



Energy Efficiency interventions in EU residential sector as driver for the Green Recovery. A comparative analysis of Germany, Italy, and Spain.

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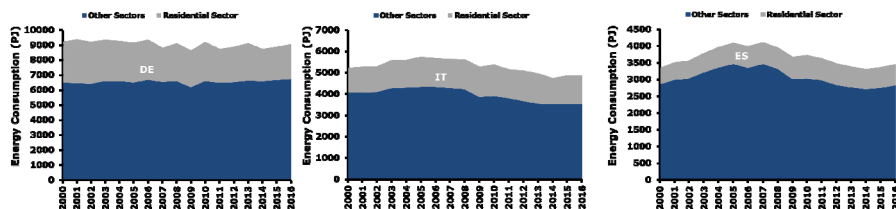
Vincenzo Bianco, Ph.D.
Professor of Energy and Thermal Sciences

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- 1** Energy Consumption Trend in DE, IT, and ES
- 2** Energy Demand Model and Forecasting
- 3** Tools for Supporting Energy Efficiency



Energy Consumption Trend in DE, IT, and ES



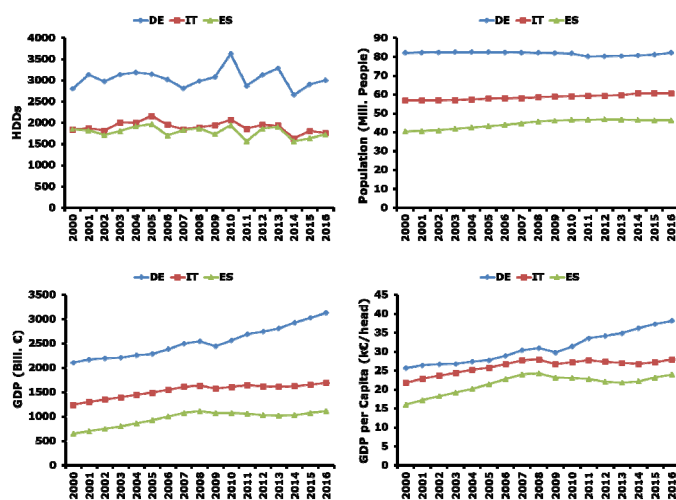
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- DE demonstrates a stable trend in the consumption pattern
- IT highlights a decrease of consumption as consequence of the economic crisis
- Es shows a reduction of consumption similar to Italy

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Trend of Relevant Macro-Variables



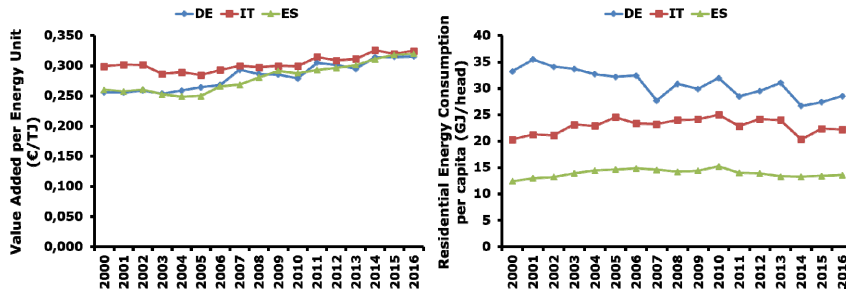
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- Similar average climatic conditions in IT and ES
- Stable trend in terms of population in all the countries
- Relevant growth of GDP in Germany with respect to the other countries

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Energy Consumption Indicators



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- Similar value added per energy unit in all the countries
- Decreasing trend of energy consumption per capita in DE

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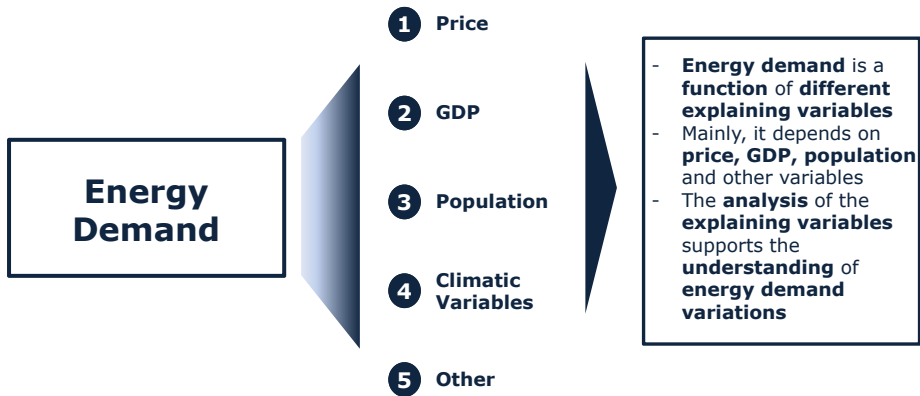
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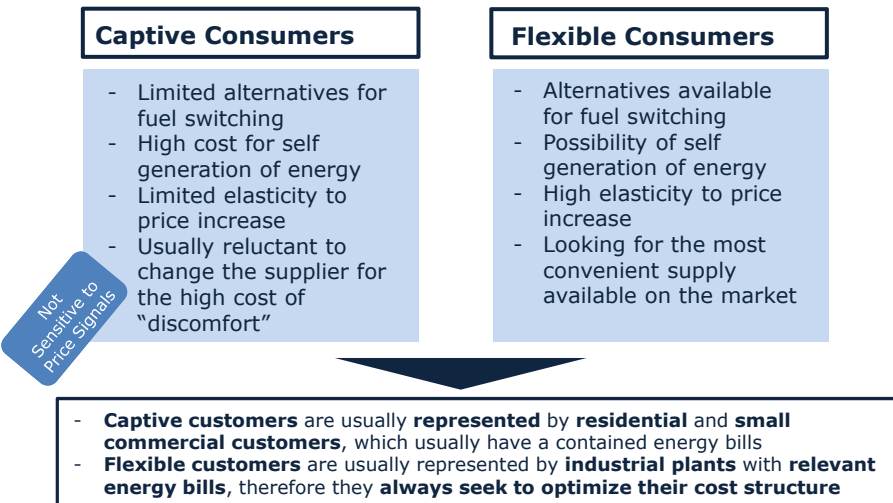
Top-Down Model for Energy Demand Estimation



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Captive vs. Flexible Consumers



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Mathematical Description

Mathematical Formulation of the Demand Equation

$$ED = \alpha \text{GDP_PC}^\beta \cdot \text{HDD}^\gamma \text{ED} (-1)^\omega$$

Logarithmic Form of the Demand Equation

$$\log(ED) = a + b \log(\text{GDP_PC}) + c \cdot \log(\text{HDD}) + d \log[ED(-1)],$$

Long Run Elasticity of Energy Demand with Respect to GDP

$$\text{LE_GDP_PC} = b/(1-d)$$

Long Run Elasticity of Energy Demand with Respect to HDDs

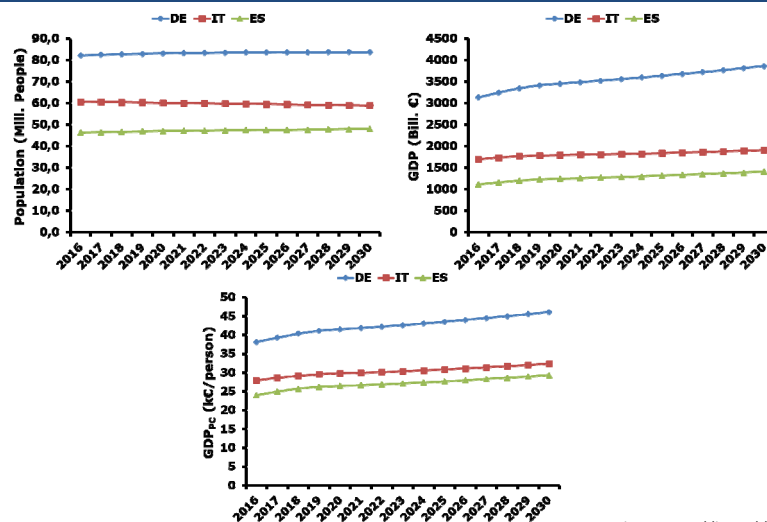
$$\text{LE_HDD} = c/(1-d)$$

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Evolution of the Explaining Variables

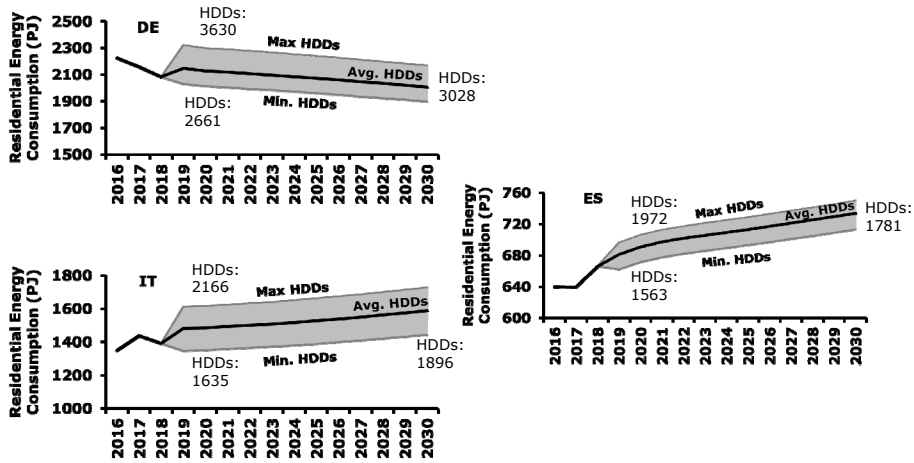


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Expected Energy Outlook



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Selection of Financing Mechanisms for Supporting Energy Efficiency

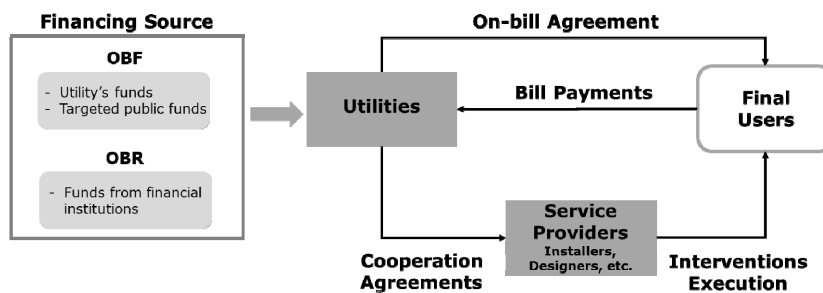
Model	Source of financing	Provider	Technical risk	Financial risk	Default risk
OBF	Utility equity/ targeted public funds	Utility	Final user	Utility	Utility
OBR	Financial institutions	Utility	Final user	Financial institutions	Utility/ financial institutions
EPC	Loan/ owner's equity	ESCO	ESCO	Final user	Financial institutions
ESA	Financial institutions	Developer (e.g. ESCO or others)	ESCO	SPV	Financial institutions
MESA	Financial institutions	Developer (e.g. ESCO or others)	ESCO	SPV	Financial institutions
PACE	Financial institutions	Public administration	Building owner	Public administration	Financial institutions

Source: RenOnBill Project, www.renonbill.eu

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On-Bill Schemes

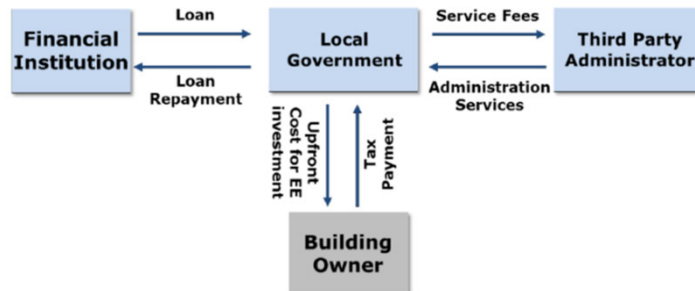


Source: Energy Reports 7 (2021) 4298-4307

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PACE Scheme



Source: RenOnBill Project, www.renonbill.eu

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Conclusions

- Residential sector is pivotal for driving energy transition
- DE seems to highlight a decoupling between energy demand and GDP, thus a "new deal" seems in progress
- The implementation of energy efficiency measures can be a stimulus to support the "Green Recovery"
- Part of the EU sources can be used to support and develop innovative energy efficiency financing approach for the residential sector

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Thank You for Your Attention !!!

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