



Exploring drivers of energy demand in Cyprus – Scenarios and policy options



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HIGHLIGHTS

- Energy demand forecasts for the Republic of Cyprus up to the year 2040 are presented.
- Study in the frame of renewable energy roadmap for Cyprus supported by IRENA.
- Four scenarios considered, some allowing for breaks with past trends of energy use.
- Rigorous implementation of energy efficiency measures is realistic.
- Strong energy savings required in line with EU decarbonisation targets.

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ABSTRACT

This paper describes a new set of energy demand forecasts for the Republic of Cyprus up to the year 2040, which have been developed in support of the renewable energy roadmap that was prepared for national authorities by the International Renewable Energy Agency. The analysis takes into account national end-use data from the residential and tertiary sector that had not been exploited up to now. Four final energy demand scenarios with diverging assumptions were defined in this study, offering a wide range of possible outcomes up to 2040; in addition, four alternative scenarios were applied for sensitivity analysis. Two of these scenarios can be regarded as those continuing the trends of the recent past in Cyprus (prior to the economic and financial downturn of years 2011–2014). However, a more rigorous implementation of energy efficiency measures in buildings and transport, as defined in the fourth scenario of this study, is also realistic; despite its potential costs, it might allow Cyprus both to decrease its carbon emissions in line with the long-term EU decarbonisation targets, and to reduce its dependence on fossil fuels, thereby promoting energy efficiency as an important climate change adaptation measure.

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1. Introduction

With over 140 member states, the International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future. Among other activities, IRENA has established a Global Renewable Energy Islands Network (GREIN) and provides assistance to Member States in the development of local or national renewable energy deployment roadmaps for islands. As part of this work programme, IRENA supported in 2014 the Republic of Cyprus in

the development of its renewable energy roadmap.

Cyprus is an island country in the Eastern Mediterranean with a population of about 800,000, which became a member of the European Union (EU) in 2004.¹ The country currently possesses no indigenous fossil energy resources, although natural gas has been discovered in its waters. Until these resources are developed and made available for domestic consumption, Cyprus remains highly dependent on imported petroleum products. Energy intensity is among the highest in the EU, due to the lack of adequate public transport modes, the absence of energy performance requirements

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¹ The information provided here refers only to the area controlled by the government of the Republic of Cyprus.

for buildings until recently, and the exclusive dependence on aviation for international travel. Its power system is isolated and depends mainly on fuel oil for the operation of power plants, with plans to use natural gas for some of its power generating capacity later in this decade. As an EU member, Cyprus has implemented policies promoting renewable energy and energy efficiency measures in compliance with the relevant EU legislation. It is also noteworthy that the country is located in a hot spot in terms of climate change impacts: it already has a semi-arid climate and is located in a region that is expected to experience the most adverse climate change effects in Europe, with significant temperature increases and some drop in already low rainfall levels (Lelieveld et al., 2012). As a result, energy supply and demand are expected to be considerably affected in the long term (Zachariadis and Hadjinicolaou, 2014); this reinforces the need for long-term energy planning as it constitutes an important part of a coherent climate change adaptation policy for the island.

The renewable energy roadmap of Cyprus consists of three parts – medium and long term projections of energy demand; a set of least cost pathways for the evolution of the electricity generation mix until 2030; and a technical study outlining operational and technological solutions to integrate high shares of variable renewable energy technologies in the national electricity system. This paper outlines the findings of the first part of the roadmap study. It describes the results of alternative energy demand scenarios in Cyprus up to the year 2040, depending on different assumptions about the structure of energy use and the implementation of energy policies.

Recent medium- and long-term energy modelling studies for Cyprus were mainly conducted in order to assist national authorities in preparing action plans in compliance with some of the EU's main legislative initiatives in the energy field – more specifically, the Renewable Energy Directive 2009/28/EU (Poullikkas et al., 2011; Zachariadis, 2011) and the Energy Efficiency Directive 2012/27/EU (Zachariadis and Michael, 2014). Compared to those studies, this paper (a) presents results from four new energy demand scenarios, which were designed in line with macroeconomic and energy price developments of summer 2014; (b) explores different pathways for final energy use in Cyprus, thus allowing for a comprehensive overview of alternative energy futures; and (c) develops projections taking into account national end-use data from the residential and tertiary sector that had not been used in any earlier study.

2. Methods

Energy forecasts for national policy analyses are usually performed with the aid of end-use accounting models or econometric models (Bhattacharyya and Timilsina, 2009). The model used for energy demand forecasts for Cyprus uses a combination of these approaches. Its specification is described in detail in IRENA (2015). On the econometric side, it employs recursive equations of final energy demand per year by sector and fuel, which describe the evolution of final energy consumption as a function of exogenous macroeconomic and price variables, using income and price elasticities (distinguishing between long-term and short-term effects) that have been largely derived from national econometric estimations and international literature; Table 1 provides an overview of these elasticities

As regards the sectoral breakdown, the model addresses the major energy-using sectors in the Cypriot economy: agriculture; cement industry; rest of industry; households; services; road passenger transport; road freight transport; and aviation. On the end-use accounting side, technology and fuel shares are determined in the model at the level of end-use energy technologies,

Table 1
Elasticities used in the energy demand forecast model (IRENA, 2015).

Sector	Income elasticity	Short-term price elasticity	Long-term price elasticity
<i>Substitutable energy forms in:</i>			
Agriculture	0.7	−0.15	−0.60
Cement industry	0.75	−0.20	−0.80
Other industry	0.75	−0.20	−0.80
Households	0.7	−0.15	−0.60
Services	0.75	−0.20	−0.80
Road passenger transport	0.9	−0.15	−0.60
Road freight transport	1.1	−0.15	−0.60
Aviation	1.2	−0.20	−0.80
<i>Non-substitutable electricity (for appliances and space cooling) in:</i>			
Agriculture	0.8	−0.15	−0.60
Cement industry	0.9	−0.10	−0.40
Other industry	0.9	−0.10	−0.40
Households	1.1	−0.10	−0.40
Services	1.1	−0.05	−0.20

as a function of their annualised costs and the maturity of each technology.

As mentioned in the introduction, this study is the first one to take advantage of the availability of end-use data in households and the tertiary sector. As far as the residential sector is concerned, the model employs data from a survey that was conducted by the Cyprus Statistical Service and was targeted on final energy consumption of households by end use (space heating, space cooling, water heating, cooking, lighting and appliances).² These data were combined with information on final household energy demand from the official national energy balance of year 2013 in order to disaggregate final residential energy consumption by end use and to enable a forecast of the future final energy needs of households. According to the end-use data, gas oil systems dominate space heating equipment, LPG for cooking is still more widespread than electricity, and solar water heaters are dominant in water heating systems. Electricity is the second most widely used energy form for space heating, water heating and cooking, and obviously the exclusive energy form used for space cooling, lighting and appliances – with the exception of a small amount of geothermal energy for space cooling (Michopoulos et al., 2015).

On the basis of this information, a forecast of residential demand for useful energy was performed. Each one of the five main end uses mentioned above was assumed to follow a different dynamic path in the future, with different sets of income and price elasticities and a different evolution of fuel shares until 2040 for each end use, depending also on the thermal efficiency of each fuel/technology and the turnover of old equipment and its replacement with new, more efficient equipment. The results of this forecast procedure were then used to calibrate parameters of the final energy demand model. In this forecast and model calibration procedure, a substantial acceleration of electrification was assumed to gradually take place in Cypriot households, through the penetration of electric cooking devices and heat pumps for space heating. As regards to the future efficiency of residential energy devices, a significant improvement in the efficiency (coefficient of performance) of heat pumps was assumed, in line with current and anticipated technological progress in this field, as well as a modest improvement in the thermal efficiency of conventional systems for space and water heating.

² 'Final energy consumption in households'. Published online at www.mof.gov.cy/cystat on 5/10/2011 (last accessed in February 2015).

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