In-Depth Assessment of the Energy Efficiency Potential in Cyprus

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Project Description

- Technical Assistance project for the government of Cyprus, funded by the European Commission's Structural Reform Support Service and the German Federal Ministry of Economy and Energy
- Aim: To assess the maximum theoretical and economically viable energy efficiency potential in Cyprus, with emphasis on buildings & industry
- First in-depth assessment of this kind in Cyprus

Methodology

- Employed engineering model to assess the maximum energy saving potential in buildings & industry
- Collected economic data for energy efficiency interventions from the national market
- Took into account realistic financial and technical constraints for Cyprus
- Constructed diverse cost-effectiveness indices on the basis of engineering modelling results and economic data
- Provided a ranking of interventions that can be exploited by authorities to determine their funding priorities
- Translated these savings to aggregate energy forecasts up to 2030 & 2050

Estimation of Energy Saving Potential

We explored:

- The theoretical (technical) energy saving potential and
- The economically viable energy saving potential in:

  (a) residential buildings

  (b) commercial buildings

  (c) industry

Residential Sector – Theoretical Potential

"*the amount of current energy consumption that can be saved if the existing residential building stock is upgraded to nearly-zero energy buildings based on national regulations*"

This potential was estimated in terms of percentage reduction in:

(a) heating energy consumption,

(b) cooling energy consumption,

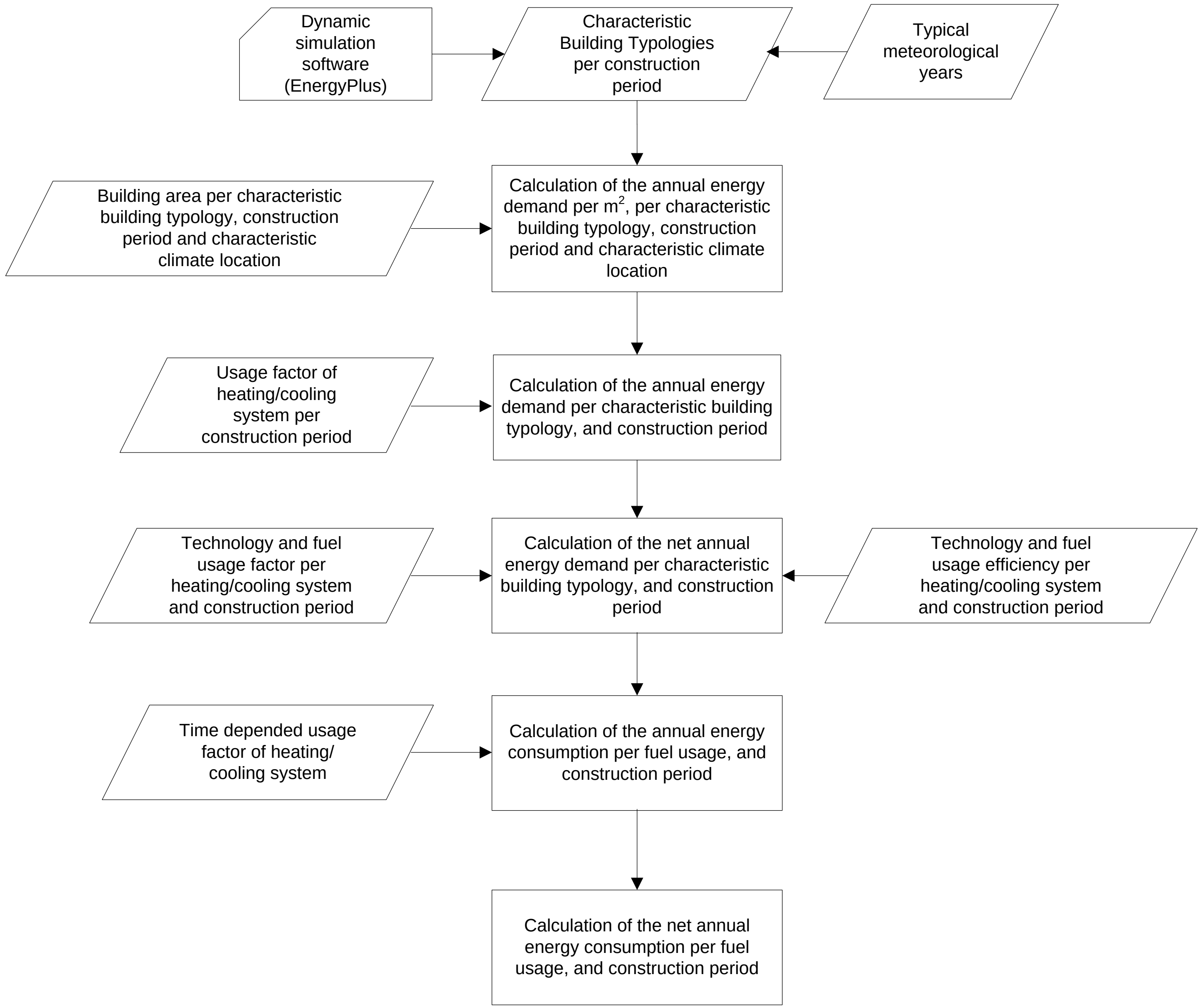
(c) energy consumption for domestic hot water production and

(d) electricity consumption for lighting and appliances

assuming the gradual penetration of the following technologies:

- High efficiency heat pumps for cooling in all buildings
- High efficiency heat pumps + high efficiency boilers for heating in buildings depending on size & location

Structure of 2EMRS Model – Energy Estimation Model for Residential Sector



Residential Sector – Theoretical Potential

The model uses four characteristic residential building envelopes of the current building stock of Cyprus which are:

(a) a single-family house

(b) a two storey house

(c) a detached house and

(d) a multi-family building

In four characteristic construction periods:

(a) before 1970

(b) 1971-1990

(c) 1991-2007

(b) 2008-now

Residential Sector – Theoretical Potential

The characteristics of each building envelope have been selected according to the construction practice of each period, resulting in 28 different envelopes in total.

These envelopes have been simulated using the EnergyPlus software in 3 different climate zones of Cyprus:

(a) coastal zone (Limassol)

(b) mainland zone (Nicosia)

(c) mountainous zone (Saittas)

resulting in 84 different case-studies overall.

In order to estimate the theoretical energy saving potential for the residential sector two series of simulations are needed (168 case-studies in total).

Residential Sector – Theoretical Potential

2EMRS model computes final residential energy consumption based on the energy simulation results and taking into consideration proper weighting factors regarding the use of:

- heating/cooling system per construction period
- technology and fuel per heating/cooling system
- efficiency per technology and fuel per heating/cooling system
- time dependent use of heating/cooling system

Residential Sector – Theoretical Potential

Heating				
Electricity	Gasoil	Kerosene	LPG	Biomass
66.2%	100.0%	100.0%	36.2%	100.0%
Cooling				
80.3%				
DHW				
26.2%	100.0%	100.0%	27.1%	100.0%
Lighting and Appliances				
55.0%				
Overall				
60.1%	100.0%	100.0%	35.6%	100.0%
Overall reduction equal to 67.4% (based on fossil fuels' balance) or 51.3% (accounting for RES production)				

Industrial Sector – Theoretical Potential

Theoretical (technical) energy saving potential for the industrial sector:

"*the amount of the current energy consumption that will be saved if industrial plants upgrade and/or replace their equipment and install high efficiency one which is available in the market*."

Due to the significant diversity of industries, pattern uses, process and equipment use, as well as the lack of existing data, the analysis was based on in-situ visits and interviews with the energy managers in:

(a) cement industry
(b) food and beverages
(c) water supply
(d) plastics
(e) building material industry.

- The results show that the theoretical (technical) energy saving potential in industry is <u>34% for electricity and 5% for fuel oil and gas oil </u>(weighted average).

Residential Sector Economically Viable Potential

Following energy interventions were considered as priority in order to improve the energy efficiency of the current residential building stock:

(a) insulation of the horizontal elements (roof, ceiling, etc.)
(b) insulation of the vertical elements (reinforced elements, masonry)
(c) installation of shading devices
(d) high efficiency windows (frame and glasses)
(e) installation of LED lighting bulbs
(f) high efficiency heat pumps
(g) solar thermal collectors
(h) high efficiency boilers (in rural areas)

+ Taking into account a total expenditure in renovations of 450-500 million € up to 2030 (from JRC study)

Residential Sector Economically Viable Potential

Heating				
Electricity	Gasoil	Kerosene	LPG	Biomass
-2.7%	14.4%	12.7%	2.0%	12.2%
Cooling				
9.9%				
DHW				
-22.1%	20.9%	35.6%	20.7%	49.8%
Lighting and Appliances				
3.9%				
Overall				
4.8%	15.2%	14.1%	3.2%	13.6%
Overall reduction equal to 7.4% (based on fossil fuels' balance) or 5.2% (accounting for RES production)				

Industrial Sector Economically Viable Potential

"the amount of the current energy consumption that will be saved if industrial plants upgrade and/or replace their equipment and install high efficiency one which is available in the market based on their economic capability/programming"

Following energy interventions were considered as a realistic priority:

(a) high efficiency electrical motors

(b) inverters

(c) automations

(d) heat recovery

(e) installation of LED lighting bulbs

(f) installation of energy efficient compressed-air systems

(g) CHP

Result: Economically viable savings of 6.2% in electricity and 0.5% for fuel oil and gas oil.

Final Energy Demand Model Outline

Sectors:

- Industry (split to Cement industry & Other industry)
- Households
- Tertiary sector
- Agriculture
- Road passenger – road freight transport (currently inactive, using output of TREMOD)
- Air transport

Fuels: Gasoline, automotive diesel, LPG, gas/diesel oil, light fuel oil, heavy fuel oil, aviation fuel, electricity, coal, renewables (solar thermal, geothermal, hydrogen, biofuels, biomass)

Reference Scenario

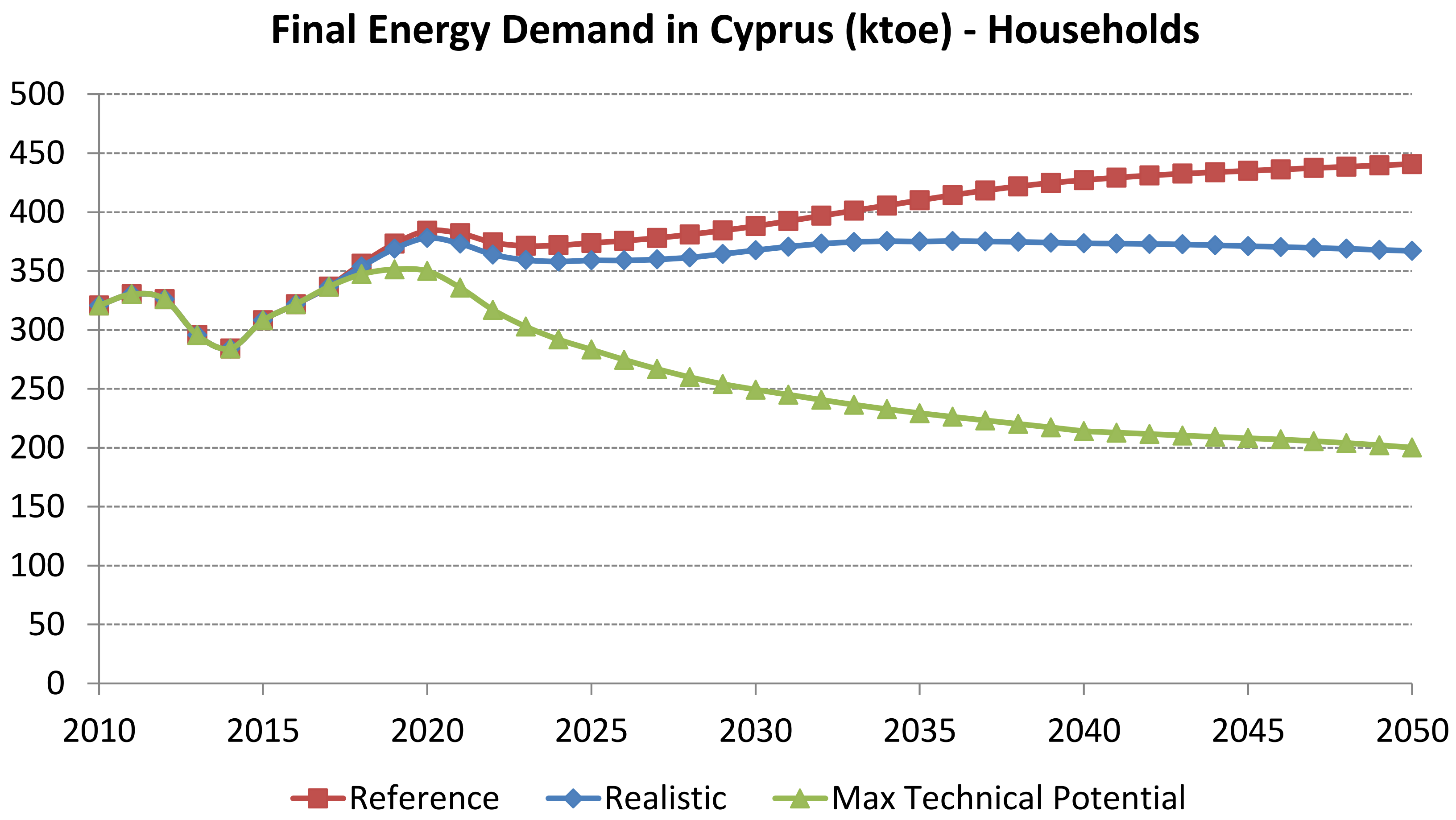
- The Reference Scenario includes all relevant policies and measures that have already been implemented or are officially planned to be adopted by the government of Cyprus in the near future, i.e implementation of:
  - Energy Labelling Directive (2010/30/EC)
  - Energy Efficiency Directive (2012/27/EU)
  - Energy Buildings Directive (2010/31/EC)
- The timeline of implementation of these measures is consistent with the plans of the national government.
- Measures not considered: Use of natural gas in power generation & end uses; Electrical interconnection of Cyprus with other countries; Construction of a LNG terminal

Alternative Scenarios

Based on the theoretical and economically viable energy efficiency potential identified in our study for each sector, two additional scenarios were developed:

- Maximum Technical Potential Scenario
  (assuming 90-95% implementation of theoretical potential up to 2040 and further improvements afterwards)
- Realistic Scenario
  (assuming achievement of economically viable potential by 2030/2040 depending on the sector, and further modest improvements afterwards)

Scenario Comparisons



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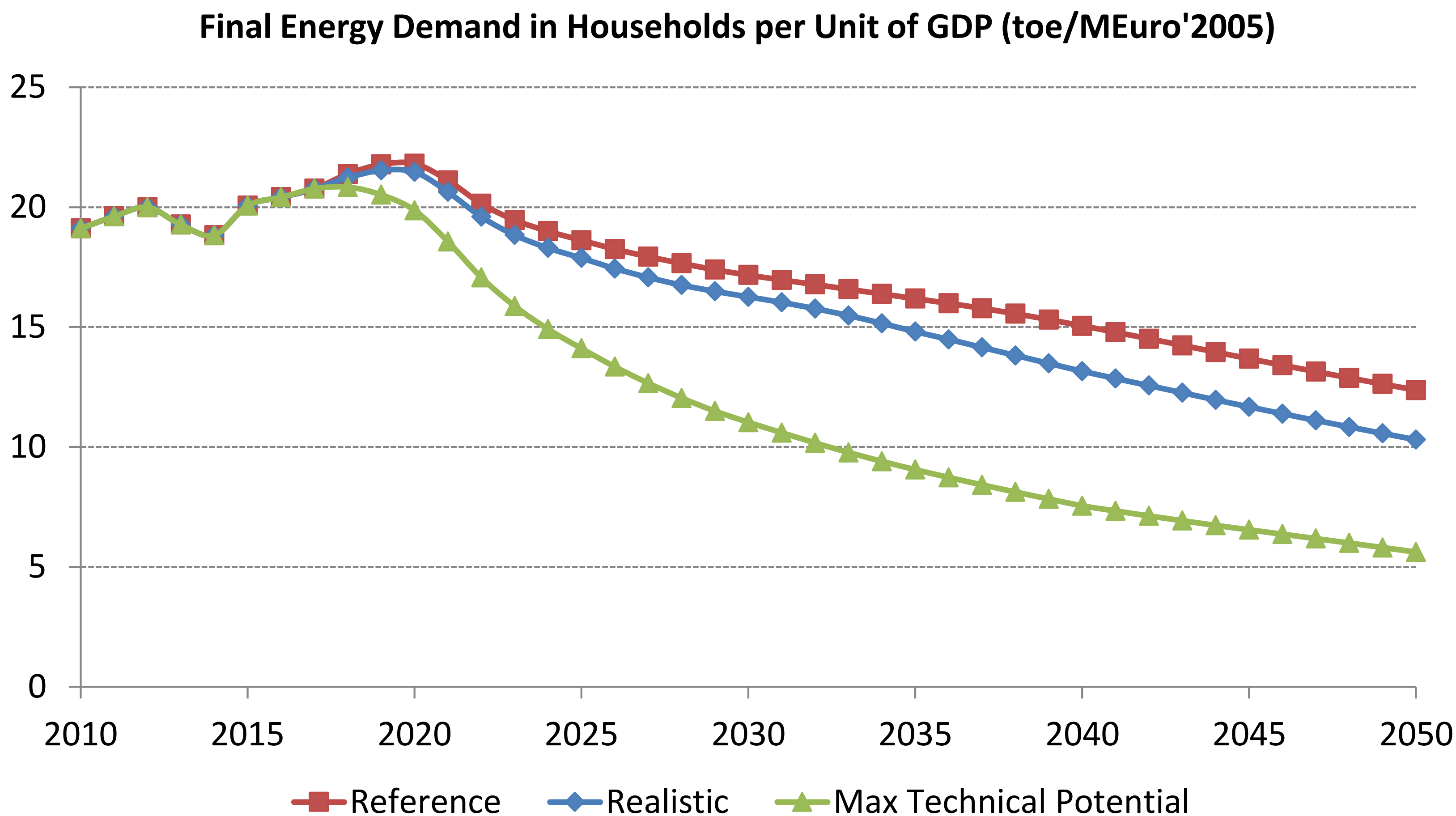

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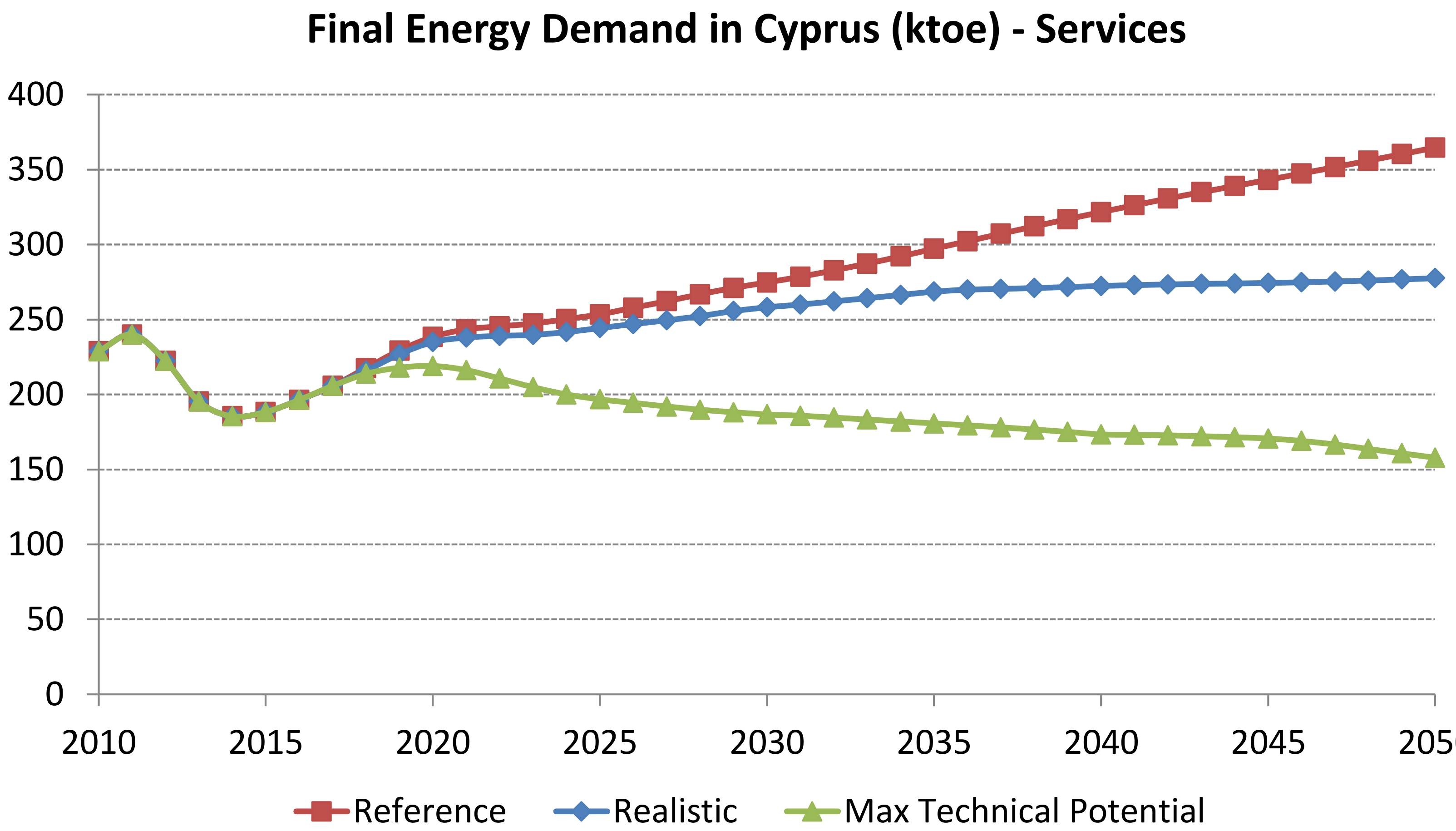

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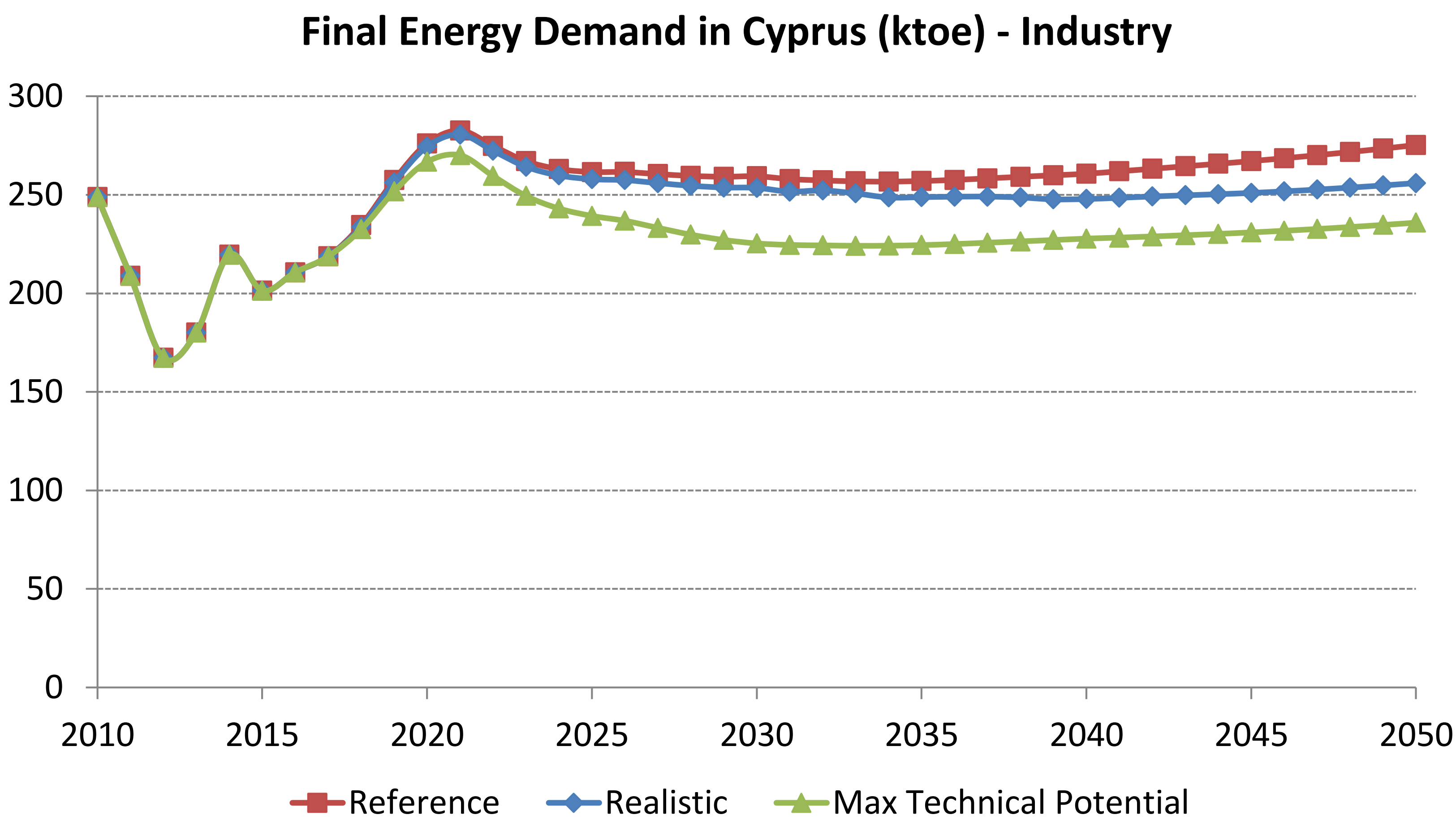

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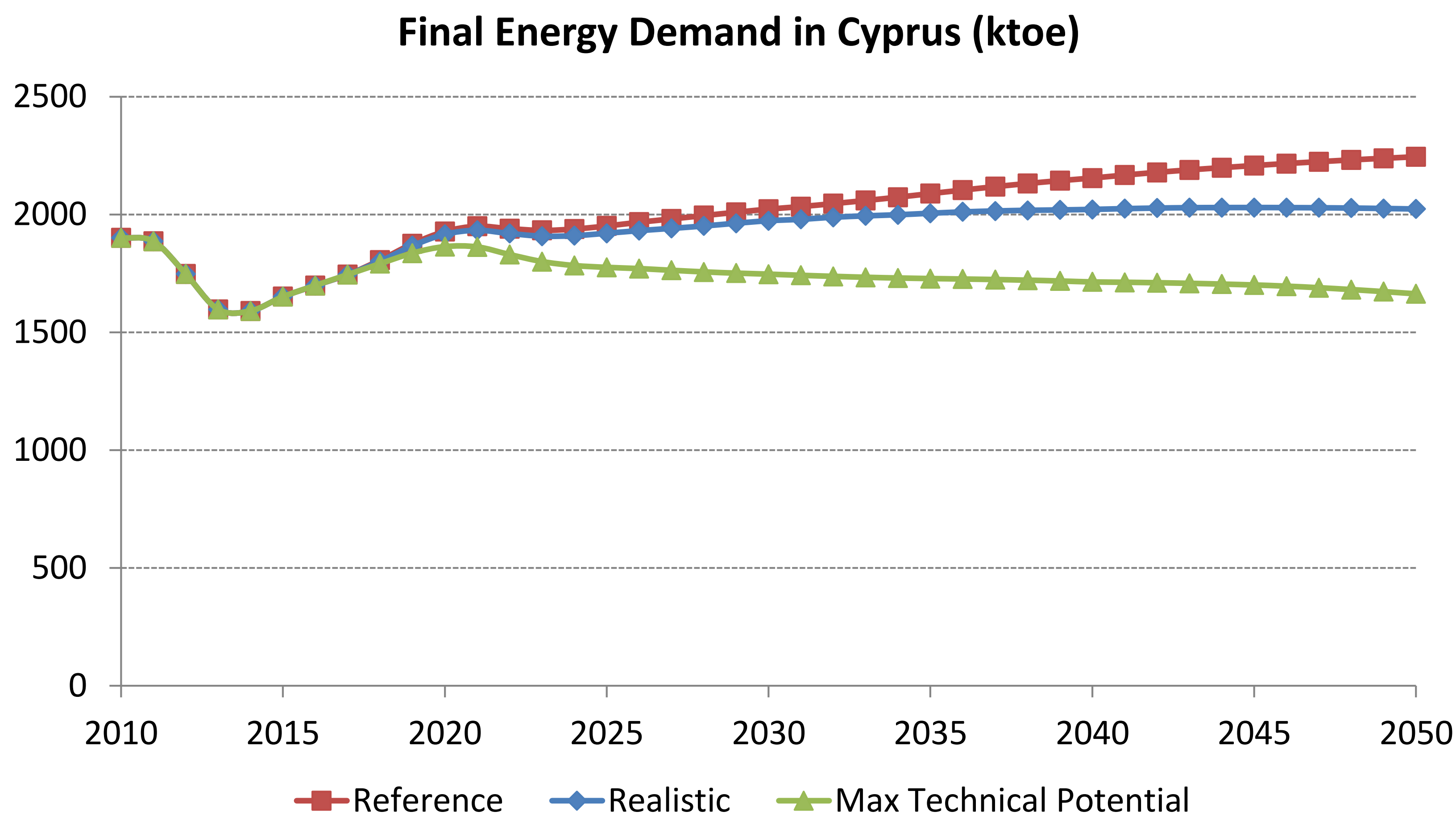

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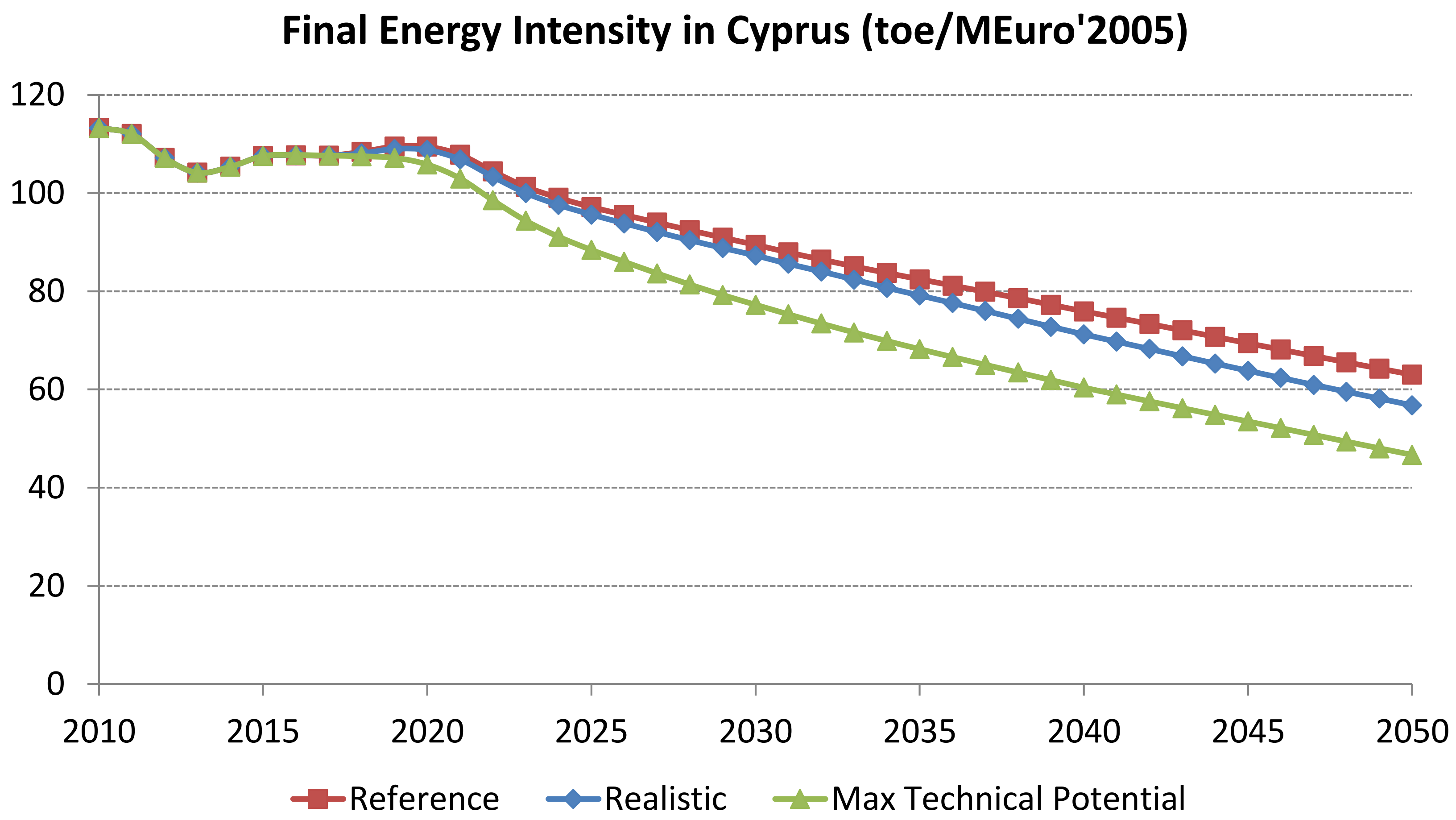

Conclusions

- Cyprus can substantially increase the energy productivity of its economy, especially in households & services
- However, the country cannot continue along a ‘business-as-usual’ path in improving the patterns of its energy system if it is to achieve the broader EU decarbonisation goals for year 2030 and beyond.
- To achieve a transition to a low-carbon economy, it is imperative to reduce the energy needs of road transport very substantially.
- Intensification of smart financial tools to enable energy efficiency investments, coupled with a green tax reform, that will gradually implement a carbon tax on non-ETS sectors and a reduction of the tax burden on labour