REGIONAL ENERGY SECURITY AND MARKET DEVELOPMENT - STRATEGIC PLANNING COMPONENT

INVESTMENT REQUIREMENTS AND BENEFITS ARISING FROM ENERGY EFFICIENCY AND RENEWABLE ENERGY POLICIES IN SELECTED ENERGY COMMUNITY COUNTRIES:

ALBANIA POLICY BRIEF

July 2012
This report was produced for review by the United States Agency for International Development (USAID). It was prepared by National Agency of Natural Resources (AKBN) and International Resources Group (IRG).

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ACRONYMS

AEO	Annual Energy Outlook
AKBN	National Agency of Natural Resources
BAU	Business as Usual
CC	Combined cycle
CRES	Centre for Renewable Energy Sources
EC	Energy Community
ECS	Energy Community Secretariat
EE	Energy Efficiency
EIA	Energy Information Association (US)
ESD	Energy Services Directive
ESEC	Energy Strategy of the Energy Community
EU	European Union
GDP	Gross Domestic Product
GFEC	Gross Final Energy Consumption
GT	Gas turbines
HGVs	Heavy Goods Vehicles
ICE	Internal combustion engine
IEA	International Energy Agency
IPA	International Policy Analysis
IRG	International Resources Group
KESH	Albania Electricity Corporation
LCVs	Light Commercial Vehicles
LDVs	Light Duty Vehicles
LPG	liquid petroleum gas
LWR	Light Water Reactor
MARKAL	MARKet ALlocation
METE	Albanian Ministry of Economy Trade and Energy
NEEAPs	National Energy Efficiency Action Plans
NANR	National Agency of Natural Resources
NEED	New Energy Externalities Developments for Sustainability
NPV	Net Present Value
NREAPs	National Renewable Energy Action Plans

OECD	Organisation for Economic Co-operation and Development
O&M	Operation and maintenance
PC	Pulverized coal
PET	Pan-European TIMES model
RE	Renewable Energy
REDP	Regional Energy Demand Planning
RESMD	Regional Energy Security and Market Development
RPS	Renewable Portfolio Standards
SF	Steam fossil
SSP	SYNENERGY Strategic Planning
TAP	Trans Adriatic Pipeline
UK	United Kingdom
US	United States
USAID	United States Agency for International Development

A. INTRODUCTION

Under the United States Agency for International Development (USAID) Regional Energy Security and Market Development (RESMD) project and in conjunction with the joint SYNENERGY Strategic Planning (SSP) effort undertaken with Greece Hellenic Aid, a strategic planning activity was undertaken to develop a comprehensive national energy planning framework to support policy making and analysis of future energy investment options.

This initiative builds on the earlier groundbreaking USAID Regional Energy Demand Planning (REDP) project that laid the foundation for integrated supply/demand energy systems analysis in Southeast Europe.

This Policy Brief provides an overview of the analysis undertaken by the Albanian Planning Team using their national MARKAL (MARKet ALlocation) integrated energy system model, MARKAL-Albania, to examine the role of energy efficiency (EE) and renewable energy (RE) in meeting future requirements out through 2030 to support sustained economic growth and while considering Energy Community (EC) commitments and European Union (EU) accession directives.

This is a revised version of a previous Policy Brief drafted during the summer of 2011. This revision has been undertaken based on a range of model improvements including the inclusion in the model of transport/refining sectors, a review of key electricity sector assumptions, updated fuel prices, and improved emissions accounting, along with a more advanced approach to the energy efficiency analysis.

The analysis reflects several years of model development and use, jointly undertaken by the Albanian Ministry of Economy Trade and Energy (METE) and the National Agency of Natural Resources (AKBN), supported by International Resources Group (IRG) and the Centre for Renewable Energy Sources (CRES). The MARKAL-Albania analysis undertaken uses a cross-sectoral, cost optimization approach to identify the most economic efficient set of measures, and produces a broadly similar mix to that being proposed in the Strategy.

This Policy Brief focuses on assessing the energy sector costs and benefits for the entire energy system of meeting energy efficiency and renewable targets in Albania, as a Contracting Party under the Athens Treaty establishing the Energy Community. It also considers how meeting the targets impacts key issues facing energy sector decision-makers – namely, how to foster energy security and diversification, and ensure competitiveness and affordability, while taking into consideration climate mitigation and other environmental issues, as part of promoting cost-effectiveness in energy planning. Furthermore, what is important for decision-makers is that there is now a strategic planning platform available for Albania, where model assumptions and policy scenarios may be readily changed and explored, that can provide analytic rigor and insights to underpin future national strategic planning and policy formulation.

The following supply and demand analyses have therefore been undertaken.

- Reference (or Business-as-Usual or BAU) development: The likely supply and investment requirements to support the evolution of the national energy system in the absence of policies and programs aimed at altering current trends. The Reference scenario is fully discussed in Section CC.

- Energy Efficiency (EE) Promotion: This demand-side policy explores the range of energy efficiency measures (e.g., conservation measures, improved appliances, building shell improvements across all sectors) that are the most cost-effective means to meet national targets aimed at reducing final energy consumption (in line with National Energy Efficiency Action Plans or NEEAPs). The EE scenario is fully discussed in Section DD.
- Renewable Energy (RE) Target: This supply side policy examines the requirements to successfully achieve a renewable energy target by 2020 (in line with that proposed by the Energy Community) aimed at enhancing energy security (by reducing imports). The RE scenario is fully discussed in Section E.
- Combined EE and RE Policies: This combination of supply-side and demand-side approaches examines the resulting synergies of these policy goals. The combined RE/EE scenario is fully discussed in Section F.

In addition, country-specific issues – in this case, the critical question of whether a natural gas pipeline will be built to provide Caspian region gas to Albania – are examined in Section G. A pipeline is assumed to be in place by 2018 in the Reference and other policy scenarios discussed first.

RESMD Policy Briefs have been prepared for eight other participating Contracting Parties and Observer Countries, as well as a Regional Overview that compiles the results from all nine countries to provide an aggregate perspective of the analyses undertaking by each.

B. KEY INSIGHTS FOR POLICY MAKERS

The analysis undertaken provides some important insights on how improving energy efficiency and promoting renewable energy impacts three key policy areas: energy security and diversification, economic competitiveness, and climate mitigation. These insights are summarized in Table 1.

Table 1. Summary Overview of the Impact of RE / EE Objectives on Key Energy Policy Issues

Policy issue / Scenario	Reference Scenario Trends	Renewables	Energy Efficiency	EE+RE
Energy security and diversification	• Increasing gas imports • Hydro-dominated generation system	• Increased use of domestic RE resources • Reduces gas imports by 3300 Ktoe (36%)	• Reduces fossil fuel imports by 3460 Ktoe (6.7%) • Lowers direct energy and electricity consumption by 4,690 Ktoe (6.2%)	• Increased use of domestic RE (although at lower level than under RE case) • Final energy further reduced compared to EE, by 7.9% • Cumulative total imports reduced by over 19.8%
Enhanced competitiveness[1]	• Electricity system expansion at a total cost of 2,483€M • Greater access to gas	• Stimulates investment in renewable market • Cuts payments for imported fuels, dropping by over 10.9% (3,950€M)	• Lower fuel costs, saving 4.2% in fuel expenditure (1,510€M) • Power sector investment reduced by 27% (680€M)	• Lower fuel costs, saving 14.3% in fuel expenditure (5,180€M)
CO_2 mitigation	• Emissions more than double by 2030 due to increased use of natural gas	• Cumulative reduction of 10.7% due to use of less fossil energy (especially gas) and lower total energy consumption	• Cumulative reduction of 7.1% due to lower total energy consumption	• Cumulative reduction of 15.3% due to more RE and lower energy consumption

[1] The analysis does not provide full insights into the real macroeconomic impacts of changes to the energy system, as it does not account for allocation of resources across other economic sectors, as a general equilibrium model does. However, by looking to minimize the costs of a sustainable energy system it is inherently fostering competiveness.

ENERGY SECURITY AND DIVERSIFICATION

Under both RE and EE scenarios, import levels will be reduced by around 17% and 7% respectively, or a 20% reduction under the combined scenario case. This is due to lower energy demand resulting from increased energy efficiency and increased use of indigenous renewable energy under an RE target. Gas imports are particularly affected. Under the RE scenario, imported gas is reduced by over 36% cumulatively, while in the EE scenario, the reduction is 9% (In the combined scenario, gas imports are reduced by 37%.)

If anything, the energy supply becomes less diversified under the RE case, with an increased reliance on hydro generation, and a significant reduction in gas supply. Large increases in investment in hydro capacity need to be balanced against issues of supply diversity, particularly if hydrological patterns change in future years (due to climate change) and leave the system exposed to shortfall. The additional costs of lower hydro generation levels are highlighted in this policy brief.

ENHANCED COMPETITIVENESS

An energy efficiency target with the right policies and programs has strong benefits for competitiveness by reducing payments for imports, decreasing power sector capacity needs, cutting industry production costs, and lowering fuel bills for households, despite the higher overall cost to the energy system. If policies that promote an increased uptake in energy efficiency are pursued without setting an explicit reduction target, there is actually an overall savings of 440 € million (Net Present Value (NPV) [2]); however, only around a 3% reduction is achieved rather than the 9% called for by the Energy Community directive. With the target in place, total fuel expenditure savings (compared to the Reference case) amount to more than 14% (in the combined scenario case), or a cumulative saving of 5.2€ billion, nearly offsetting the cost of the more expensive efficient technologies. Once transformed, the energy system savings continue into the future, making the Albania energy system more competitive over time.

The proposed 2020 RE target increases the cost of the energy system due to the additional renewable generation investment required, particularly towards 2030, under the assumption that the RE share is to be sustained over time. To meet the target, an additional 1,000 MW of RE capacity will be required by 2020, and over 1,700 MW by 2030. Energy system costs are 2.9% higher (1.3€ billion). If the RE target is implemented in parallel with energy savings mandates, the combined cost of meeting renewable targets and energy efficiency targets are reduced, with additional costs of 2.7% compared to an aggregate increase (across both policy scenarios undertaken individually) of 3.2%. It is important to note that electricity prices increase, so understanding the distribution of impacts and, where necessary, reducing competitiveness or social impacts, will be important.

In addition, as already mentioned, a combined EE+RE policy can substantially reduce imports, saving valuable foreign exchange funds, amounting to 5.2€ billion cumulatively that can offset some of the more expensive generation and efficient device upfront costs and be rechanneled for other domestic priorities.

It should also be noted that the ancillary direct economic benefits arising from these domestic-centered polices, such as increased jobs to undertake a large number building retrofits and deploying renewable power generation alternatives, are not captured by this analysis.

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[2] All references to total system costs over the entire planning horizon are discounted at 7.5% and reported according to a 2006 base year as Net Present Values.

CO_2 MITIGATION

The policies examined show strong synergies with a goal of moving to a lower carbon footprint for the Albanian energy economy. The combined EE and RE policy leads to cumulative reductions of 15.3% in CO_2 emissions. This is accomplished by increasing renewable generation from hydro and wind power of the order of 1,500 MW, compared to the Reference scenario, coupled with the overall reduction in demand for energy owing to the more efficient energy system.

POLICY IMPLICATIONS

The Energy Community region faces daunting investment challenges to replace aging infrastructure and keep pace with energy demand growth. As the Energy Strategy of the Energy Community[3] (ECES) notes, the Western Balkans region will require an additional 13 GW of investment in new power plants just through 2020, at a cost of nearly 30 billion Euros, a figure that dwarfs actual investment in new capacity over the past two decades. The MARKAL-Albania Reference scenario shows that rapid electricity demand growth requires a doubling of electricity generation capacity by 2030 to 2.8 GW at a cost of nearly 2.5 € billion. At the same time, policy priorities to ensure secure, diverse supplies and mitigate carbon dioxide emissions increase the challenges.

Investment in energy efficiency is a key strategy to meet these priorities. The MARKAL-Albania analysis shows that a 3% reduction in final energy consumption can be achieved at a net savings of 440 € million (or 1.0%), while achieving the more ambitious NEEAP target of 9% requires only a modest cost increment of 0.6% (249 € million) over the baseline, while saving 1.5 € billion in fuel expenditures and reducing both imports and carbon emissions by 7%. Achieving these goals requires a 12% increased investment (or 1.3 €billion) in more efficient demand devices, permitting a nearly 700 € million reduction in new power plant expenditures, as the need for capacity growth is reduced by nearly 250 MW. The most cost effective areas for energy efficiency investment identified in this analysis include residential and commercial space heating, industrial process heat, and vehicle efficiency. The MARKAL-Albania model can be used, along with market analysis, to identify key technology and building opportunities and develop targeted measures to achieve this potential.

Meeting RE targets, on the other hand, increases energy system costs by 2.9% (or just under 1.3 €billion) and requires more than a doubling of the required power sector capacity additions, and over a 3.3 €billion in increased investment costs. Achieving the target yields substantial benefits: a more than 16% decrease in imports and an 11% decrease in both fuel expenditures (4 €billion) and carbon emissions. The cumulative capacity addition needed to reach the target by 2020 is approximately 1,000 MW (at a cost of €2.6 billion), a very ambitious goal. As noted above, an additional reliance on hydropower may increase the risks from a poor hydrological year, and these risks should be balanced against those arising from dependence on imported gas supplies. Further analysis using the stochastic formulation of MARKAL can explore uncertainty associated with future water availability and help formulate more robust hedging strategies.

Although the investment challenges are significant, pursuing the EE and RE strategies simultaneously leads to important synergies. The increase in system cost is limited to 3% (or just over 1.3 €billion), or 0.5% less than the sum of the two strategies separately. The savings are

[3] Energy Community, 2012. 10thMC/18/10/2012 - Annex 19/27.07.2012

dramatic: a 14% decrease in fuel costs (5.2 €billion), 15% decrease in carbon emissions, and nearly a 20% decrease in imports. The benefits of these investments extend beyond 2030, creating a lasting shift of the economy onto a lower energy intensity, more sustainable and secure trajectory.

The analyses described herein also make it clear that Albania now has an integrated energy system planning model that can be used to examine in more detail the best policies to achieve these and other policy goals. Key areas for future analysis include assessing tradeoffs regarding hydro versus other RE capacity investments, designing feed-in tariffs to encourage RE development, and developing targeted EE policies, including standards and appliance and retrofit subsidies.

C. ALBANIA BUSINESS-AS-USUAL ENERGY PATHWAY

To assess the impact of different policies and programs on the evolution of the energy system in Albania, a Reference scenario was developed, taking into account specific characteristics of the national energy system, such as existing technology stock, domestic resource availability and import options, and near-term policy interventions. The Reference scenario is aligned with the National Strategy of Energy 2003-2015, and draft Energy Strategy 2009-2025. In addition, all other available national data sources (State Statistical Office, National Energy Balances, etc.) as well as some international databases (e.g., International Energy Agency or IEA) were utilized. The full list of information sources is provided in Appendix I. Once established, the Reference scenario can also produce baseline estimates of energy consumption and carbon emissions to measure trends with respect to achieving NEEAP and low emission development goals.

A key assumption underpinning the Reference scenario is that by 2018 natural gas will be readily available to power generation and industry sectors owing to the completion of the Trans Adriatic Pipeline (TAP) pipeline. Section G explores an alternative Reference case to look at the implications for Albania's energy future without this pipeline.

Under the Reference scenario, energy consumption is projected to grow significantly, by 130% in terms of final energy by 2030, driven by strong Gross Domestic Product (GDP) growth and increasing per capita consumption. This will require nearly doubling electricity generation capacity from 1,492 to 2,869 MW and results in higher import levels, as well as growth in CO_2 emissions. Key indicators from the Reference scenario are shown in Table 2 and summarized subsequently.

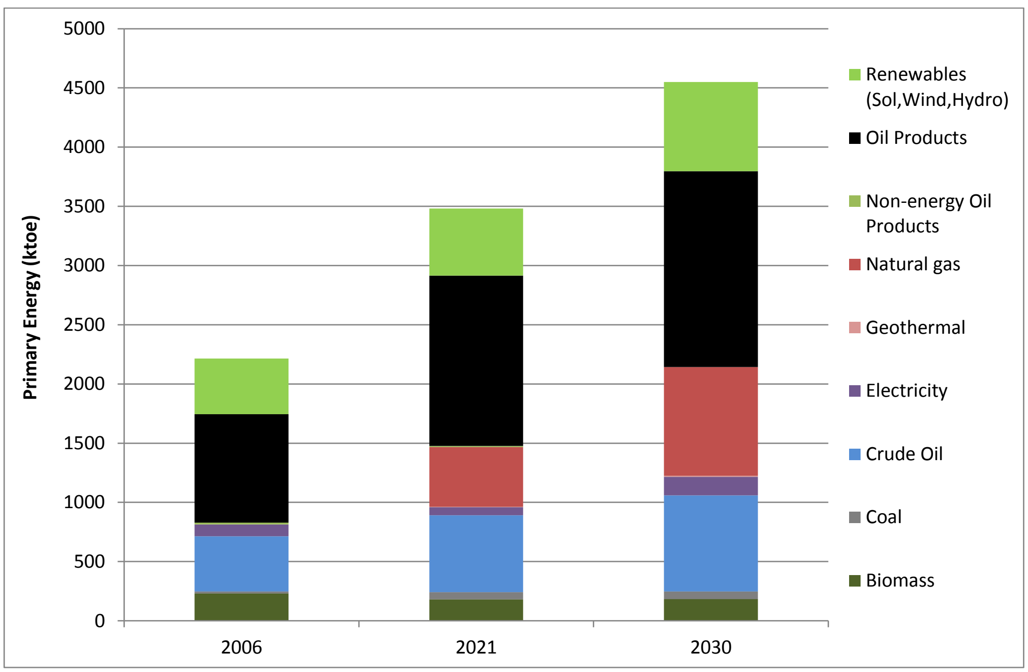
Table 2. Key Indicators for the Reference Scenario

Indicator	2006	2030	Annual Growth Rate (%)	Overall Growth (%)
Primary Energy (Ktoe)	2,215	4,550	3.0%	105.5%
Final Energy (Ktoe)	1,826	4,206	3.5%	130.3%
Power plant capacity (MW)	1,492	2,869	2.8%	92.3%
Imports (Ktoe)	1,017	2,793	4.3%	174.5%
CO_2 emissions (Kt)	3,796	8,977	3.7%	136.5%
GDP (€ Mill.)	7,200	29,671	6.1%	312.1%
Population (000s)	3,150	3,732	0.7%	18.5%
Final Energy intensity (toe/€000 GDP)	0.254	0.142	-2.4%	-44.1%
Final Energy intensity (toe/Capita)	0.580	1.127	2.8%	94.4%

Primary energy consumption in 2030 is projected to be 4,550 ktoe, increasing from 2006 levels by 106%. While growing GDP and increasing household energy intensity are driving up energy demand, it is also important to note that energy intensity per unit of economic output is significantly lower than observed in 2006 – estimated to be 0.142 toe/1000€, a reduction of around 44%. This is a result of the continuation of current structural changes in the Albanian economy and natural technological progress underway throughout the world.

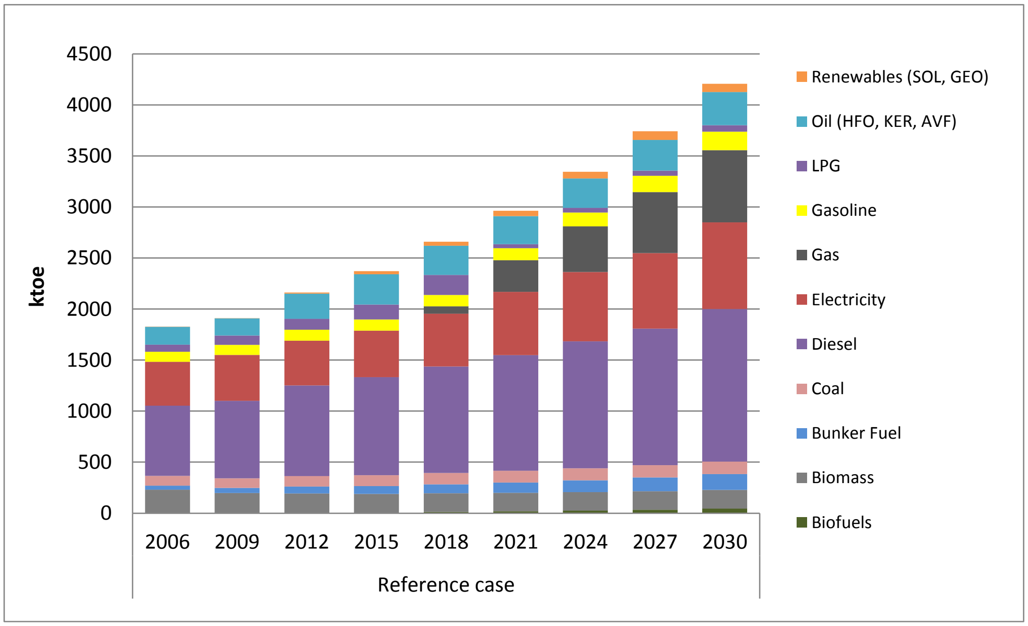
In addition to the significant growth in primary energy supply, the supply becomes more diverse. As shown in Figure 1, primary energy supply more than doubles with imported natural gas accounting for 20% of total supply. The growth in transport demand is reflected in the increase in oil products (imported) and crude oil, although the share in primary energy is similar. The contribution of renewable energy sources (excluding biomass) to total primary energy during this period declines from 21% to 17%, although it grows in absolute terms. The biomass contribution drops from 10% to 4%, as households switch to more modern forms of energy.

Figure 1. Primary Energy Supply – 2006 / 2021 / 2030



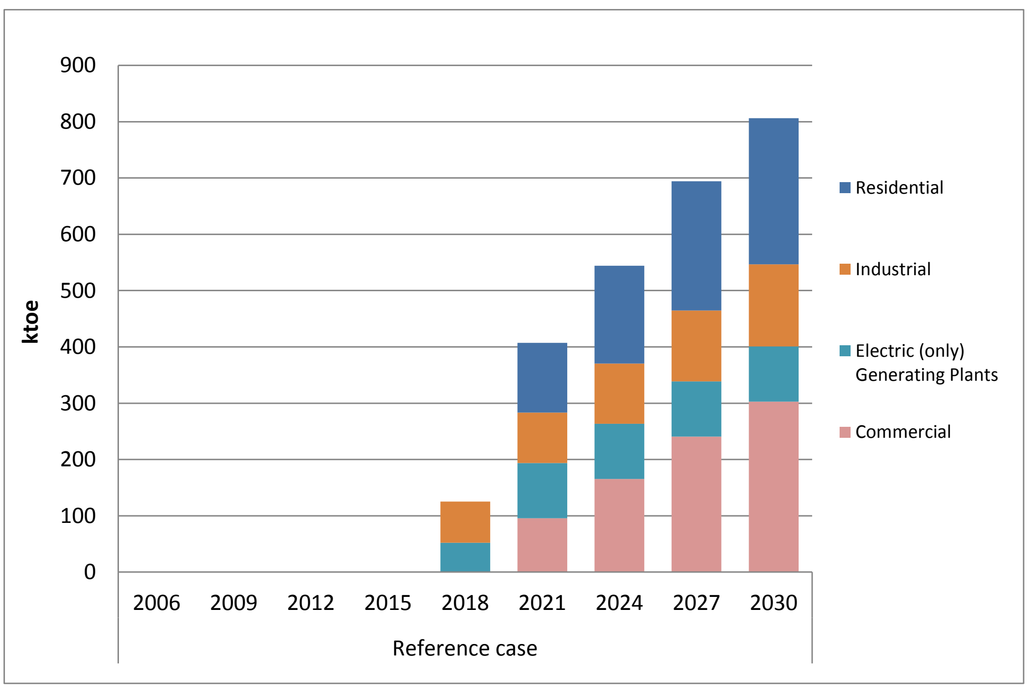
Total final energy consumption grows by over 130% over the planning horizon, with the most significant change being natural gas, available through import from 2018, increasing from an initial level of 3% to 17% by 2030, as shown in Figure 2.

Figure 2. Final Energy Consumption by Energy Type



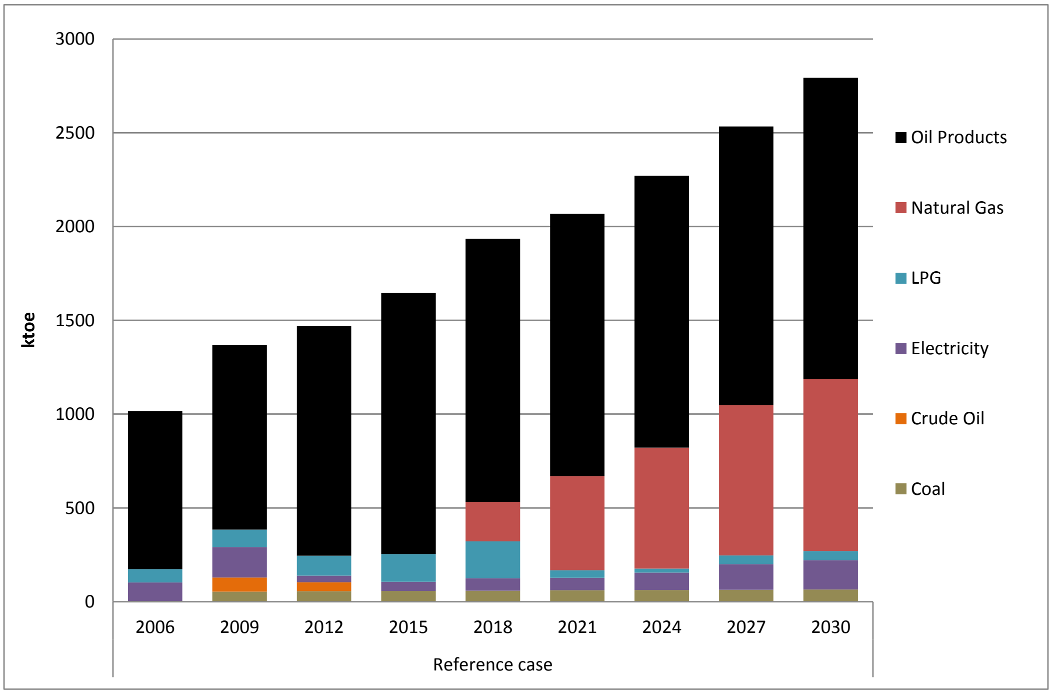
A more detailed view of gas consumption by sector is shown in Figure 3. It shows that the majority of gas is used in the residential, commercial, and industry sectors but with significant take-up for power generation also. In the residential sector, gas is used primarily for cooking and space/water heating, while in the commercial sector the main uses are for cooking and space heating. Gas is used across most industry sectors for the production of high temperature heat for a number of different processes.

Figure 3. Gas Consumption by Sector and Power Plant Type



The majority of Albania's fossil energy requirements are imported. This demand for natural gas increases import dependency, resulting in a near tripling of imports by 2030 (relative to current levels). The high consumption of gas in end-use sectors reflects the criticality of the assumption that increased gas pipeline capacity and supply will materialize, and points to this as being an important issue for future sensitivity analysis (see Section G for analysis of Reference case and scenarios *without gas*).

Figure 4. Imports by Type

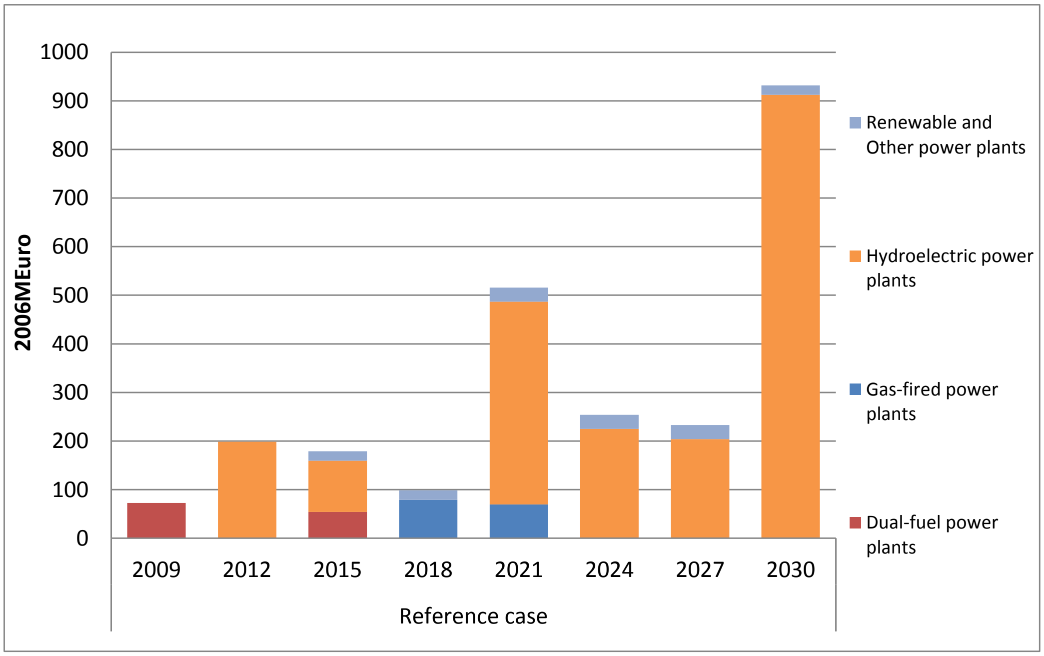


New power generation capacity additions needed are shown in Table 3. Continued expansion of hydropower is the most prevalent with cumulative additional capacity of 869 MW by 2030. Gas plants are built as gas supply comes online, in 2018. Wind also makes an important contribution, primarily incentivized by a feed-in tariff. Table 3 shows the new capacity additions in each three-year period.

Table 3. Additional Power Plant Capacity by Fuel Type (MW)

Plant Type	2009	2012	2015	2018	2021	2024	2027	2030	Total
Dual-fired	97	0	72	0	0	0	0	0	169
Gas	0	0	0	114	100	0	0	0	214
Hydro	0	99	48	0	227	123	68	304	869
Wind	0	0	20	20	30	30	30	20	150
Total New Capacity	97	99	140	134	357	153	98	324	1,402
% of Installed Capacity	6.2%	5.9%	7.8%	6.9%	15.6%	6.2%	3.9%	11.3%	

Figure 5. Total Investment Cost of New Power Plants



* Investment levels are not annual but cumulative for a three-year period

Growth in the energy system will require significant levels of new investment and increased payments for fuel. However, energy system expenditures are generally expected to absorb a smaller percentage of GDP in 2030 due to the reduced energy intensity per unit of economic output, as shown in Table 2. A breakdown of the energy system cost components is presented in Table 4, showing the growth in expenditure for fuel (extraction, import, and sector differential charges), operating and maintenance (O&M) costs (fixed and variable), investments in new power plants, and the purchase of new end-use devices. The investment expenditures for new power plants and devices are incurred as demand rises and existing power plants and devices reach the end of their operational lifetimes.

Table 4. Annual Energy System Expenditure (€ Million)[4]

Expenditure Type	2009	2012	2015	2018	2021	2024	2027	2030
Fuel Costs	1,124	1,468	2,005	2,419	2,715	3,135	3,662	4,303
Operation and Maintenance Costs	392	439	492	574	689	783	886	1,021
Annualized Investment (Demand)	272	567	856	1,230	1,541	1,797	2,104	2,424
Annualized Investment (Power)	8	27	46	56	108	134	158	251
Total	**1,795**	**2,501**	**3,399**	**4,278**	**5,054**	**5,850**	**6,810**	**8,000**

[4] For power plants and end-use devices, the upfront capital cost is amortized over the lifetime of the unit with annualized payments calculated according to the lifetime and cost of capital. These annualized payments, along with associated operating and maintenance costs and fuel expenditures constitute the overall energy system cost. The annualized investment costs associated with existing power plants and demand devices are not included.

Under the Reference scenario assumptions, to add the 1,402 MW of new generation capacity required by 2030, a total investment of 2.483€ billion is required, which translates to average annual payments of around 120€ million. At the same time, by 2030 over 1.2€ billion annually will be required to cover the cost of new demand devices, with the majority of this investment made by the private sector, including households. Fuel supply costs will also increase significantly, driven by growing demand and increasing prices, from 673€ million per year to 2.28€ billion per year.

D. EXAMINATION OF THE PROMOTION OF ENERGY EFFICIENCY IN ALBANIA

The Ministerial Council of the Energy Community adopted Decision D/2009/05/MC-EnC in December 2009 concerning the implementation of certain Directives on Energy Efficiency, including Directive 2006/32/EC on energy end-use efficiency and energy service demands (ESD). This required Contracting Parties (under Article 14(2)) to submit their first National Energy Efficiency Action Plan by June 2010.

The background to this Directive was highlighted in the *Green Paper on the Security of Energy Supply* (2000) which noted increasing dependence on external energy sources, and an increase from 50% to 70% by 2030. At the same time, the role of the energy sector as an emission source needed to be addressed, responsible for no less than 78% of EU greenhouse gas emissions. Therefore, efforts were required to focus on improving end-use energy efficiency and controlling energy demand.[5] The Directive notes that: *Improved energy end-use efficiency will make it possible to exploit potential cost-effective energy savings in an economically efficient way.*

A first National Energy Efficiency Plan for Albania was published on October 5, 2011, and included a national indicative energy savings target of 9% (of current consumption levels) by 2018, with an interim target in 2012 of 3%. The target was based on the methodology outlined in Annex 1 of the Directive.

This analysis provides insights into the cost-effective technologies that would be required to meet the NEEAP target. It is difficult to compare the outputs of this analysis with the measures listed in the NEEAP, as those measures tend to be related to policies and programs rather than technologies per se. It is also difficult to compare costs, as the NEEAP only cites implementation costs required in the public budget, not the costs of the actual technologies net of fuel savings (which MARKAL provides).[6]

It is also clear that the costs of overcoming barriers to take-up of different technologies can be significant, and require strong policies and programs. Such barriers are highlighted in the World Bank (2010) report *Status of Energy Efficiency in the Western Balkans*.[7]

The costs attributed to such barriers (e.g., long payback period, lack of familiarity, inconvenience, high transaction costs) and extra hidden costs (e.g., appliance and building standards, information campaigns, low interest (subsidized) loans, "giveaway" programs for the poor) are accounted for in this analysis by the inclusion of so-called hurdle rates,[8] as discussed in Appendix II. As a result, such options are not invested in under the Reference case. However, it is assumed that when energy efficiency policies (e.g., setting a NEEAP target) are pursued,

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5 See European Commission website – http://europa.eu/legislation_summaries/energy/energy_efficiency/l27057_en.htm

6 In addition, no impact assessment is available against which to cross-compare the MARKAL analysis.

7 Report can be found at ECS website - http://www.energy-community.org/pls/portal/docs/664179.PDF

8 For example, UK studies include *The hidden costs and benefits of domestic energy efficiency and carbon saving measures* (Ecofys 2009) and *Review and development of carbon dioxide abatement curves for available technologies as part of the Energy Efficiency Innovation Review* (Enviros Consulting 2006).

programs aimed at reducing these impediments (or "hurdles") are also put in place, reducing those inherent added costs.

Under such a scenario (no EE target but reduced barriers to uptake), there is only a 3% reduction in final energy consumption in 2018 (not the required 9% under NEEAP), though with an overall savings to the energy system of 440 € million (or 1.0%, as shown in Table 6). Thus simply removing some of these barriers is not enough to meet the reduction levels required by the target in the NEEAP. So finding the balance between policies, programs, and targets is important to ensure that goals are achieved without undue burden on the economy or individuals.

Policies that promote increased energy efficiency in order to meet the NEEAP target have other significant benefits, as described below.

- A modest increase in discounted energy system costs of 0.6% (249€ million) is observed under the NEEAP target, where without programs and policies to reduce barriers to uptake the cost to meet the same target would potentially increase nearly three times that.
- 6.7% cumulative reductions (3,458 ktoe) in imports are observed under the NEEAP target, enhancing energy security goals.
- Significant cumulative reduction in final energy of 6.2% is observed (4,693 ktoe), as are strong synergies with low emission development, reducing CO_2 emissions by 7.1% (or 11,628 Kt).

The basis for the energy efficiency target is the Albanian NEEAP, which has a percentage reduction calculated from the 2006-2009 average final energy consumption levels, which results in total reduction requirements from the Reference scenario levels as shown below in Table 5. As the NEEAP only extends out to 2018, it is assumed that the reductions under NEEAP continue over the later years in the planning horizon, reflecting Government ambition to maintain improvements in energy efficiency over time.

Table 5. Energy Efficiency Targets

Approach	2012	2015	2018	2021	2024	2027	2030
NEEAP target	3.0%	6.0%	9.0%	9.0%	9.0%	9.0%	9.0%
Reduction totals* (ktoe)	55	109	164	164	164	164	164

* Reduction totals are relative to average across 2006/2009 consumption levels

Table 6 shows the key results as change between the EE and Reference scenarios. The *Energy Efficiency Promotion* illustrates the benefits of EE policies and measures that lower the barriers associated with the uptake of more efficient devices and the *Energy Efficiency + Target* represents the former but also requires that the NEEAP consumption reduction target be met. In the first case, this represents a situation where only the most cost-effective technologies are taken up, incentivised by policies and programmes that have been put in place. It illustrates that cost savings can be made by EE promotion, to reduce the socio-economic barriers to uptake of more efficient technologies. In the second case, a target "forces" the model to go beyond this economically efficient level, and deploy additional higher cost technologies to meet the target level.

The focus of this section is on the *Energy Efficiency + Target* case, as the NEEAP is the main on-going policy action in this area. As shown in the table, all of the key cumulative metrics (other than overall system cost and investment in new demand technologies) are reduced due to efficiency savings. For example, power plant investment reduces by 27.4%, imports drop by 6.7%, and fuel expenditure goes down by 4.1%; saving 680M€/3,458 Ktoe/ 1.51B€ respectively. Such savings enhance economic competitiveness and energy security.

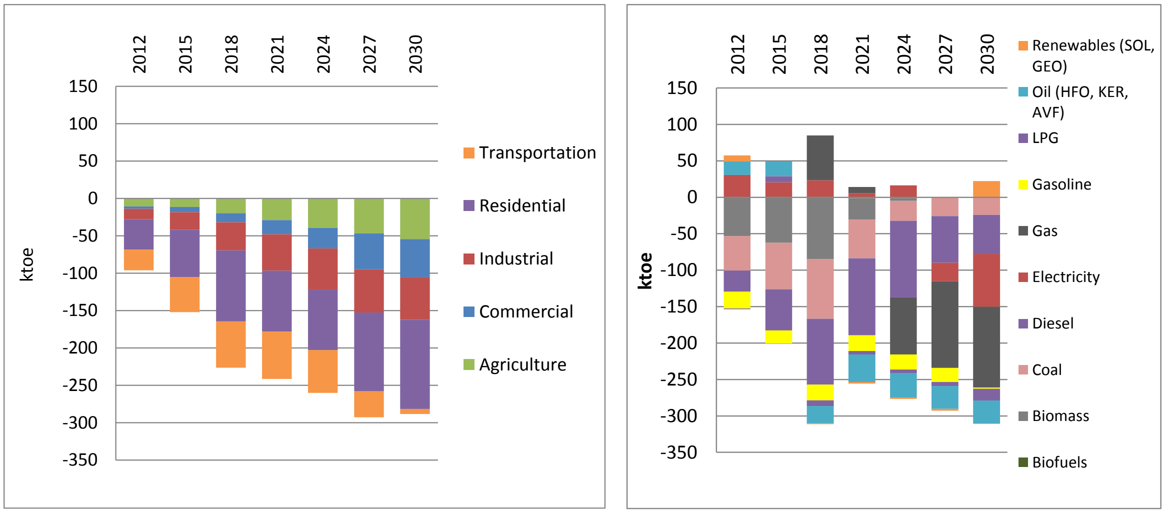
The slightly higher overall cost of the energy system is due to the increased expenditure (12.1% cumulatively) for better performing demand devices that, despite policies and programs, still command a premium over conventional devices, though this is lower than would otherwise be the case in the absent of such actions. At the end of the section we briefly discuss variants of the EE analysis to look more at energy efficiency policy in Albania.

Table 6. Cumulative Impacts of the EE Target on the Energy System (Change Compared to Reference Scenario)

Indicator	Units	Reference	Energy Efficiency Promotion		Energy Efficiency + Target	
Total Discounted Energy System Cost	2006M€	44,138	-440	-1.0%	249	0.6%
Primary Energy Supply	Ktoe	88,579	-2,873	-3.2%	-4,399	-5.0%
Imports	Ktoe	51,305	-2,644	-5.2%	-3,458	-6.7%
Fuel Expenditure	2006M€	36,327	-673	-1.9%	-1,506	-4.1%
Power Plant New Capacity	MW	1,402	-242	-17.3%	-235	-16.7%
Power Plant Investment Cost	2006M€	2,483	-673	-27.1%	-680	-27.4%
Demand Technology Investments	2006M€	10,791	224	2.1%	1307	12.1%
Final Energy	Ktoe	75,554	-2,784	-3.7%	-4,693	-6.2%
CO_2 Emissions	Kt	163,561	-8,666	-5.3%	-11,628	-7.1%

The contribution of different sectors to the targets is shown in Figure 6, indicating that energy saving potential is economy-wide, and that all sectors provide a significant contribution. Under the energy efficiency target, the residential sector provides the largest savings (37% of total savings), followed by the transport sector (20%) through a move to hybrid vehicles and more efficient conventional (internal combustion engine or ICE) vehicles, and industry (19%).

Figure 6. Final Energy Reduction by Sector and Fuel under Energy Efficiency Target

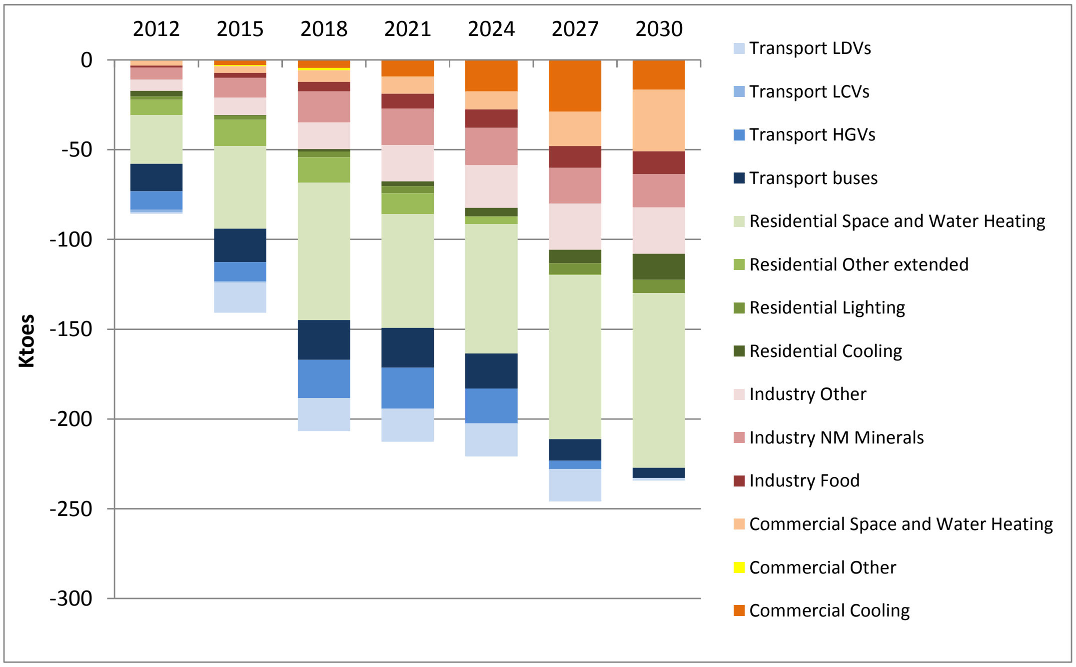


In terms of fuels, the largest near-term reductions come from biomass (residential), coal (industry), and diesel (transport). The overall net reduction is lower than these reductions suggest due to an increase in oil and gas being used in more efficient technologies. Later in the time horizon (2024) onwards, large reductions in gas for space heating in the residential sector are observed due to switching to more efficient appliances, as described below.

A more detailed overview of savings by energy service demands are shown in Figure 7. The most cost-effective reductions occur in the more efficient provision of space and water heating, with a strong uptake of heat pumps (using electricity) and more efficient use of appliances. This leads to a fairly strong reduction in gas consumption, while electricity consumption levels increase by a small percentage. For the transport sector, there is an increasing uptake of hybrid vehicles across light duty vehicles (LDVs), light commercial vehicles (LCVs), and heavy goods vehicles (HGVs). There is also some penetration of plug-in hybrid electric vehicles in the LDV stock from 2018. The bus fleet moves towards more advanced ICE technology.

In industry, savings are most prevalent in the food and non-metallic mineral industries, where efficiency savings from process heat are realized. Much of the commercial savings are in cooling and heating, where most of the savings are from more efficient appliance uptake and some increased penetration of heat pumps. Lighting does not feature significantly, as much of the efficiency savings are realized in the Reference case due to assumed market restrictions on the sale of incandescent bulbs.

Figure 7. Final Energy Reduction by Energy Service Type under Energy Efficiency Target



It is important to highlight that there are significant uncertainties concerning the potential of opportunities for energy efficiency. This is highlighted in the World Bank (2010) report *Status of Energy Efficiency in the Western Balkans*. Therefore, it is important to continually review the data in the model for use in future analyses, assessing new data available in Albania to further improve the robustness of the analysis.

Under the EE target, costs are shown to increase overall despite significant reductions in fuel expenditure. This is because the model uses higher discount rates for more advanced appliances (as described earlier and more fully in Appendix II) to reflect the market barriers and costs of policies to overcome them. However, the cost increases are modest, at 0.6% higher than the Reference case. In addition, the analysis does not reflect the wider economic benefits that could come from energy efficiency promotion, in terms of export competitiveness or stimulating new industries e.g. for solar water heaters. At the same time, significant co-benefits arise from pursuing energy efficiency goals, including CO_2 reductions (7.1% reductions) and energy security through reduced imports (6.7% reduction).

The modest costs observed for the EE target case are significantly higher if policies and programs are not introduced to reduce the barriers to uptake of energy efficient technologies, at 2.3% compared to 0.6%. Conversely, the modeling also suggests that a more aggressive NEEAP target post-2018 can be achieved at only modest additional cost. A 15% reduction by 2024 results in additional costs of 0.7% compared to the Reference case, highlighting scope for additional action.

Such insights are useful in the context of the EU ambition to reduce primary energy by 20% by 2020 (relative to projected primary energy consumption). In fact, the EU is proposing a new Directive (*Proposal for a Directive of the European Parliament and of the Council on energy efficiency and repealing Directives 2004/8/EC and 2006/32/EC. EC draft 12046/2011, COM(2011)370, Issued 22 June 2011*) that is seeking to ensure that the 20% energy efficiency target can be met by 2020 – as current legislation (including the ESD) will not achieve this goal.

E. ASSESSMENT OF A RENEWABLE ENERGY STRATEGY FOR ALBANIA

A Renewable Energy Directive for the EU sets targets for Member States in order to achieve the objective of getting 20% of its energy from renewable sources by 2020. This Directive is part of the set of measures that will enable the EU to cut greenhouse emissions and make it less dependent on imported energy. In addition, this will help develop the clean energy industry, further encouraging technological innovation and employment.

The Energy Community Secretariat (ECS) commissioned a study in 2009 examining illustrative RE targets for the contracting parties,[9] adopting the RE Directive methodology for allocating targets, with biofuels assumed to contribute 10% of transportation sector energy requirements. This study has subsequently been updated with revised targets estimated.[10] A 2020 renewables target of 39% of Gross Final Energy Consumption (GFEC) for Albania has been proposed by the ECS and was used in the analysis presented below.

Recently, Albania has developed a draft Renewable Strategy, supported by UNDP. This strategy assesses the mix of options that might be required to meet a target similar to that currently being proposed by the ECS. The timeliness of this assessment should help to provide additional underlying evidence for the Strategy as it is further developed.

Key insights are highlighted below and summarized in Table 7, then elaborated upon in the rest of this section.

- Cumulative energy system costs (to 2030) are 2.9% higher. While this is a relatively modest increase, it is important to highlight significant additional power sector investment is needed out to 2030 increasing by 113%, or 1588 MW, at a cumulative cost of €3.3 billion. The cumulative capacity addition by 2020 is approximately 1,000 MW (€2.6 billion), a capacity increase consistent with Albania's own draft RE Strategy.

- Energy security is enhanced with a 16.5% cumulative decrease in the imports required, while demand for final energy is reduced by 3.8% as a result of increased use of indigenous electricity and increased biofuel use in the transport sector.

- This policy contributes towards moving to a lower emissions pathway, with cumulative CO_2 reduction reaching almost 10.7% (between 2009-2030).

9 Study on the Implementation of the New EU Renewable Directive in the Energy Community to Energy Community Secretariat, IPA Energy + Water Economics, United Kingdom, February 2010.

10 Updated Calculation of the 2020 RES Targets for the Contracting Parties of the Energy Community, Presentation by ECS to 8th Renewable Energy Task Force meeting, 06 March 2012.

Table 7. Cumulative Impacts of the RE Target on the Energy System (Compared to Reference Scenario)

Indicator	Units	Reference	RE Target Change	
Total Discounted Energy System Cost	M€2006	44,138	1,279	2.9%
Primary Energy Supply	Ktoe	88,579	-3,364	-3.8%
Imports	Ktoe	51,305	-8,478	-16.5%
Fuel Expenditure	M€2006	36,327	-3,953	-10.9%
Power Plant New Capacity	MW	1,402	1,588	113.3%
Power Plant Investment Cost	M€2006	2,483	3,283	132.2%
Final Energy	Ktoe	75,554	-2,860	-3.8%
CO_2 Emissions	Kt	163,561	-17,494	-10.7%

The Reference scenario showed an increase in new hydro and wind power generation capacity of about 1,019 MW out of a total for new capacity additions of 1402 MW. In other words, renewable electricity generation is playing a crucial part in meeting future demand (see Figure 9) without an established renewable energy target. However, to further enhance energy security and address climate change, pursuing an even more aggressive renewables strategy has merit, though at a cost.

Under the RE target, cumulative additions in RE capacity (between 2009-2030) total 2,740 MW out of total new capacity of 2,990 MW. Comparing this to the Reference case, this means an additional 1,700 MW of RE capacity, half of which is wind generation capacity. This suggests that meeting the target and critically sustaining it beyond 2020 will require strong policies to stimulate investment and attract high levels of capital in the power generation sector. The additional capital required under the RE target in the power generation sector is estimated at 3.3 € billion.

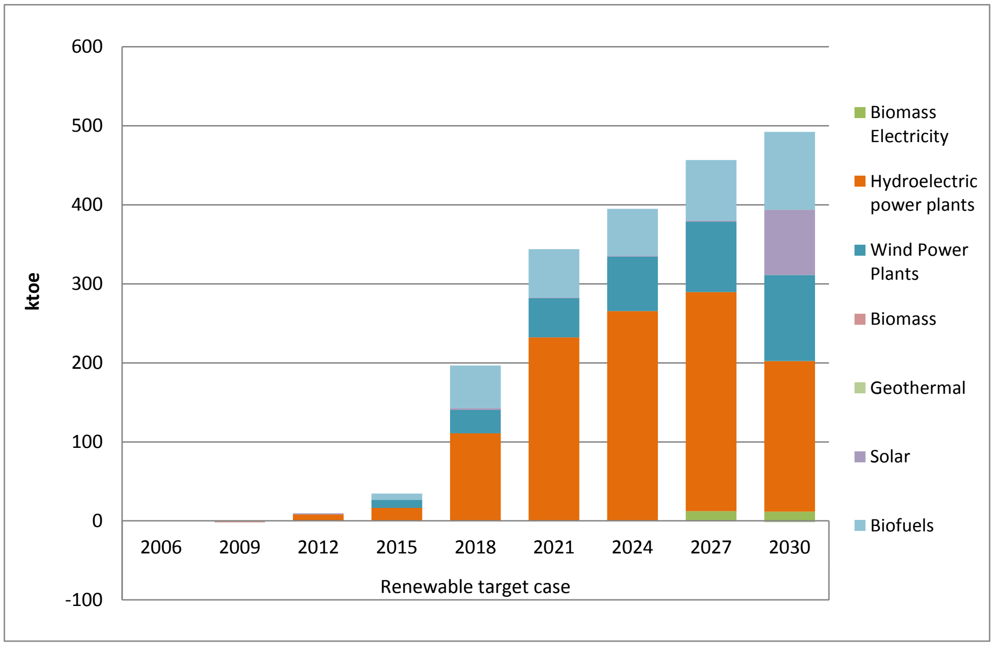
By 2020, when the target has to be met, the additional investment (above that observed in the Reference case) is 1,160 MW. In cumulative investment terms, that is equivalent to 2.7€ billion, with some investment in hydro plant brought forward compared to that observed under the Reference case. The large increases in capacity above the Reference case are well illustrated in Figure 8 and Figure 9.

A consequence of this substantial increase in more expensive renewable generation is a doubling of the electricity price (based on the levelized cost of generation calculated in the model). While overall electricity consumption increases, the higher price does incentivize the uptake of more efficient devices, which is why combining the EE and RE policies has merit, as discussed in the next section.

The other main contributor to the renewable energy target is biofuels, which are required to contribute a minimum of 10% of transport fuels by 2020. In 2021, the percent contribution of biofuels to additional renewable energy required is 18%; this level of contribution is maintained to 2030.

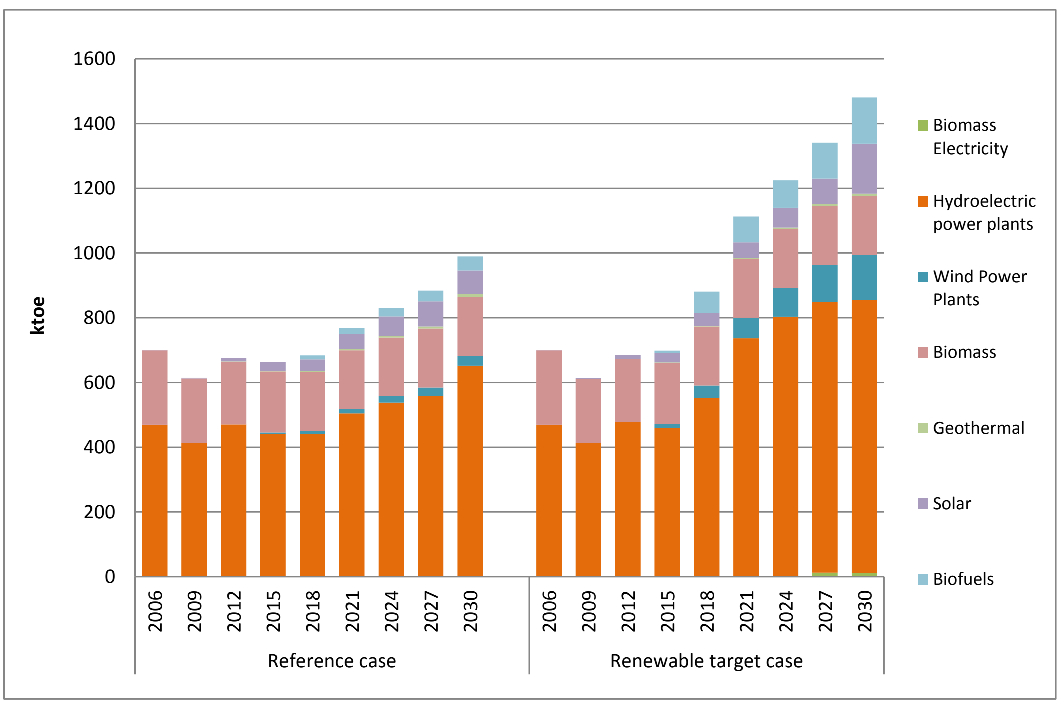
A summary of the change in renewable energy use sourced from centralized electricity and distributed technologies compared with the Reference scenario is provided in Figure 8.

Figure 8. Additional Renewable Energy under RE Target, Compared to the Reference Scenario



Total renewable energy under the Reference and RE target cases are compared below, in Figure 9.

Figure 9. Total Renewable Energy under Reference and RE Target Cases



Sustaining the target after 2020 becomes significantly more difficult due to the overall growth of the energy system (making the same percentage share much higher in absolute terms). This results in the increased uptake of solar in the final period, increased investment in wind, and some uptake of biomass electricity generation (particularly with all hydro potential taken). This suggests that it is critical for decision-makers to take into consideration the post-2020 regime and plan for even steeper investment if the RE target share is to be maintained.

Adapting the energy system to meet the target increases total energy system costs by 2.9%, or 1,279€ million relative to the Reference scenario over the entire planning horizon. In the power sector alone, a 132% increase in cumulative (undiscounted) investment, or 3.3€ billion is needed.

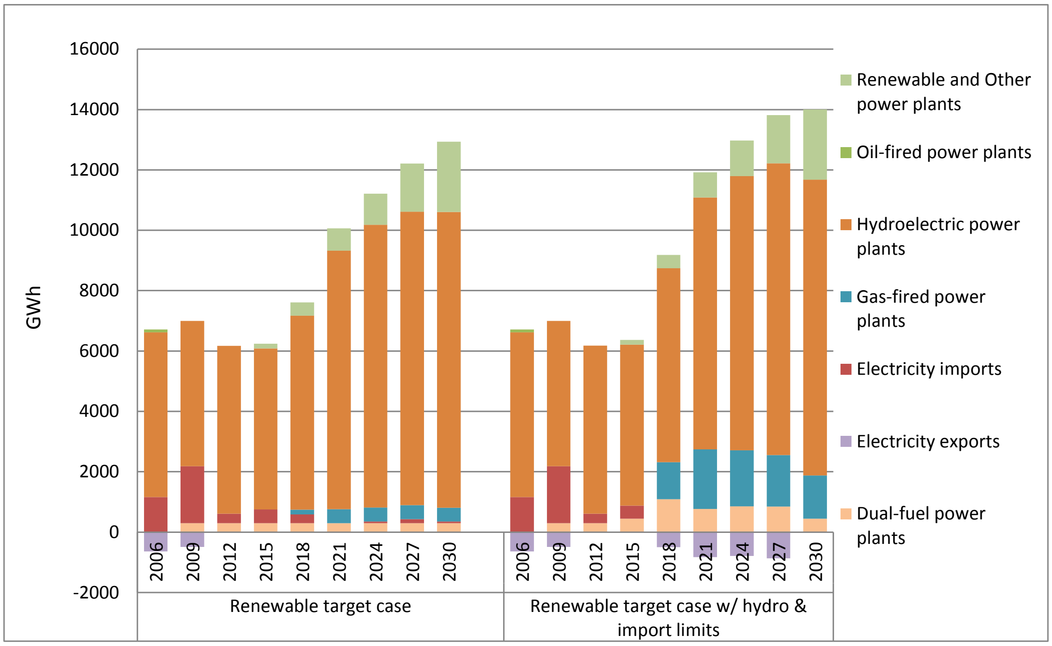
While the challenges of ramping up investment to meet the target are clear, a significant shift to renewables has two important co-benefits. Energy imports drop by over 16.5% and CO_2 emissions are reduced (cumulatively) by almost 10.7% relative to the Reference scenario. This suggests strong synergies between an ambitious renewable policy and other policies relating to low emission strategies, energy security, and competiveness. Furthermore, as discussed in Section F, coordinating policies that encourage energy efficiency can dramatically enhance the benefits and lower the cost of meeting a renewables target.

It is also worth highlighting the issue of the system's climate resilience. Increasing investment in hydro generation, with limited diversification, could leave Albania more vulnerable to climate change impacts, particularly reduced precipitation levels.[11] Further sensitivity analysis was therefore undertaken to explore how Albania can achieve the RE target if it reduces its reliance on a hydro-dominated system.

In Figure 9, the RE target case is compared to a case where the contribution of hydro/imports has been limited to 70% of total generation (from 2018 onwards). In 2021, in the RE case, the share of imports/hydro is 85%; it is around 80% out to 2030. This restricted hydro case reflects a situation where investment has shifted to gas generation due to the reduction in hydro. Hydro generation is still relatively high due to the RE target. This restricted case leads to additional system costs of 4.0% compared to the Reference scenario. An area for future analysis can be to use the stochastic formulation of MARKAL to explore uncertainty associated with future water availability to help with formulating more robust hedging strategies.

[11] ESMAP (2009), Climate Vulnerability Assessments, An Assessment of Climate Change Vulnerability, Risk, and Adaptation in Albania's Energy Sector, Energy Sector Management Assistance Program, November 2009, World Bank, Washington DC.

Figure 10. Electricity Generation by Year under RE Target and RE Target with Limits on Hydro / Imports



F. COORDINATED RENEWABLES AND ENERGY EFFICIENCY POLICIES FOR ALBANIA

As a Contracting Party to the Energy Community Albania has committed to simultaneously making progress with respect to both energy efficiency and renewable headway goals. Promoting both energy efficiency and renewable energy goals in parallel may have strong policy synergies. This analysis looked at assessing both objectives at the same time. In the case of Albania, the NEEAP and draft Renewable Strategy will be implemented in parallel; therefore, this analysis is a better reflection of the policy reality. What the analysis highlights is that this is more cost-effective due to the synergies between these policy areas.

Key insights include:

- Energy system costs increase by 1,308€ million or 3%. Despite this increase, the analysis shows that undertaking both policies in parallel is lower in cost than if undertaken in isolation. In isolation, the RE target case increases system costs by 2.9% and the EE case by 0.6% (or 3.5% if both cases were aggregated).
- The efforts to reduce final energy through energy efficiency (reduces by 7.9%) means a lower level of renewable energy required, resulting in lower overall costs.
- CO_2 emissions and imports are each reduced by 15.3% and 19.8%, illustrating important synergies and co-benefits arising from the implementing efficiency and renewable energy policies together.

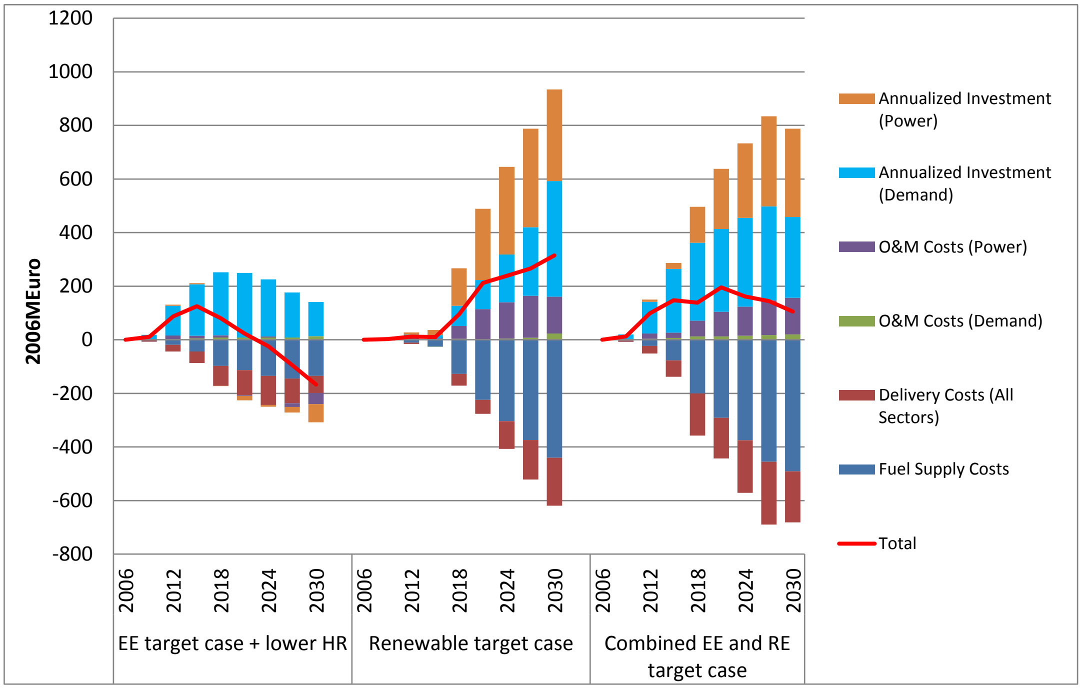
Table 8 shows the key result changes between the combined RE & EE scenario and the Reference scenario.

Table 8. Cumulative Impacts of Combined RE/EE Targets on the Energy System (Compared to Reference Scenario)

Indicator	Units	Reference	EE + RE Targets Change	
Total Discounted Energy System Cost	2006M€	44,138	1,308	3.0%
Primary Energy Supply	Ktoe	88,579	-6,178	-7.0%
Imports	Ktoe	51,305	-10,168	-19.8%
Fuel Expenditure	2006M€	36,327	-5,183	-14.3%
Power Plant New Capacity	MW	1,402	1,530	109.2%
Power Plant Investment Cost	2006M€	2,483	3,154	127.0%
Demand Technology Investments	2006M€	10,791	1959	18.2%
Final Energy	Ktoe	75,554	-5,996	-7.9%
CO_2 Emissions	Kt	163,561	-25,032	-15.3%

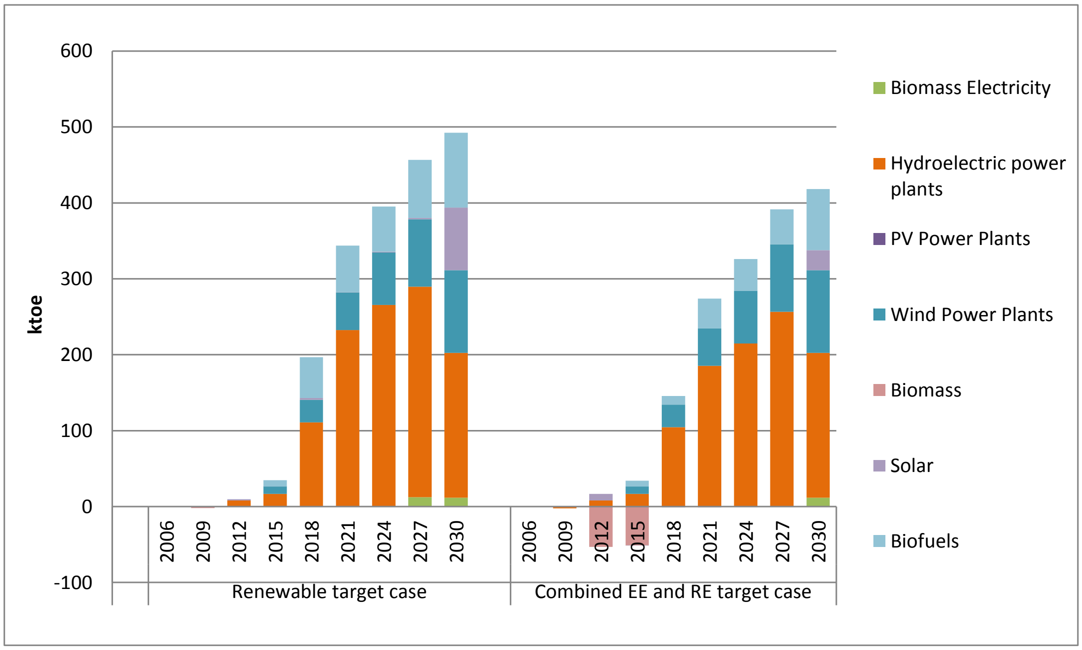
Figure 11 shows the change in annual energy system costs for the three policy scenarios relative to the Reference scenario. The bars show the increases (positive) and decreases (negative) in annual system cost components, and the change in net costs over time is shown as the red line. Overall, costs increase due to the additional investment needs for renewable generation capacity, and the additional costs of energy efficient demand devices. Fuel savings (in dark blue) can be seen in all scenarios, reaching over 490€ million per year in the combined scenario by 2030.

Figure 11. Costs and Savings from Renewable and Energy Efficiency Policies



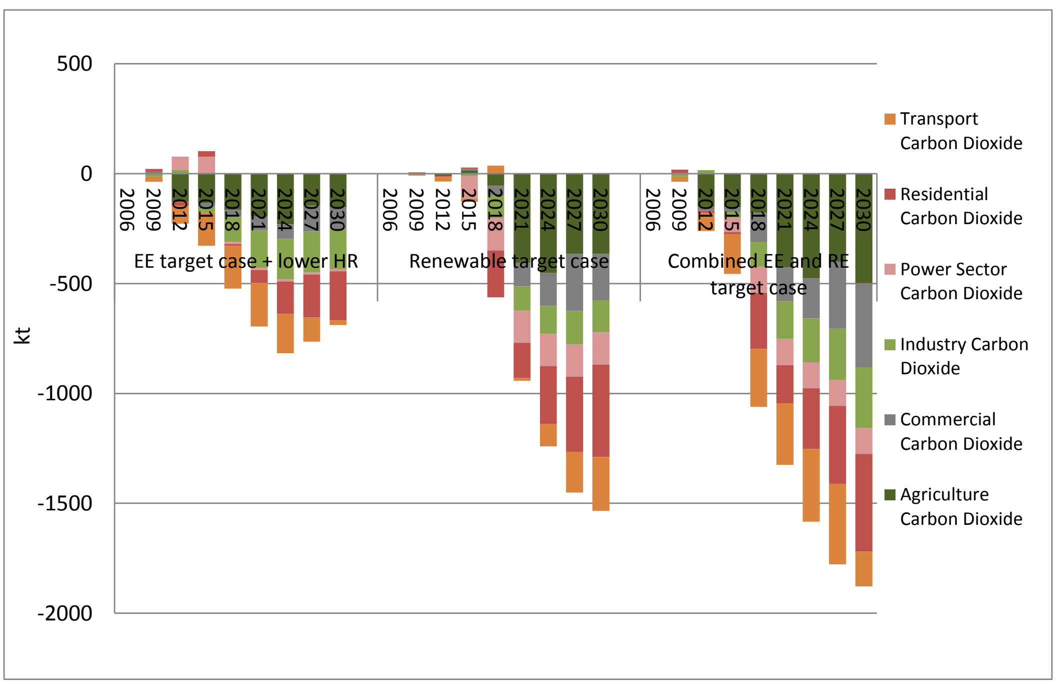
The synergies of meeting both targets at an overall lower cost are illustrated in Figure 12 below. Energy efficiency results in lower levels of renewable energy being required, as the renewable target is relative to (gross) final energy consumption.

Figure 12. Renewable Energy Consumption under RE and RE+EE Combined Cases



CO_2 emission reductions are shown in Figure 13, illustrating the significant savings associated with energy efficiency and renewable policy.

Figure 13. Sectoral CO_2 Emission Reductions under RE, EE and RE+EE Combined Cases



G. EXPLORING ADDITIONAL NATIONAL PRIORITIES – UNAVAILABILITY OF NATURAL GAS

The Reference scenario points to an increasingly important role for natural gas in the energy system. A sensitivity analysis was undertaken to assess the economic and energy system impacts if gas is not available, and the alternative technology investment choices.

The key findings are summarized below, and reflected in Table 9 and figures that follow.

- The unavailability of gas would lead to increases in the cost of the energy system. An additional cost of 596€ million is estimated, or a 1.3% increase compared to the Reference scenario. This highlights the importance of gaining access to natural gas. However, this additional cost estimate does not fully reflect the advantage that gas brings in terms of security of supply, particularly due to concerns over the vulnerable in future years of water supply due to climate change.

- The modest increase in cost is driven by an additional investment in new hydro capacity of over 520 MW (between 2018-2027), although the net increase is 271 MW. The net cumulative investment is around 1.35€ billion, or an increase of more than 54% compared with the Reference scenario.

- This expansion of the generation system is in response to increased demand for electricity in the end use sectors, which were heavily reliant on gas (post-2021) in the Reference case. Liquid petroleum gas (LPG) and oil are also important alternative fuels in the absence of gas.

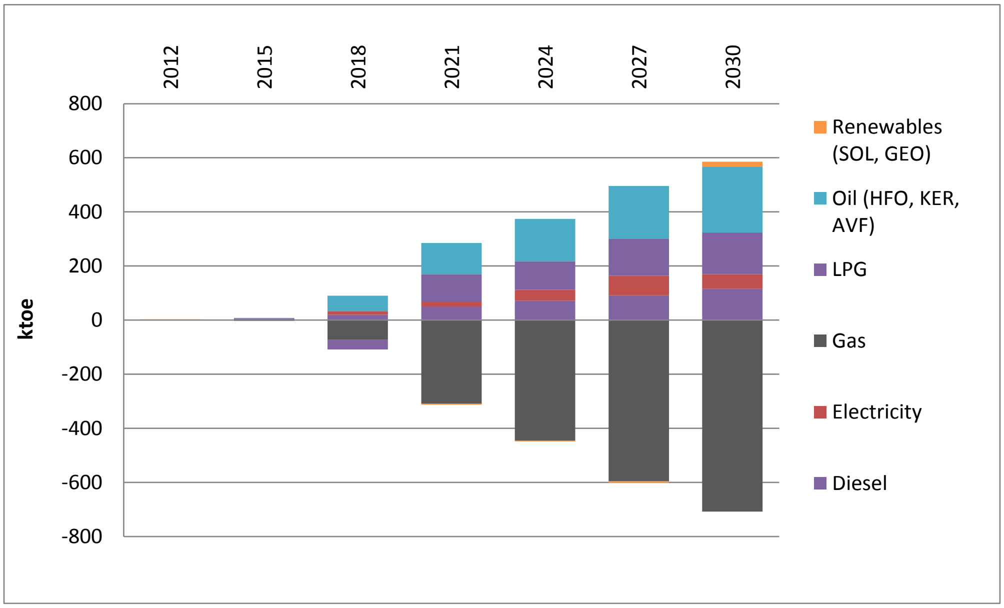
- Imports drop by over 7% compared to the Reference case, while CO_2 emissions drop by 2.4% (cumulatively), due to the uptake of hydro electricity in place of gas.

Table 9. Key Results: No Gas sensitivity (Cumulative) Difference from the Reference Scenario

Indicator	Units	Reference	No Gas Pipeline Change	
Total Discounted Energy System Cost	2006M€	44,138	596	1.3%
Primary Energy Supply	Ktoe	88,579	-2,030	-2.3%
Imports	Ktoe	51,305	-3,873	-7.5%
Fuel Expenditure	2006M€	36,327	702	1.9%
Power Plant New Capacity	MW	1,402	271	19.4%
Power Plant Investment Cost	2006M€	2,483	1,349	54.3%
Final Energy	Ktoe	75,554	-1,030	-1.4%
CO_2 Emissions	Kt	163,561	-3,925	-2.4%

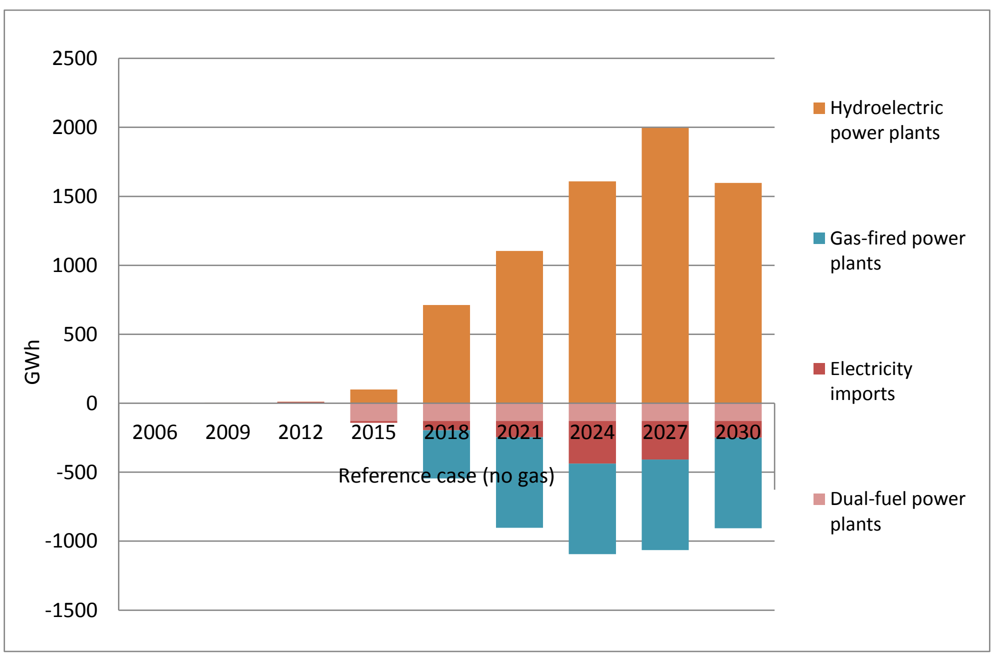
The unavailability of gas leads to increases in the consumption of electricity, oil, and LPG. While increased consumption of these fuels is observed across most sectors, oil demand strongly increases in the industry sector, LPG and oil demand increases in the commercial, and LPG and electricity increases in residential sectors.

Figure 14. Change in Final Energy under No Gas Scenario



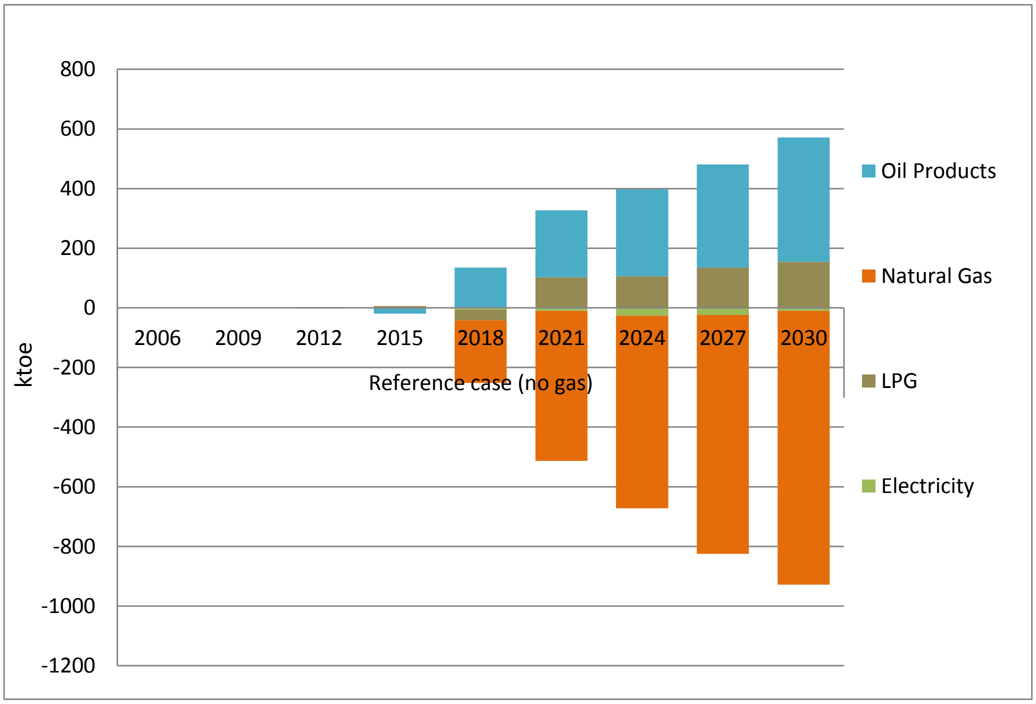
The increase in electricity consumption leads to an expansion of the generation system based on additional hydro generation capacity, as shown in Figure 15.

Figure 15. Change in Electricity Generation under No Gas Scenario



Compared to the Reference case, imports overall are reduced. Specific energy products, oil, and LPG increase, with increased demand for these fuels in end use sectors.

Figure 16. Change in Imports under No Gas Scenario



In summary, this sensitivity reflects that the availability of natural gas does lower the overall the energy system cost, although not by a significant amount. This conclusion also holds when RE and EE targets are assessed with no gas available.

APPENDIX I: DATA SOURCES AND KEY ASSUMPTIONS

The Albania analysis is based on numerous data inputs and assumptions, and therefore requires a set of key national data sources. The sources of this information are listed by data requirement in Table 10 below.

Table 10. Key Data Sources

Data Requirement	Source
2006 Energy Balance	Albania Energy Balance 2006 prepared by Albania National Agency of Natural Resources (NANR)
Domestic Energy Prices	Ministry of Economy, Trade and Energy, Regulatory Energy Entity
Resource Potential, including imports/exports	Ministry of Economy, Trade and Energy, General Directory of Custom , National Agency of Natural Resources, Albania Electricity Corporation (KESH), Albpetrol
Installed capacity and characterization of existing electricity, heating and CHP plants	Ministry of Economy, Trade and Energy, Electricity Company,
Electricity generation by plant (type)	Albania Electricity Corporation
Timing of demands for energy services	Albania National Agency of Natural Resources
Fuel consumption patterns by energy service	Albania National Agency of Natural Resources
Demand Drivers	Ministry of Finance, INSTAT
Known energy policies	National Strategy of Energy 2003-2015, update Strategy 2009-2025, draft NEEP 2009 and EU Questionnaire (April 2010)

Drawing on these data sources provisions, the resulting model is reasonably strong. However, there are some specific areas where data availability and quality could be further improved, either through better coordination with statistical agencies or based on further research.

The Planning Team has ensured (to the extent possible) that current or planned policy is reflected in the Reference scenario (e.g. Feed-in tariffs for renewable energy, natural gas import policy, CO_2 taxes). They have also consulted with different sector experts to ensure that the Reference scenario in the model is reasonable, and does not diverge significantly from other analyses undertaken e.g. for the Energy Strategy, draft Renewable Energy Strategy, Energy Efficiency Strategy.

A set of key assumptions provide the basis for developing the Reference case, which properly reflects the situation in Albania (see Table 11 to Table 13 below).

Table 11. Key Assumptions in the Reference Scenario: Power Sector - Hydro

A. Plant Performance Data

Power Sector - Hydro		Technology Performance									
		Available from (in model)	Life	Installed or Available Capacity	Build rate	Efficiency	Seasonal Load Factor (1) (6)			Annual Load Factor	Contribution to peak (7)
							Summer	Winter	Other		
			Years	MW	MW/yr	%	Fraction			Fraction	Fraction
Existing plant - Cascade (2)				1433			0.310	0.481	0.428	0.41	
	Fierze	2006	40	500	-		0.311	0.372	0.368		1.00
	Koman	2006	40	600	-		0.291	0.491	0.436		1.00
	V. Dejes	2006	40	250	-		0.323	0.612	0.524		1.00
	Ulez	2006	40	25	-		0.244	0.977	0.483		1.00
	Shkopet	2006	40	24	-		0.522	0.868	0.655		1.00
	Other (5)	2006	40	34	-		0.522	0.868	0.655		1.00
Existing plant - Small hydro		2006	40	34	-					0.25	0.50
New build - Cascade (3)											
	Ashta	2013	60	48			0.30	0.47	0.42	0.399	1.00
	Kalivaci	2015	60	100			0.31	0.48	0.42	0.407	1.00
	Devolli	2018	60	319	50 (4)		0.27	0.42	0.37	0.359	1.00
	Vjosa	2021	60	428			0.31	0.48	0.42	0.407	1.00
	Osumi	2021	60	94			0.27	0.42	0.37	0.359	1.00
	Skavica	2021	60	350			0.28	0.43	0.38	0.365	1.00
New build - Small hydro (3)		2012	40	380	20					0.214	0.50

B. Plant Cost Data

	Technology Costs (on €2006 basis)					
	Investment	Full project cost	Fixed O&M	Var. O&M	Fuel costs	Levelised cost (calculated)
	€/kW	€ Million	€/kW	€ cents /kWh	€ cents /kWh	€ cents / kWh
New build - Cascade (3)						
Ashta	3333	160			-	9.57
Kalivaci	1290	129			-	3.63
Devolli	2915	930			-	9.30
Vjosa	2804	1200			-	7.89
Osumi	2660	250			-	8.48
Skavica	1714	600			-	5.38
New build - Small hydro (3)	1500	570				8.18

(1) In the model, 'winter' season is 15 Nov - 15 Mar; 'summer' season is 1 Jun - 15 Sep; the rest of the year is 'intermediate'
(2) The lifetime used for these existing plant is to ensure that they are available for the time horizon of the model (and therefore are not plant specific)
(3) These are projects available in future years (although Ashta and Kalivaci are forced into model as already under construction)
(4) This build rate relates to all hydro projects not yet under construction to ensure a reasonable representation of what might be possible in future years
(5) This is capacity coming online between 2006-09 (incl. Bistric 1+2, and Lana Bregas)
(6) New build seasonal load factors based on pattern of generation observed in 2006/2009 (as these were 'average' years). These are adjusted or tied to predicted annual load factors (in column K)
(7) This is the maximum contribution of the available capacity during the peak period; for intermittent generation, it is low to characterise the uncertainty of contributing to peak generation

Table 12. Key Assumptions in the Reference Scenario: Power Sector - Other

Power Sector - Thermal + Other (10)	Technology Performance							Technology Costs (on €2006 basis)				
	Available from (in model)	Life	Installed or Available	Build rate	Efficiency	Annual Load Factor (8a)	Contribution to peak	Investment	Fixed O&M	Var. O&M	Fuel costs	Levelised cost
		Years	MW	MW/yr	%	Fraction	Fraction	€/kW	€/kW	€ cents /kWh	€ cents /kWh	€ cents / kWh
Vlora (Dual fuel CCGT)	2009	35	97	-	58%	85%	1.00					
CCGT (Natural gas) (9)	2018 (8)	35			58%	85%	1.00	700	20	0.58	2.67	6.42
Coal-fired Steam Turbine	2018	40			40%	85%	1.00	2000	25	0.43	0.86	5.65
Wind (centralised)	2012	20	1600	35	-	25%	0.15	1500		1.72		9.77

(8) This start date depends on when gas is available
(8a) This is entered into the model as maximum availability factor (not a fixed load factor)
(9)This plant can also be built as a dual fuel plant (like Vlora) for small additional investment cost (
10) In addition to yet to be expoited hydro potential, thermal options are also available. The model decides on what capacity to build based on economics, plant operation, and level of demand, within constraints specified e.g. build rates

Table 13. Key Assumptions in the Reference Scenario: Energy Prices / Infrastructure

Import Commodity Price Assumptions (11)	Units	2006	2009	2012	2015	2018	2021	2024	2027	2030
Gas	(€/MBTU)	5.82	5.03	6.05	7.27	7.83	8.33	8.66	9.03	9.45
Coal	(€/ton)	50.07	66.12	66.29	66.46	69.67	72.40	73.90	75.22	76.45
Oil (crude)	(€/boe)	49.16	41.05	51.21	63.88	70.20	76.07	80.14	84.20	88.35
Electricity (12) (13)	(cents€/kWh)	4.78	4.87	5.13	5.39	5.65	5.91	6.17	6.43	6.69

(11) For fossil commodities, these are 'beach' prices based on IEA projections WEO 2010), and therefore do not take account of additional taxes or delivery costs specific to Albania (although these are captured in the model); this is important to note for levelised cost estimate in this XLS
(12) 2006/2009 are reported average values; projected values will be improved to be based on reference case electricity prices observed in other models in the region (default assumption of 40% increase)
(13) Imported electricity is not permitted for use during the peak load period

Other key assumptions

Electricity system	Units	2006	2009	2012	2015	2018	2021	2024	2027	2030
Transmission Losses (14)	% of	4.68%	3.0%	3.0%	3.00%	3.00%	2.80%	2.80%	2.70%	2.50%
Distribution Losses (15)	total	36.32%	32.3%	29.0%	28.3%	27.7%	27.0%	26.3%	25.7%	25.00%
Total Losses	system	41.00%	35.3%	32.0%	31.33%	30.67%	29.80%	29.13%	28.37%	27.50%
Investment cost to reduce losses - distribution (16)	€ / kW									
Import-Export Capacity (17)	MW	380	380	380	600	600	600	600	600	600
Investment cost estimate	€ / kW				704.5					
Gas Transmission / Distribution										
Transmission investment (18)	€m / Bcm					150.0				
Transmission capacity	Bcm					1.5	1.5	1.5	1.5	1.5
Distribution investment	€ / Mcm					48.3				

(14) 2012 based on 2010 reported data; assumed small additional improvement out to 2030
(15) 2012 based on 2010 reported data; losses assumed to drop to 25% by 2030 as a result of ongoing maintenance
(16) It would be good to provide the option for investment to improve technical distribution efficiency - but this requires investment cost estimates
(17) Import-export capacity estimated to increase to 600 MW (based on IEA Western Balkans report), due to Kosovo and Montenegro 400 kV lines. In theory, capacity could be higher but assumed not due to system instability.
(18) Based on TAP investment of 1.5 billion for total 10 Bcm capacity

The primary data for technologies used in the non-transport end use sectors draws on the technology characterizations employed in the EU NEEDS model. This is a pan-European MARKAL/TIMES model that has evolved into a standard planning framework for numerous EU countries, as well as the EU Joint Research Centre, and used for key EU policy analysis (such as RES2020 examining the RES directive http://www.res2020.eu/).

Technology characterizations depict the current typical technology available in 2009, and assumptions are then made that reflect the cost and performance improvement of more efficient alternatives. There are more than 300 instances of these core technologies, and then up to three levels of improved devices available to the analyst to include in their model. The cost (M€/PJa) and performance characteristics for a subset of the key base devices are shown in Table 14.

Table 14. Characterization of Key Base Demand Devices

Energy Service Demand	Demand Device	Investment Cost (€/GJ)	Efficiency (Fraction)
Commercial cooling	Central air conditioning	2.74	3.00
	Air heat pump	6.26	3.40
	Split air conditioner	2.74	3.00
Commercial lighting	Incandescent bulbs	5.00	1.00
	Halogen lamps	30.00	2.00
	Fluorescent lamps	20.00	4.00
Commercial space heating	Electric furnace	3.90	0.85
	Gas furnace	4.88	0.76
	Oil furnace	5.37	0.70
	Solar thermal (with oil)	23.42	0.68
	Solar thermal (with gas)	15.75	0.70
Commercial water heating	Electric water heater	10.00	0.90
	Gas water heater	20.00	0.70
	LPG water heater	20.00	0.70
	Oil water heater	12.00	0.65
Iron & Steel High temperature heat	High temperature heat (Gas)	20.00	0.75
Iron & Steel Mechanical drive	Motor drive (Electricity)	5.00	0.88
Iron & Steel Low temperature heat	Low temperature heat	10.00	0.72
Residential space heating	Electric Furnace	4.49	0.86
	Gas Furnace	4.39	0.67
	Oil Furnace	6.17	0.62
	Solar thermal (with oil)	15.85	0.68
	Solar thermal (with gas)	8.96	0.70
	Ground source heat pump	20.13	3.33
	Solar heat pump	16.78	4.00

Energy Service Demand	Demand Device	Investment Cost (€/GJ)	Efficiency (Fraction)
	Biomass furnace	5.72	0.55
	Coal furnace	5.72	0.57
	LPG furnace	6.45	0.67
	Heat pumps	13.42	1.90
Residential cooling	Ground source heat pump	1.54	2.55
	Solar heat pump	3.09	0.64
	Air source heat pump	0.99	2.00
Residential lighting	Incandescent bulbs	15.28	1.00
	Halogen	19.10	2.80
	CFL	16.55	4.60
Residential hot water	Electric water heater	10.00	0.90
	Gas / LPG water heater	20.00	0.70
	Oil water heater	12.00	0.65
	Biomass water heater	14.00	0.60
	Solar (with electric) water heater	60.00	0.90
	Solar (with gas) water heater	70.00	0.70

The characterization of the improved devices varies by end-use, but in general for a series of efficiency improvements by, for example 20%/30%/50 %, the base purchase price may increase a corresponding 0.74/1.34/2 times. All these assumptions may be adjusted for national circumstances, though most use this standard approach as described.

Note that due to lack of data on the process details of Albania industry an approach that calibrates to the current energy intensity of each industrial demand, where rather than representing specific processes up to three generic options with various price/performance improvements in the future is employed.

The transport sector is a key new sector added to the model in the last six months. It uses data from a range of sources, summarized below.

- Default values for new vehicle efficiencies and activity data are taken from a study funded by the European Commission called *EU Transport GHG: Routes to 2050 project*, which can be found at http://www.eutransportghg2050.eu. The data values are taken from the project's Sultan Tool (see Table 15) but adjusted to take account of country specific data / assumptions

- Information on the relative efficiencies across different types of LDVs and the difference in costs (now and in future years) is based on information from Annual Energy Outlook (AEO) 2011.[12] Only the relative efficiency numbers are used and applied to information from the Sultan Tool mentioned above. Relative cost values are applied to user-provided information on standard gasoline/diesel vehicles.

[12] AEO refers to Annual Energy Outlook. This is an annual publication focusing on energy projections prepared by the US Energy Information Association (EIA). For more information, go to http://www.eia.gov/analysis/

- Marine and aviation estimates are from the best available data from the United States (US)/United Kingdom (UK) National MARKAL models. This approach is satisfactory as these subsectors in the model are not subject to technology choice.

Table 15. Sultan Tool Values on Vehicle Efficiencies, Payloads, and Annual Activity

Vehicle type	Fuel	Efficiency		Payload	Activity	
		mvkm/PJ	mpkm OR mtkm/PJ	Persons / tonnes	km per yr	pkm / tkm per yr
Buses	DST	110	1659	15.05	43,817	659,331
	ELC	330	4968	15.05	43,817	659,331
Cars	GSL	428	700	1.64	13,189	21,573
	DST	449	735	1.64	13,189	21,573
	LPG	427	698	1.64	13,189	21,573
Motorcycles	GSL	984	1078	1.10	5,664	6,209
Heavy trucks	DSL	91	781	8.54	49,201	420,233
	CNG	69	588	8.54	49,201	420,233
Medium trucks	DSL	204	328	1.61	15,992	25,674
Rail Pass.	DSL	20	2453	124.6		
	ELC	32	3949	124.6		
Rail Freight	DSL	14	5431	393.0		
	ELC	22	8721	393.0		

Figure 17. LDV Efficiency by Type in Albania MARKAL Model

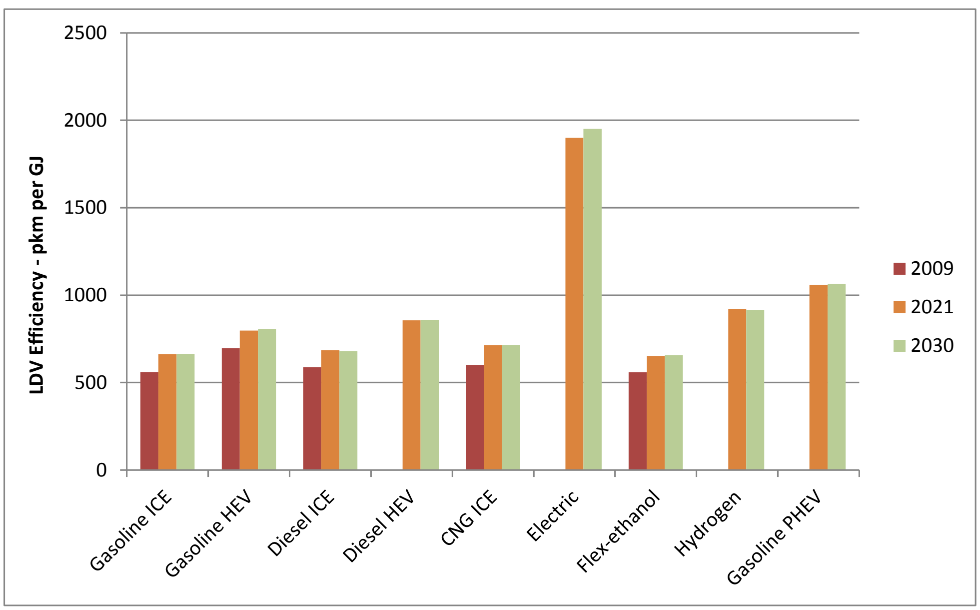
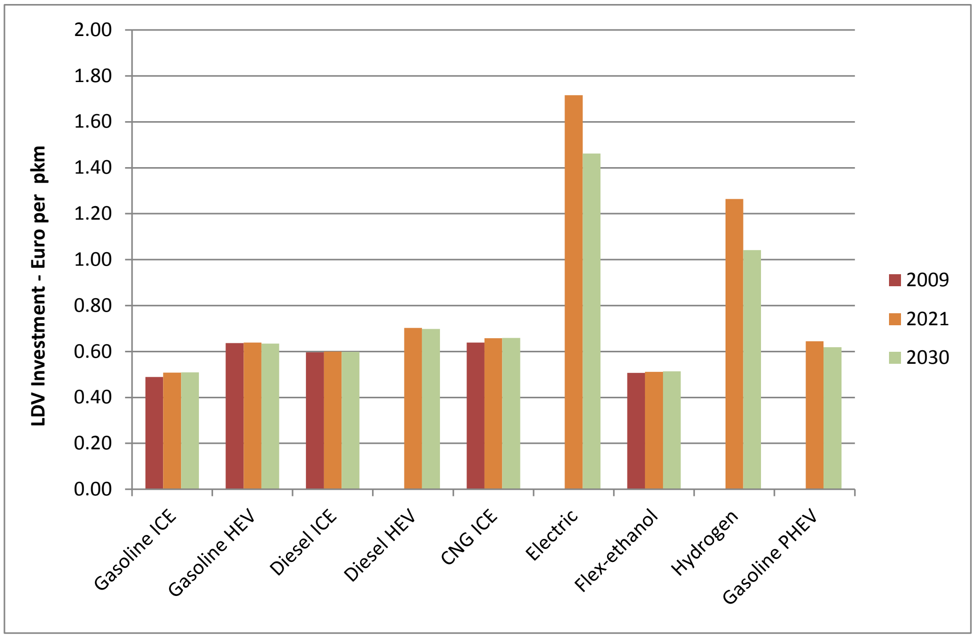


Figure 18. LDV Efficiency by Type in Albania MARKAL Model



For year 2006, the transport sector is calibrated to the national energy balance. The transport sector energy totals have been disaggregated using Albania statistics, and other information sources, such as those provided by the Organisation for Economic Co-operation and Development (OECD).

Transport demands use the same core drivers that are used in other sectors, namely annual GDP growth rates and population growth. Different transport subsectors are subject to different projections approaches. LDVs and two-wheelers use a vehicle ownership – GDP per capita relationships, with elasticity factors (from the IEA) that capture the strength of the relationship based on different income bands. Other freight-based subsectors use a more simple approach based on GDP growth rates. All derived drivers are based on information from the IEA.

APPENDIX II: A Closer Look at Modeling Energy Efficiency POLICIES AND MEASURES.

As MARKAL/TIMES is a least-cost optimization modeling framework, it evaluates competing alternatives within an energy system based strictly on lifecycle costs, within other constraints imposed on the model. The lifecycle costs are the purchase price + operating costs + payments for fuel spread over the entire operational lifetime of the device. This approach tends to favor energy efficient devices because the fuel savings accrued over the lifetime will be greater than the costs associated with the investment and operation of the device. However, in reality, consumers do not necessarily evaluate purchasing on this basis. Decisions may be impacted by a range of factors which act as barriers to investment in EE devices including:

- Risks and uncertainty around new technologies (perhaps due to lack of information)
- High transaction costs (affecting the ease of choice)
- Problems accessing capital (as EE devices often have higher purchase prices)
- Other costs not included or missed in typical economic analysis (known in the literature as hidden and missing costs)
- Consumer inertia (perhaps due to non-economic factors, e.g. stick with what own (even if past performance lifetime), buy only what know, style)
- Longer pay-back periods undermining the attractiveness of making the alternative investment with higher upfront cost

These factors often lead to energy efficient appliances being overlooked even though under strict economic principles, they should be selected. Such barriers to uptake are widely acknowledged in the field of energy efficiency research.

To deal with this "behavior" within a MARKAL/TIMES model, there are basically two main options: 1) impose firm upper limits on the rate of uptake of new devices or 2) use sector/technology-specific discount rates (so-called "hurdle" rates) to take account of barriers that prevent these investments from happening. This second approach enables some aspects of consumer behavior that typically may be characterized as economically irrational (in a perfectly competitive market) to be reflected in the model. The additional costs associated with overcoming the above barriers could be seen as representing the cost of policies and programs that might be associated with overcoming such barriers (e.g. labeling, information campaigns, appliance/building standards).

The first approach (*firm constraints)*, used previously for the RESMD EE analysis, has the disadvantage of underestimating the costs of EE (which was a criticism of the earlier work) and tends to be an all-or-nothing choice by the model. In addition, it is difficult to use in association with an EE target.

The second approach *(flexible constraints)* is considered a less rigid, more flexible approach as the model is free to find the cost-effective penetration level for the EE devices, taking into consideration these extra costs (but with no firm limits as per the first approach). The difficulty with it is that there is only limited empirical evidence on what the "hurdle" rates should be for each technology, though research in the United States (US) and United Kingdom (UK) point to a 15-25% premium.

The set-up of these different approaches for the baseline run and energy efficiency policy run are summarized in the table below.

Scenario / Approach	Previous approach – "firm constraints"	Revised approach – "flexible constraints"
Baseline	In general, energy efficiency devices are restricted to 10% uptake as a share of a given technology category.	Energy efficiency uptake is calibrated to the levels seen under the 'firm constraints' approach – but using hurdle rates not firm constraints.
Energy efficiency	The constraints were relaxed to 50% (or whatever a country thought was appropriate) of new devices purchases in 2030 to determine the economically efficient uptake. The approach was used to demonstrate the impact of energy efficient devices but was not policy driven targets. It did not capture the additional costs associated with energy efficiency devices (as reflected in the hurdle rates).	Two mechanisms are applied to the baseline – an energy efficiency target was introduced and hurdle rates were reduced to a level based on an empirical basis. The big advantage of this approach is that it is target based (so policy relevant) and reflects much of the costs associated with implementing energy efficiency measures.

The sections below describe in greater detail how to implement the revised approach, where "hurdle" rates are used to keep the EE devices out of the Reference scenario (for the most part), based upon the assumption that without policies and programs people will tend to buy what they know and what has the lowest upfront cost.

Calibrating New Demand Device Uptake in the Reference Scenario

As summarized in the table above, an approach has been established that uses hurdle rates (technology specific discount rates) to control new technology uptake. The benefit of such an approach is that alternative scenarios (e.g., consumption reduction targets) can be explored without the requirement to adjust constraints that impose hard bounds (limits) on the rate of penetration of advanced technologies, because now their uptake is limited on the basis of cost rather than using fixed limits.

The calibration process for various RESMD models uses hurdle rates of 20 to 40% to achieve the dampening of the new device updates to the original Reference scenario level. This reflects the fact that in the absence of policy it is highly unlikely that (most) people will recognize the cost savings over the lifetime of an advanced improved device and overcome the higher upfront cost. Then, as EE policies and programs incentivize uptake, these hurdle rates are reduced. Under the EE target case, hurdle rates are reduced to the range of 10-20%, reflecting the impact of policies (e.g., appliance standard – that eliminates inefficient options from the market place) and programs (e.g., low interest loans for building shell improvements and the purchase of efficient appliances).

Conducting EE Analysis

Empirical evidence in the US/UK literature indicates that there is a required rate of return perceived by consumers for EE measures of between 15-25%. These hurdle rates can be reduced by incentives, programs, and campaigns (such as those called for in NEEAPs) to reduce the barriers seen by consumers. Thus, rates in the range of 10 to 20%, reflecting low interest loans or simply the cost of credit card purchase for the high efficiency devices, are reflective of the environment under such policies.

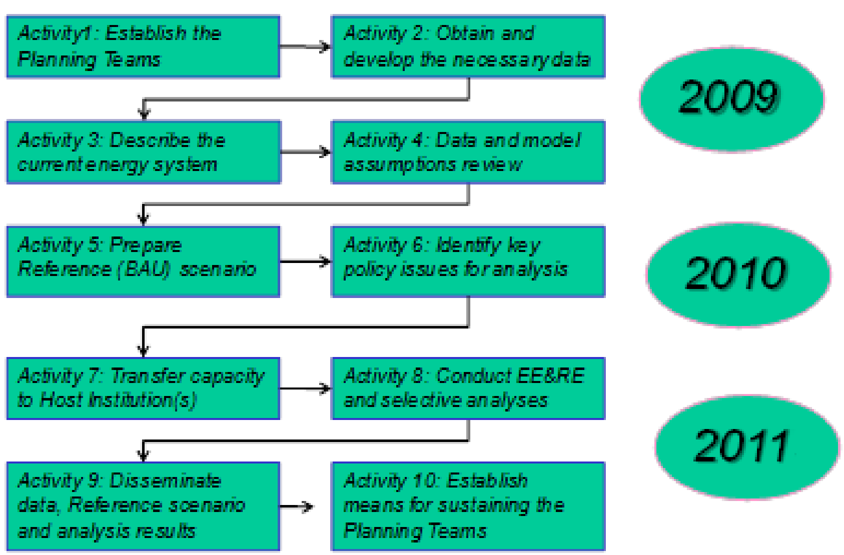
APPENDIX III: PROJECT ACTIVITIES AND METHODOLOGY EMPLOYED

Major Project Activities

The consultant teams for International Resource Group (IRG) and the Centre for Renewable Energy Sources (CRES) worked with key personnel from the Albanian Ministry of Economy Trade and Energy (METE) and the National Agency of Natural Resources (AKBN) to establish a credible MARKAL-Albania model, and guide this Planning Team's use of the model to assess and analyze several policy alternatives aimed at improving energy efficiency and increasing the use of renewable energy resources.

Over the course of two years, the joint SYNENERGY Strategic Planning (SSP) effort undertaken by the United States Agency for International Development (USAID) and Greece Hellenic Aid was able to introduce new methods, implement these methods, and transfer the capabilities to the national counterparts in a sustainable manner (see Figure 19). The figure shows that data development and team building came first, taking much of Year One to arrive at an accurate quantitative description of the country's current energy system, and identify the options available for consideration over the next 20 years. For the Planning Teams that were involved in the precursor to SYNENERGY activities, the USAID-sponsored Regional Energy Demand Planning (REDP) undertaking, Activities 1 - 5 were replaced by improvements to their initial models built and updating of their Reference Scenario, along with supplemental training for new members of those Planning Teams.

Figure 19. Sequence of Project Activities



Once the data and information systems were established it was possible to reproduce a valid energy balance for each of the countries. These energy balances, relying on best available information and a consistent management framework, provide the foundation for useful policy analysis and assessment.

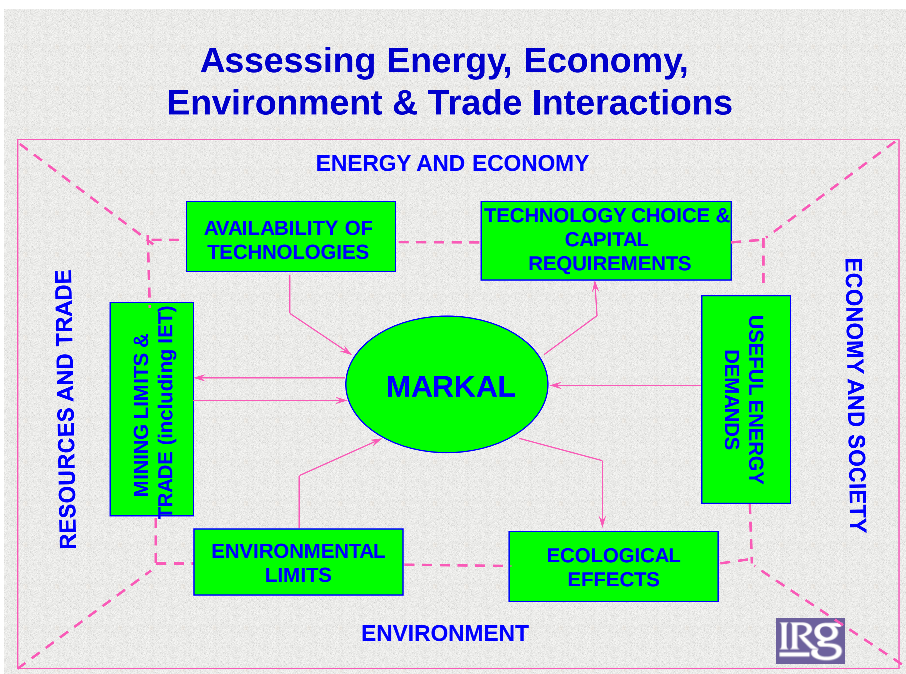
At least as important as the energy balances themselves, and the accompanying information systems, is the process of building a team of professionals in each country who can work with the data, maintain the information systems, and support higher level analytical approaches. This team building should be considered a major benefit of the project for the region. However, to date, only a couple of the countries have moved actively on Activity 10 and looked to established means for sustaining the Planning Teams, so this will be more actively pursued in the next phase of the project.

Methodology Employed

Patterned after successful efforts in other countries, this project has transferred significant energy system modeling and analytical capabilities, along with a practical approach to decision support. Such capabilities are focused on the use of a consistent framework for analysis and assessment, the MARKAL/TIMES model, making collaborative efforts among the participating countries simpler and more transparent.

The MARKAL/TIMES model produces robust, scenario-based projections of a country's energy balance, fuel mix, and expenditures required for the energy system over time. The model relates economic growth to the necessary resources, trade and investments, incorporating a nation's environmental standards (or goals), depicting the least-cost energy future (see Figure 20).

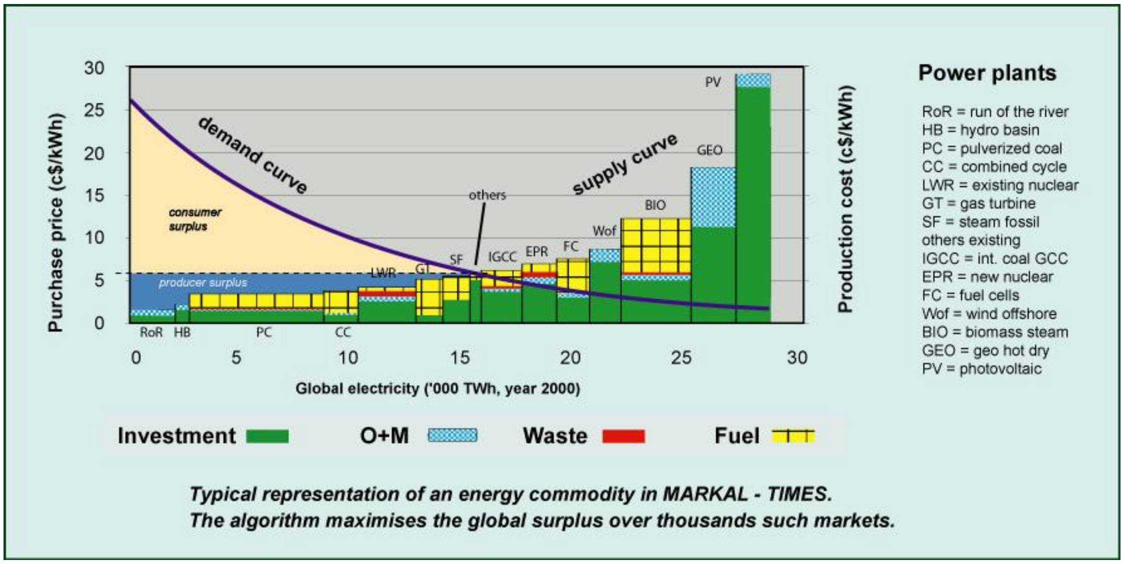
Figure 20. Interactions in the MARKAL/TIMES Model



The MARKAL/TIMES model simulates energy consumption and investment/supply decisions on the basis of a simple calculus of costs and benefits. Producers will supply the market as long as consumers will pay a price equal to or greater than the cost of supply. The model performs this calculation simultaneously for each energy form and all the energy service demands, solving for the least cost solution for the energy required to support economic growth.

In the example below (Figure 21) the model meets electricity demand by first dispatching run-of-river (RoR) hydro plants, then pumped hydro (HB), next pulverized coal (PC), then combined cycle (CC), nuclear (LWR), gas turbines (GT), and finally steam fossil (SF) up to a price of $.06/kWh. If more electricity needs to be delivered the model will turn to more expensive types of power plants, but at some point the consumer will switch to some other fuel (e.g., gas for space heating) rather than pay more for electricity. This basic principle is applied across the board to ensure that the least-cost deployment of technologies and consumption of fuels is realized, within the constraints imposed on the model. A fuller description of MARKAL/TIMES and its use internationally may be found at www.etsap.org.

Figure 21. Power Plant Dispatch in the MARKAL/TIMES Model



One of the most relevant suite of studies conducted recently using are those sponsored by the European Union that employ MARKAL/TIMES to represent the pan-European energy picture as a closely tied integration of the national energy systems. The initial incarnation of this was realized as part of the New Energy Externalities Developments for Sustainability (NEEDS)[13] undertaking. The Pan-European TIMES model (PET)[14] evolved from the original NEEDS model and has been employed for series of high profile EU projects, including RES2020[15] examining the EU renewables directive,[16] REALISEGRID[17] looking to promote the optimal development of the European national transmission grid infrastructure, and the Risk of Energy Availability: Common Corridors for Europe Supply Security (REACCESS).[18] Another pair of high-profile uses of MARKAL/TIMES is the IEA Energy Technology Perspectives[19] and UK Climate Change Policy "White Paper."[20]

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[13] http://www.isis-it.net/needs/

[14] http://www.res2020.eu/files/fs_inferior01_h_files/pdf/deliver/The_PET_model_For_RES2020-110209.pdf

[15] http://www.res20202.eu

[16] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF

[17] http://realisegrid.rse-web.it/

[18] http://reaccess.epu.ntua.gr/TheProject/ProjectObjectives.aspx

[19] http://www.iea.org/techno/etp/index.asp.

[20] http://www.ukerc.ac.uk/ResearchProgrammes/EnergySystemsandModelling/ESM.aspx.

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