THE FISCAL INCIDENCE OF RENEWABLE ENERGY IN THE EU

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RENEWABLE ENERGY CHALLENGES

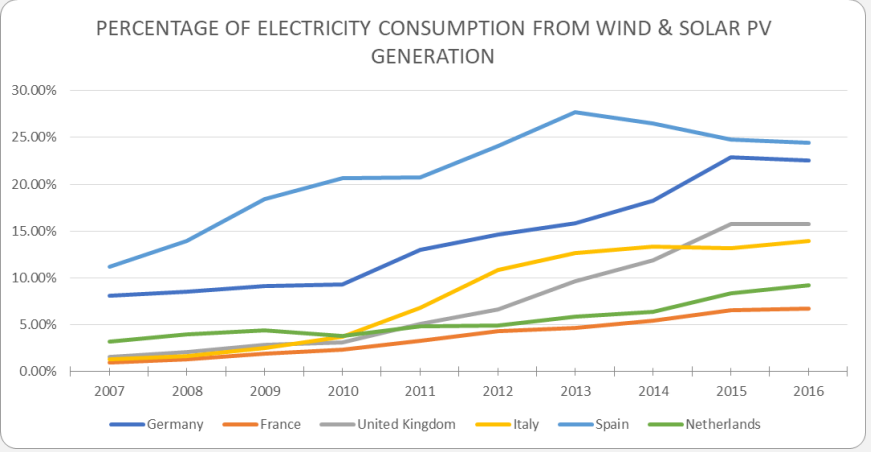
- In liberalised power markets, electricity generated by Solar PV and Wind Turbines because of its high cost on a Levelized Basis requires support to induce private investment.
- Compared to conventional dispatchable fossil fuel or nuclear, RE generation produces far less electricity (Solar PV 18%, On Shore Wind 25%, Off-Shore Wind 33%).
- Rewarding RE investment is problematic because there are insufficient hours to generate adequate returns; hence subsidies or support is needed.

SUPPORTING RE

- Various incentives are used to support RE including incentive tariffs, price premiums, tax credits and allowances.
- RE is also given *dispatch priority* requiring conventional plants to reduce output whenever the sun shines or wind blows.
- Dispatch priority creates balancing costs for both the Grid and Fossil Fuel plants
- The distributed nature of RE generation requires additional investment in connections and transmission.
- In some markets, dispatchable plants are given capacity payments to be available for both peak demand and if and when RE does not generate.
- Across support schemes, we see in general a transference of risk from private investors to third parties.

CROSS EU ELECTRICITY PRICE COMPARISONS

- The price of electricity comprises both fixed and variable cost components although for Renewables it is almost entirely the former.
- The fixed and variable cost component of electricity prices vary greatly across the EU.
- Such differences in how electricity costs are met have distributional effects.



RE SUPPORT & EXPENDITURE

The issue of how we pay for supporting RE would not matter *if* the amounts involved were small but they are not.

- Since 2007, we have seen a large increase in the percent contribution made by RE to electricity consumption.

EU 28 + NORWAY ESTIMATED ADDITIONAL EXPENDITURE ON RE 2016 (Assuming a Wholesale Fossil Fuel Generation Price of €45.00 and a Weighted Average Price of Solar PV (4%) and Wind (11%) of €172.77

Electricity Consumption by Sectors 2016 (MWh)		Green Energy Contribution 15% (MWh)	Additional Expenditure on Wind and Solar RE (Euros, Billions)
Industry	1,013,148,000	151,927,200	€26.26 bn
Transport	63,828,000	9,574,200	€1.65 bn
Households	1,707,301,000	256,095,150	€44.25 bn

RE EXPENDITURE

- Although EU Feed-in-Tariffs have been reduced for *new* investment, efforts by various governments to apply the revised tariff retrospectively have been largely unsuccessful.
- To the extent that Industry, Business and Transport do not absorb the cost of supporting RE, an additional € 28 billion in costs on top of the €44 already faced by retail consumers must be met directly through the pricing structure or indirectly through burden shifting.
- The magnitude of RE support across the EU, raises the question of whether retail consumers, households within a given country are treated equally

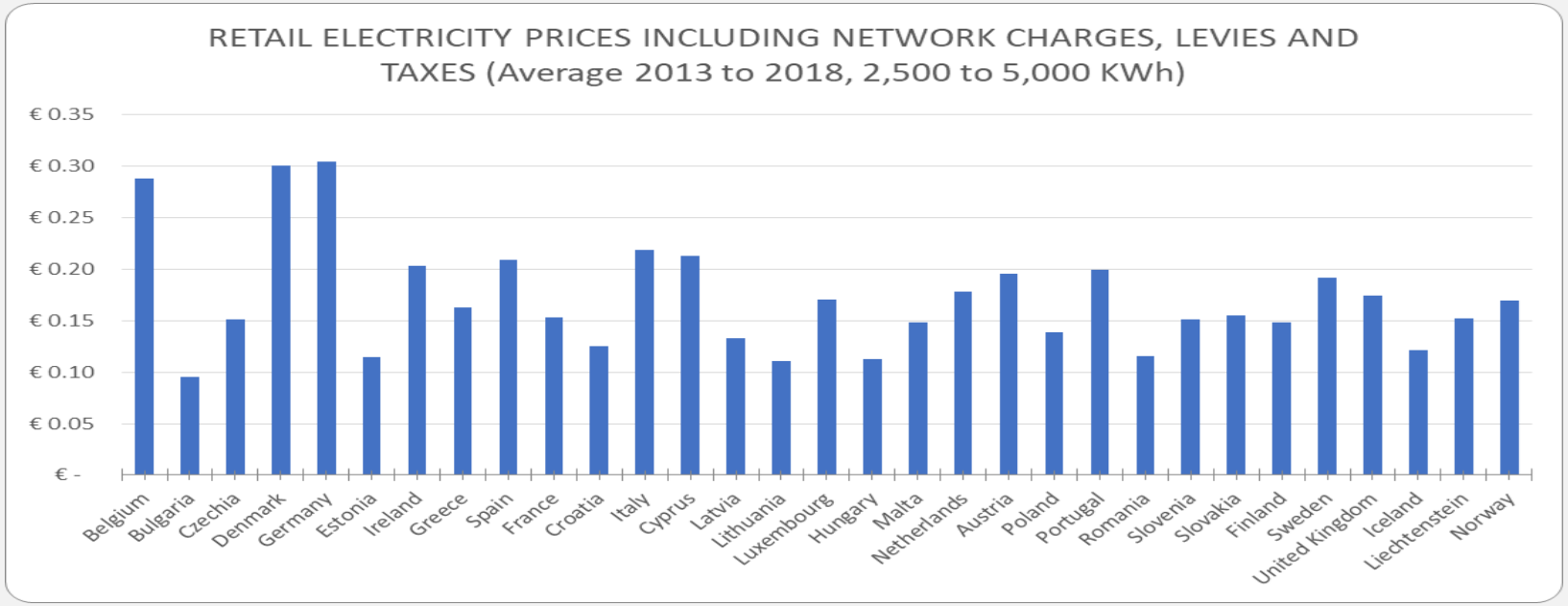
ELECTRICITY PRICING: COMPONENTS

- Wholesale costs refer to how much a supplier must pay for electricity to supply the retail customer. Such electricity may be priced through a contract with a generator.
- Network charges concern the wires for transmission and distribution carrying electricity to homes and businesses.
- Taxes and Levies involve all manner of social initiatives: Environmental and Social costs for such objectives as a saving energy, reducing emissions and encouraging the use of renewable energy.
- In the UK, we see that network charges plus taxes and levies now represent nearly 43% and exceed the wholesale energy cost component.

COMPONENTS OF RETAIL ELECTRICITY PRICES UK 2016 (Source: Ofgem.gov.uk)	
Wholesale costs	33.52%
Network costs	25.46%
Environmental and social obligation costs	17.45%
Other direct costs	1.26%
Operating costs	17.15%
Supplier pre-tax margin	0.40%
VAT	4.76%

ELECTRICITY PRICES ACROSS THE EU

Notwithstanding common grid codes and integration through connectors, at country level electricity prices paid by households vary greatly because of different tariff structures and the respective contributions from network charges, taxes and levies.



AVERAGE EU RETAIL (HOUSEHOLD) ELECTRICITY PRICES (EUROS/KWH)

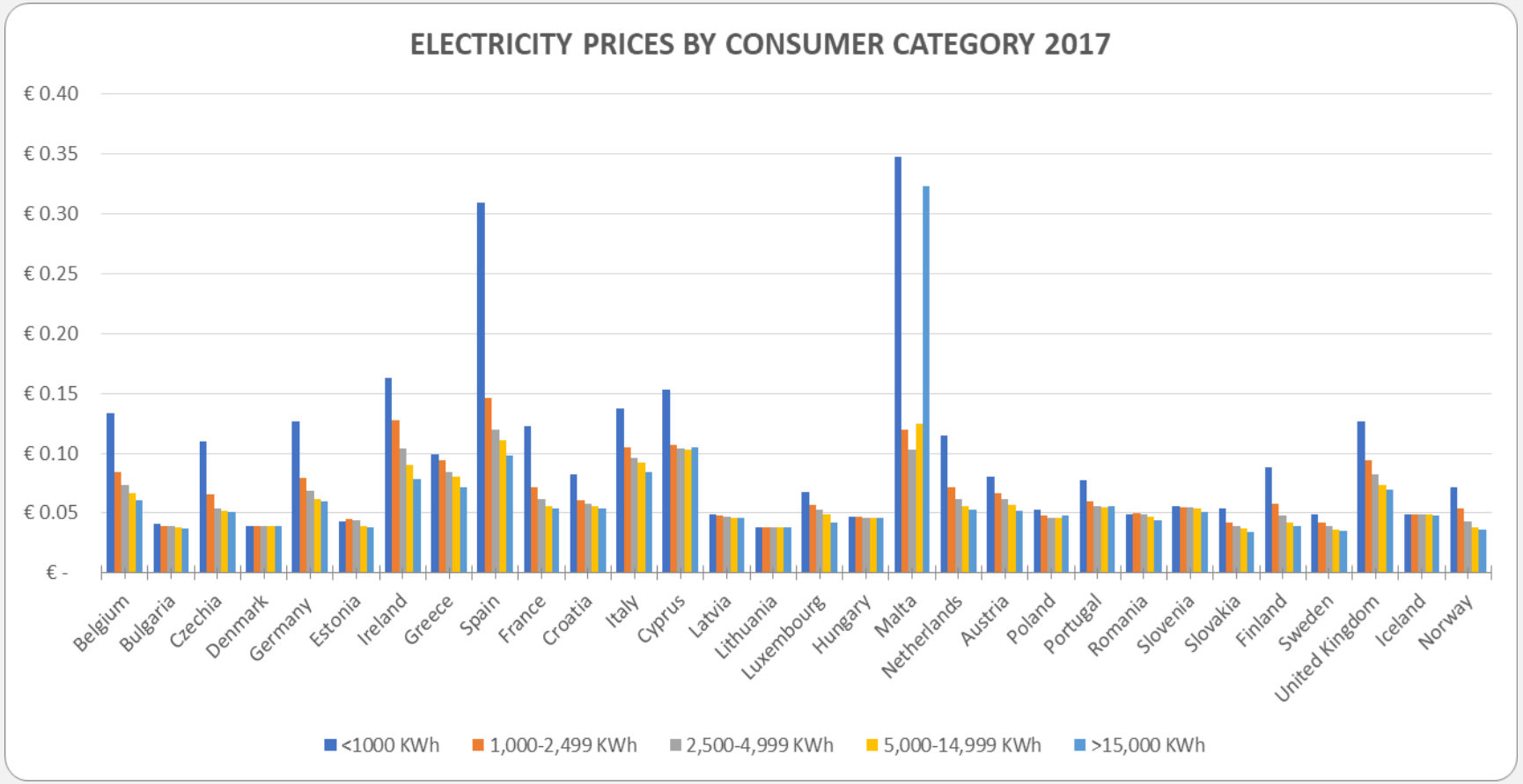
Even if Levies and Taxes are excluded from our calculations, we still observe large differences as shown in the table below:

AVERAGE EU RETAIL ELECTRICITY PRICES EUORS/KWh		
Retail Prices and Levies w/o Taxes & Levies	Electricity Prices excluding Taxes & Levies	Electricity Prices including Taxes & Levies
Minimum	€0.08	€0.09
Maximum	€0.19	€0.30
Average	€0.12	€0.15
Percent Difference Minimum to Maximum	92%	119%

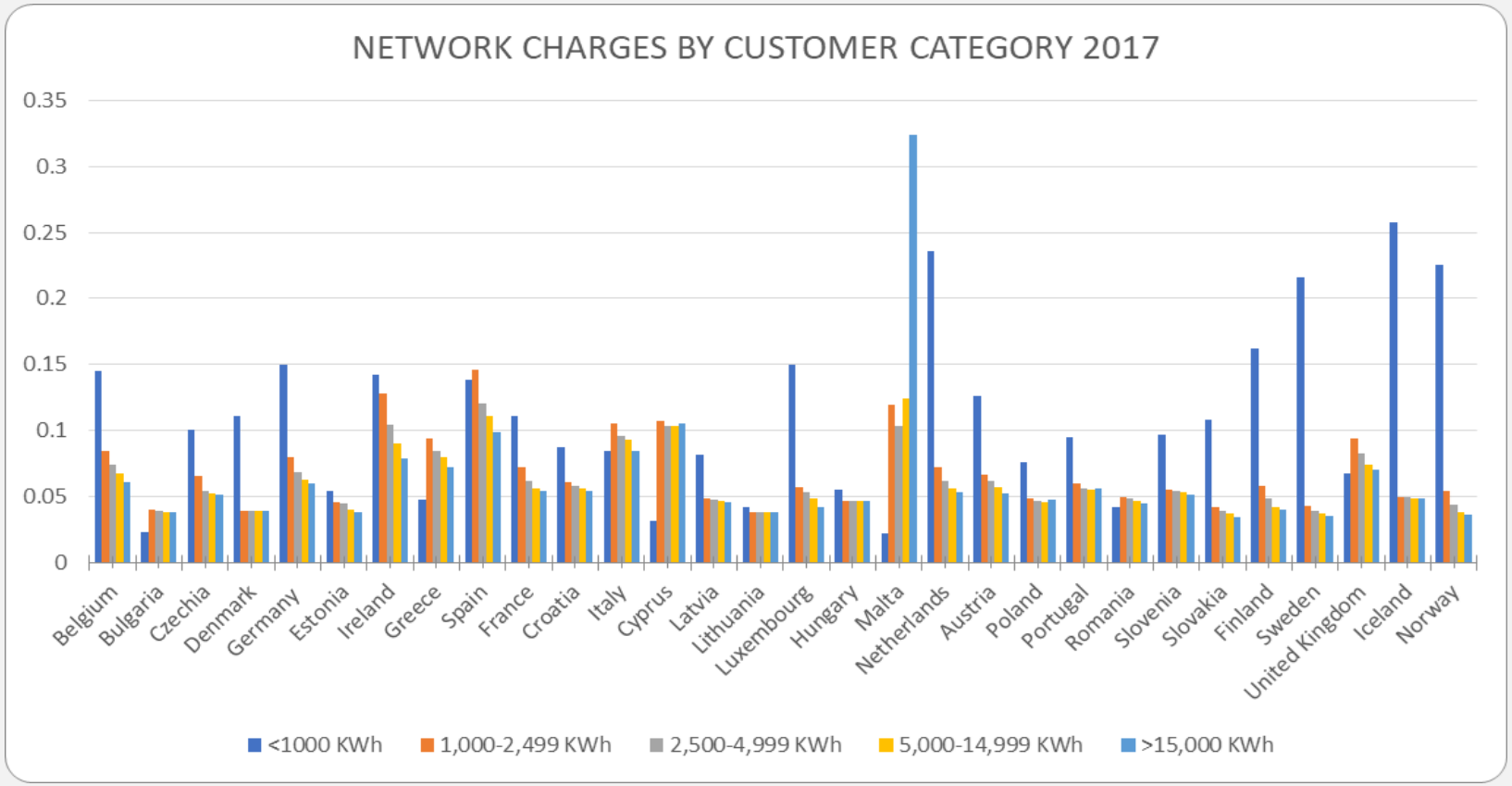
PRICING OF ELECTRICITY BY HOUSEHOLD SIZE

Annual Household Electricity Consumption (KWh) (Eurostat Categories)		
Household Consumption Levels	Minimum	Maximum
First	0	1,000
Second	1,000	2,499
Third	2,500	4,999
Fourth	5,000	14,999
Fifth	15,000	

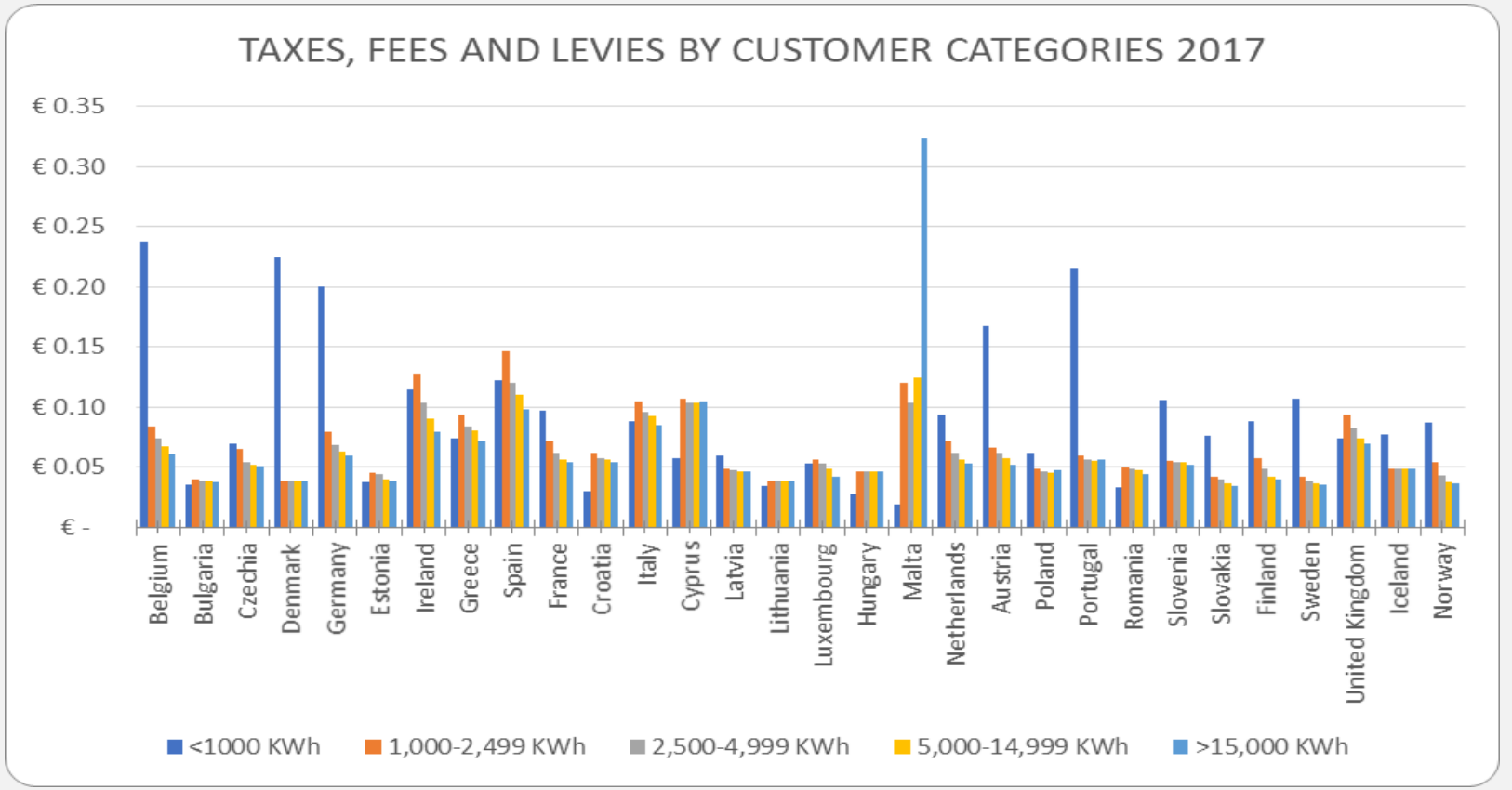
THE MORE ONE TAKES THE LESS ONE PAYS



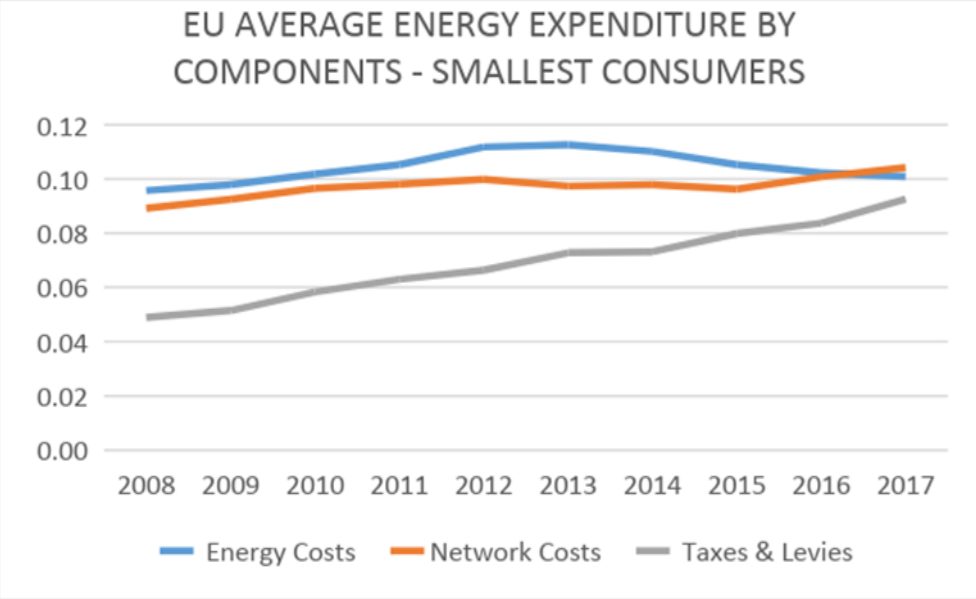
NETWORK CHARGES BY CONSUMER CATEGORY, 2017

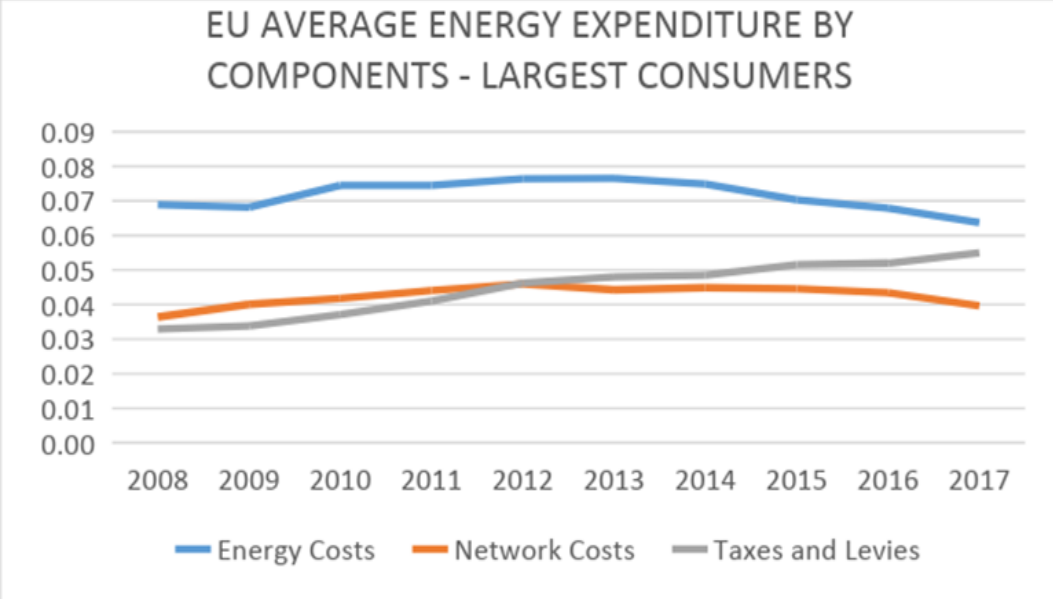


TAXES, FEES AND LEVIES BY CONSUMER CATEGORIES, 2017

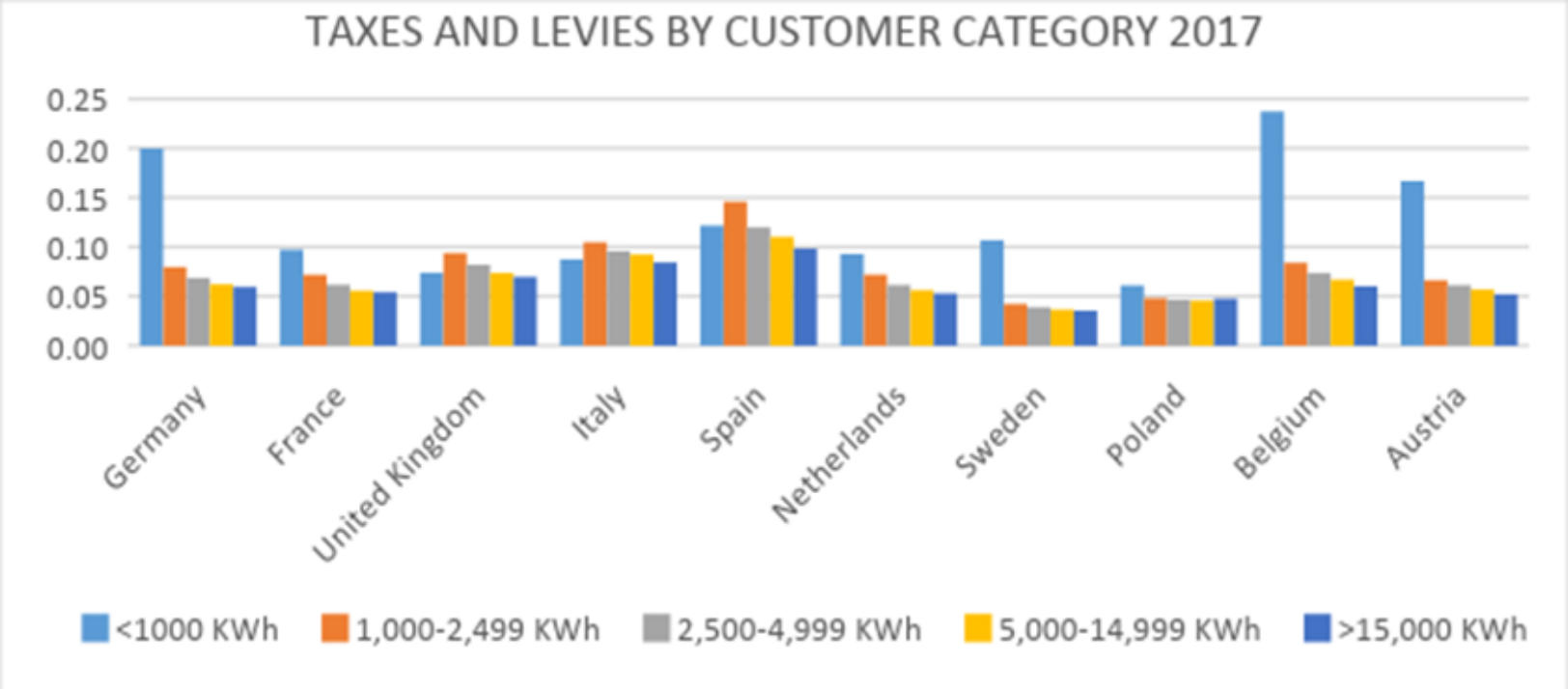


RETAIL ELECTRICITY PRICES HAVE INCREASED MOST FOR THE SMALLEST CONSUMERS

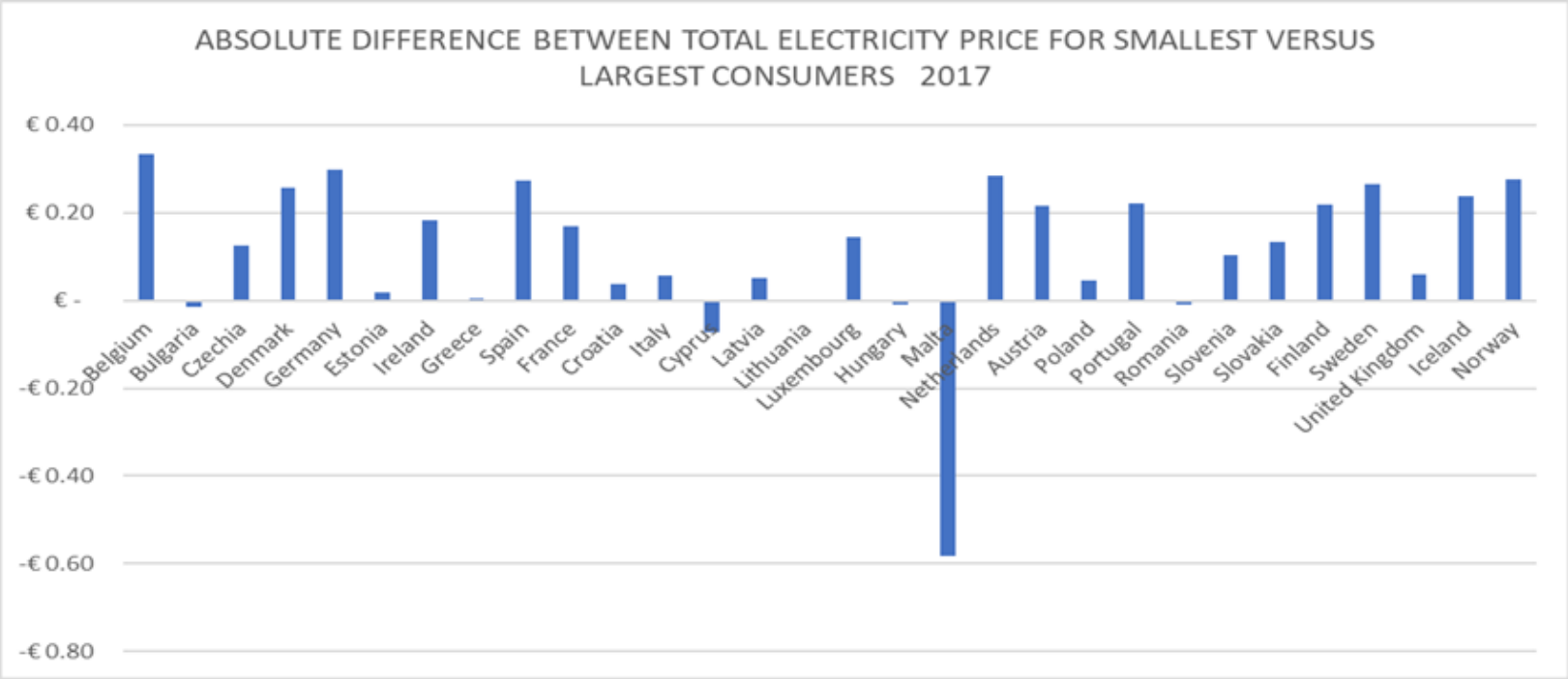




SMALLEST HOUSEHOLDS PAY THE MOST FOR TAXES AND LEVIES



REGRESSIVE PRICING ACROSS THE EU



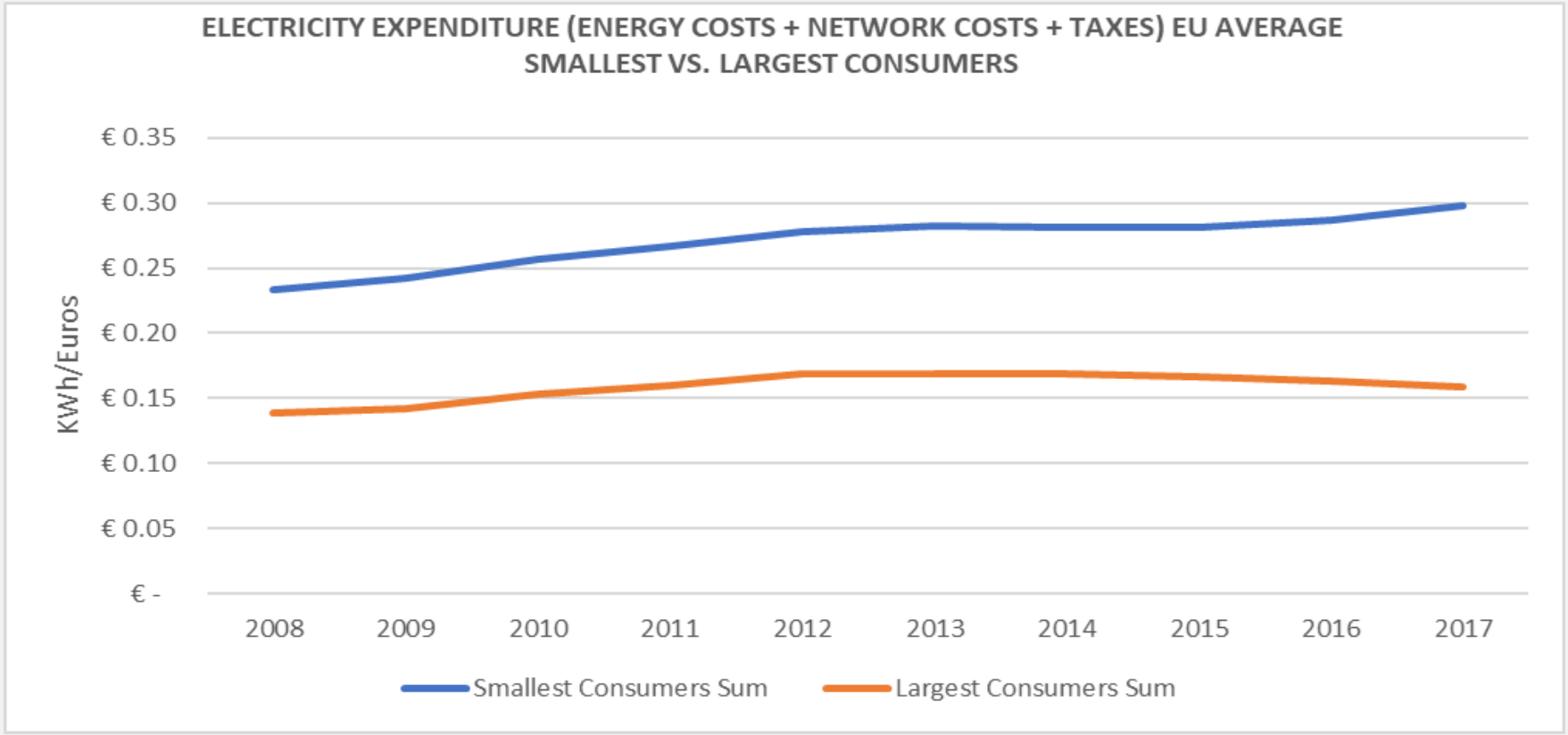
Belgium leads in regressiveness with the largest absolute difference of 34 pence between what the smallest versus largest consumers pay.

EU WIDE REGRESSIVENESS STATISTICS

EU + NORWAY COMPARISONS OF ENERGY PRICE COMPONENTS SMALLEST VS. LARGEST CONSUMERS PERCENT DIFFERENCE 2017			
	Energy Costs	Network charges	Taxes
Maximum	115%	203%	166%
Average	42%	84%	49%
Minimum	0%	-2%	-10%

Retail Electricity Pricing Structure (Source: Eurostat, 2018)

REGRESSIVENESS HAS GROWN OVER TIME



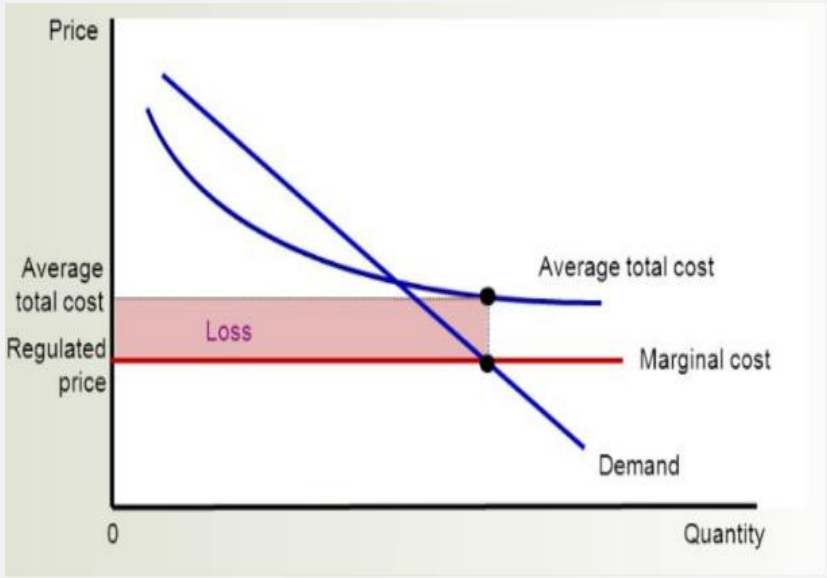
BIGGER HOMES, BIGGER CONSUMPTION BIGGER INCOME

- Data on electricity consumption by socio-demographic statistics is not available for all countries of the EU.
- EU collects retail electricity prices according to five annual household consumption levels, as we have shown.
- For Germany there are some household surveys; in the UK electricity consumption is collected by size of dwelling and other parameters, age and number of occupants.
- We have used the size of dwelling as a proxy for income arguing that the lager one's home, the greater one's income.
- For the UK, the average household consumers 71 KWh per annum per square meter.
- Smaller homes tend to use electricity for space heating and have less cavity insulation.
- In continental Europe, 79% of residential energy consumption is for space and water heating of which 36% comes from burning natural gas (Eurostat, 2018).
- In Germany the encouragement of heat-pumps in homes has led top greater electricity consumption.

HOUSEHOLD WEALTH (Quintiles)	OWN WITH MORTGAGE	OWN OUTRIGHT	RENT
1 (Least Wealthy)	7.80%	0.20%	92.00%
2	43.20%	11.40%	45.40%
3	50.40%	38.00%	11.60%
4	44.60%	49.80%	5.60%
5 (Most Wealthy)	40.40%	56.40%	3.20%

Home Ownership and Financing (Source: UK ONS)

REGRESSIVE PRICING AND RENEWABLE ENERGY RELIANCE



- As a natural monopoly, electricity generation presents a problem: To correct the inefficiency of a natural monopolist, prices may be set through regulation at marginal costs making customer expenditure a linear function of price and quantity but this leads to a loss, requiring a subsidy to continue operating.
- To cover the loss, a two-part non-linear tariff consisting of a fixed amount or fee, *invariant to consumption*, plus a price per unit is levied.
- This approach to pricing electricity addresses the shortfall but raises the question of how the fixed portion should be shared.
- To cover the Loss show in the figure an amount Loss/N, where N is the number of customers could be charged.
- Under this approach all customers regardless of consumption pay an equal portion of fixed costs.
- Although EU electricity markets are deregulated and privatised, the technology of RE, almost entirely driven by fixed costs but supported per unit of output, creates the problem of how such cost be shared across customers.

CORRELATION BETWEEN REGRESSIVENESS AND RE CONSUMPTION

CORRELATIONS BETWEEN GREEN ENERGY CONSUMPTION AND REGRESSIVENESS: SMALLEST CUSTOMERS VS. LARGEST CUSTOMERS EU 28 + Norway 2008 to 2017	
Correlations	Smallest vs. Largest Consumers
Correlation between RE Consumption and Regressiveness in Energy Costs	28%
Correlation between RE Consumption and Regressiveness of Network charges	2%
Correlations between RE Consumption and Regressiveness of Taxes and Levies	44%

CORRELATION BETWEEN REGRESSIVENESS AND RE CONTRIBUTION 2008 TO 2016 TOP TEN EU ECONOMIES	
Regressiveness in Prices	37%
Regressiveness in Prices excluding Belgium and Poland	47%
Regressiveness in Taxes and Levies	37%
Regressiveness in Taxes and Levies excluding Belgium and Poland	40%

(Source: Author's calculations using Eurostat data)

RANKINGS OF CORRELATION BETWEEN RE CONTRIBUTION AND REGRESSIVENESS 2008 TO 2017

RANKING OF CORRELATIONS BETWEEN PRICE REGRESSIVENESS AND RE CONTRIBUTION 2008 to 2017			
Finland	98%	Ireland	68%
Austria	95%	United Kingdom	67%
The Netherlands	95%	Denmark	63%
Czech Republic	79%	Bulgaria	54%
German	74%	Hungary	45%
Slovenia	72%	Romania	44%
Greece	71%	Sweden	44%
Italy	70%	Slovakia	30%

Source: Author's calculations using Eurostat data

EXPLANATIONS

- Correlation does not prove causation but the observed relationship is widespread.
- With RE, whether a household takes 2000 KWh or 10,000 KWh is immaterial from a cost perspective.
- Regressive pricing to recover fixed capital costs is appealing as it reduces the risk of either a linear pricing model or even a non-linear model in which both variable and fixed costs are recovered.
- Regressive pricing is exacerbated through the effects of taxes and levies along with how poorer households live.
- Lower income cohorts in rented accommodation are unlikely to be investing in Solar PV and therefore miss-out on access to capturing the subsidies for RE.
- Faced with the threats of lower sales because of greater efficiency, the impact of random renewable output and under-utilisation of dispatchable generation, having predictable returns on assets is desirable.
- Having predictable returns may even lower the cost of capital and thus Utilities and Integrated Energy Suppliers have an incentive to favour regressive pricing structures.

SOLUTIONS TO REGRESSIVE PRICING OF RE IN LIBERALISED ELECTRICITY MARKETS

- In the US many regulators are implementing mechanisms to decouple revenues from commodity sales (electricity) to promote efficiency and conservation.
- Although the Variable Costs of RE are zero, to ensure Total Revenue equals Total Costs, pricing could still be tied to the volume of consumption.
- In a few countries a flat pricing structure is applied. Different fixed fees could be charged to different consumers.
- Perhaps supporting RE in a fair and equitable manner requires a discriminatory two-part tariff; not based on the willingness to pay but rather the ability to pay.
- Putting a greater burden of fixed costs upon the largest consumers and households perhaps through a lump sum tax might be justified on equality of loss to marginal utility.