ΠΑΡΑΡΤΗΜΑ IV. LONG-TERM ENERGY FORECASTS FOR CYPRUS: SCENARIOS AND POLICY OPTIONS

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SUMMARY

This paper presents the results from an energy forecast model developed by the author specifically for the energy sector of the Republic of Cyprus. The model was used during the year 2010 to assist Cypriot authorities in their preparation of the National Renewable Energy Action Plan of Cyprus in line with the requirements of Directive 2009/28/EC, as well as for the assessment of the energy efficiency potential in view of ongoing discussions within the EU for the adoption of mandatory national energy efficiency targets. Major macroeconomic and price assumptions of the model are presented, and results from model application under different assumptions with regard to a) the penetration of renewable energy technologies and b) energy efficiency options are outlined and discussed. On the basis of these scenarios the paper discusses the relevant policy implications for Cyprus, and more specifically issues related to compliance with EU energy and climate legislation and the consequences for national greenhouse gas emissions.

1. Introduction

In Cyprus, like in any other country, there is an increasing need for the existence of a comprehensive mathematical model that performs forecasts of energy production, energy use and energy-related emissions of greenhouse gases and air pollutants, and whose results should be widely acceptable by governmental authorities so that it can be used for the submission of reports to international bodies such as the European Commission, the European Environment Agency and the United Nations Framework Convention on Climate Change. However, there has been no such model in Cyprus up to now, and each authority is using own projections of energy use and emissions, depending on individual requirements.

For this reason, the author is currently developing an energy model for Cyprus, which has been used up to now by the Cyprus Energy Service and the Cypriot Regulatory Authority for Energy for the preparation of renewable energy penetration and energy efficiency scenarios in the framework of national obligations of the Republic of Cyprus within the EU.

The model calculates future annual energy consumption in each major economic sector of Cyprus (agriculture, cement industry, other industry, households, services, road transport and air transport) as a function of future macroeconomic variables and future oil prices. Then it calculates fuel shares in each sector, depending on technology costs, the penetration potential of various technologies, and technical constraints for the uptake of new technologies, and allows computing future final energy consumption by sector and fuel.

The forecasts shown here are based on data from official energy balances of the period 2005-2009 provided by the Cyprus Energy Service. Developments in year 2009 were particularly important for these projections because 2009 was a year of economic recession, which is also reflected in the decrease observed in the final consumption of some energy products. Therefore, compared to earlier forecasts performed in spring 2010, forecasts have been revised downwards for most sectors and fuels, following the economic downturn that continued to some extent in year 2010 as well. Compared to the projections used by the Republic of Cyprus in June 2010 in its National Renewable Energy Action Plan, the projections shown here are lower due to a revised estimation of energy savings from existing measures, which was provided by the Cyprus Energy Service to the author in early 2011; however, total energy savings between the two basic scenarios that will be described in Section 4 below have remained the same as in the June 2010 National Renewable Energy Action Plan.

This paper reports on the assumptions and the results of model calculations.

2. Macroeconomic and Energy Price Assumptions

Forecasts of economic growth in Cyprus (both aggregate and for each one of the main economic sectors mentioned above) are shown in Table 1. They were obtained from the most recent announcements of official sources (available up to June 2010) such as the Cyprus Statistical Service, the government of Cyprus, the European Commission and the International Monetary Fund. According to these, Cyprus was expected to experience a second year of negative growth in 2010 (−0.4% in real Gross Domestic Product compared to 2009) and then gradually turn to positive growth in 2011 (with real GDP increasing by 1.3% compared to 2010). GDP was expected to exceed the levels of year 2008 only in year 2012; this explains to a large extent the decrease or stagnation of final energy consumption which is projected for the period 2010−2012. After 2012 stronger growth is assumed, which is expected to exceed 3% per year (in real terms) in 2015 and then to stabilize at about 2.5% in the year 2020. Private consumption is expected to follow the general trends of GDP. The contribution of industry and agriculture to total GDP is expected to fall slightly in the coming decade. As usual, the same organisations published revised forecasts during the second half of 2010, but since the above assumptions were used in the official projections of the Republic of Cyprus, in this paper we report results based on these assumptions.

As regards international crude oil prices, the most recent forecast of the International Energy Agency was used (as available in June 2010). According to this, a modest growth in prices is assumed for the next decade, and oil prices are expected to reach 100 US$ per barrel at 2008 prices in 2020 – or about 134 US$ per barrel in current prices of that year. This evolution is displayed in Table 2.

3. Sectoral Fuel Shares in Final Energy Consumption

Having computed total energy consumption for each main economic sector, it is necessary as a next step to calculate – for each future year – how this consumption is allocated among different fuels. For this purpose, it is necessary to simulate the uptake of different technologies/fuels by sector, based on each technology's costs as well as on the technically exploitable potential of each technological option. This Section reports on such assumptions for all end use sectors and fuels except electricity, which is dealt with separately in Section 5.

To calculate future sectoral fuel shares, detailed technical information was obtained from the Cyprus Energy Service on the basis of earlier specialised sectoral studies. In principle it was assumed that no drastic changes in the fuel mix of final energy consumption will take place in the decade 2010–2020, apart from some shifts towards renewable energy forms (including biomass and biofuels) to ensure compliance with related EU legislation. Results of these projections show that, in the household sector, the shares of LPG and kerosene are projected to continue decreasing, from 24% and 10% respectively in year 2005 to 20% and 5% respectively in year 2020. A slight increase in the share of solar thermal is foreseen – from 20% in 2005 and 27% in 2008 to 34% in 2020 – because, although there is little scope for further increases in the use of solar panels for water heating purposes, some increase in the use of solar technologies for space heating and cooling is foreseen. The share of biomass is projected to rise a little, from 3.5% in 2008 to 6% in 2020. Some use of geothermal energy is also foreseen; up to 2020 it is expected to reach 1.5% final non-electricity household consumption in comparison to 0.2% in year 2009.

Cement industry and agriculture are assumed to basically use the same fuels as today. As regards the other industrial and services sectors, an almost tripling of the share of solar thermal energy use is projected (from 6% in 2005 and 2008 to 17% in 2020) in view of increasingly available solar technologies for space heating and cooling that may also be promoted by governmental grants. Biomass is also expected to grow, from 3.3% of total non-electricity consumption in 2008 to 7% in year 2020.

In the road transport sector, a gradual penetration of biofuels is forecast, in an attempt to fulfil EU requirements. Up to the year 2015, the biofuel share is assumed to be fully taken up by biodiesel. In line with information available from the Cyprus Energy Service, it is currently technically feasible to blend up to 7% biodiesel (by volume) with conventional diesel fuel; in energy terms, this corresponds to a fraction of about 6% biodiesel. Since diesel fuel constitutes about half of the current fuel use in road transport – and is assumed to remain at these levels in the next decade – the biofuel share in total automotive fuel consumption was assumed to reach 3% by 2015. In the second half of the coming decade we assumed that it will be feasible to blend biodiesel with conventional diesel oil at greater ratios, and that the use of biofuels (such as bioethanol) in conventional gasoline will become more widespread at European level. Hence the share of biofuels in total automotive fuel consumption is projected to increase gradually and reach 4.9% in the year 2020.

In the absence of any breakthrough technologies, electricity use in road transport is expected to rise very slowly, from essentially zero in 2009 to 0.4% in 2020. LPG may appear as a new fuel in this sector in light

of recent governmental intentions to promote public transport using partly LPG-powered buses. No introduction of hydrogen-powered vehicles is projected until 2020. Finally, no substitution of jet fuel by biofuels or hydrogen was assumed to take place in aviation up to the year 2020.

4. Energy Efficiency of Final Consumption Sectors

To simulate the effect of energy efficiency measures on national energy consumption, three distinct scenarios have been set up, in line with the needs of the Cyprus Energy Service and the Cypriot Regulatory Authority for Energy, leading to three different energy forecasts. The scenarios contain different assumptions with regard to the implementation of energy efficiency measures in the residential, industrial, tertiary and transport sectors. Such measures include both:

– Actions taken as a result of mandatory compliance with EU legislation, such as the 'Energy Services Directive' (2006/32/EC), the Directive on labelling and standard product information of the energy consumption by energy-related products (2010/30/EC) and the Directive on energy performance of buildings (2010/31/EC); and

– Additional national measures such as subsidies for energy efficiency and renewable energy investments by households and firms.

More specifically, the following scenarios were considered:

1. A 'do nothing' scenario, simulating what would happen until 2020 if no energy efficiency measures had been taken after the mid-2000s. This is a rather theoretical scenario as it assumes that even the existing EU legislation and national measures are not implemented. As a result of this scenario, no autonomous efficiency improvement is assumed to take place from 2010 onwards; the only possible increase in energy efficiency is induced by higher energy prices.

2. A 'reference' scenario, which assumes that no additional measures – at EU and national level – are implemented after 2010. In other words, Directives adopted in year 2010 and national subsidies up to the year 2010 are assumed to take effect, but no post-2010 actions are included. According to bottom-up calculations of the Cyprus Energy Service, measures included in this scenario will lead to savings – compared to the 'do nothing' scenario – of 163.8 ktoe in final energy consumption (50.5 ktoe in final electricity consumption and 113.3 ktoe in final consumption of all other fuels). If measures that encourage the domestic generation of renewable energy whereby reducing the amount of purchased energy are excluded (because they have already been included in the renewable projections explained in Section 3 of this paper and hence the savings induced by these measures should not be counted again), this scenario includes savings – compared to the 'do nothing' scenario – of 156.7 ktoe in final energy consumption (48.6 ktoe in final electricity consumption and 108.2 ktoe in final consumption of all other fuels).

3. A 'energy efficiency' scenario, assuming that further energy efficiency measures are adopted in the post-2010 period, such as a continuation of national subsidies for investments in energy saving

technologies, the implementation of the 'recast Buildings Directive' at EU level and the adoption of further legislation on near-zero energy buildings later in this decade, and generally the gradual implementation of the EU Energy Efficiency Action Plan 2011.

The effect of each scenario on sectoral efficiency development is as follows:

– In road transport, a small efficiency improvement is foreseen in the 'reference scenario' in view of a) governmental plans to promote public transport modes and b) a limited number of subsidies for hybrid, electric and low-CO_2 cars. The 'energy efficiency scenario' assumes an accelerated introduction of more fuel efficient cars due to CO_2-related vehicle taxes and a stronger use of public transportation, leading to savings of 57 ktoe compared to the 'reference scenario'. Small efficiency improvements are expected in aviation too due to better utilisation of existing aircraft, thanks also to the introduction of aviation in the EU Emissions Trading System; these are forecast to cause 10 ktoe of savings compared to the 'reference scenario'.

– In the rest of the economic sectors, primarily in buildings in the residential and tertiary sectors, further energy savings of 23 ktoe in final non-electricity consumption are calculated compared to the 'reference scenario'. Since almost all energy saving potential in the residential and industrial sectors is expected to have been utilised already in the 'reference scenario', only about one third (8 ktoe) of the additional savings are foreseen to be achieved in the residential sector, less than 1 ktoe in industry and 14 ktoe in the service sectors of the economy, in which there is still more unexploited potential (e.g. in office buildings).

5. Power Generation

The electricity sector is not modelled explicitly by our energy model in its current form; instead official forecasts of the power generation sector (adopted by the Cypriot Energy Regulatory Authority) are used as input in our model, and fuel inputs for power generation are then calculated on the basis of appropriate assumptions. In this case, total electricity generation for each one of the three scenarios mentioned above was assumed as follows:

– For the 'reference scenario' and the 'energy efficiency scenario', the corresponding June 2010 forecasts of the Regulatory Authority were used. According to these, electricity production will reach 633 and 683 ktoe in year 2020 for the 'reference scenario' and the 'energy efficiency scenario' respectively. These forecasts were included by the government of Cyprus in the National Renewable Energy Action Plan submitted to the European Commission in June 2010.

– For the 'do-nothing' scenario, it was assumed that electricity generation will be higher than the 'reference scenario' forecast by 53.5 ktoe, which is equal to the savings of 48.6 ktoe in final electricity between the two scenarios as mentioned in Section 4 of this paper, multiplied by 1.1 to account for 10%

of transmission and distribution losses in order to calculate savings in electricity generation on the basis of savings in final electricity.

As regards fuel inputs in power generation, for each one of the 'do nothing' and 'reference' scenarios two alternatives were examined: one alternative assuming the introduction of natural gas in the energy system from year 2015 onwards, and one alternative assuming that natural gas will not penetrate in power generation of the country until 2020. These two alternatives are intended to illustrate the effect from the introduction of natural gas on primary energy consumption of Cyprus. The 'energy efficiency scenario' was calculated by assuming that natural gas will enter the market in 2015, as foreseen by the Regulatory Authority in its official forecasts.

In all cases it was assumed that renewable electricity generation will reach the levels foreseen by the official Renewable Energy Action Plan of June 2010, i.e. 16% of total power generation (101 ktoe) in the year 2020.

For all three scenarios, the thermal efficiency of power generation under the case with natural gas was calculated on the basis of the official forecasts of the Regulatory Authority. Overall thermal efficiency of non-renewable power plants is forecast to increase considerably thanks to the introduction of natural gas, from about 35% in year 2009 to 49.2% in 2020. Fuel inputs for each year of the period 2011–2020 were assumed after personal communication with the Cyprus Energy Service, whose information led to assumptions on the utilisation of different power plants during this period. As is obvious from the Regulatory Authority's forecasts, most of the power generation in year 2020 will take place in natural gas fired combined cycle gas turbine (CCGT) power plants. A considerable fraction of electricity will be produced by renewable energy sources, and only a tiny fraction of fuel oil and diesel oil will be used.

For the alternative case of no natural gas penetration, it was assumed that the thermal efficiency of non-renewable power plants will improve slightly, from about 35% in year 2009 to 40% in 2020. This may happen because all newly built power plants in Cyprus use the CCGT technology. Even though their utilisation will not be as high as in the case of natural gas (because in the absence of natural gas they have to operate with more expensive diesel oil and plant operators will prefer to use cheaper fuel oil burning power plants more intensively than CCGT plants), and despite a somewhat lower thermal efficiency of these plants when they operate on diesel oil instead of natural gas, still they will improve the average thermal efficiency to some extent, so that a gradual increase of average efficiency up to 40% in 2020 seems to be justified.

6. Detailed Results

Tables 3 to 8 present the energy demand forecasts by fuel up to the year 2020, for the main economic sectors covered: households, agriculture, cement industry, services and rest of industry, road transport and air transport. Results of both the 'reference scenario' and the 'energy efficiency scenario' are displayed; results of the 'do nothing scenario' are not reported here for brevity but are available upon request. Tables 9 and 10 report total final energy demand forecasts, for 'heating and cooling' (i.e. all

sectors except transport and all final energy forms except electricity) and transport respectively, whereas Tables 11 and 12 show total final non-electricity consumption for all sectors, by sector and fuel respectively. Finally, Tables 13 displays the projected energy savings between the 'reference' and 'energy efficiency' scenarios, and Table 14 presents total savings to be attained by all energy efficiency-related measures in the 'energy efficiency' scenario compared to the 'do nothing' scenario. As is evident from the latter two tables, the maximum savings in national energy consumption that can be attained in the 'energy efficiency' scenario is 14.4% compared to the 'reference scenario', which lies behind the indicative EU-wide target of 20% savings expressed by the European Commission in the energy and climate package of 2009. Moreover, the greatest part of these savings comes from the introduction of natural gas in the energy system of Cyprus; if natural gas penetration is considered as part of the 'reference scenario', total savings to be achieved in the 'energy efficiency scenario' are limited to 192 ktoe or 6%.

7. Comparison with European Commission Forecasts

Table 15 shows a comparison between the forecasts of our two scenarios with the projected energy demand according to the latest baseline scenario of the European Commission (PRIMES 2009 Baseline), whose results are the basis of the Commission Communication COM (2010) 265 entitled 'Analysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakage' that was released in an unofficial version on 26 May 2010. When comparing these forecasts it is necessary to keep in mind the important differences in the underlying macroeconomic assumptions, which are also shown on top of Table 11: According to the Commission, whose assumptions are based on macroeconomic forecasts available up to May 2009, real GDP of Cyprus is expected to rise by 44% over the period 2010-2020. Our forecasts, which are based on information available up to May 2010, assume a real GDP growth of 32% over the same decade.

As a result of this GDP difference and also because of different assumptions on the evolution of energy efficiency in buildings, our energy demand projections are lower than those of the European Commission, particularly in the 'additional energy efficiency' scenario. Note that our model is much more 'optimistic' (i.e. foresees much lower energy consumption in 2020) than the Commission for heating and cooling, and considerably more 'pessimistic' (i.e. forecasts higher consumption than the Commission) in road transport, whereas projections are similar in the case of air transport.

If we observe energy intensity (i.e. the amount of energy consumed per unit of GDP) it turns out that, even under the 'additional energy efficiency' scenario, our forecast shows a slower decrease in energy intensity over the period 2010–2020 than the Commission forecast (see bottom of Table 15). This means that our forecast is less 'optimistic' in terms of the potential for energy efficiency improvements, which is appropriate for an official governmental energy forecast: if too high decreases in energy intensity are foreseen – which are difficult to achieve in reality – then the country may not be well prepared to address problems associated with security of energy supply and greenhouse gas emissions.

8. Conclusions and Policy Implications

The scenarios examined in this paper lead to the following policy-related conclusions:

– Even under optimistic assumptions on the effectiveness of national and EU-wide measures on the energy efficiency of buildings, it does not seem to be possible for the Republic of Cyprus to achieve a 20% reduction in national energy consumption in the year 2020 compared to a reference scenario.

– The maximum improvement seems to be of the order of 14% – compared to a reference scenario – and this can only be achieved if the reference scenario does not account for the introduction of natural gas in the energy system of Cyprus. If natural gas is included in the reference case, then the attainable savings in an 'energy efficiency' scenario are less than half of the 14% mentioned above.

– A large part of the energy saving potential in buildings – particularly residential buildings – has been already exploited thanks to the implementation of the EU Directives on the energy performance of buildings and the introduction of relevant national subsidies. There seems to still be more unexploited potential in buildings in the service sectors.

– Attempts to further improve the energy efficiency of the Cypriot energy system must be focused on road transport, which is the sector consuming by far the greatest part of non-electricity energy. No serious nationwide energy savings can be attained in the coming years if road transport is overlooked. A substantial push of public transport modes, along with CO_2-based vehicle taxation that rewards low-CO_2 (and low fuel consuming) cars can contribute to this target. This policy priority is fully in line with the obligation of the Republic of Cyprus to reduce greenhouse gas emissions of non-ETS sectors (i.e. sectors not subject to the EU Emissions Trading System) by 5% in 2020 compared to 2005; it is impossible to even approach this 5% target without a serious emission reduction effort in road transport.

– As regards the renewable energy objectives, it seems that the only possibility to meet the 2020 target of 10% renewables in transport (as foreseen by Directive 2009/28/EC) is to ensure that all biofuels consumed in Cyprus in 2020 will come from wastes, residues, non-food cellulosic or other material that counts double towards this target. Currently a very small fraction of biofuels (about 260 toe according to the Cyprus Energy Service) come from such material. It follows that compliance with the 10% renewables target in transport will require producing or (mainly) importing this type of bio fuels only.

– Renewable energy targets in heating and cooling are also relatively ambitious, and it remains to be seen whether they can be achieved in the coming years. For this purpose, a continuation of national subsidies for the installation of renewables in the residential and tertiary sectors is clearly needed.

Following this modelling work, a major recommendation for governmental authorities of the Republic of Cyprus is to realise the great need for a comprehensive national energy model, which will perform forecasts of energy production and consumption under different scenarios on the basis of state-of-the-art forecasting techniques, and will also calculate greenhouse gas emissions. Such a modelling tool will be able to address most of the needs of governmental authorities in preparing their energy and

environmental assessments as well as in submitting reports in line with their reporting obligations in the European Commission and other international organisations.

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Table 1: Macroeconomic assumptions.

Year	2005	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Real GDP (mio Euros at 2005 prices)	13462	15270	15004	14944	15138	15516	16024	16559	17105	17642	18167	18679	19176	19656
Real private consumption (mio Euros at 2005 prices)	8699	10794	10468	10353	10571	10966	11482	11986	12474	12943	13389	13808	14196	14551
Sectoral shares of GDP:														
Agriculture	2.8%	2.1%	2.1%	2.1%	2.1%	2.0%	2.0%	2.0%	2.0%	2.0%	1.9%	1.9%	1.9%	1.9%
Industry	11.3%	10.2%	9.9%	9.9%	9.9%	9.8%	9.8%	9.7%	9.7%	9.6%	9.6%	9.5%	9.5%	9.5%
Construction	8.2%	8.7%	8.2%	8.2%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.4%	8.4%
Services	77.7%	79.0%	79.7%	79.8%	79.8%	79.9%	79.9%	80.0%	80.0%	80.1%	80.1%	80.2%	80.2%	80.3%

Sources:

Official national accounts, Statistical Service of the Republic of Cyprus, March 2010

European Commission, Spring macroeconomic forecasts for years 2010-2011, May 2010

Stability Programme submitted by the Republic of Cyprus to the European Commission, March 2010

IMF World Economic Outlook for years 2012-2015, April 2010

Forecasts of the Cypriot Ministry of Finance for year 2020

Forecasts of sectoral GDP shares made by the author

Table 2: Crude oil price assumptions.

Year	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Crude oil import prices (US$ per barrel at 2008 prices)	59.6	77.7	79.5	81.4	83.3	85.1	87.0	89.6	92.2	94.8	97.4	100.0

Source: International Energy Agency World Energy Outlook 2009, Paris, France

Table 3: Final non-electricity consumption forecasts for the households sector (toe).

	Households – Reference scenario						
	LPG	Kerosene	Gasoil	Solar thermal	Geothermal	Biomass	Total
2005	38334	14964	71400	30953	0	1771	157422
2008	38558	12670	68900	47656	0	6037	173821
2009	39838	17000	71070	49476	351	7190	184925
2010	37596	16113	67892	50128	340	6961	179030
2011	35557	14631	63764	48657	546	6974	170130
2012	34009	13407	60558	47743	739	7048	163503
2013	32739	12337	57880	47132	922	7151	158161
2014	31453	11299	55200	46416	1090	7226	152683
2015	30154	10297	52529	45599	1243	7272	147094
2016	28814	9322	49816	44634	1378	7282	141246
2017	27478	8392	47141	43586	1498	7264	135359
2018	26150	7508	44513	42462	1603	7221	129456
2019	24836	6672	41939	41269	1692	7153	123561
2020	23539	5885	39427	40016	1765	7062	117694

	Households – Additional energy efficiency scenario						
	LPG	Kerosene	Gasoil	Solar thermal		Biomass	Total
2005	38334	14964	71400	30953	0	1771	157422
2008	38558	12670	68900	47656	0	6037	173821
2009	39838	17000	71070	49476	351	7190	184925
2010	37596	16113	67892	50128	340	6961	179030
2011	35410	14570	63500	48455	544	6945	169424
2012	33727	13296	60056	47347	733	6989	162149
2013	32333	12184	57162	46548	910	7063	156200
2014	30934	11112	54289	45650	1072	7107	150164
2015	29534	10085	51448	44661	1217	7123	144068
2016	28104	9093	48588	43534	1344	7102	137766
2017	26690	8152	45789	42335	1455	7056	131476
2018	25160	7224	42827	40853	1542	6947	124552
2019	23541	6325	39754	39119	1603	6780	117122
2020	21863	5466	36621	37168	1640	6559	109317

Table 4: Final non-electricity consumption forecasts for agriculture (toe).

	Agriculture – Reference scenario			
	LPG	Gasoil	Biomass	Total
2005		27283	103	27386
2008	2337	27262	0	29599
2009	1229	24418	959	26606
2010	1200	23738	1039	25977
2011	1186	23795	1041	26022
2012	1183	24076	1052	26312
2013	1187	24507	1071	26764
2014	1191	24958	1090	27238
2015	1194	25407	1108	27710
2016	1195	25821	1126	28142
2017	1195	26208	1142	28545
2018	1192	26567	1157	28916
2019	1188	26897	1170	29255
2020	1182	27195	1182	29560

Agriculture – Additional energy efficiency scenario

	LPG	Gasoil	Biomass	Total
2005	0	27283	103	27386
2008	2337	27262	0	29599
2009	1229	24418	959	26606
2010	1200	23738	1039	25977
2011	1186	23793	1041	26019
2012	1183	24071	1052	26306
2013	1186	24500	1070	26756
2014	1190	24948	1089	27227
2015	1194	25395	1108	27696
2016	1195	25806	1125	28125
2017	1194	26190	1141	28525
2018	1192	26546	1156	28893
2019	1187	26872	1169	29229
2020	1181	27168	1181	29530

Table 5: Final non-electricity consumption forecasts for the cement industry (toe).

	Cement Industry – Reference scenario						
	LFO	HFO	Pet coke	Coal	Other	Biomass	Total
2005	7038	17053	112368	36405	3308	671	176843
2008	2423	10084	115533	25574	5712	6727	166053
2009	733	6893	110811	13097	7070	6705	145309
2010	722	6792	109195	12906	6967	6607	143189
2011	731	6872	110481	13058	7049	6685	144877
2012	747	7027	112973	13353	7208	6836	148144
2013	769	7235	116310	13747	7421	7038	152520
2014	793	7453	119819	14162	7645	7250	157121
2015	816	7676	123392	14584	7873	7466	161807
2016	839	7890	126846	14992	8093	7675	166336
2017	861	8100	130220	15391	8308	7879	170760
2018	883	8305	133502	15779	8518	8078	175065
2019	904	8502	136681	16155	8721	8270	179233
2020	924	8693	139744	16517	8916	8456	183250

	Cement Industry – Additional energy efficiency scenario						
	LFO	HFO	Pet coke	Coal	Other	Biomass	Total
2005	7038	17053	112368	36405	3308	671	176843
2008	2423	10084	115533	25574	5712	6727	166053
2009	733	6893	110811	13097	7070	6705	145309
2010	722	6792	109195	12906	6967	6607	143189
2011	731	6870	110437	13053	7046	6682	144819
2012	747	7022	112883	13342	7202	6830	148026
2013	768	7226	116170	13730	7412	7029	152337
2014	791	7441	119627	14139	7632	7238	156870
2015	815	7660	123146	14555	7857	7451	161484
2016	837	7872	126542	14956	8074	7657	165937
2017	859	8078	129856	15348	8285	7857	170283
2018	880	8278	133076	15729	8491	8052	174505
2019	901	8472	136190	16097	8689	8241	178589
2020	921	8658	139186	16451	8880	8422	182518

Table 6: Final non-electricity consumption forecasts for rest of industry and services sectors (toe).

	Services + Other Industry – Reference scenario							
	LPG	Kerosene	Gasoil	Solar thermal	Biomass	LFO	HFO	Total
2005	20778	1649	80697	10318	1650	52820	0	167912
2008	17526	1539	53518	8410	4615	29381	25657	140646
2009	20222	1924	54308	8731	3831	28897	18331	136244
2010	19697	1874	52510	8891	3731	28146	17855	132705
2011	19741	1878	50830	10281	4297	28081	17895	133004
2012	19951	1898	49553	11775	4906	28250	18085	134418
2013	20272	1929	48503	13371	5556	28572	18376	136580
2014	20609	1961	47433	15024	6231	28914	18682	138854
2015	20949	1993	46306	16725	6924	29254	18990	141141
2016	21238	2021	45009	18430	7619	29519	19252	143088
2017	21511	2047	43629	20160	8324	29759	19499	144929
2018	21768	2071	42166	21911	9038	29972	19732	146657
2019	22007	2094	40624	23678	9758	30158	19949	148267
2020	22227	2115	39006	25458	10483	30316	20149	149753

	Services + Industry – Additional energy efficiency scenario							
	LPG	Kerosene	Gasoil	Solar thermal	Biomass	LFO	HFO	Total
2005	20778	1649	80697	10318	1650	52820	0	167912
2008	17526	1539	53518	8410	4615	29381	25657	140646
2009	20222	1924	54308	8731	3831	28897	18331	136244
2010	19697	1874	52510	8891	3731	28146	17855	132705
2011	19605	1865	50479	10210	4267	27887	17771	132084
2012	19676	1872	48870	11613	4838	27861	17836	132566
2013	19854	1889	47504	13096	5442	27984	17998	133766
2014	20045	1907	46135	14613	6060	28123	18171	135054
2015	20235	1925	44727	16155	6688	28257	18342	136328
2016	20372	1938	43174	17678	7308	28316	18467	137253
2017	20491	1950	41560	19204	7929	28348	18575	138058
2018	20488	1949	39688	20623	8506	28211	18572	138038
2019	20362	1937	37589	21909	9029	27905	18458	137190
2020	20115	1914	35300	23039	9487	27435	18234	135525

Table 7: Final energy consumption forecasts in road transport (toe).

	Road Transport – Reference scenario						
	LPG	Gasoline	Diesel	Biofuels	Electricity	Hydrogen	Total
2005	0	321006	359305	0	5719	0	686030
2008	0	391744	364025	14179	6556	0	776504
2009	0	401804	334519	15131	0	0	751454
2010	0	385552	321978	15753	0	0	723283
2011	291	387717	322557	17050	291	0	727906
2012	592	393604	326205	18538	592	0	739531
2013	907	402028	331908	20193	907	0	755943
2014	1237	410879	337907	21924	1237	0	773184
2015	1581	419822	343922	23719	1581	0	790625
2016	1936	424552	350836	27260	1936	0	806519
2017	2301	428825	357491	30900	2301	0	821818
2018	2677	432622	363864	34630	2677	0	836469
2019	3062	435925	369932	38439	3062	0	850419
2020	3454	438718	375674	42317	3454	0	863619

	Road Transport – Additional energy efficiency scenario						
	LPG	Gasoline	Diesel	Biofuels	Electricity	Hydrogen	Total
2005	0	321006	359305	0	5719	0	686030
2008	0	391744	364025	14179	6556	0	776504
2009	0	401804	334519	15131	0	0	751454
2010	0	383778	320497	15680	0	0	719955
2011	288	384033	319492	16888	288	0	720990
2012	583	387821	321412	18266	583	0	728665
2013	889	393918	325212	19785	889	0	740693
2014	1205	400222	329142	21356	1205	0	753130
2015	1531	406396	332923	22960	1531	0	765341
2016	1862	408294	337401	26216	1862	0	775635
2017	2198	409582	341449	29514	2198	0	784940
2018	2538	410248	345046	32839	2538	0	793210
2019	2881	410287	348176	36178	2881	0	800405
2020	3226	409695	350821	39518	3226	0	806486

Table 8: Final energy consumption forecasts in air transport (toe).

	Air Transport – Reference scenario			
	Kerosene	Biofuels	Hydrogen	Total
2005	300595	0	0	300595
2008	295432	0	0	295432
2009	273669	0	0	273669
2010	256939	0	0	256939
2011	258814	0	0	258814
2012	264127	0	0	264127
2013	271828	0	0	271828
2014	279991	0	0	279991
2015	288308	0	0	288308
2016	295793	0	0	295793
2017	303019	0	0	303019
2018	309954	0	0	309954
2019	316567	0	0	316567
2020	322825	0	0	322825

Air Transport – Additional energy efficiency scenario

	Kerosene	Biofuels	Hydrogen	Total
2005	300595	0	0	300595
2008	295432	0	0	295432
2009	273669	0	0	273669
2010	256425	0	0	256425
2011	257740	0	0	257740
2012	262426	0	0	262426
2013	269415	0	0	269415
2014	276783	0	0	276783
2015	284220	0	0	284220
2016	290752	0	0	290752
2017	296946	0	0	296946
2018	302769	0	0	302769
2019	308191	0	0	308191
2020	313182	0	0	313182

Table 9: Total final non-electricity consumption forecasts for heating and cooling (toe).

	Heating and cooling – Reference scenario											
	LPG	Kerosene	Gasoil	Solar thermal	Geothermal	Biomass	LFO	HFO	Pet coke	Coal	Other	Grand total
2005	59112	16613	179380	41271	0	4195	59858	17053	112368	36405	3308	529563
2008	58421	14209	149680	56066	0	17379	31804	35741	115533	25574	5712	510119
2009	61289	18924	149796	58207	351	18685	29630	25224	110811	13097	7070	493084
2010	58493	17987	144140	59020	340	18339	28869	24647	109195	12906	6967	480902
2011	56484	16509	138389	58938	546	18997	28812	24768	110481	13058	7049	474032
2012	55142	15305	134187	59518	739	19842	28997	25113	112973	13353	7208	472377
2013	54198	14265	130890	60503	922	20816	29342	25611	116310	13747	7421	474025
2014	53253	13259	127591	61440	1090	21796	29707	26136	119819	14162	7645	475896
2015	52297	12290	124242	62324	1243	22771	30070	26665	123392	14584	7873	477752
2016	51247	11343	120646	63063	1378	23702	30358	27142	126846	14992	8093	478812
2017	50184	10439	116978	63745	1498	24609	30620	27600	130220	15391	8308	479593
2018	49110	9580	113246	64372	1603	25493	30855	28037	133502	15779	8518	480095
2019	48031	8766	109460	64948	1692	26351	31062	28451	136681	16155	8721	480317
2020	46948	7999	105629	65474	1765	27182	31240	28841	139744	16517	8916	480257

	Heating and cooling – Additional energy efficiency scenario											
	LPG	Kerosene	Gasoil	Solar thermal	Geothermal	Biomass	LFO	HFO	Pet coke	Coal	Other	Grand total
2005	59112	16613	179380	41271	0	4195	59858	17053	112368	36405	3308	529563
2008	58421	14209	149680	56066	0	17379	31804	35741	115533	25574	5712	510119
2009	61289	18924	149796	58207	351	18685	29630	25224	110811	13097	7070	493084
2010	58493	17987	144140	59020	340	18339	28869	24647	109195	12906	6967	480902
2011	56200	16436	137771	58665	544	18935	28618	24641	110437	13053	7046	472346
2012	54586	15168	132998	58960	733	19710	28607	24858	112883	13342	7202	469046
2013	53374	14073	129166	59643	910	20604	28752	25224	116170	13730	7412	469059
2014	52169	13019	125372	60263	1072	21495	28914	25612	119627	14139	7632	469315
2015	50962	12010	121569	60816	1217	22370	29071	26003	123146	14555	7857	469576
2016	49671	11031	117568	61212	1344	23192	29153	26338	126542	14956	8074	469081
2017	48375	10101	113539	61539	1455	23983	29207	26653	129856	15348	8285	468341
2018	46839	9173	109060	61476	1542	24661	29091	26850	133076	15729	8491	465989
2019	45091	8262	104215	61028	1603	25218	28806	26930	136190	16097	8689	462130
2020	43160	7380	99089	60207	1640	25649	28356	26892	139186	16451	8880	456890

Table 10: Total final energy consumption forecasts in road and air transport (toe).

	Transport – Reference scenario							
	LPG	Gasoline	Diesel	Kerosene	Biofuels	Electricity	Hydrogen	Grand total
2005	0	321006	359305	300595	0	5719	0	986625
2008	0	391744	364025	295432	14179	6556	0	1071936
2009	0	401804	334519	273669	15131	0	0	1025123
2010	0	385552	321978	256939	15753	0	0	980222
2011	291	387717	322557	258814	17050	291	0	986721
2012	592	393604	326205	264127	18538	592	0	1003659
2013	907	402028	331908	271828	20193	907	0	1027771
2014	1237	410879	337907	279991	21924	1237	0	1053175
2015	1581	419822	343922	288308	23719	1581	0	1078933
2016	1936	424552	350836	295793	27260	1936	0	1102312
2017	2301	428825	357491	303019	30900	2301	0	1124837
2018	2677	432622	363864	309954	34630	2677	0	1146423
2019	3062	435925	369932	316567	38439	3062	0	1166986
2020	3454	438718	375674	322825	42317	3454	0	1186443

	Transport – Additional energy efficiency scenario							
	LPG	Gasoline	Diesel	Kerosene	Biofuels	Electricity	Hydrogen	Grand total
2005	0	321006	359305	300595	0	5719	0	986625
2008	0	391744	364025	295432	14179	6556	0	1071936
2009	0	401804	334519	273669	15131	0	0	1025123
2010	0	383778	320497	256425	15680	0	0	976379
2011	288	384033	319492	257740	16888	288	0	978731
2012	583	387821	321412	262426	18266	583	0	991091
2013	889	393918	325212	269415	19785	889	0	1010107
2014	1205	400222	329142	276783	21356	1205	0	1029913
2015	1531	406396	332923	284220	22960	1531	0	1049561
2016	1862	408294	337401	290752	26216	1862	0	1066387
2017	2198	409582	341449	296946	29514	2198	0	1081886
2018	2538	410248	345046	302769	32839	2538	0	1095979
2019	2881	410287	348176	308191	36178	2881	0	1108596
2020	3226	409695	350821	313182	39518	3226	0	1119668

Table 11: Total final non-electricity consumption forecasts for all sectors, by sector (ktoe).

	Reference scenario						
	Households	Agriculture	Cement Industry	Services + Other Industry	Road Transport	Air Transport	Total
2005	157	27	177	168	680	301	1510
2008	174	30	166	141	770	295	1575
2009	185	27	145	136	751	274	1518
2010	179	26	143	133	723	257	1461
2011	170	26	145	133	728	259	1460
2012	164	26	148	134	739	264	1475
2013	158	27	153	137	755	272	1501
2014	153	27	157	139	772	280	1528
2015	147	28	162	141	789	288	1555
2016	141	28	166	143	805	296	1579
2017	135	29	171	145	820	303	1602
2018	129	29	175	147	834	310	1624
2019	124	29	179	148	847	317	1644
2020	118	30	183	150	860	323	1663

	Additional energy efficiency scenario						
	Households	Agriculture	Cement Industry	Services + Other Industry	Road Transport	Air Transport	Total
2005	157	27	177	168	680	301	1510
2008	174	30	166	141	770	295	1575
2009	185	27	145	136	751	274	1518
2010	179	26	143	133	720	256	1457
2011	169	26	145	132	721	258	1451
2012	162	26	148	133	728	262	1460
2013	156	27	152	134	740	269	1478
2014	150	27	157	135	752	277	1498
2015	144	28	161	136	764	284	1518
2016	138	28	166	137	774	291	1534
2017	131	29	170	138	783	297	1548
2018	125	29	175	138	791	303	1559
2019	117	29	179	137	798	308	1568
2020	109	30	183	136	803	313	1573

Table 12: Total final non-electricity consumption forecasts for all sectors, by fuel (ktoe).

	Reference scenario																
	LPG	Kerosene	Gasoil	LFO	HFO	Pet coke	Coal	Gasoline	Diesel	Jet fuel	Biofuels	Hydrogen	Solar	Geothermal	Biomass	Other	Total
2005	59	17	179	60	17	112	36	321	359	301	0	0	41	0	4	3	1510
2008	58	14	150	32	36	116	26	392	364	295	14	0	56	0	17	6	1575
2009	61	19	150	30	25	111	13	402	335	274	15	0	58	0	19	7	1518
2010	58	18	144	29	25	109	13	386	322	257	16	0	59	0	18	7	1461
2011	57	17	138	29	25	110	13	388	323	259	17	0	59	1	19	7	1460
2012	56	15	134	29	25	113	13	394	326	264	19	0	60	1	20	7	1475
2013	55	14	131	29	26	116	14	402	332	272	20	0	61	1	21	7	1501
2014	54	13	128	30	26	120	14	411	338	280	22	0	61	1	22	8	1528
2015	54	12	124	30	27	123	15	420	344	288	24	0	62	1	23	8	1555
2016	53	11	121	30	27	127	15	425	351	296	27	0	63	1	24	8	1579
2017	52	10	117	31	28	130	15	429	357	303	31	0	64	1	25	8	1602
2018	52	10	113	31	28	134	16	433	364	310	35	0	64	2	25	9	1624
2019	51	9	109	31	28	137	16	436	370	317	38	0	65	2	26	9	1644
2020	50	8	106	31	29	140	17	439	376	323	42	0	65	2	27	9	1663

	Additional energy efficiency scenario																
	LPG	Kerosene	Gasoil	LFO	HFO	Pet coke	Coal	Gasoline	Diesel	Jet fuel	Biofuels	Hydrogen	Solar	Geothermal	Biomass	Other	Total
2005	59	17	179	60	17	112	36	321	359	301	0	0	41	0	4	3	1510
2008	58	14	150	32	36	116	26	392	364	295	14	0	56	0	17	6	1575
2009	61	19	150	30	25	111	13	402	335	274	15	0	58	0	19	7	1518
2010	58	18	144	29	25	109	13	384	320	256	16	0	59	0	18	7	1457
2011	56	16	138	29	25	110	13	384	319	258	17	0	59	1	19	7	1451
2012	55	15	133	29	25	113	13	388	321	262	18	0	59	1	20	7	1460
2013	54	14	129	29	25	116	14	394	325	269	20	0	60	1	21	7	1478
2014	53	13	125	29	26	120	14	400	329	277	21	0	60	1	21	8	1498
2015	52	12	122	29	26	123	15	406	333	284	23	0	61	1	22	8	1518
2016	52	11	118	29	26	127	15	408	337	291	26	0	61	1	23	8	1534
2017	51	10	114	29	27	130	15	410	341	297	30	0	62	1	24	8	1548
2018	49	9	109	29	27	133	16	410	345	303	33	0	61	2	25	8	1559
2019	48	8	104	29	27	136	16	410	348	308	36	0	61	2	25	9	1568
2020	46	7	99	28	27	139	16	410	351	313	40	0	60	2	26	9	1573

Table 13: Forecast of energy savings to be achieved between 'energy efficiency' and 'reference' scenarios.

(ktoe)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Savings in final non-electricity consumption	4	10	16	23	30	37	46	54	64	76	90
Residential	0	1	1	2	3	3	3	4	5	6	8
Total Industry	0	0	0	0	0	0	0	0	1	1	1
Tertiary	0	1	2	3	4	5	6	7	9	11	14
Agriculture	0	0	0	0	0	0	0	0	0	0	0
Road Transport	3	7	11	15	20	25	31	37	43	50	57
Air Transport	1	1	2	2	3	4	5	6	7	8	10
Savings in final electricity consumption	1	5	11	16	21	26	31	37	42	47	50
Savings in primary electricity production because of savings in final electricity	3	15	29	42	55	58	66	77	87	96	102
Savings in primary electricity due to introduction of natural gas*	0	0	0	0	0	190	259	264	267	270	271
Total savings in primary electricity	3	15	29	42	55	249	325	340	354	365	373
Savings in national energy consumption	7	24	45	65	84	286	371	394	418	442	463
As a fraction of reference energy consumption	*0.2%*	*0.9%*	*1.6%*	*2.3%*	*2.9%*	*9.6%*	*12.2%*	*12.7%*	*13.3%*	*13.9%*	*14.4%*

*including energy savings in primary energy from additional measures in transmission/distribution system

Table 14: Forecast of energy savings to be achieved between 'energy efficiency' and 'do nothing' scenarios.

(ktoe)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Savings in final non-electricity consumption	5	22	40	58	77	96	116	135	156	179	202
Residential	0	12	23	34	45	56	67	77	88	99	109
Total Industry	0	0	0	0	0	1	1	1	1	1	1
Tertiary	0	1	2	4	5	6	8	9	11	14	17
Agriculture	0	0	0	0	0	0	0	0	0	0	0
Road Transport	4	7	12	16	22	27	33	39	46	53	61
Air Transport	1	2	2	4	5	6	7	9	10	12	13
Savings in final electricity consumption	1	11	21	32	42	52	62	73	83	93	103
Savings in primary electricity production because of savings in final electricity	3	28	55	83	109	119	133	153	172	192	210
Savings in primary electricity due to introduction of natural gas	0	0	0	0	0	200	278	288	297	305	309
Total savings in primary electricity	3	28	55	83	109	319	410	441	470	496	519
Savings in national energy consumption	7	50	95	141	187	415	526	576	626	675	721
As a fraction of reference energy consumption	*0.3%*	*1.8%*	*3.3%*	*4.8%*	*6.2%*	*13.3%*	*16.4%*	*17.6%*	*18.7%*	*19.8%*	*20.7%*

Table 15: Comparison of our forecasts with the latest baseline energy forecasts for Cyprus (PRIMES 2009 Baseline) that were released by the European Commission on 26 May 2010 as background information for Commission Communication COM(2010) 265.

GDP assumptions				
(MEuros'1995)	2005	2010	2020	Difference 2020-2010
Our scenarios	13462	14944	19656	31.5%
COM(2010) 265 baseline	13700	15600	22500	44.2%
1. Non-electricity consumption for heating and cooling in residential, services and industry sectors				
(ktoe)	2005	2010	2020	Difference 2020-2010
Our reference scenario	530	481	480	-0.1%
Our energy efficiency scenario	530	481	457	-5.0%
COM(2010) 265 baseline	540	636	779	22.5%
2. Road Transport				
(ktoe)	2005	2010	2020	Difference 2020-2010
Our reference scenario	686	723	864	19.4%
Our energy efficiency scenario	686	720	806	12.0%
COM(2010) 265 baseline	673	726	769	5.9%
3. Air Transport				
(ktoe)	2005	2010	2020	Difference 2020-2010
Our reference scenario	301	257	323	25.6%

Our energy efficiency scenario	301	256	313	22.1%
COM(2010) 265 baseline	299	344	434	26.2%
4. Total Final Non-Electricity Demand*				
(ktoe)	2005	2010	2020	Difference 2020-2010
Our reference scenario	1516	1461	1667	14.1%
Our energy efficiency scenario	1516	1457	1577	8.2%
COM(2010) 265 baseline	1512	1706	1982	16.2%
5. Total Final Non-Electricity Intensity* (Demand per Unit of GDP)				
(toe/Meuro'1995)	2005	2010	2020	Difference 2020-2010
Our reference scenario	113	98	85	-13.3%
Our energy efficiency scenario	113	98	80	-17.7%
COM(2010) 265 baseline	110	109	88	-19.4%

* Note: transport includes a very small amount of electricity