UGI INTERNATIONAL

LPG Is The Future

19 APRIL 2016

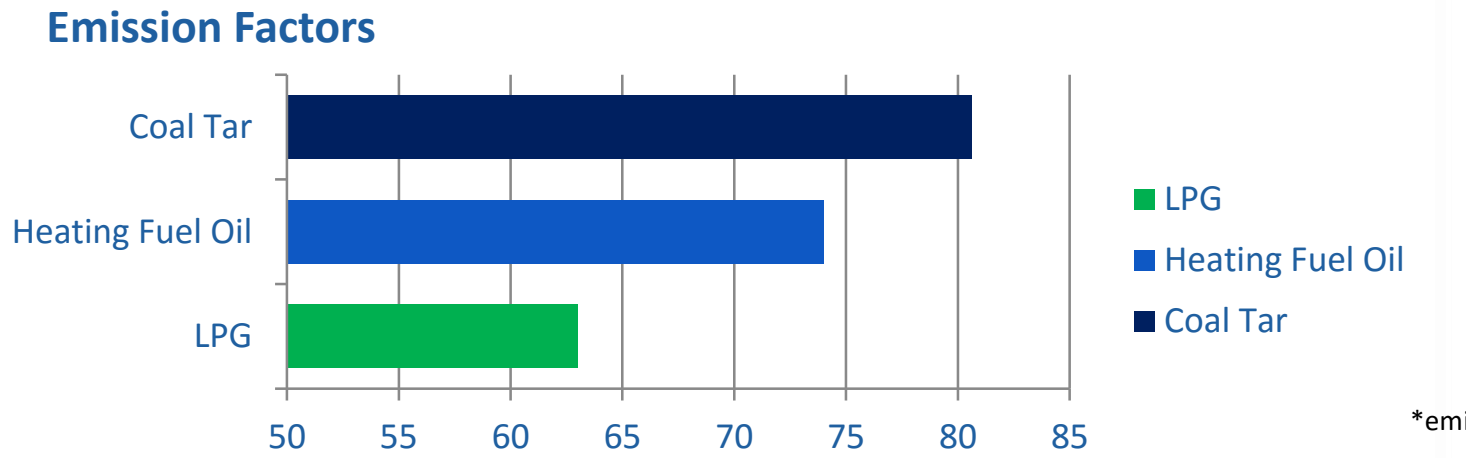
AGENDA

- LPG in a Nutshell
- A Challenging EU Energy Context
- LPG as a Sustainable Off-Grid Energy
- A Model for a More Sustainable Off-Grid Europe
- From Potential to Reality

LPG in a Nutshell

LPG

- 66% of global supply from natural gas processing (approx. 50% in Europe)
- Liquid under moderate pressure
- Hundreds of applications in the Home, Business, Farm, Transport
- Emits 49% less carbon than Coal, 17% less than Heating Oil
- Emits almost no Black Carbon (believed to be the 2nd biggest contributor to climate change)

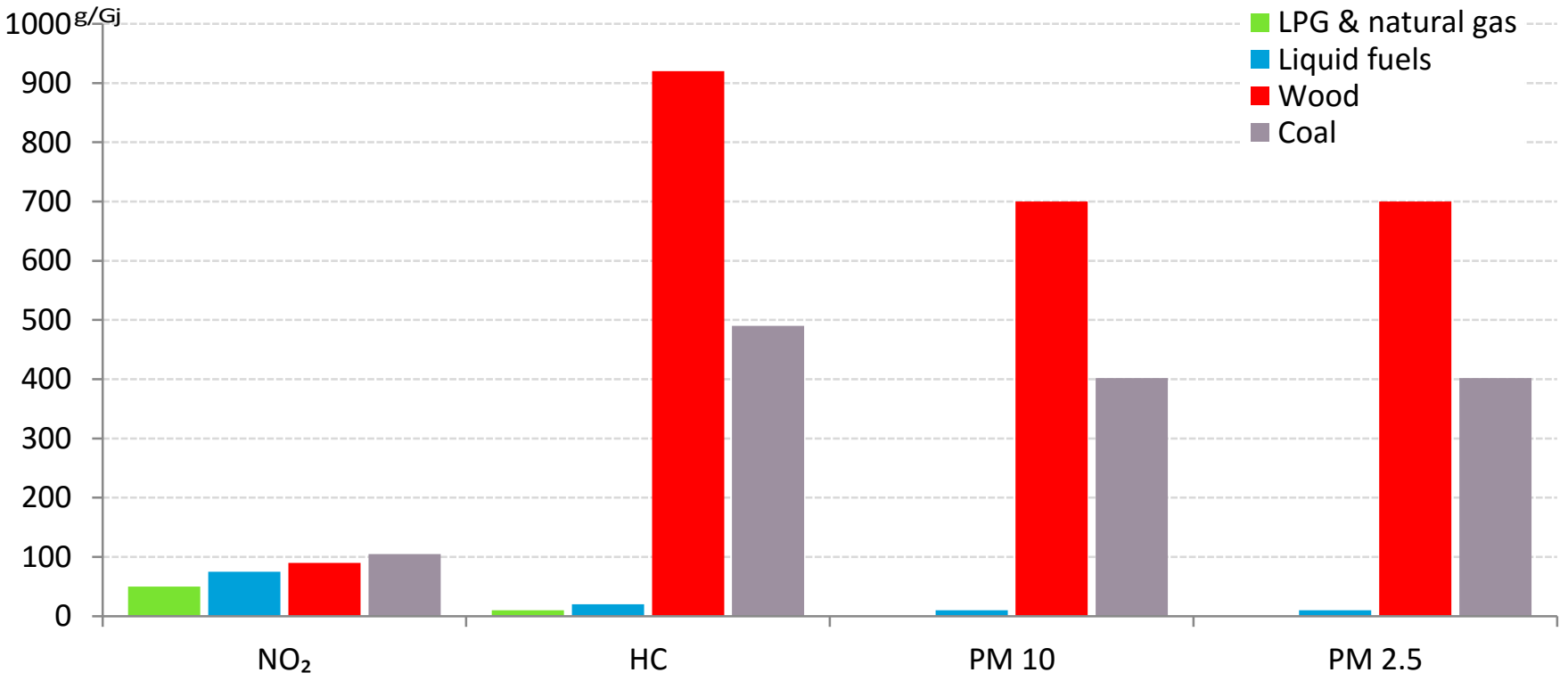


*emission factor (tCO2/TJ)

Source: United Nations Intergovernmental Palen on Climate Change

LPG in a Nutshell

LPG produces low levels of particle and NOx emissions, meaning that it does not pollute the air as much as many other energy sources.

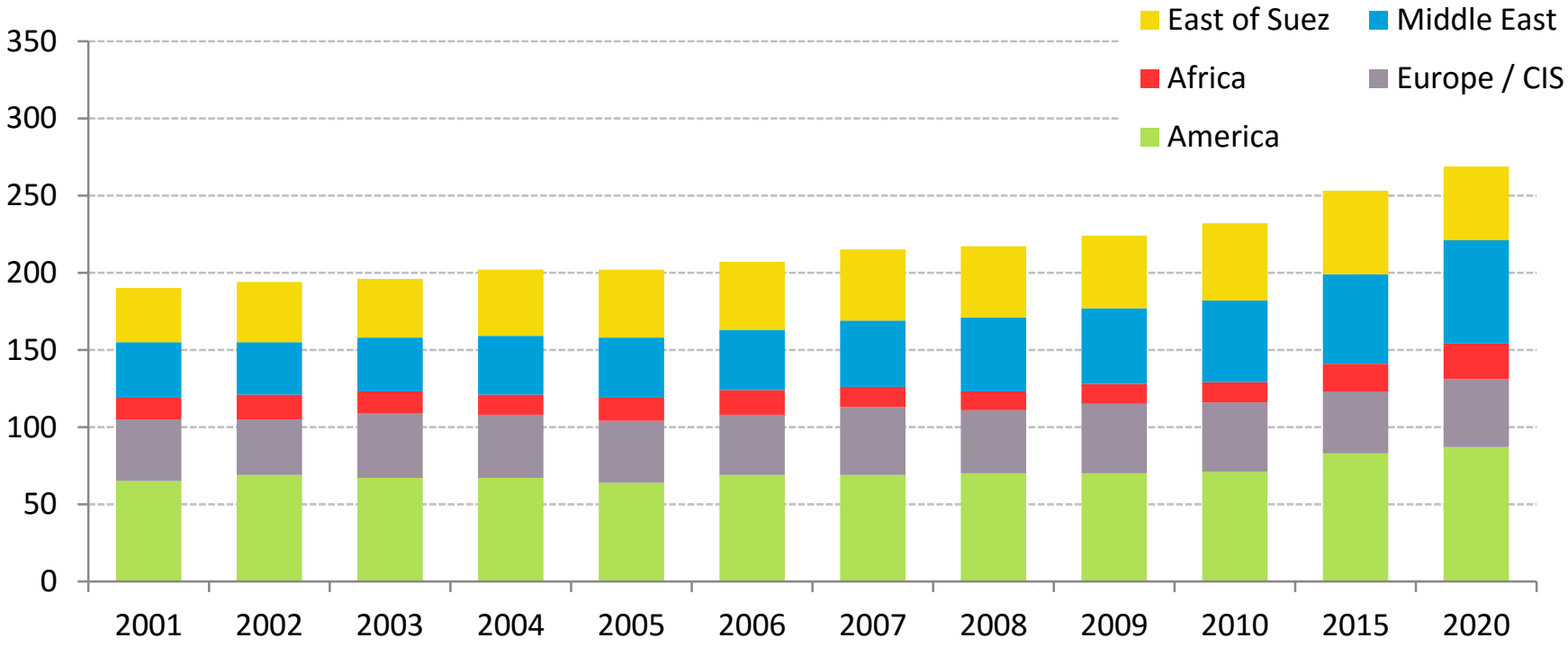


Source: LPG and Local Air Quality, A Scientific Review, Atlantic Consulting, 2009

Stationary- combustion priority pollutant emissions by fuel type

LPG in a Nutshell

Due to its diverse origins and the fact that it is easily transportable, LPG offers a secure alternative to other energy sources which are part of a grid system



Projected LPG Supply by Region (in million tons)

Source: Purvin and Gertz

A Challenging EU Energy Context

Residential Sector as a priority

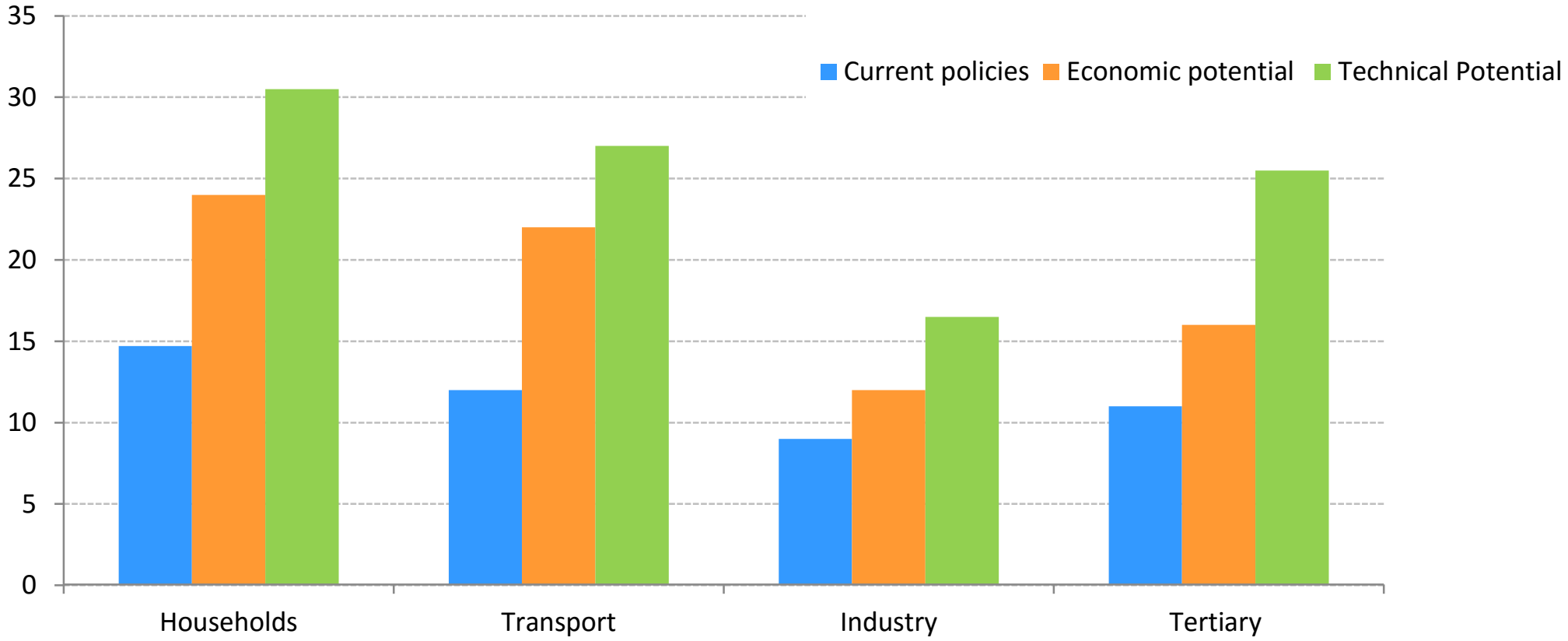
- 25% of final energy use
- Space Heating, Water Heating and Cooking represent 85% of residential energy use
- 20% renewables by 2020 (translates to 80% non-renewables)
- Typical breakdown of residential energy consumption by application

Typical breakdown of residential energy consumption by application

Source: Odyssee indicator, Build-up

A Challenging EU Energy Context

Final energy saving potential in EU 27 in 2020 (as percentage of the projections done in 2007)



Source: European Commision

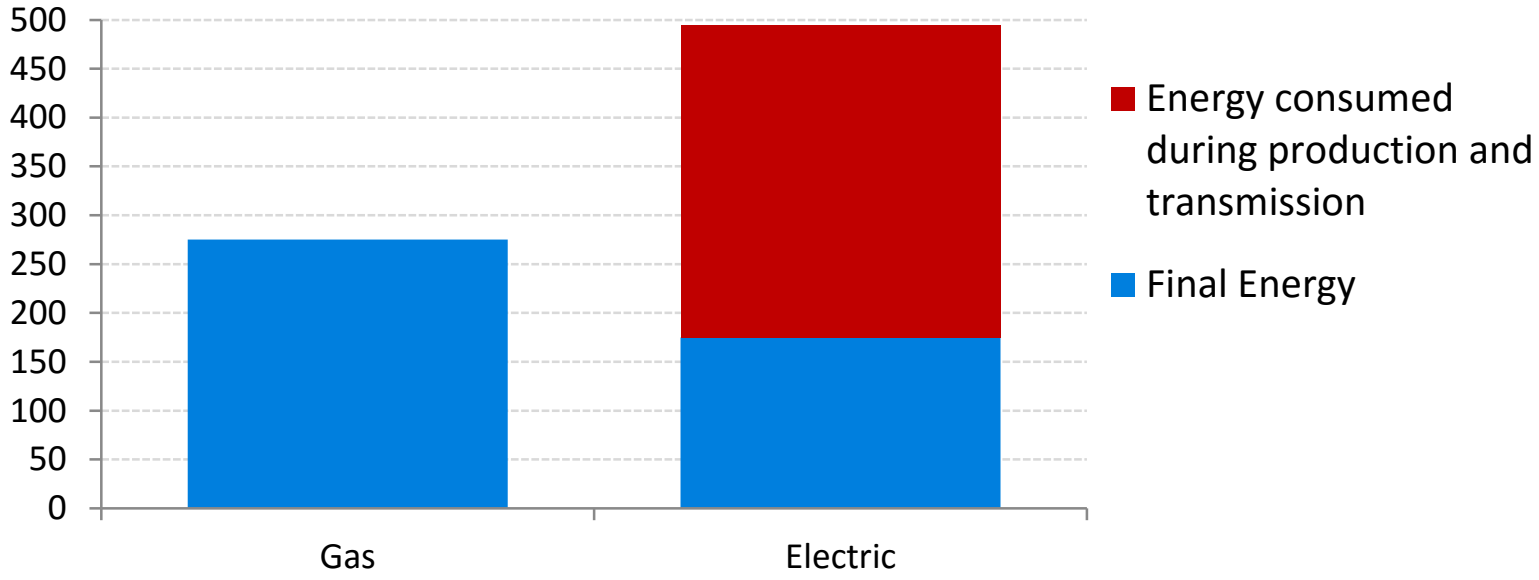
A Challenging EU Energy Context

Electricity to the rescue ?

- EU's power generation model is Carbon Intensive
- Projected declining role of coal in electricity in the EU 27 from 26 % in 2010 to 22 % in 2013
- Potential carbon capture and storage technology not yet established
- 200 billion Euros need to be invested in energy transmission network by 2020

A Challenging EU Energy Context

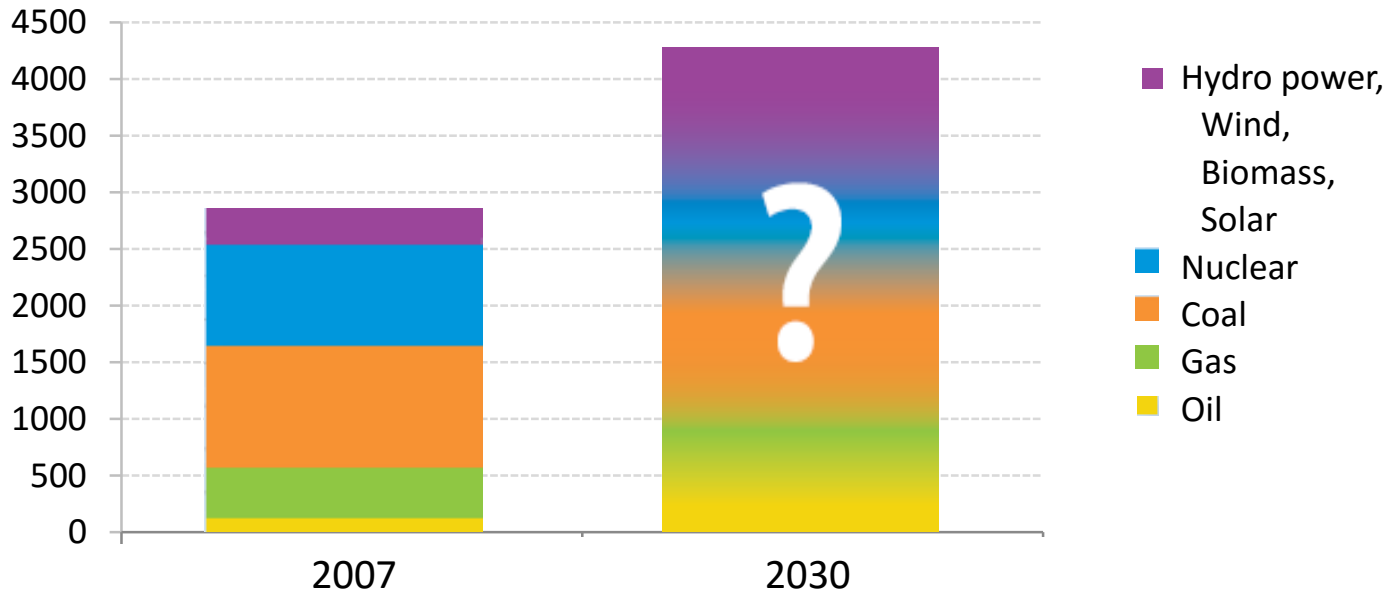
Problematic perspective of using electricity for domestic applications



Comparative energy efficiency of gas and electric stoves

A Challenging EU Energy Context

In seeking to reduce the carbon footprint of houses in OGE, it might be tempting to turn to electricity as a heating and cooking solution on the grounds that it produces no on site carbon dioxide emissions and is available more or less everywhere in Europe. Such a vision glosses over the practical reality that the EU's power generation model is still relatively carbon-intensive and will remain so through at least 2030



Expected growth in electricity generation in billion (10 9) kWh in the EU

LPG as a Sustainable Off-Grid Energy

LPG: The natural Off-Grid Alternative

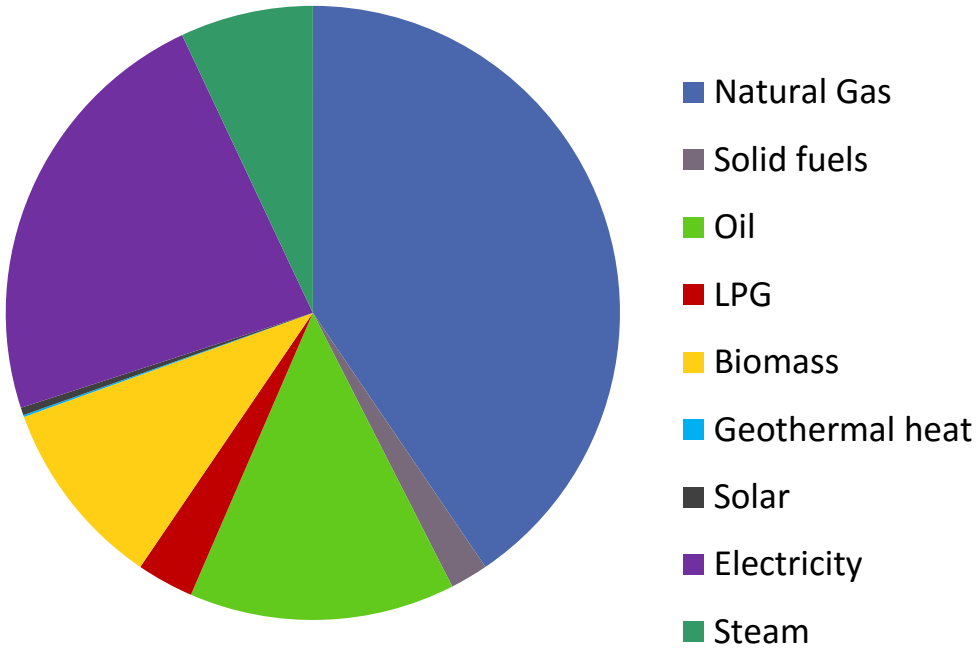
- Clean Burning
- Lower carbon gaseous fuel
- Flexible distribution network- fuel supply network has unlimited reach
- Technical advances of LPG- fueled appliances

Ideal fuel for:

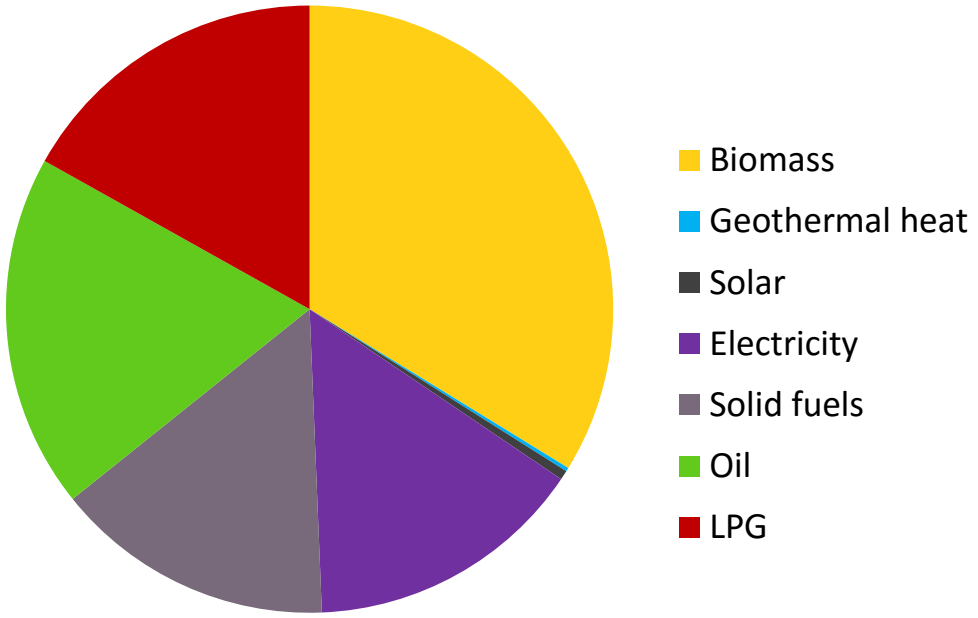
- Central heating systems
- Condensing boilers
- Hybrid systems (solar thermal combined gas)
- Instantaneous water heater
- Micro- cogeneration units

LPG as a Sustainable Off-Grid Energy

2010 EU-27 Total Residential Energy Mix



2010 EU-27 OGE Residential Energy Mix



LPG as a Sustainable Off-Grid Energy

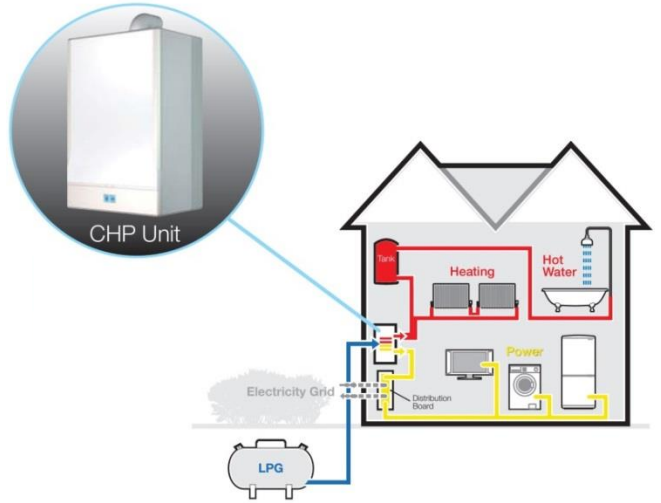
LPG and Solar Energy: An Emerging Partnership

- Clean Burning
- Up to 80% of hot water home needs produced by solar thermal systems
- The reliability of a conventional fuel with renewable energy
- LPG as a primary or complementary source- the sun does not shine every day and cannot guarantee a permanent, natural heating

LPG as a Sustainable Off-Grid Energy

Gas Heat Pumps (GHP): Warmth by Other Means

- Innovative approach- a heat pump instead of boiler
- Recovering heat from natural sources and transfers it using a refrigerant gas
- Can be switched over to work as air conditioner
- Highly efficient appliance - produce more energy than consume
- Renewable energy source under the EU's Renewable Energy Directive (2009/28/EC)
- GHP outperform EHP in cold temperatures
- Reduced ramp-up-time
- LPG supplementary burner match the energy requirements



LPG as a Sustainable Off-Grid Energy

From LPG to BIO- Propane: A Renewable Alternative

Biopropane (BioLPG) is a clean-burning, renewable fuel which can replace liquefied petroleum gas in all consumer and industrial applications.

- Fundamental change
- LPG derived exclusively from renewable sources
- Compatible with the EU's energy model
- $C0_2$ neutral fuel for the transport, industrial and residential sectors
- Reducing dependence on imported fossil resources

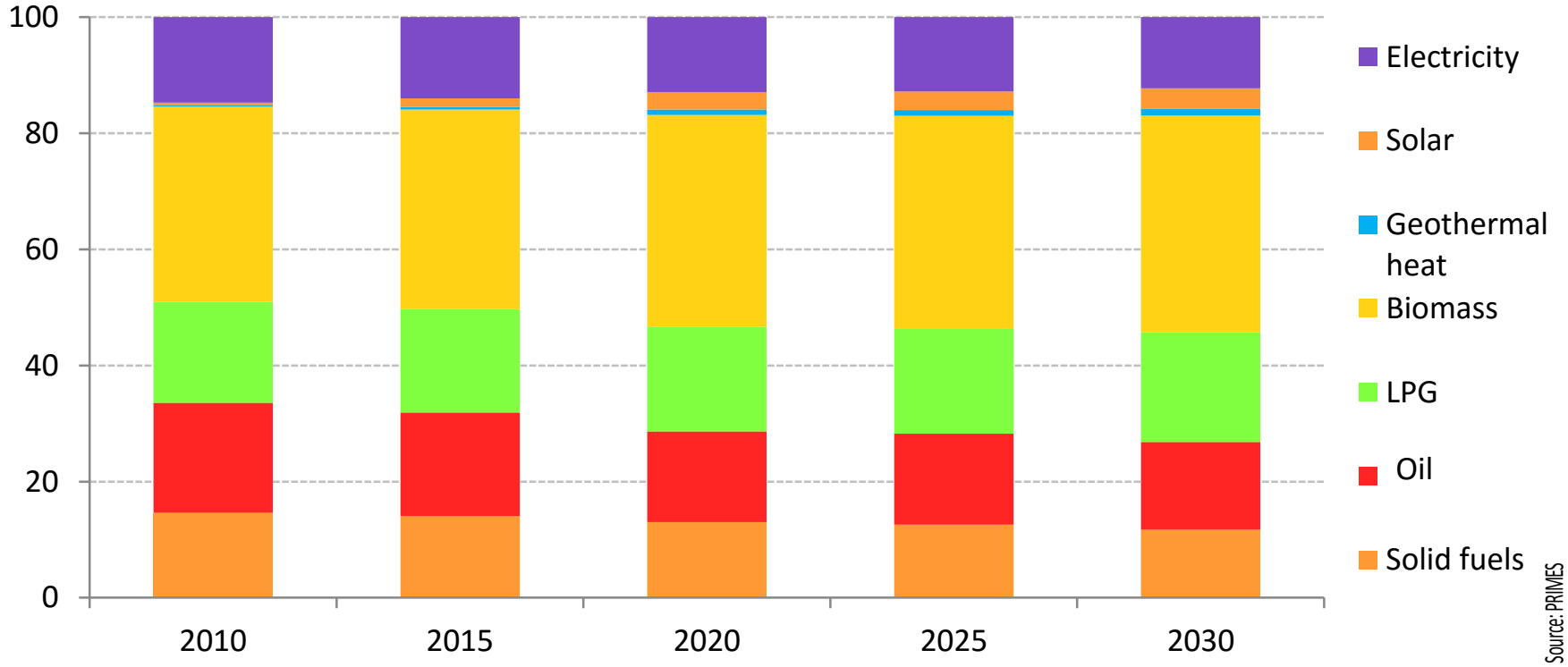
A Model for a More Sustainable Off- Grid Europe

Reducing sector of heating oil and solid fuel as a matter of priority

- Commitment of both: governments and consumers
- Better energy and using energy better
- Exploitation of an intelligent combination of gas, renewables and energy efficiency
- Intuitive vision of a more sustainable OGE energy model

A Model for a More Sustainable Off- Grid Europe

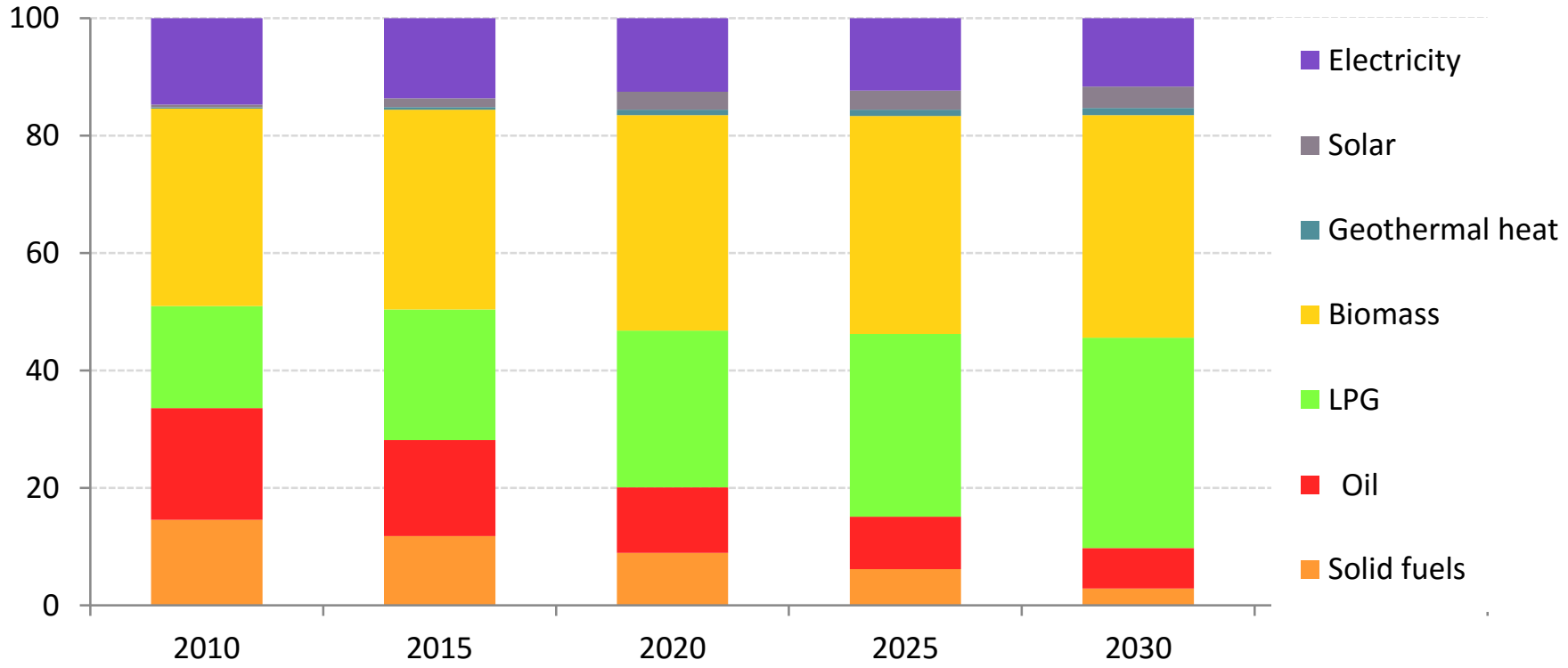
The reference case, these fuels continue to play a major role in meeting OGE's domestic energy needs through 2030



Projected Evolution of the OGE Residential Energy Mix Reference Scenario

A Model for a More Sustainable Off- Grid Europe

In the LPG scenario more sustainable picture begins to emerge. A greater role for LPG as a fuel for gas powered heating, cooking equipment, micro cogeneration and renewable-gas hybrid systems

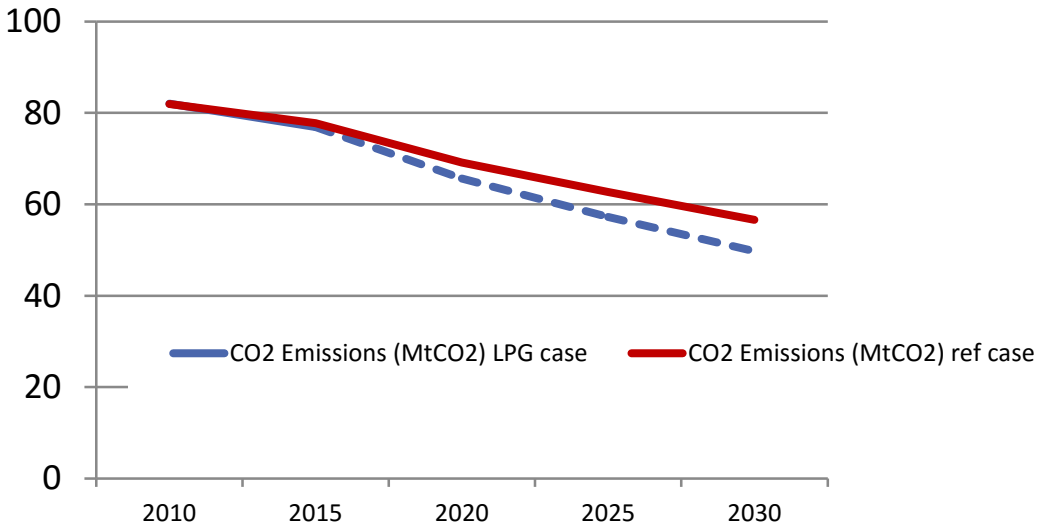


Projected Evolution of the OGE Residential Energy Mix LPG Scenario

Source: PRIMES

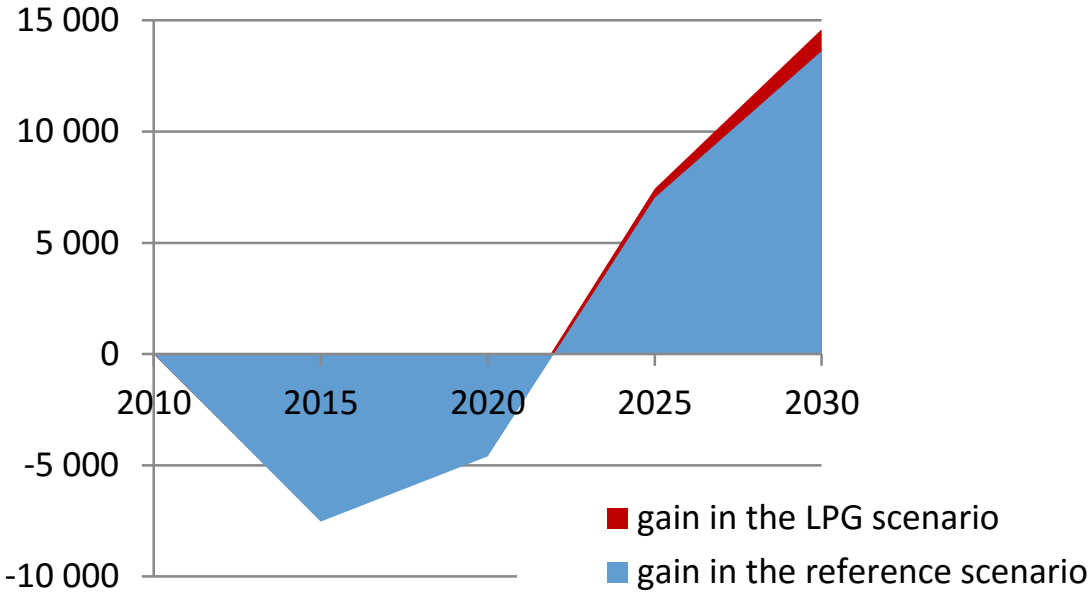
A Model for a More Sustainable Off- Grid Europe

Comparison of avoided C02 Emissions in LPG and Reference Cases



- Growth of gas from 8.8 million Toe to 14.1 million Toe within OGE leads to the removal from the energy mix of 18.5 million TOE of solid fuels and 20.9 million Toe of heating oil by 2030
- 184 million tons fewer $C0_2$ than in reference case

Anticipated Efficiency Gains for the European Residential Energy System - LPG and Reference Scenarios



Source: PRIMES

- 7% improvement in the energy efficiency over the reference case by 2030

A Model for a More Sustainable Off- Grid Europe

A booster for Renewable Energy

- Changes must start now if full potential for progress by 2030 is to be exploited
- Solar and geothermal heat sectors account 2% more than in the Reference scenario
- Appealing vision of a modern and sustainable OGE
- Win- win partnership with policy makers

From Potential to Reality

The way forward

- A steady, incremental approach on new energy model
- Renewable- based technologies will gradually erode the position of conventional alternatives
- Cleaner fossil fuels taking place of their less environmentally friendly liquid and solid counterparts
- LPG together with renewables significant role

From Potential to Reality

Commitments from the LPG Industry

- Mobilizing significant resources by European LPG industry
- Inherently close and direct contacts with customers- from suppliers to advisors
- Paired LPG-powered residential energy systems with a renewable element
- Cooperating with equipment manufacturers, installers and energy advisors
- Development of bio-propane in order to provide Europe and Europeans with a carbon neutral, domestically produced gaseous fuel

From Potential to Reality

Public Policy for a more Sustainable Residential OGE

- Promote a relation allocation of energy resources
- Avoid an all or nothing approach
- Acknowledge the existence of competing imperatives
- See the world as it will be, not as it could be
- Make energy efficiency a priority

From Potential to Reality

From Principle To Practice

Precept	Examples of Corresponding Policy Paths
Promote a rational allocation of energy resources	Diversion of heating oil/diesel from residential to transport sector
Avoid an all or nothing approach	Establish interim objectives and corresponding means in parallel to long-term emission reduction strategies
Acknowledge the existence of competing imperatives	Ensure that $C0_2$ reductions resulting from the switch to biomass are not negated by the associated black carbon emissions
See the world as it will be, not as it could be	Take a prudent approach to promoting increased reliance on electricity until there is greater certainty as regards prospects for establishing a low carbon power generation model
Make energy efficiency a priority	Continue efforts to encourage the uptake of more efficient fuels and appliances

From Potential to Reality

Concluding Remarks

- The way forward is clear
- Through an intelligent mobilisation of renewable energies, energy efficiency measures and an increased uptake of immediately available and lower carbon gaseous fuels, at the expense of liquid and solid fuel alternatives, the European residential energy system can become a considerably more sustainable proposition by 2030
- As the 'LPG Scenario' set out by the PRIMES model has demonstrated, LPG, as part of a broader strategy to increase the share of renewables and promote energy efficiency, can make a difference. Under this alternative scenario, residential Europe becomes 7% more energy efficient, emits 184 million fewer tons of C02 and sees an additional 2% share for solar and geothermal energy as compared to the Reference case
- The European LPG industry is committed to working together with policy-makers, end-users and all interested stakeholders at EU and national level to help ensure that this potential is exploited to optimal effect over the coming two decades and beyond