smooth prices),
4. ITR (Intervention (State) -Technology based - Rough prices),
5. ITS (Intervention (State) -Technology based - Smooth prices).

The scenario characteristics and key assumptions used in each run of the model are presented below in a synthetic way for each scenario.

Table 1: SECURE scenarios structuring dimensions

EU Energy policy	Liberalisation, Competition (L)				State Intervention (I)			
EU Climate policy	Technology Based (T)		Hard Cap on Emissions (C)		Technology Based (T)		Hard Cap on Emissions (C)	
International Energy Markets	Smooth Path, stable prices (S)	Rough Ride, high prices (R)	Smooth Path, stable prices (S)	Rough Ride, high prices (R)	Smooth Path, stable prices (S)	Rough Ride, high prices (R)	Smooth Path, stable prices (S)	Rough Ride, high prices (R)
Scenario	(1) Openfield, Technology-push	(2) Managing risks through competition	(3) Ecological virtue through market		(4) Competitivity at risk	(5) Bocage, Comeback of nations		
Scenario	LTS	LTR	LCS		ITS	ITR		

Table 2: SECURE scenarios parameters

Scenario	LTS	LTR	LCS		ITS	ITR				
Discount rate in EU	16%	16%	16%		4%	4%				
Carbon value		2005	2010	2020	2050		2005	2010	2020	2050
	EUR	5	10	15	25	EU	5	10	15	25
	RAN1	0	5	10	20	- 20% 2020	0	5	10	20
	ROW	0	0	5	15	- 60% 2050	ROW	0	0	5
Technology performances	Optimistic	Optimistic	Norm		Optimistic	Optimistic				
Oil and gas resources	Norm	-20%	Norm		-20%	Norm				

1. The Reference case

The SECURE study has developed a Reference projection of the world energy system to test different scenarios for technology and climate policies in the next half-century, with a particular concern and focus on the European energy security.

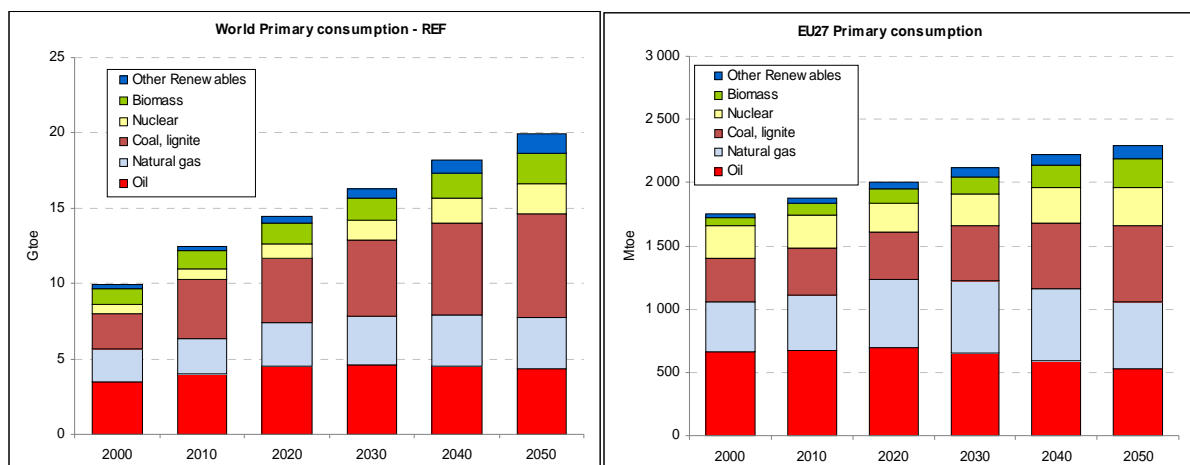
The Reference projection provides an image of the energy scene to 2050, as resulting from the continuation of on-going trends and structural changes in the world economy. This projection has been developed with the POLES modelling system that provides a tool for the simulation and economic analysis of world energy scenarios under environmental constraints. It is not a General Equilibrium, but a Partial Equilibrium Model for the energy sector, with a dynamic recursive simulation process. From the identification of the drivers and constraints in the energy system, the model allows to describe the pathways for energy development, fuel supply, greenhouse gas emissions, international and end-user prices, from today to 2050.

The approach combines a high degree of detail in the key components of the energy systems and a strong economic consistency, as all changes in these key components are largely determined by relative price changes at sectoral level. The model identifies 47 regions for the world, with 22 energy demand sectors and about 40 energy technologies – now including generic “very low energy” end-use technologies. Therefore, each scenario can be described as the set of economically consistent transformations of the initial Reference case that is induced by the introduction of policy constraints.

This Reference projection adopts exogenous forecasts for population and economic growth in the different world regions. In order to take into account the current financial and economic crisis the SECURE reference has a GDP growth rate that is 20 % less than in the preceding ADAM project for the period from 2008 to 2015. This corresponds to a world GDP that is in 2015 more than 6% lower than considered in preceding POLES energy outlooks, but might however be considered as an optimistic view on the capability of recovery of the world economy in the short-medium term. Other hypotheses on world economic growth may be explored in future runs of the model.

The projection is based on consistent assumptions on the availability of fossil energy resources and for the costs and performances of future technologies. It uses a world energy sector simulation model – the POLES model – to describe the development to 2050 of the national and regional energy systems and of their interactions through international energy markets, under constraints on resources and from climate policy. This kind of business as usual scenario, without particular liberalisation of the energy markets, supposes a normal discounting rate of the investment at 8%. **Figure 1a and 1b** describe the dynamics of the world and European energy system, in the initial settings considered in the Reference.

Figure 1a and 1b: Reference Case – World and Europe Gross Inland Consumption



The key outcomes of the Reference case are a doubling of world energy consumption from 2000 to 2050, with a levelling-off of world oil and gas production after 2030. In spite of a significant development in nuclear energy, biomass and other renewables, which in 2050 represent more than one fourth of world Gross Inland Consumption (GIC), the primary source that most gains in importance as its contribution in absolute value is multiplied by three between 2000 and 2050.

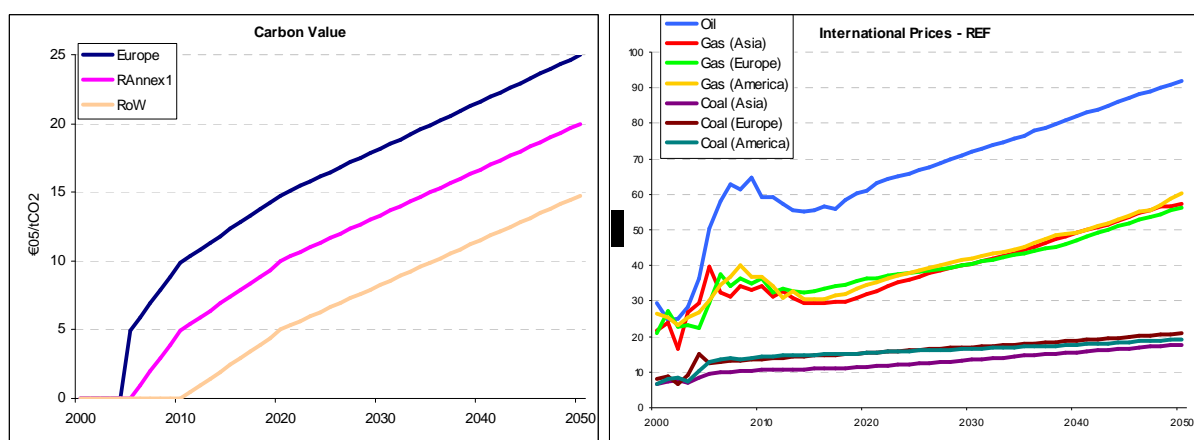
As for Europe, the dynamics in GIC is much less pronounced with an increase from 1.7 Gtoe to 2.3 Gtoe between 2000 and 2050. There again one notes the levelling-off of oil and gas, the progress of renewable and the penetration of coal, although with a more modest magnitude that at world level. From this base case, the different SECURE 2008 scenarios have been derived, with contrasted hypotheses along the structuring dimensions of the scenarios.

2. LTS: Liberalisation – Technology based – Smooth prices

First of all, the projection of the world energy system in the LTS scenario has to account for “minimum” climate policies (although these policies exist in the Reference case but are developed with a very low level of ambition). GHG abatement policies are included through a carbon penalty or “carbon value”, which is differentiated across the world regions, i.e. higher in the industrialised than in the developing ones. It assumes that Europe keeps the lead in climate policies. The carbon value varies by region to indicate different levels of commitment:

- In Europe a carbon value of 5 €/tCO₂ is assumed in 2005, 10 €/tCO₂ is assumed in 2010, in line with estimates provided for the European Emission Trading System; the value increases linearly to 15 €/tCO₂ in 2020 and 25 €/tCO₂ in 2050.
- In the rest of the Annex B countries a still more modest policy is assumed with a carbon value starting at 5 €/tCO₂ in 2010 and staying subsequently at half the level that is adopted in Europe, so ending at 20 €/tCO₂ in 2050.
- In the emerging and developing non-Annex B countries, moderate climate policies are progressively introduced after 2010 also reaching a carbon value of 15 €/tCO₂ in 2050.

Figure 2a and 2b: LTS – Exogenous Carbon Value and endogenous international energy prices



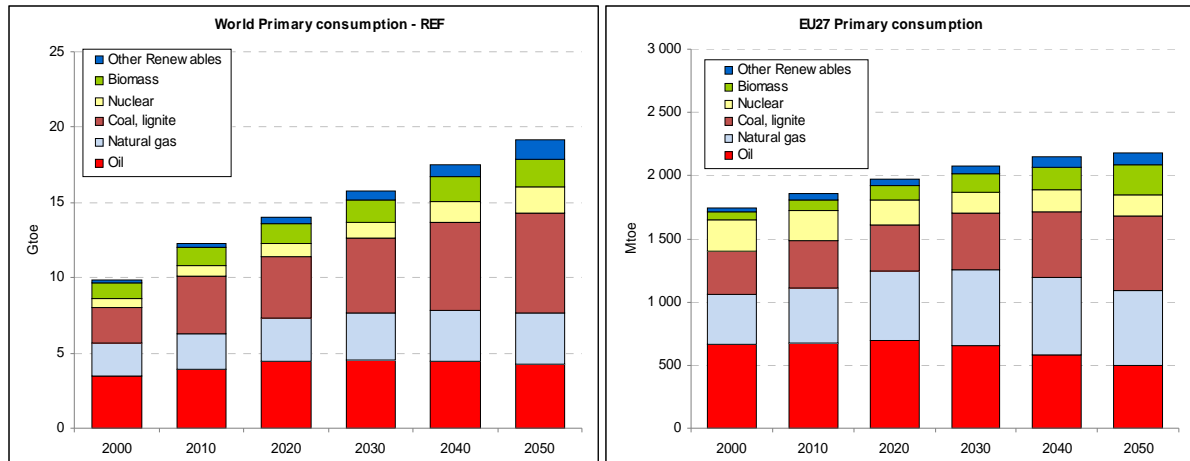
One important hypothesis of all the Liberalisation-based energy scenarios is that the discount rate in Europe is higher than in the usual projections. In that case, the chosen

discount rate is 16% instead of 8%, which reflects not only higher capital costs for the energy sector but also a structural preference of energy companies for solutions with short-term paybacks, accordingly to the framework of intensified competition and expectations of high return on investment.

An important aspect of the projections performed with the POLES model is that they rely on a framework of permanent competition between technologies with dynamically changing attributes. The expected cost and performance data for each critical technology are gathered and examined in a customised database – TECHPOLES – that organises and standardises the information in a manner appropriate to the task. The LTS scenario considers alternative technological pathways that illustrate possible ways of the European energy system evolution. It implies a accelerated technological progress in all low-carbon energy technology: CCS, nuclear, renewables and efficient end-use technologies.

The combination of these different hypotheses explains the main results of the scenario, with slightly lower Gross Inland Consumption and CO₂ emissions at world level, as compared to the initial Reference Case. Total energy consumption is also lower in EU27 but the most important difference between LTS and REF appears in the development of nuclear energy: clearly the hypotheses adopted primarily for the discount rate and secondarily for the relative cost of the other power generation technologies clearly affects the development of nuclear energy in Europe: in a liberalized context with shorter time horizon for investment decisions, nuclear clearly loses ground compared to other generation options: starting at approximately 250 Mtoe in 2005, nuclear production is at 170 Mtoe in 2050, as compared to 300 Mtoe in the initial Reference, which testimonies of a loss of competitiveness in the new economic setting supposed in LTS. As a consequence energy CO₂ emissions are higher in Europe in the LTS case, in spite of the lower GIC.

Figure 3a and 3b: LTS – World and Europe Gross Inland Consumption

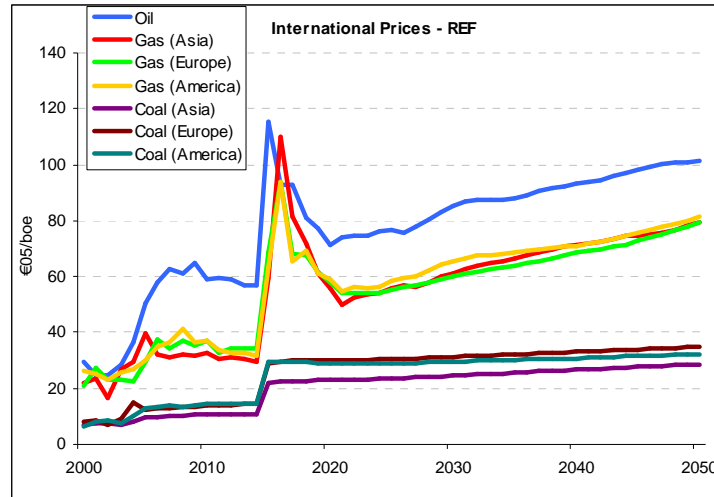


3. LTR: Liberalisation – Technology based – Rough prices

The assumptions about oil and gas resources are critical in POLES because present market behaviour and a series of recent studies suggest that access to supplies to meet future increase in demand may be difficult. Any energy outlook for the long-term has to deal with the possibility of “peak oil” and “peak gas” that some geologists expect soon. The consequent increase in prices may profoundly influence the development of competing energy technologies and reshape the future energy system. SECURE-LTR gives special attention to the evaluation of oil and gas resources. The scenario reviews the assumptions concerning Ultimate Recoverable Resources as -20 % of the corresponding one in the reference and LTS case.

In this scenario we also suppose a shock price, with a doubling of the oil and gas prices in 2015, compared to the LTS price profile. This allows analyzing the impacts of price shocks and instability at the 2020 horizon.

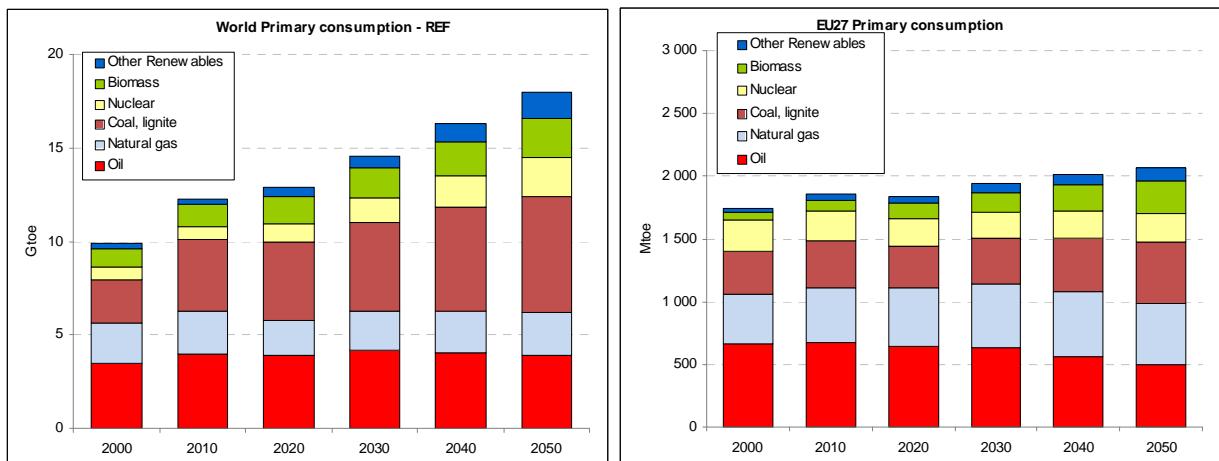
Figure 4: International energy price trajectories with an exogenous shock in 2015



The consequences of the price shock are noticeable and relatively long lasting, even if, as can be expected the price hike is followed by a kind of counter-shock: on the whole period the oil price is higher than in the LTS scenario, reflecting a higher scarcity due to downward reserve revision in this scenario.

The consequences on the world energy balance are also noticeable, with lower GIC at world and European level and lower total oil consumption. More surprisingly it appears that this oil and gas scarcity scenario is mostly prejudicial to natural gas, which development in the electricity sector, as opposed to coal and principally nuclear and renewable, is strongly limited by the 2015 price shock and subsequent high price level.

Figure 5a and 5b: LTS – World and Europe Gross Inland Consumption

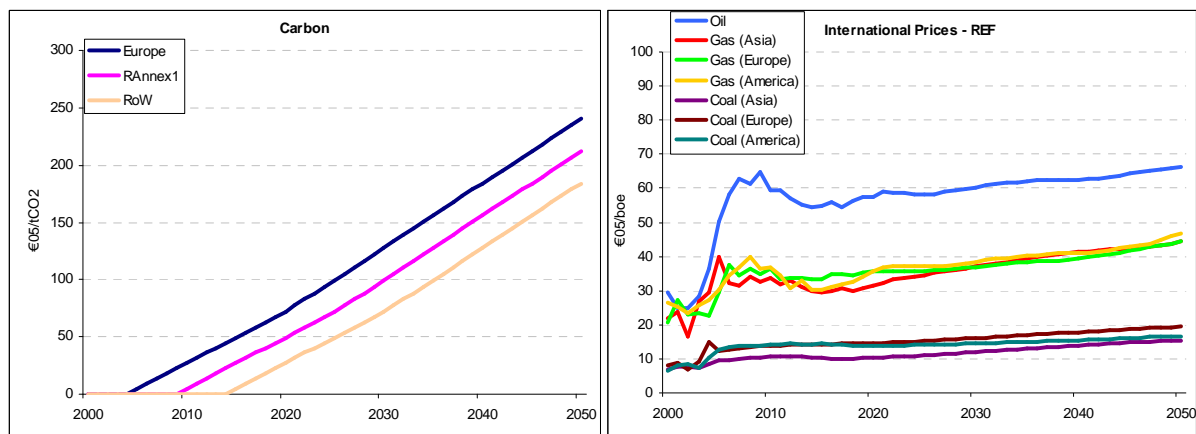


4. LCS: Liberalisation – Cap on emissions – Smooth prices

The main feature of this scenario is the introduction of a cap on emissions. This Carbon Constraint scenario reflects a state of the world with already (if not overly ...) ambitious climate targets, aiming at an emission profile that is compatible in the long-term with concentration levels around 450 ppm for CO₂. This scenario tries to depict the climate policy of the EU that is now in preparation, in its milder version: -20% of the European emissions of 1990 in 2020 and -50% in 2050.

The liberalisation of the energy markets is translated here as in the former scenarios by a higher discounting rate, for the investment costs, than in the Reference case. Assumptions concerning the technology performances and resources are identical. This scenario shows the expected changes in the structure and development of the world energy system in a context of a legally binding carbon cap.

Figure 6a and 6b: LCS – Carbon Value meeting the emission cap and endogenous international energy prices



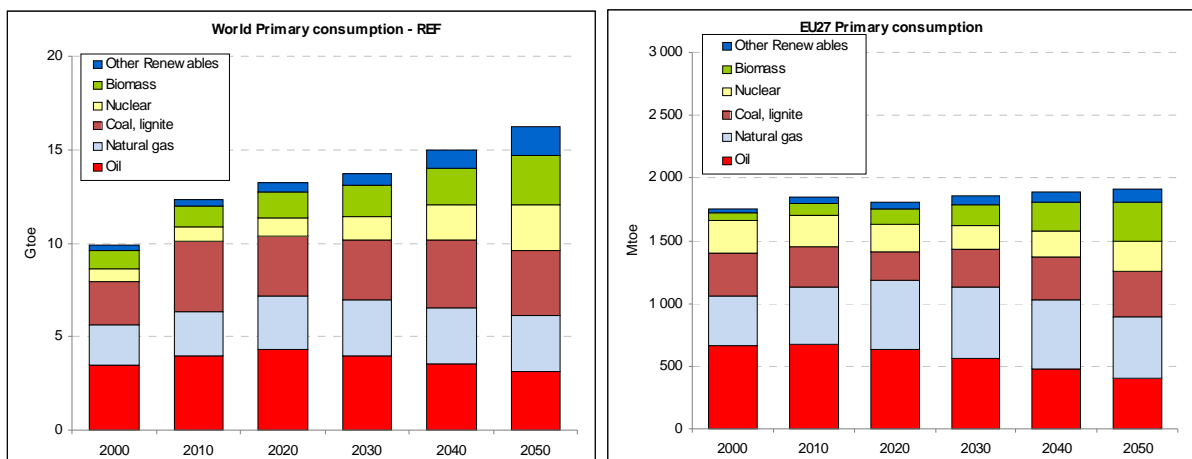
One can note that the carbon Value that is necessary to induce new trajectories in the world and European energy system is an order of magnitude higher than the value used in the other scenarios. This corresponds to the fact that the LCS scenario reveals the need for radical changes in the energy systems.

This translates into two main aspects: the gross inland consumption and fuel-mix in Europe and in the world are significantly different from the ones obtained in the LTS

scenario, with lower gross inland consumption, much lower coal and oil contributions and higher renewables and nuclear. In Europe the total energy consumption is almost stabilized

Interestingly enough the EU gas consumption is not significantly modified in this scenario until 2020. This is good news for gas exporters to Europe. However, the prices of oil and gas are much lower in this scenario than in the LTS case as the carbon values that are imposed in all countries of the world induce a drastic reduction in coal, oil and gas demand. Consequently the endogenous price mechanisms in the model translate into a stabilization of international energy price at the current level.

Figure 7a and 7b: LCS – World and Europe Gross Inland Consumption

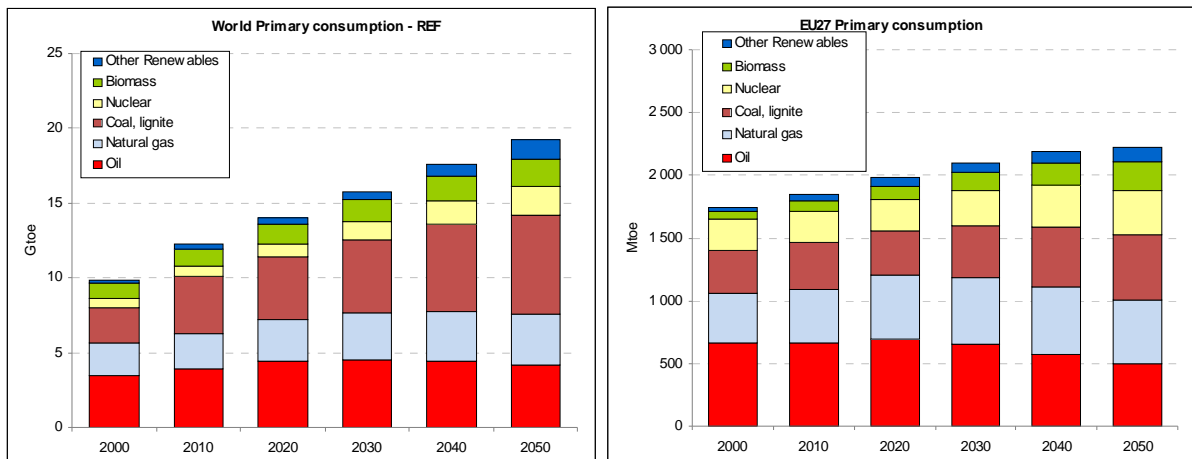


5: ITS: Intervention (State) – Technology based – Smooth prices

This scenario is similar to LTR scenario, except the assumption concerning the discount rate used for investment decision in Europe, which is here much lower (4%) reflecting a lesser degree of liberalization, more state intervention and a longer time horizon considered for decision in the energy sector. This has an impact for all investment intensive – and most of the time low-carbon – technologies, but particularly for nuclear energy, as it doesn't encounter the same potential constraints. As a consequence the

development of nuclear energy in Europe is profoundly altered, with a total contribution of 360 Mtoe in 2050, i.e. more than two times the contribution noticed in the LTS case.

Figure 8a and 8b: ITS – World and Europe Gross Inland Consumption

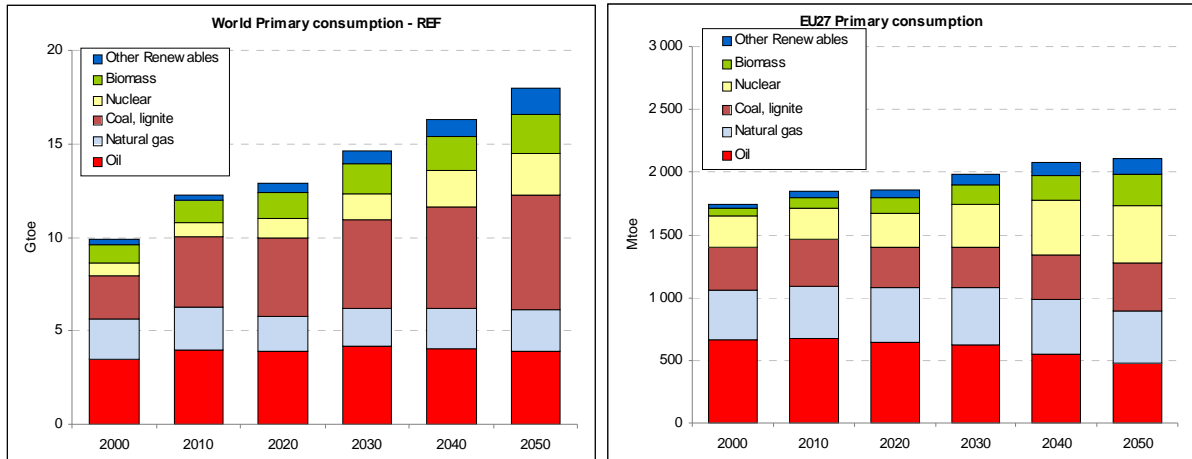


As a consequence EU27 emissions are significantly reduced in that case in which without any strong carbon value European emissions are stabilized in 2050 approximately at their 1990 level.

6: ITR – Intervention (State) -Technology based - Rough prices

Similarly, this scenario corresponds to the LTR scenario, with a similar international context of oil and gas scarcity and price instability, while the main change corresponds the assumption concerning the discount rate in Europe, which is here much lower (4%).

Figure 9a and 9b: ITR – World and Europe Gross Inland Consumption



Due to higher international energy prices and a lower discount rate in Europe, energy demand is limited while investment intensive solutions such as renewables are nuclear are strongly stimulated. As a result this scenario is the one with the higher share of renewables and the lowest CO2 emissions, of all cases that do not consider strong carbon cap / carbon value: in 2050 the CO2 emissions of the european energy sector are in that case at 90% of their 1990 level.



SECURE – SECURITY OF ENERGY CONSIDERING ITS UNCERTAINTY,
RISK AND ECONOMIC IMPLICATIONS
PROJECT NO 213744
DELIVERABLE NO 3.2 & 4.1



ANNEX A: World Summary Energy Balances (REF + 5 SECURE Scenarios)

Results - REF - World	1990	2000	2005	2010	2020	2030	2050
Key Indicators							
Population (Millions)	5 246	6 078	6 457	6 835	7 569	8 190	9 066
GDP (G\$95)	29 992	50 076	60 532	76 116	108 433	143 861	228 416
Per capita GDP (\$95/cap)	5 717	8 238	9 374	11 136	14 325	17 566	25 195
Gross Inland Cons/GDP (toe/M\$95)	291	201	190	167	135	115	88
Gross Inland Cons/capita (toe/cap)	1,7	1,7	1,8	1,9	1,9	2,0	2,2
Electricity Cons/capita (kWh/cap)	1 830	2 067	2 314	2 616	3 065	3 699	5 235
Transport fuels per capita (toe/cap)	0,30	0,32	0,34	0,34	0,37	0,38	0,39
CO2 emissions/capita (tCO2/cap)	4,0	3,9	4,3	4,7	4,8	4,8	4,6
% of renewables in Gross Inland Cons	13	12	12	12	12	13	16
% of renewables in electricity	20	19	18	17	19	20	25
Primary Production (Mtoe)	8 806	9 856	11 322	12 691	14 703	16 534	20 188
Coal, lignite	2 211	2 302	3 087	3 883	4 292	5 100	6 938
Oil	3 234	3 507	3 879	4 173	4 779	4 867	4 554
Natural gas	1 708	2 132	2 264	2 399	2 898	3 228	3 459
Nuclear	525	686	731	768	945	1 231	1 984
Hydro, geothermal	216	232	260	278	336	373	435
Biomass and wastes	913	991	1 086	1 155	1 354	1 514	1 944
Wind, solar	0	5	14	35	100	221	874
Gross Inland Consumption (Mtoe)	8 741	10 063	11 494	12 676	14 673	16 501	20 125
Coal, lignite	2 205	2 345	3 087	3 883	4 292	5 100	6 938
Oil	3 200	3 684	4 062	4 173	4 779	4 867	4 554
Natural gas	1 678	2 120	2 252	2 385	2 868	3 195	3 397
Biomass and wastes	913	992	1 087	1 155	1 354	1 514	1 944
Others	745	922	1 005	1 080	1 380	1 825	3 292
Final Consumption (Mtoe)	5 702	7 077	7 963	8 596	10 145	11 066	12 512
<i>by source</i>							
Coal, lignite	870	639	816	999	1 102	1 058	949
Oil	2 546	3 137	3 472	3 597	4 259	4 385	4 067
Natural gas	999	1 071	1 154	1 185	1 390	1 514	1 557
Electricity	825	1 081	1 285	1 538	1 995	2 606	4 082
Biomass and wastes	916	916	988	1 020	1 122	1 167	1 262
Heat	179	234	248	257	271	288	312
Hydrogen	0	0	0	0	5	47	283
<i>by sector</i>							
Industry	2 411	2 579	2 954	3 222	3 742	3 970	4 122
Transport	1 549	1 936	2 171	2 306	2 784	3 073	3 572
Household, Service, Agriculture	1 857	2 562	2 838	3 067	3 620	4 023	4 818
Inputs in electricity generation (Mtoe)							
Coal		1 551	2 073	2 604	2 913	3 678	5 235
Gas		691	726	808	1 013	1 130	1 196
Oil		274	298	301	189	156	217
Biomass		54	67	80	176	282	555
Electricity Generation (TWh)	11 846	15 197	18 198	21 830	28 469	37 241	57 762
Thermal	7 600	9 875	12 295	15 411	20 040	26 231	37 563
<i>of which:</i>							
Coal	4 427	5 813	7 924	10 287	13 184	17 974	26 754
Gas	1 695	2 790	2 912	3 627	5 376	6 378	7 022
Biomass and wastes	146	149	188	240	682	1 219	2 817
Nuclear	2 013	2 591	2 768	2 920	3 659	4 870	8 178
Hydro+Geoth	2 229	2 700	3 027	3 231	3 906	4 339	5 054
Solar	1	1	4	12	60	255	2 533
Wind	4	31	104	257	803	1 540	4 324
Hydrogen	0	0	0	0	1	7	110
CO2 Emissions (MtCO2)	20 857	23 925	28 079	31 872	36 124	39 473	41 960
<i>of which:</i>							
Electricity generation		8 568	10 804	13 118	14 412	16 928	20 062
Industry		4 407	5 151	5 743	6 460	6 410	5 834
Transport		5 750	6 427	6 776	8 125	8 611	8 280
Household, Service, Agriculture		2 959	3 193	3 409	4 000	4 033	3 749
CO2 Sequestration (Mt CO2)	0	0	0	8	127	1 091	5 297

Results - LTS - World	1990	2000	2005	2010	2020	2030	2050
Key Indicators							
Population (Millions)	5 246	6 078	6 457	6 835	7 569	8 190	9 066
GDP (G\$95)	29 992	50 076	60 532	74 666	103 703	137 342	217 534
Per capita GDP (\$95/cap)	5 717	8 238	9 374	10 924	13 701	16 770	23 994
Gross Inland Cons/GDP (toe/M\$95)	291	201	190	167	137	116	89
Gross Inland Cons/capita (toe/cap)	1,7	1,7	1,8	1,8	1,9	2,0	2,1
Electricity Cons/capita (kWh/cap)	1 830	2 067	2 314	2 577	2 961	3 566	5 012
Transport fuels per capita (toe/cap)	0,30	0,32	0,34	0,33	0,36	0,37	0,38
CO2 emissions/capita (tCO2/cap)	4,0	3,9	4,3	4,6	4,6	4,7	4,5
% of renewables in Gross Inland Cons	13	12	12	12	12	13	16
% of renewables in electricity	20	19	18	17	19	20	26
Primary Production (Mtoe)	8 806	9 845	11 308	12 505	14 289	16 021	19 428
Coal, lignite	2 211	2 302	3 087	3 794	4 139	4 923	6 633
Oil	3 234	3 507	3 879	4 133	4 686	4 770	4 447
Natural gas	1 708	2 135	2 266	2 370	2 854	3 190	3 470
Nuclear	525	674	719	748	857	1 075	1 719
Hydro, geothermal	216	232	260	278	336	373	434
Biomass and wastes	913	990	1 083	1 147	1 326	1 484	1 903
Wind, solar	0	5	14	34	91	207	822
Gross Inland Consumption (Mtoe)	8 741	10 048	11 476	12 487	14 249	15 979	19 363
Coal, lignite	2 205	2 342	3 087	3 794	4 139	4 923	6 633
Oil	3 200	3 684	4 062	4 133	4 686	4 770	4 447
Natural gas	1 678	2 122	2 251	2 352	2 815	3 148	3 406
Biomass and wastes	913	990	1 083	1 147	1 326	1 484	1 903
Others	745	910	993	1 060	1 282	1 654	2 974
Final Consumption (Mtoe)	5 702	7 077	7 963	8 510	9 921	10 811	12 188
<i>by source</i>							
Coal, lignite	870	639	816	985	1 085	1 044	940
Oil	2 546	3 137	3 472	3 564	4 175	4 297	3 974
Natural gas	999	1 071	1 154	1 174	1 354	1 478	1 557
Electricity	825	1 081	1 285	1 515	1 928	2 512	3 908
Biomass and wastes	916	916	988	1 015	1 103	1 147	1 244
Heat	179	234	248	257	271	288	312
Hydrogen	0	0	0	0	6	45	254
<i>by sector</i>							
Industry	2 411	2 579	2 954	3 181	3 674	3 905	4 093
Transport	1 549	1 936	2 171	2 286	2 728	3 005	3 450
Household, Service, Agriculture	1 857	2 562	2 838	3 044	3 518	3 901	4 645
Inputs in electricity generation (Mtoe)							
Coal		1 548	2 073	2 536	2 788	3 539	5 046
Gas		693	724	790	1 005	1 127	1 194
Oil		274	298	297	189	156	211
Biomass		52	64	77	169	274	543
Electricity Generation (TWh)	11 846	15 197	18 197	21 498	27 490	35 882	55 265
Thermal	7 600	9 875	12 294	15 108	19 470	25 626	36 715
<i>of which:</i>							
Coal	4 427	5 813	7 941	10 068	12 658	17 389	26 009
Gas	1 695	2 790	2 896	3 553	5 348	6 386	7 024
Biomass and wastes	146	149	188	242	666	1 193	2 741
Nuclear	2 013	2 591	2 768	2 890	3 347	4 268	7 082
Hydro+Geoth	2 229	2 700	3 027	3 238	3 902	4 334	5 045
Solar	1	1	4	11	47	223	2 300
Wind	4	31	104	250	724	1 425	4 033
Hydrogen	0	0	0	0	1	6	90
CO2 Emissions (MtCO2)	20 857	23 916	28 074	31 339	35 147	38 395	40 871
<i>of which:</i>							
Electricity generation		8 559	10 799	12 797	13 904	16 328	19 385
Industry		4 407	5 151	5 662	6 363	6 329	5 814
Transport		5 750	6 427	6 717	7 967	8 443	8 111
Household, Service, Agriculture		2 959	3 193	3 385	3 872	3 898	3 629
CO2 Sequestration (Mt CO2)	0	0	0	8	116	1 121	4 979

Results - LTR - World	1990	2000	2005	2010	2020	2030	2050
Key Indicators							
Population (Millions)	5 246	6 078	6 457	6 835	7 569	8 190	9 066
GDP (G\$95)	29 992	50 076	60 532	74 666	103 703	137 342	217 534
Per capita GDP (\$95/cap)	5 717	8 238	9 374	10 924	13 701	16 770	23 994
Gross Inland Cons/GDP (toe/M\$95)	291	201	190	167	126	108	83
Gross Inland Cons/capita (toe/cap)	1,7	1,7	1,8	1,8	1,7	1,8	2,0
Electricity Cons/capita (kWh/cap)	1 830	2 067	2 314	2 577	2 908	3 426	4 830
Transport fuels per capita (toe/cap)	0,30	0,32	0,34	0,33	0,32	0,34	0,36
CO2 emissions/capita (tCO2/cap)	4,0	3,9	4,3	4,6	4,2	4,2	4,0
% of renewables in Gross Inland Cons	13	12	12	12	15	15	19
% of renewables in electricity	20	19	18	17	22	23	30
Primary Production (Mtoe)	8 806	9 845	11 308	12 496	13 083	14 818	18 200
Coal, lignite	2 211	2 302	3 087	3 796	4 165	4 762	6 220
Oil	3 234	3 507	3 879	4 142	4 089	4 384	4 123
Natural gas	1 708	2 135	2 266	2 350	1 941	2 116	2 324
Nuclear	525	674	719	749	995	1 303	2 068
Hydro, geothermal	216	232	260	278	342	378	437
Biomass and wastes	913	990	1 083	1 146	1 413	1 609	2 083
Wind, solar	0	5	14	34	138	265	944
Gross Inland Consumption (Mtoe)	8 741	10 048	11 476	12 482	13 052	14 787	18 149
Coal, lignite	2 205	2 342	3 087	3 796	4 165	4 762	6 220
Oil	3 200	3 684	4 062	4 142	4 089	4 384	4 123
Natural gas	1 678	2 122	2 251	2 337	1 911	2 086	2 274
Biomass and wastes	913	990	1 083	1 146	1 413	1 609	2 083
Others	745	910	993	1 061	1 473	1 945	3 449
Final Consumption (Mtoe)	5 702	7 077	7 963	8 510	8 959	9 942	11 372
<i>by source</i>							
Coal, lignite	870	639	816	984	1 025	1 012	927
Oil	2 546	3 137	3 472	3 567	3 647	3 953	3 697
Natural gas	999	1 071	1 154	1 172	999	1 059	1 140
Electricity	825	1 081	1 285	1 515	1 893	2 413	3 766
Biomass and wastes	916	916	988	1 015	1 118	1 174	1 275
Heat	179	234	248	257	271	288	311
Hydrogen	0	0	0	0	6	44	257
<i>by sector</i>							
Industry	2 411	2 579	2 954	3 180	3 244	3 547	3 781
Transport	1 549	1 936	2 171	2 288	2 447	2 823	3 275
Household, Service, Agriculture	1 857	2 562	2 838	3 042	3 268	3 573	4 317
Inputs in electricity generation (Mtoe)							
Coal		1 548	2 073	2 537	2 811	3 375	4 579
Gas		693	724	781	631	704	745
Oil		274	298	304	191	146	192
Biomass		52	64	77	234	364	647
Electricity Generation (TWh)	11 846	15 197	18 197	21 493	26 913	34 369	53 160
Thermal	7 600	9 875	12 294	15 103	18 004	22 767	31 964
<i>of which:</i>							
Coal	4 427	5 813	7 941	10 068	12 739	16 505	23 453
Gas	1 695	2 790	2 896	3 521	3 518	4 061	4 407
Biomass and wastes	146	149	188	241	941	1 587	3 248
Nuclear	2 013	2 591	2 768	2 892	3 897	5 189	8 556
Hydro+Geoth	2 229	2 700	3 027	3 238	3 976	4 391	5 085
Solar	1	1	4	11	66	295	2 894
Wind	4	31	104	250	969	1 720	4 555
Hydrogen	0	0	0	0	1	6	107
CO2 Emissions (MtCO2)	20 857	23 916	28 074	31 339	31 713	34 559	36 438
<i>of which:</i>							
Electricity generation		8 559	10 799	12 801	13 176	14 869	17 156
Industry		4 407	5 151	5 660	5 444	5 608	5 204
Transport		5 750	6 427	6 724	7 093	7 884	7 598
Household, Service, Agriculture		2 959	3 193	3 382	3 321	3 291	3 119
CO2 Sequestration (Mt CO2)	0	0	0	8	180	1 013	4 459

Results - LCS - World	1990	2000	2005	2010	2020	2030	2050
Key Indicators							
Population (Millions)	5 246	6 078	6 457	6 835	7 569	8 190	9 066
GDP (G\$95)	29 992	50 076	60 532	74 666	103 703	137 342	217 534
Per capita GDP (\$95/cap)	5 717	8 238	9 374	10 924	13 701	16 770	23 994
Gross Inland Cons/GDP (toe/M\$95)	291	201	190	167	129	102	75
Gross Inland Cons/capita (toe/cap)	1,7	1,7	1,8	1,8	1,8	1,7	1,8
Electricity Cons/capita (kWh/cap)	1 830	2 067	2 314	2 578	2 858	3 275	4 793
Transport fuels per capita (toe/cap)	0	0	0	0	0	0	0
CO2 emissions/capita (tCO2/cap)	4,0	3,9	4,3	4,6	3,9	2,8	1,7
% of renewables in Gross Inland Cons	13	12	12	12	14	17	25
% of renewables in electricity	20	19	18	17	21	23	34
Primary Production (Mtoe)	8 806	9 856	11 322	12 509	13 442	13 979	16 370
Coal, lignite	2 211	2 302	3 087	3 739	3 166	3 187	3 467
Oil	3 234	3 507	3 879	4 135	4 515	4 202	3 314
Natural gas	1 708	2 132	2 264	2 413	2 913	3 007	2 958
Nuclear	525	686	731	759	991	1 272	2 475
Hydro, geothermal	216	232	260	279	346	392	446
Biomass and wastes	913	991	1 086	1 151	1 407	1 666	2 647
Wind, solar	0	5	14	33	105	253	1 064
Gross Inland Consumption (Mtoe)	8 741	10 063	11 494	12 497	13 423	13 962	16 398
Coal, lignite	2 205	2 345	3 087	3 739	3 166	3 187	3 467
Oil	3 200	3 684	4 063	4 135	4 515	4 202	3 314
Natural gas	1 678	2 120	2 252	2 402	2 895	2 990	2 986
Biomass and wastes	913	992	1 087	1 151	1 407	1 666	2 647
Others	745	922	1 005	1 070	1 441	1 917	3 984
Final Consumption (Mtoe)	5 702	7 077	7 963	8 496	9 293	9 253	9 938
<i>by source</i>							
Coal, lignite	870	639	816	980	877	467	234
Oil	2 546	3 137	3 472	3 554	3 918	3 758	3 016
Natural gas	999	1 071	1 154	1 171	1 216	1 134	924
Electricity	825	1 081	1 285	1 515	1 860	2 307	3 737
Biomass and wastes	916	916	988	1 017	1 147	1 266	1 490
Heat	179	234	248	257	271	288	312
Hydrogen	0	0	0	0	4	32	225
<i>by sector</i>							
Industry	2 411	2 579	2 954	3 175	3 329	3 072	3 136
Transport	1 549	1 936	2 171	2 281	2 593	2 736	2 910
Household, Service, Agriculture	1 857	2 562	2 838	3 040	3 371	3 445	3 892
Inputs in electricity generation (Mtoe)							
Coal		1 551	2 073	2 486	2 081	2 501	2 956
Gas		691	726	836	1 219	1 360	1 478
Oil		274	298	309	276	159	116
Biomass		54	67	79	199	318	888
Electricity Generation (TWh)	11 846	15 197	18 198	21 508	26 510	32 834	52 454
Thermal	7 600	9 875	12 295	15 135	17 779	21 457	28 566
<i>of which:</i>							
Coal	4 427	5 813	7 922	9 846	9 396	11 611	14 406
Gas	1 695	2 790	2 913	3 757	6 447	7 803	9 132
Biomass and wastes	146	149	188	239	778	1 374	4 515
Nuclear	2 013	2 591	2 768	2 886	3 843	5 032	10 247
Hydro+Geoth	2 229	2 700	3 027	3 239	4 026	4 555	5 187
Solar	1	1	4	11	56	265	3 416
Wind	4	31	104	236	805	1 518	4 917
Hydrogen	0	0	0	0	1	7	120
CO2 Emissions (MtCO2)	20 857	23 925	28 080	31 239	29 835	23 199	15 847
<i>of which:</i>							
Electricity generation		8 568	10 805	12 733	10 601	6 216	2 704
Industry		4 407	5 151	5 644	5 376	3 809	2 513
Transport		5 750	6 427	6 700	7 548	7 631	6 377
Household, Service, Agriculture		2 959	3 193	3 372	3 497	2 766	1 750
CO2 Sequestration (Mt CO2)	0	0	0	9	1 426	7 604	13 866

Results - ITS - World	1990	2000	2005	2010	2020	2030	2050
Key Indicators							
Population (Millions)	5 246	6 078	6 457	6 835	7 569	8 190	9 066
GDP (G\$95)	29 992	50 076	60 532	74 666	103 703	137 342	217 534
Per capita GDP (\$95/cap)	5 717	8 238	9 374	10 924	13 701	16 770	23 994
Gross Inland Cons/GDP (toe/M\$95)	291	201	190	167	138	117	89
Gross Inland Cons/capita (toe/cap)	1,7	1,7	1,8	1,8	1,9	2,0	2,1
Electricity Cons/capita (kWh/cap)	1 830	2 067	2 314	2 577	2 965	3 571	5 018
Transport fuels per capita (toe/cap)	0	0	0	0	0	0	0
CO2 emissions/capita (tCO2/cap)	4,0	3,9	4,3	4,6	4,6	4,6	4,4
% of renewables in Gross Inland Cons	13	12	12	12	12	13	16
% of renewables in electricity	20	19	18	18	20	20	26
Primary Production (Mtoe)	8 806	9 845	11 309	12 500	14 298	16 067	19 536
Coal, lignite	2 211	2 302	3 088	3 787	4 128	4 913	6 592
Oil	3 234	3 507	3 879	4 131	4 683	4 760	4 432
Natural gas	1 708	2 135	2 266	2 359	2 822	3 139	3 417
Nuclear	525	674	719	759	902	1 180	1 920
Hydro, geothermal	216	232	260	277	334	372	433
Biomass and wastes	913	990	1 083	1 147	1 324	1 481	1 899
Wind, solar	0	5	14	40	104	222	843
Gross Inland Consumption (Mtoe)	8 741	10 048	11 476	12 483	14 261	16 023	19 466
Coal, lignite	2 205	2 342	3 088	3 787	4 128	4 913	6 592
Oil	3 200	3 684	4 061	4 131	4 683	4 760	4 432
Natural gas	1 678	2 122	2 251	2 343	2 785	3 096	3 348
Biomass and wastes	913	990	1 083	1 148	1 324	1 481	1 899
Others	745	910	993	1 075	1 340	1 773	3 195
Final Consumption (Mtoe)	5 702	7 077	7 963	8 511	9 928	10 825	12 230
<i>by source</i>							
Coal, lignite	870	639	816	985	1 084	1 042	937
Oil	2 546	3 137	3 472	3 564	4 174	4 294	3 965
Natural gas	999	1 071	1 154	1 175	1 359	1 487	1 572
Electricity	825	1 081	1 285	1 515	1 930	2 515	3 912
Biomass and wastes	916	916	988	1 015	1 103	1 148	1 243
Heat	179	234	248	257	271	288	312
Hydrogen	0	0	0	0	6	51	288
<i>by sector</i>							
Industry	2 411	2 579	2 954	3 181	3 679	3 913	4 109
Transport	1 549	1 936	2 171	2 286	2 728	3 007	3 468
Household, Service, Agriculture	1 857	2 562	2 838	3 044	3 520	3 905	4 654
Inputs in electricity generation (Mtoe)							
Coal		1 548	2 073	2 529	2 777	3 516	4 940
Gas		693	724	781	972	1 071	1 138
Oil		274	297	295	186	151	206
Biomass		52	64	77	167	269	531
Electricity Generation (TWh)	11 846	15 197	18 197	21 498	27 521	35 928	55 327
Thermal	7 600	9 875	12 293	15 015	19 178	25 081	35 668
<i>of which:</i>							
Coal	4 427	5 813	7 942	10 044	12 608	17 250	25 407
Gas	1 695	2 790	2 896	3 493	5 129	6 027	6 667
Biomass and wastes	146	149	188	242	651	1 169	2 677
Nuclear	2 013	2 591	2 768	2 932	3 530	4 692	7 949
Hydro+Geoth	2 229	2 700	3 027	3 224	3 889	4 320	5 030
Solar	1	1	4	12	59	246	2 401
Wind	4	31	104	316	864	1 581	4 165
Hydrogen	0	0	0	0	1	7	113
CO2 Emissions (MtCO2)	20 857	23 916	28 074	31 281	34 963	37 996	40 258
<i>of which:</i>							
Electricity generation		8 559	10 799	12 741	13 721	15 933	18 804
Industry		4 407	5 151	5 662	6 364	6 333	5 826
Transport		5 750	6 427	6 718	7 965	8 428	8 070
Household, Service, Agriculture		2 959	3 193	3 385	3 877	3 909	3 648
CO2 Sequestration (Mt CO2)	0	0	0	8	181	1 313	5 173

Results - ITR - World	1990	2000	2005	2010	2020	2030	2050
Key Indicators							
Population (Millions)	5 246	6 078	6 457	6 835	7 569	8 190	9 066
GDP (G\$95)	29 992	50 076	60 532	74 666	103 703	137 342	217 534
Per capita GDP (\$95/cap)	5 717	8 238	9 374	10 924	13 701	16 770	23 994
Gross Inland Cons/GDP (toe/M\$95)	291	201	190	167	126	108	84
Gross Inland Cons/capita (toe/cap)	1,7	1,7	1,8	1,8	1,7	1,8	2,0
Electricity Cons/capita (kWh/cap)	1 830	2 067	2 314	2 577	2 914	3 439	4 850
Transport fuels per capita (toe/cap)	0,30	0,32	0,34	0,33	0,32	0,34	0,36
CO2 emissions/capita (tCO2/cap)	4,0	3,9	4,3	4,6	4,2	4,2	4,0
% of renewables in Gross Inland Cons	13	12	12	12	14	15	19
% of renewables in electricity	20	19	18	18	22	23	30
Primary Production (Mtoe)	8 806	9 845	11 309	12 490	13 118	14 866	18 247
Coal, lignite	2 211	2 302	3 088	3 789	4 135	4 725	6 121
Oil	3 234	3 507	3 879	4 140	4 116	4 374	4 109
Natural gas	1 708	2 135	2 266	2 338	1 914	2 068	2 270
Nuclear	525	674	719	759	1 057	1 441	2 277
Hydro, geothermal	216	232	260	277	341	377	436
Biomass and wastes	913	990	1 083	1 146	1 408	1 605	2 069
Wind, solar	0	5	14	40	147	277	966
Gross Inland Consumption (Mtoe)	8 741	10 048	11 476	12 477	13 089	14 832	18 190
Coal, lignite	2 205	2 342	3 088	3 789	4 135	4 725	6 121
Oil	3 200	3 684	4 061	4 140	4 116	4 374	4 109
Natural gas	1 678	2 122	2 251	2 326	1 885	2 035	2 214
Biomass and wastes	913	990	1 083	1 147	1 408	1 605	2 069
Others	745	910	993	1 076	1 544	2 094	3 678
Final Consumption (Mtoe)	5 702	7 077	7 963	8 510	8 984	9 952	11 394
<i>by source</i>							
Coal, lignite	870	639	816	984	1 023	1 009	925
Oil	2 546	3 137	3 472	3 567	3 667	3 950	3 692
Natural gas	999	1 071	1 154	1 172	1 002	1 063	1 146
Electricity	825	1 081	1 285	1 515	1 897	2 422	3 782
Biomass and wastes	916	916	988	1 015	1 118	1 174	1 274
Heat	179	234	248	257	271	288	311
Hydrogen	0	0	0	0	7	47	264
<i>by sector</i>							
Industry	2 411	2 579	2 954	3 180	3 252	3 552	3 794
Transport	1 549	1 936	2 171	2 288	2 459	2 823	3 277
Household, Service, Agriculture	1 857	2 562	2 838	3 042	3 274	3 577	4 323
Inputs in electricity generation (Mtoe)							
Coal		1 548	2 073	2 531	2 787	3 341	4 507
Gas		693	724	770	604	653	686
Oil		274	297	302	194	140	184
Biomass		52	64	77	229	360	637
Electricity Generation (TWh)	11 846	15 197	18 197	21 494	26 962	34 495	53 374
Thermal	7 600	9 875	12 293	15 010	17 699	22 214	31 091
<i>of which:</i>							
Coal	4 427	5 813	7 942	10 046	12 626	16 323	23 043
Gas	1 695	2 790	2 896	3 456	3 334	3 737	4 039
Biomass and wastes	146	149	188	241	917	1 564	3 191
Nuclear	2 013	2 591	2 768	2 933	4 146	5 745	9 412
Hydro+Geoth	2 229	2 700	3 027	3 223	3 965	4 378	5 071
Solar	1	1	4	12	78	317	3 004
Wind	4	31	104	315	1 073	1 833	4 675
Hydrogen	0	0	0	0	1	7	121
CO2 Emissions (MtCO2)	20 857	23 916	28 074	31 281	31 585	34 172	35 901
<i>of which:</i>							
Electricity generation		8 559	10 799	12 747	13 002	14 508	16 674
Industry		4 407	5 151	5 660	5 447	5 603	5 209
Transport		5 750	6 427	6 723	7 130	7 873	7 582
Household, Service, Agriculture		2 959	3 193	3 382	3 335	3 297	3 124
CO2 Sequestration (Mt CO2)	0	0	0	8	213	1 126	4 450

ANNEX B: EU27 Summary Energy Balances (REF + 5 SECURE Scenarios)

Results - REF - EU27	1990	2000	2005	2010	2020	2030	2050
Key Indicators							
Population (Millions)	440	483	489	492	493	490	471
GDP (G\$95)	7 570	11 870	13 013	15 022	18 674	22 133	28 620
Per capita GDP (\$95/cap)	17 218	24 561	26 599	30 516	37 841	45 154	60 728
Gross Inland Cons/GDP (toe/M\$95)	202	148	143	125	108	96	80
Gross Inland Cons/capita (toe/cap)	3,5	3,6	3,8	3,8	4,1	4,3	4,9
Electricity Cons/capita (kWh/cap)	4 601	5 226	5 634	6 144	7 233	8 627	11 540
Transport fuels per capita (toe/cap)	0,63	0,72	0,76	0,76	0,81	0,81	0,76
CO2 emissions/capita (tCO2/cap)	8,5	8,4	8,6	8,7	9,0	9,1	9,1
% of renewables in Gross Inland Cons	4	6	7	7	8	9	10
% of renewables in electricity	13	15	15	16	18	19	21
Primary Production (Mtoe)	879	936	904	987	947	945	1 085
Coal, lignite	349	215	210	239	227	234	269
Oil	124	164	125	149	114	84	67
Natural gas	140	208	183	209	203	162	114
Nuclear	198	250	264	254	232	250	304
Hydro, geothermal	26	33	30	33	34	35	36
Biomass and wastes	43	64	85	86	103	112	127
Wind, solar	0	2	7	12	23	37	68
Gross Inland Consumption (Mtoe)	1 531	1 758	1 866	1 878	2 008	2 121	2 298
Coal, lignite	421	351	360	377	366	433	602
Oil	588	666	690	673	697	655	527
Natural gas	252	389	431	438	542	570	534
Biomass and wastes	43	64	85	91	114	142	227
Others	228	287	300	299	289	321	408
Final Consumption (Mtoe)	1 088	1 231	1 304	1 307	1 432	1 499	1 551
<i>by source</i>							
Coal, lignite	137	75	68	59	49	58	90
Oil	506	580	604	588	627	596	469
Natural gas	201	271	292	288	318	317	275
Electricity	174	217	237	260	307	364	468
Biomass and wastes	35	48	54	60	73	92	143
Heat	36	39	49	51	57	64	74
Hydrogen	0	0	0	0	1	8	33
<i>by sector</i>							
Industry	416	440	449	434	485	522	573
Transport	275	347	371	373	400	395	360
Household, Service, Agriculture	396	444	484	499	547	582	619
Inputs in electricity generation (Mtoe)							
Coal		252	269	300	304	356	465
Gas		98	119	128	192	215	218
Oil		41	42	41	26	16	23
Biomass		15	28	25	34	41	64
Electricity Generation (TWh)	2 413	2 965	3 311	3 570	4 213	4 991	6 382
Thermal	1 367	1 614	1 896	2 102	2 691	3 251	4 097
<i>of which:</i>							
Coal	964	925	1 000	1 148	1 340	1 719	2 364
Gas	185	506	637	709	1 117	1 294	1 306
Biomass and wastes	15	41	80	73	125	172	326
Nuclear	759	945	998	965	892	980	1 238
Hydro+Geoth	287	383	344	379	393	401	415
Solar	0	0	2	4	15	26	89
Wind	1	22	71	120	223	330	524
Hydrogen	0	0	0	0	0	1	18
CO2 Emissions (MtCO2)	3 740	4 039	4 224	4 263	4 450	4 454	4 299
<i>of which:</i>							
Electricity generation		1 351	1 467	1 608	1 688	1 740	1 897
Industry		699	681	613	634	687	753
Transport		1 022	1 089	1 087	1 152	1 079	799
Household, Service, Agriculture		691	720	702	719	682	577
CO2 Sequestration (Mt CO2)	0	0	0	0	35	222	577

Results - LTS - EU27	1990	2000	2005	2010	2020	2030	2050
Key Indicators							
Population (Millions)	440	483	489	492	493	490	471
GDP (G\$95)	7 570	11 870	13 013	14 856	18 205	21 573	27 884
Per capita GDP (\$95/cap)	17 218	24 561	26 599	30 179	36 889	44 011	59 168
Gross Inland Cons/GDP (toe/M\$95)	202	147	142	125	108	96	78
Gross Inland Cons/capita (toe/cap)	3,5	3,6	3,8	3,8	4,0	4,2	4,6
Electricity Cons/capita (kWh/cap)	4 601	5 226	5 634	6 106	7 093	8 400	10 768
Transport fuels per capita (toe/cap)	0,63	0,72	0,76	0,76	0,81	0,81	0,75
CO2 emissions/capita (tCO2/cap)	8,5	8,3	8,6	8,6	9,0	9,3	9,3
% of renewables in Gross Inland Cons	4	6	6	7	8	9	10
% of renewables in electricity	13	15	15	16	18	19	22
Primary Production (Mtoe)	879	926	890	967	900	858	940
Coal, lignite	349	215	210	238	224	234	258
Oil	124	164	125	149	112	83	66
Natural gas	140	209	183	208	201	161	113
Nuclear	198	241	254	239	194	167	171
Hydro, geothermal	26	33	30	33	34	35	36
Biomass and wastes	43	62	82	84	102	110	126
Wind, solar	0	2	7	12	20	33	62
Gross Inland Consumption (Mtoe)	1 531	1 745	1 852	1 854	1 973	2 077	2 186
Coal, lignite	421	348	361	374	363	446	594
Oil	588	667	689	671	698	655	500
Natural gas	252	390	429	436	550	596	589
Biomass and wastes	43	62	82	89	114	144	234
Others	228	278	291	284	248	235	269
Final Consumption (Mtoe)	1 088	1 231	1 304	1 303	1 425	1 494	1 536
<i>by source</i>							
Coal, lignite	137	75	68	59	49	57	88
Oil	506	580	604	587	627	595	444
Natural gas	201	271	292	286	316	318	301
Electricity	174	217	237	258	301	354	436
Biomass and wastes	35	48	54	60	72	90	139
Heat	36	39	49	51	57	64	74
Hydrogen	0	0	0	0	3	15	53
<i>by sector</i>							
Industry	416	440	449	434	487	523	571
Transport	275	347	371	372	400	397	355
Household, Service, Agriculture	396	444	484	497	539	574	609
Inputs in electricity generation (Mtoe)							
Coal		249	270	297	300	363	457
Gas		99	117	126	200	237	245
Oil		41	41	40	25	17	23
Biomass		13	25	23	36	45	72
Electricity Generation (TWh)	2 413	2 965	3 309	3 547	4 134	4 861	5 957
Thermal	1 367	1 614	1 895	2 101	2 768	3 479	4 312
<i>of which:</i>							
Coal	964	925	1 014	1 146	1 338	1 766	2 374
Gas	185	506	623	710	1 180	1 438	1 476
Biomass and wastes	15	41	80	77	145	201	357
Nuclear	759	945	998	940	766	663	682
Hydro+Geoth	287	383	344	386	397	405	416
Solar	0	0	2	4	6	14	50
Wind	1	22	71	115	197	299	483
Hydrogen	0	0	0	0	0	1	13
CO2 Emissions (MtCO2)	3 740	4 029	4 222	4 239	4 457	4 547	4 400
<i>of which:</i>							
Electricity generation		1 341	1 465	1 592	1 697	1 829	2 026
Industry		699	681	613	639	691	757
Transport		1 022	1 089	1 083	1 148	1 075	773
Household, Service, Agriculture		691	720	699	711	675	573
CO2 Sequestration (Mt CO2)	0	0	0	0	27	228	491

Results - LTR - EU27	1990	2000	2005	2010	2020	2030	2050
Key Indicators							
Population (Millions)	440	483	489	492	493	490	471
GDP (G\$95)	7 570	11 870	13 013	14 856	18 205	21 573	27 884
Per capita GDP (\$95/cap)	17 218	24 561	26 599	30 179	36 889	44 011	59 168
Gross Inland Cons/GDP (toe/M\$95)	202	147	142	125	101	90	74
Gross Inland Cons/capita (toe/cap)	3,5	3,6	3,8	3,8	3,7	4,0	4,4
Electricity Cons/capita (kWh/cap)	4 601	5 226	5 634	6 106	6 960	8 056	10 318
Transport fuels per capita (toe/cap)	0,63	0,72	0,76	0,76	0,75	0,78	0,72
CO2 emissions/capita (tCO2/cap)	8,5	8,3	8,6	8,6	8,2	8,4	8,3
% of renewables in Gross Inland Cons	4	6	6	7	9	10	11
% of renewables in electricity	13	15	15	16	20	22	26
Primary Production (Mtoe)	879	926	890	882	945	877	984
Coal, lignite	349	215	210	238	248	237	253
Oil	124	164	125	140	129	74	50
Natural gas	140	209	183	131	173	129	87
Nuclear	198	241	254	239	209	203	223
Hydro, geothermal	26	33	30	33	34	35	36
Biomass and wastes	43	62	82	84	107	117	132
Wind, solar	0	2	7	12	26	39	69
Gross Inland Consumption (Mtoe)	1 531	1 745	1 852	1 854	1 842	1 944	2 070
Coal, lignite	421	348	361	374	331	362	486
Oil	588	667	689	672	641	629	493
Natural gas	252	390	429	434	474	516	497
Biomass and wastes	43	62	82	89	125	160	265
Others	228	278	291	284	270	277	329
Final Consumption (Mtoe)	1 088	1 231	1 304	1 303	1 311	1 388	1 431
<i>by source</i>							
Coal, lignite	137	75	68	59	40	44	70
Oil	506	580	604	587	570	567	430
Natural gas	201	271	292	286	270	268	251
Electricity	174	217	237	258	295	340	418
Biomass and wastes	35	48	54	60	77	95	146
Heat	36	39	49	51	57	64	74
Hydrogen	0	0	0	0	2	11	41
<i>by sector</i>							
Industry	416	440	449	434	428	467	518
Transport	275	347	371	372	371	381	341
Household, Service, Agriculture	396	444	484	496	513	540	573
Inputs in electricity generation (Mtoe)							
Coal		249	270	298	280	302	376
Gas		99	117	125	176	213	207
Oil		41	41	41	30	20	29
Biomass		13	25	23	41	54	88
Electricity Generation (TWh)	2 413	2 965	3 309	3 547	4 049	4 654	5 694
Thermal	1 367	1 614	1 895	2 101	2 574	3 068	3 735
<i>of which:</i>							
Coal	964	925	1 014	1 148	1 248	1 459	1 931
Gas	185	506	623	705	1 029	1 280	1 237
Biomass and wastes	15	41	80	77	172	245	439
Nuclear	759	945	998	940	827	809	914
Hydro+Geoth	287	383	344	386	401	408	419
Solar	0	0	2	4	7	16	57
Wind	1	22	71	115	240	353	557
Hydrogen	0	0	0	0	0	1	12
CO2 Emissions (MtCO2)	3 740	4 029	4 222	4 241	4 050	4 100	3 930
<i>of which:</i>							
Electricity generation		1 341	1 465	1 593	1 586	1 629	1 768
Industry		699	681	613	520	572	635
Transport		1 022	1 089	1 084	1 061	1 037	760
Household, Service, Agriculture		691	720	699	651	613	515
CO2 Sequestration (Mt CO2)	0	0	0	0	16	123	337

Results - LCS - EU27	1990	2000	2005	2010	2020	2030	2050
Key Indicators							
Population (Millions)	440	483	489	492	493	490	471
GDP (G\$95)	7 570	11 870	13 013	14 856	18 205	21 573	27 884
Per capita GDP (\$95/cap)	17 218	24 561	26 599	30 179	36 889	44 011	59 168
Gross Inland Cons/GDP (toe/M\$95)	202	148	143	124	99	86	69
Gross Inland Cons/capita (toe/cap)	3,5	3,6	3,8	3,7	3,7	3,8	4,1
Electricity Cons/capita (kWh/cap)	4 601	5 226	5 634	6 098	6 754	8 011	10 693
Transport fuels per capita (toe/cap)	1	1	1	1	1	1	1
CO2 emissions/capita (tCO2/cap)	8,5	8,4	8,6	8,3	7,0	5,9	4,3
% of renewables in Gross Inland Cons	4	6	7	7	9	10	13
% of renewables in electricity	13	15	15	16	18	18	23
Primary Production (Mtoe)	879	936	904	969	863	816	985
Coal, lignite	349	215	210	218	158	161	173
Oil	124	164	125	149	110	71	48
Natural gas	140	208	183	216	203	157	106
Nuclear	198	250	264	249	211	189	239
Hydro, geothermal	26	33	30	33	35	35	36
Biomass and wastes	43	64	85	88	107	120	149
Wind, solar	0	2	7	11	20	31	70
Gross Inland Consumption (Mtoe)	1 531	1 758	1 866	1 844	1 808	1 856	1 914
Coal, lignite	421	351	360	324	232	291	368
Oil	588	666	690	670	631	562	406
Natural gas	252	389	431	464	553	575	483
Biomass and wastes	43	64	85	93	127	172	312
Others	228	287	300	293	265	256	346
Final Consumption (Mtoe)	1 088	1 231	1 304	1 286	1 289	1 294	1 282
<i>by source</i>							
Coal, lignite	137	75	68	54	23	22	21
Oil	506	580	604	578	564	511	367
Natural gas	201	271	292	283	274	233	150
Electricity	174	217	237	258	287	338	433
Biomass and wastes	35	48	54	62	83	117	199
Heat	36	39	49	51	57	64	74
Hydrogen	0	0	0	0	1	8	38
<i>by sector</i>							
Industry	416	440	449	427	419	434	461
Transport	275	347	371	367	375	360	318
Household, Service, Agriculture	396	444	484	492	496	500	503
Inputs in electricity generation (Mtoe)							
Coal		252	269	255	201	259	337
Gas		98	119	156	246	304	301
Oil		41	42	49	26	14	13
Biomass		15	28	25	37	42	82
Electricity Generation (TWh)	2 413	2 965	3 311	3 543	3 933	4 623	5 885
Thermal	1 367	1 614	1 897	2 102	2 543	3 231	3 959
<i>of which:</i>							
Coal	964	925	998	975	874	1 185	1 634
Gas	185	506	637	852	1 429	1 813	1 849
Biomass and wastes	15	41	80	74	134	175	419
Nuclear	759	945	998	946	809	729	948
Hydro+Geoth	287	383	344	389	403	411	423
Solar	0	0	2	4	7	13	56
Wind	1	22	71	102	171	237	479
Hydrogen	0	0	0	0	0	1	19
CO2 Emissions (MtCO2)	3 740	4 039	4 225	4 105	3 461	2 906	2 035
<i>of which:</i>							
Electricity generation		1 351	1 467	1 513	1 082	778	564
Industry		699	681	591	483	461	354
Transport		1 022	1 089	1 068	1 074	974	663
Household, Service, Agriculture		691	720	684	597	475	294
CO2 Sequestration (Mt CO2)	0	0	0	0	350	993	1 527

Results - ITS - EU27	1990	2000	2005	2010	2020	2030	2050
Key Indicators							
Population (Millions)	440	483	489	492	493	490	471
GDP (G\$95)	7 570	11 870	13 013	14 856	18 205	21 573	27 884
Per capita GDP (\$95/cap)	17 218	24 561	26 599	30 179	36 889	44 011	59 168
Gross Inland Cons/GDP (toe/M\$95)	202	147	142	124	109	97	80
Gross Inland Cons/capita (toe/cap)	3,5	3,6	3,8	3,8	4,0	4,3	4,7
Electricity Cons/capita (kWh/cap)	4 601	5 226	5 634	6 107	7 146	8 484	10 992
Transport fuels per capita (toe/cap)	1	1	1	1	1	1	1
CO2 emissions/capita (tCO2/cap)	8,5	8,3	8,6	8,5	8,7	8,6	8,2
% of renewables in Gross Inland Cons	4	6	6	7	8	9	11
% of renewables in electricity	13	15	15	18	21	22	25
Primary Production (Mtoe)	879	926	890	974	950	971	1 129
Coal, lignite	349	215	210	233	220	227	243
Oil	124	164	125	149	112	83	66
Natural gas	140	209	183	204	200	161	114
Nuclear	198	241	254	249	239	275	361
Hydro, geothermal	26	33	30	32	33	34	35
Biomass and wastes	43	62	82	84	102	110	126
Wind, solar	0	2	7	17	33	48	84
Gross Inland Consumption (Mtoe)	1 531	1 745	1 851	1 849	1 980	2 102	2 230
Coal, lignite	421	348	361	367	356	423	518
Oil	588	667	689	669	695	649	494
Natural gas	252	390	429	425	511	530	511
Biomass and wastes	43	62	82	89	113	142	227
Others	228	278	291	299	305	357	479
Final Consumption (Mtoe)	1 088	1 231	1 304	1 303	1 429	1 498	1 545
<i>by source</i>							
Coal, lignite	137	75	68	59	49	58	89
Oil	506	580	604	587	627	593	443
Natural gas	201	271	292	287	317	320	302
Electricity	174	217	237	259	303	358	446
Biomass and wastes	35	48	54	60	73	90	140
Heat	36	39	49	51	57	64	74
Hydrogen	0	0	0	0	3	15	52
<i>by sector</i>							
Industry	416	440	449	434	491	528	580
Transport	275	347	371	372	399	396	355
Household, Service, Agriculture	396	444	484	497	539	574	610
Inputs in electricity generation (Mtoe)							
Coal		249	270	291	293	340	384
Gas		99	117	116	163	174	169
Oil		41	41	38	23	13	19
Biomass		13	25	24	33	42	65
Electricity Generation (TWh)	2 413	2 965	3 309	3 547	4 159	4 899	6 068
Thermal	1 367	1 614	1 894	2 009	2 477	2 913	3 364
<i>of which:</i>							
Coal	964	925	1 015	1 125	1 305	1 634	1 952
Gas	185	506	623	646	940	1 039	1 011
Biomass and wastes	15	41	80	77	132	185	318
Nuclear	759	945	998	981	949	1 100	1 489
Hydro+Geoth	287	383	344	372	385	393	402
Solar	0	0	2	4	18	35	158
Wind	1	22	71	181	331	456	630
Hydrogen	0	0	0	0	0	2	24
CO2 Emissions (MtCO2)	3 740	4 029	4 222	4 182	4 278	4 202	3 862
<i>of which:</i>							
Electricity generation		1 341	1 464	1 537	1 525	1 496	1 505
Industry		699	681	614	643	696	762
Transport		1 022	1 089	1 083	1 147	1 068	766
Household, Service, Agriculture		691	720	699	712	678	577
CO2 Sequestration (Mt CO2)	0	0	0	0	84	315	534

Results - ITR - EU27	1990	2000	2005	2010	2020	2030	2050
Key Indicators							
Population (Millions)	440	483	489	492	493	490	471
GDP (G\$95)	7 570	11 870	13 013	14 856	18 205	21 573	27 884
Per capita GDP (\$95/cap)	17 218	24 561	26 599	30 179	36 889	44 011	59 168
Gross Inland Cons/GDP (toe/M\$95)	202	147	142	124	102	92	76
Gross Inland Cons/capita (toe/cap)	3,5	3,6	3,8	3,8	3,8	4,1	4,5
Electricity Cons/capita (kWh/cap)	4 601	5 226	5 634	6 107	7 047	8 269	10 755
Transport fuels per capita (toe/cap)	0,63	0,72	0,76	0,76	0,75	0,78	0,72
CO2 emissions/capita (tCO2/cap)	8,5	8,3	8,6	8,5	7,9	7,7	7,1
% of renewables in Gross Inland Cons	4	6	6	7	9	10	12
% of renewables in electricity	13	15	15	18	22	24	27
Primary Production (Mtoe)	879	926	890	892	999	1 011	1 201
Coal, lignite	349	215	210	234	238	221	223
Oil	124	164	125	140	128	74	50
Natural gas	140	209	183	130	170	129	87
Nuclear	198	241	254	249	271	344	462
Hydro, geothermal	26	33	30	32	34	34	35
Biomass and wastes	43	62	82	84	107	115	133
Wind, solar	0	2	7	17	36	51	91
Gross Inland Consumption (Mtoe)	1 531	1 745	1 851	1 849	1 861	1 988	2 118
Coal, lignite	421	348	361	368	314	326	386
Oil	588	667	689	670	642	620	478
Natural gas	252	390	429	423	442	456	413
Biomass and wastes	43	62	82	89	122	157	253
Others	228	278	291	299	340	429	588
Final Consumption (Mtoe)	1 088	1 231	1 304	1 303	1 318	1 397	1 448
<i>by source</i>							
Coal, lignite	137	75	68	59	40	44	71
Oil	506	580	604	587	571	563	424
Natural gas	201	271	292	286	271	269	249
Electricity	174	217	237	259	299	349	436
Biomass and wastes	35	48	54	60	77	94	145
Heat	36	39	49	51	57	64	74
Hydrogen	0	0	0	0	3	13	49
<i>by sector</i>							
Industry	416	440	449	434	433	475	530
Transport	275	347	371	372	372	380	342
Household, Service, Agriculture	396	444	484	496	514	543	577
Inputs in electricity generation (Mtoe)							
Coal		249	270	292	263	266	295
Gas		99	117	115	145	158	135
Oil		41	41	39	30	16	22
Biomass		13	25	24	38	51	79
Electricity Generation (TWh)	2 413	2 965	3 309	3 547	4 098	4 774	5 932
Thermal	1 367	1 614	1 894	2 009	2 274	2 496	2 768
<i>of which:</i>							
Coal	964	925	1 015	1 127	1 163	1 268	1 479
Gas	185	506	623	640	830	929	802
Biomass and wastes	15	41	80	77	153	232	390
Nuclear	759	945	998	981	1 075	1 375	1 899
Hydro+Geoth	287	383	344	372	391	396	404
Solar	0	0	2	4	18	37	161
Wind	1	22	71	181	340	469	673
Hydrogen	0	0	0	0	0	2	25
CO2 Emissions (MtCO2)	3 740	4 029	4 222	4 183	3 883	3 763	3 350
<i>of which:</i>							
Electricity generation		1 341	1 464	1 539	1 422	1 320	1 262
Industry		699	681	613	524	578	639
Transport		1 022	1 089	1 084	1 061	1 024	735
Household, Service, Agriculture		691	720	699	653	615	513
CO2 Sequestration (Mt CO2)	0	0	0	0	43	155	310