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Abstract: Consumer-centric energy markets and distribution grid tartiff reform: A review of the current debate in Denmark, Germany and the EU

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Published in:
5th International Conference on Smart Energy Systems in Copenhagen, on 10-11 September 2019

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Publication date:
2019

Document Version
Publisher's PDF, also known as Version of record

Link to publication from Aalborg University

Citation for published version (APA):
Hasberg, K. S. (2019). Abstract: Consumer-centric energy markets and distribution grid tartiff reform: A review of the current debate in Denmark, Germany and the EU. In H. Lund, B. V. Mathiesen, & P. A. Østergaard (Eds.), *5th International Conference on Smart Energy Systems in Copenhagen, on 10-11 September 2019* (pp. 149-149). Aalborg Universitet.

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From distribution to interaction grid

Fundamental questions on the role of and tariff design in distribution networks of 100% renewable energy systems

A framework for evaluating grid tariff policy proposals?

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Smart Energy Systems conference

Session 13

September 10, 2019

Background

As generation costs of renewables are falling and prosumers are on the rise, policy debates are changing:

- towards post-feed-in-tarif market designs
- towards flexibility incentives
- … and towards grid tariff reform

Agenda (with spoiler)

1. Ask two fundamental questions (in order to establish an analytical lens):
   1) What is the role of a grid (a), and what is part of it? (b)
   2) Who pays, and according to what principle?
2. Evaluate current *regulatory principles* through this lens
3. Evaluate current *grid reform proposals* through this lens
4. Conclude
   1) Grid reform cannot sensibly be discussed without a new understanding of the role of the grid (=interaction grid)
   2) Grid reforms cannot sensibly be designed independently of (flexibility) market reforms
5. Outlook: Who owns data?

1: Ask fundamental questions

1) What is the role of a grid (a), and what is part of it? (b)
2) Who pays, and according to what principle?

1. a): What is/was the role of a grid?

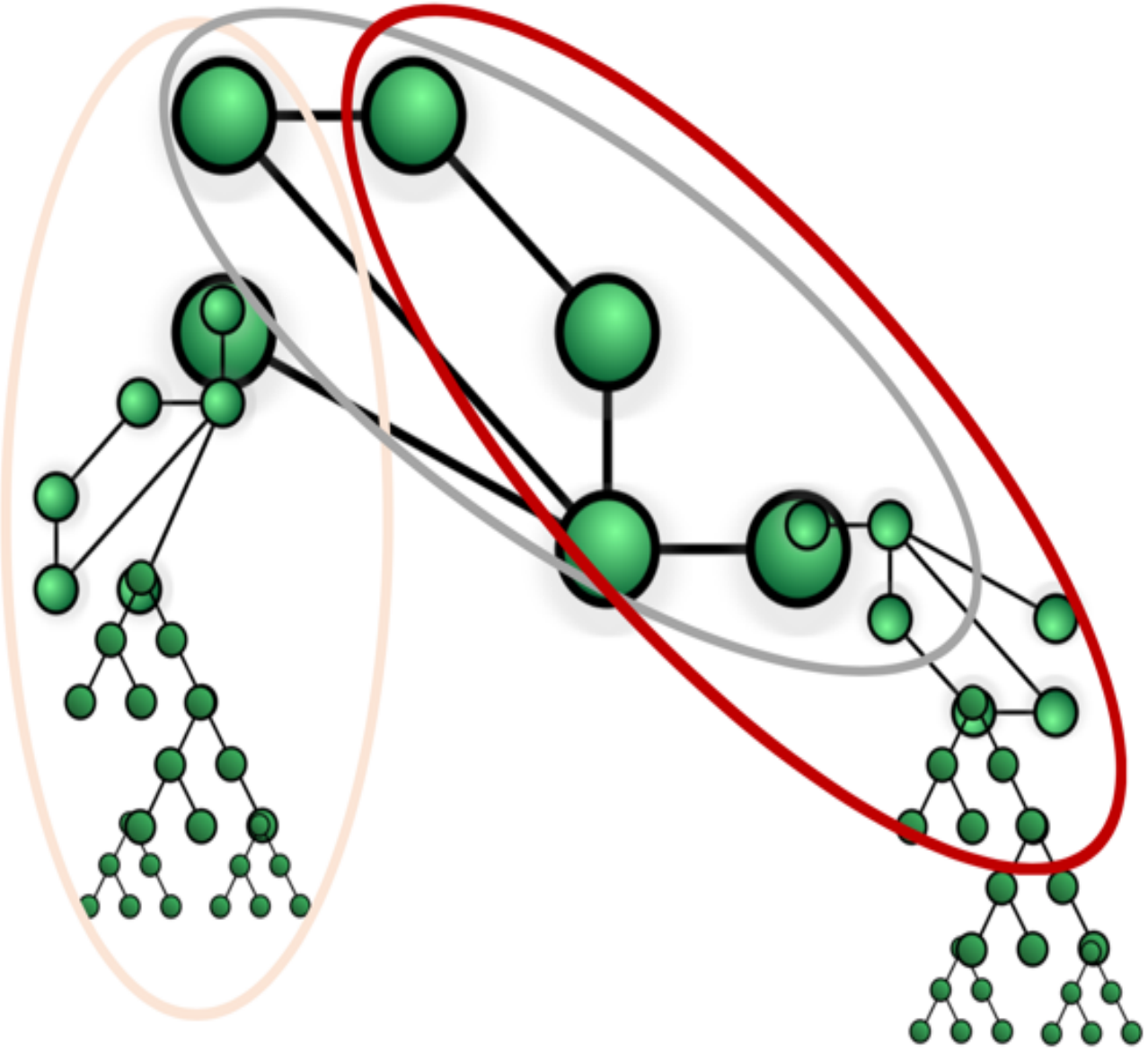


Figure 2: Ideal-type illustration of centrally organized electricity network following the waterfall principle: A consumer pays for all voltage levels from their connection point at low voltage (beige), medium voltage (red) and high voltage (grey)
Source: Wikimedia Commons (2006, 2008) and own illustration

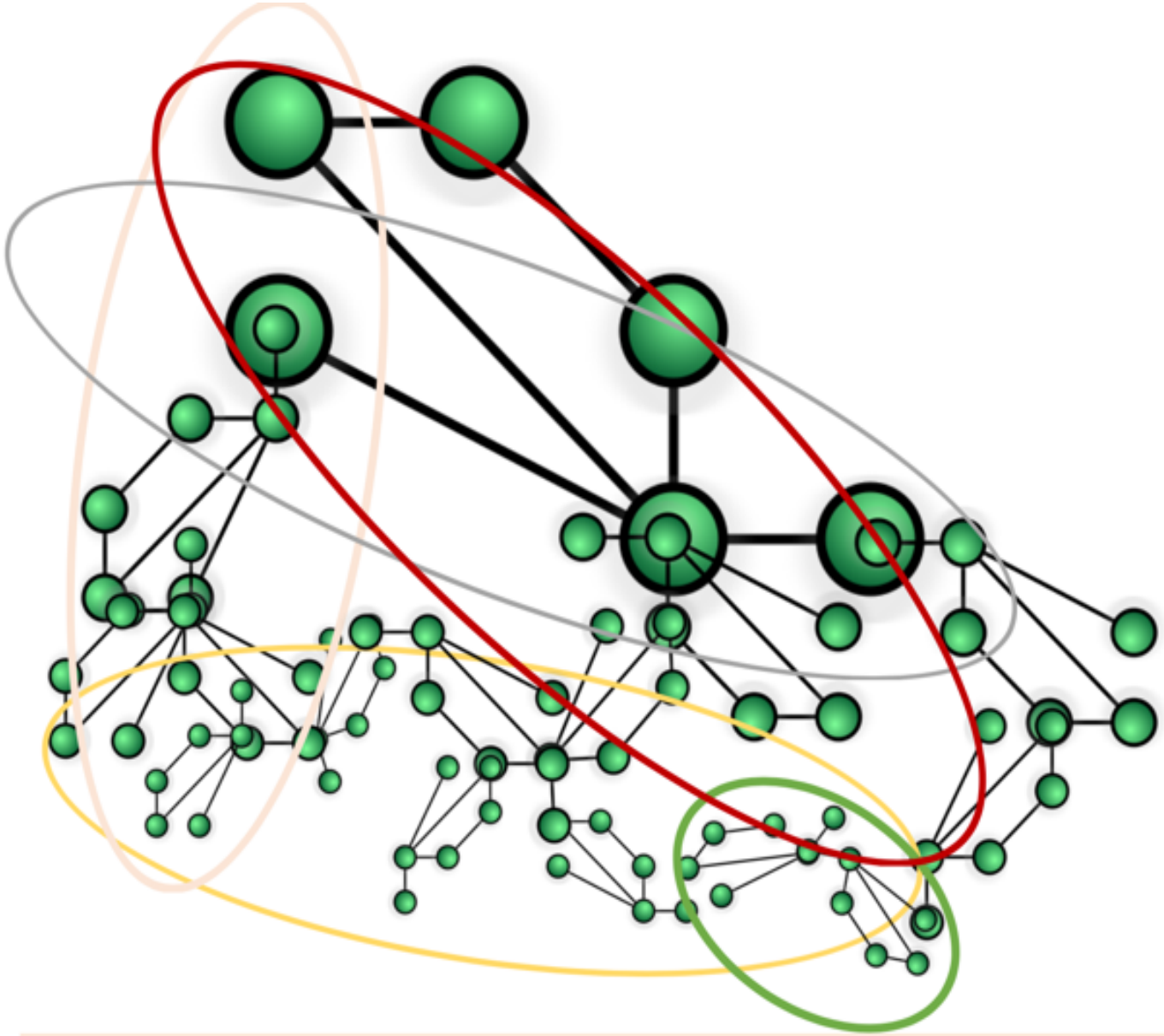
Zentral organisiertes Stromsystem:
Teilvermaschtes Übertragungsnetz mit hierarchischem Verteilnetz
Beige = Strombezug bei Niederspannungsanschluss
Rot = Strombezug bei Mittelspannungsanschluss
Grau = Strombezug bei Hochspannungsanschluss

Tomorrow:

Figure 3: Decentrally organized electricity grid based on ‚subsidiarity principle'.

Teilvermaschtes Übertragungsnetz mit teilvermaschtem Verteilnetz

Beige = Strombezug über alle Netzebenen bei Niederspannungsanschluss
Rot = Strombezug bei Mittelspannungsanschluss
Grau = Strombezug bei Hochspannungsanschluss
Grün = Strombezug innerhalb des Niederspannungsnetzes
Gelb = Strombezug innerhalb des Nieder- und Mittelspannungsnetzes



Partial conclusion 1.a.)

- The role of the grid is to facilitate the transition to a renewables-based smart energy system

1. b.): What is part of the grid?

- If the grid and it‘s operation is defined as a natural monopoly, then, by definition, only natural monopoly activities are part of the grid

Partial conclusion 1.b)

- Both today and tomorrow: Natural monopoly

2. Who pays, how much and according to what principles? Illustration of EU consumer electricity prices:

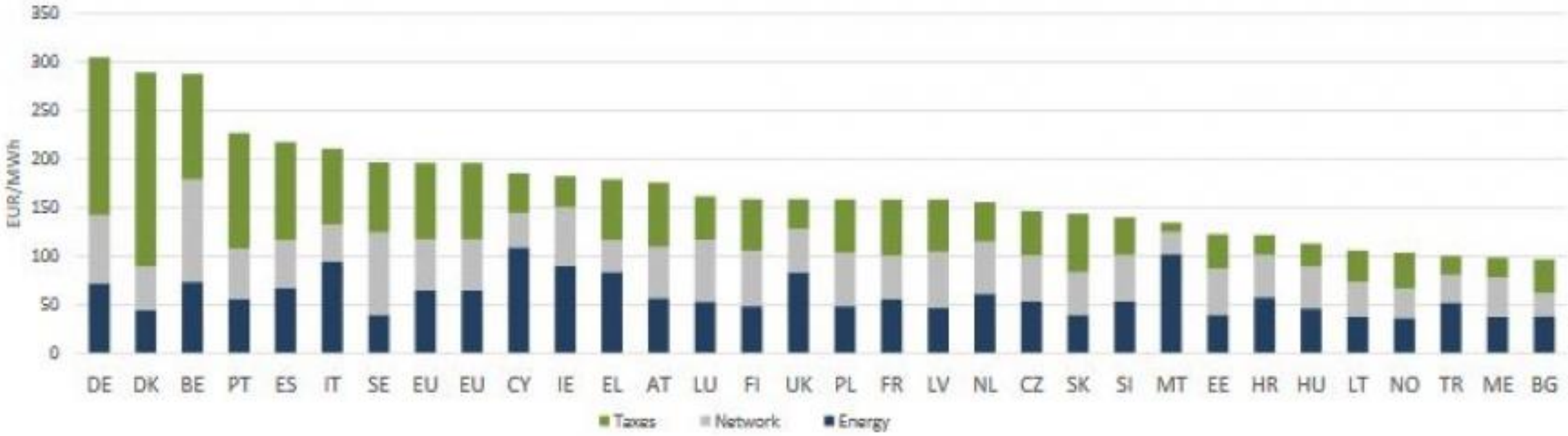


Figure 2 — Household electricity prices in 2017 (most representative consumption band) — Source: DG ENER in-house data collection[3]

Illustration of EU industry electricity prices:

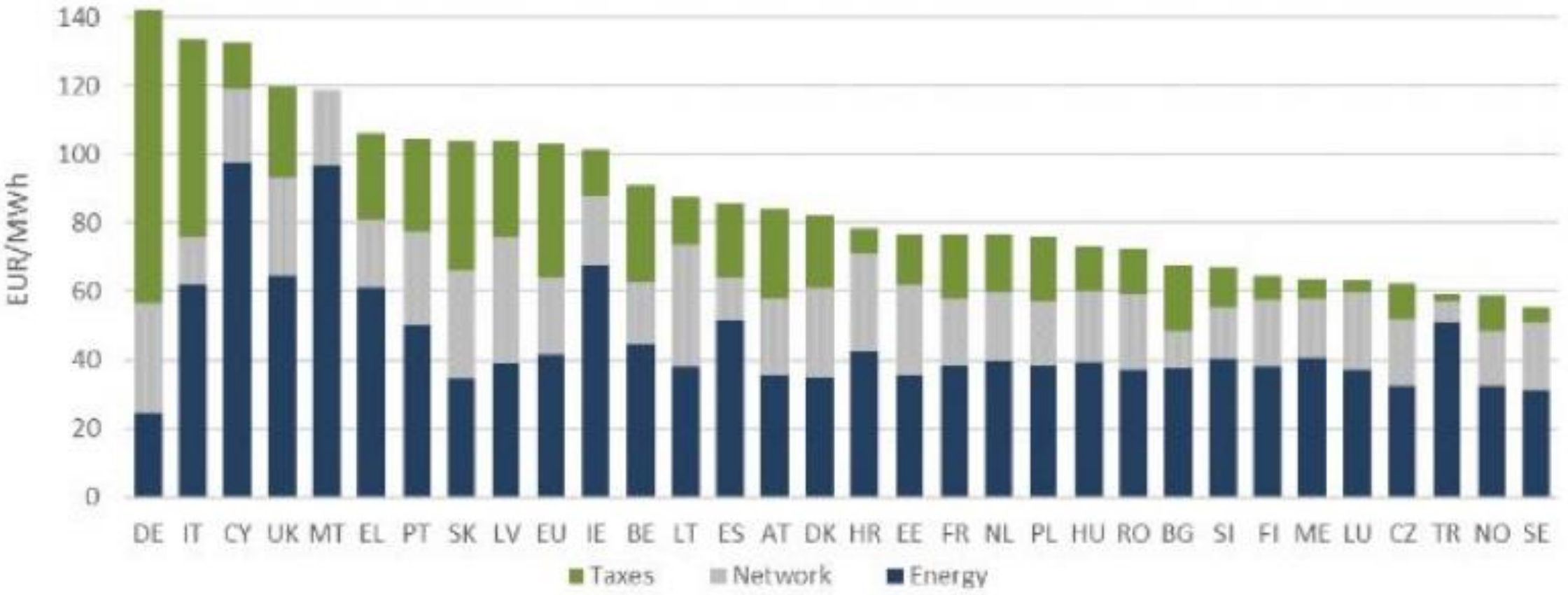


Figure 3 — Industrial electricity prices in 2017 — Source: DG ENER in-house data collection

Break-down of current Danish consumer prices

Electricity price components households, july 2019	DK: Radius & Ørsted	
	DKK	EUR
Wholesale electricity	33,45 øre/kWh	4,49 cent/kWh
PSO-levy	0,0 øre/ kWh	0 cent/kWh
Subscription	31,2 DKK/ Month	4,19EUR/Month
Sum electricity charges excl. VAT	4,49 cent/kWh + 4,19 EUR/Month	
Grid subscription	25 DKK/Month	3,36EUR/Month
Local grid charge	30,01 øre/kwh	4,03 cent/kWh
	From 2020: 3,48 /8,97 cent/kWh	
Regional Grid charge	(not applicable in Radius grid)	
Transmission charge	4,4 øre / kWh	0,59 cent/kWh
System charge	3,6 øre / kWh	0,48 cent/kWh
Balancing charge	0,13 øre / kWh	0,017 cent/kWh
Regulation authority charge	0,13 øre / kwh	0,017 cent/kWh
Sum of grid charges excl. VAT		5,13 cent/kWh + 3,36 EUR/Month
Electricity tax	91,00 øre/kWh	12,2 cent/kWh
Value-added tax	25 %	5,46 cent/kWh + 1,89 EUR/Month
Sum Taxes +VAT	17,66 cent/kWh + 1,89 EUR/Month	
Total		27,28 cent/kWh + 9,44 EUR/Month

Figure 1: Composition of household electricity price in Denmark, july 2019.
Sources:: 50 Hertz Transmission u. a. 2019; Dansk Energi 2018; Ørsted.dk 2019;
Vattenfall Europe 2019; own calculations

A small dictionary of grid principles (*not* literal translations)

ENG	DK	DE	Definition
„cost orientation principle“	Omkostningsægthed	Verursacherprinzip	Currently by definition mostly a consumer, not a producer
„Waterfall principle“	vandfaldsprincip	*Kostenwälzungs-prinzip*	The highest voltage level is the assumed level of generation.
„Stamp principle“		„Eine Briefmarke für ganz Europa“	Grid use costs the same no matter where electricity comes from
Revenue cap regulation	Indtægtsramme-regulering	Anreizregulierung	Today, allows for supernormal profits
Frequently used terms without exact equivalents across languages:			
Not-for-profit ownership	hvile-i-sig-selv, forbrugereje	Daseinsvorsorge Rekommunalisierung	These are terms used when not-for-profit ownership is being practiced or considered

Evaluation current grid tariff principles

	Question 2: Who pays for grids, how much, and according to which principle?			
	(1) Waterfall principle	(2) Cost orientation principle	(2) Revenue cap regulation	(4) „Stamp principle“
1a: Does it facilitate a smart energy system?	No. The highest voltage level is the default level of origin by definition.	No. It seems that by definition, the „cause“ of costs can only be newcomers to the system, that is, new producers or new prosumers	No. Flexibilities cannot be bought, but only be built This leads to a “copper only“ strategy,	No, because local production is not „rewarded“ / lower transportation costs of combined local production and consumption is not reflected. Combination of this principle with the (1) discriminates producers at distribution level
1b: Is it a natural monopoly activity?	Yes, but it leads to over-investment in transmission capacity and underinvestment at distribution level	Yes, but it is inherently conservative because of the built-in path dependence	Yes, but the revenue cap regulation allows for supernormal profits	Yes, but it can be considered as a form of consumer subsidy for remote production that leads to expansion of the natural monopoly.

Evaluate exemplary policy proposals

	Question 2: Who pays for grids, how much, and according to which principle? Examples of policy proposals			
	Time (grid status) differentiated grid tarifs	distance differentiation (e.g. s from your neighbor than from offshore)	Capacity vs. Energy (usually: Increasing the capacity price component compared to todays kWh-based charge	Differentiation according to security of supply (remote control of supply, „netprodukter“)
1a: Does it facilitate a smart energy system?	They can, but do not necessarily. What if grids are clogged with coal power?	Yes (it is a revision of the waterfall principle)	Only in combination with a flexibility market. Also, flat rate has the social downside (DK: „vender den tunge ende nedad“)	Yes, if the control parameters are set to maximise renewables uptake in the grid
1b: Is it a natural monopoly activity?	No. Could be provided via flexibility market	Yes. Paying less for grid use for electricity from your neighbor is a natural monopoly activity	Yes.	No. Could be provided via a flexibility market

local flexibility markets are an alternative to grid tariff reform

4. Conclusions

- **Re-interpreting the cost-orientation principle** as a principle of lowest system costs, reflecting a smart energy system thinking
- **Replacing the waterfall (and stamp) principles** by a **subsidiarity principle**
- **Unbundling monopoly and market domains at last** by **estabilishing local flexibility markets**
- **Redesigning the revenue cap regulation** (indtægtrammeregulering) can make the network operator a buyer of flexibilities, serving both as an incentive to the non-discriminatory and neutral role of the network monopoly and to make consumers more flexible through aggregators, thereby creating the basis for local flexibility markets
- **Departing from the copper plate assumption** in electricity market design by implementing „electricity regions“
- **Incentivizing PPA‘s (power purchase agreements)** for a a post feed-in era

…can lead to successful energy policy reforms on the path to 100 % renewable smart energy systems

5. Outlook: More on power and ownership

More on grid ownership:

→Hvelplund, Frede, and Søren Djørup. 2019. "Consumer Ownership, Natural Monopolies and Transition to 100% Renewable Energy Systems." *Energy* 181: 440–49. https://doi.org/10.1016/j.energy.2019.05.058.

More on data ownership:

Intelligent meters do not only shift loads, but also power structures in energy systems

→Hasberg, Kirsten Sophie. 2019. From Energopower to Infopower: Smart Energy Systems as Co-Constituted by Energy & Information Systems.

The introduction of hourly consumer electricity prices and time-varying network charges in Denmark (flexafregning) through the mandatory installation of smart meters gives distribution system operators data sovereignty over consumer data, which extends their monopoly position beyond the natural monopoly of the physical grid.

Please help me find…

- Incoherent arguments
- Unclear points
- Logical fallacies

Thank you!

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