European University Institute

ROBERT SCHUMAN CENTRE FOR ADVANCED STUDIES

FSR ENERGY & CLIMATE

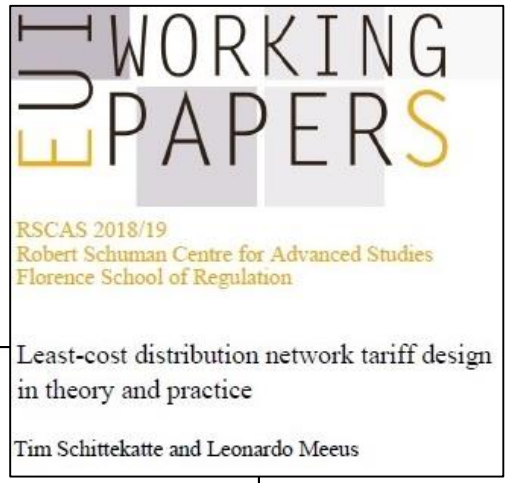
The future direction of network tariff structures

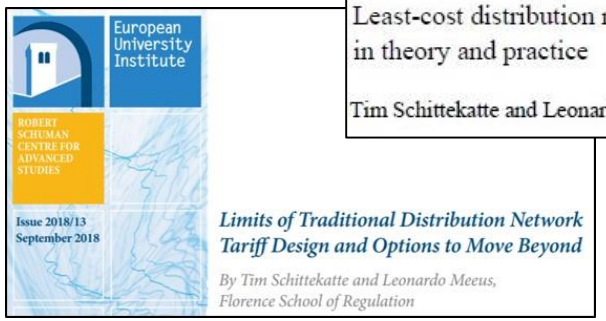
CEER Workshop on Emerging Issues in Network Tariffs
19th October 2018

Tim Schittekatte

Setup presentation

- Least-cost distribution network tariff design in theory and practice





- Three thoughts beyond least-cost distribution network tariff design in theory and practice

Focus distribution network access tariff design

"Something is dying alright, just not the utility. It's the ability of regulators, utilities, and interest groups to push around revenue collection among customers without the customers pushing back."

S. Borenstein (Economics professor UC Berkeley)

UTILITIES

NV Energy CEO: Solar Has Gotten a 'Free Ride' on the Grid

"What are you avoiding by putting PV on rooftops? I would suggest it is not a lot."

by Herman K. Trabish
August 19, 2013

 http://dx.doi.org/10.1016/j.tej.2014.07.003 *The Electricity Journal*

Rediscovering Residential Demand Charges

In an environment of declining sales growth and rising costs, electric utilities and their stakeholders are exploring

Ryan Hledik *is a Senior Associate in The Brattle Group's San Francisco office. His expertise is in assessing the economics of demand-side policies*

ENERGY INSTITUTE AT HAAS

The Economics of Fixed Cost Recovery by Utilities

Severin Borenstein

July 2016

Contents lists available at ScienceDirect

Energy Economics

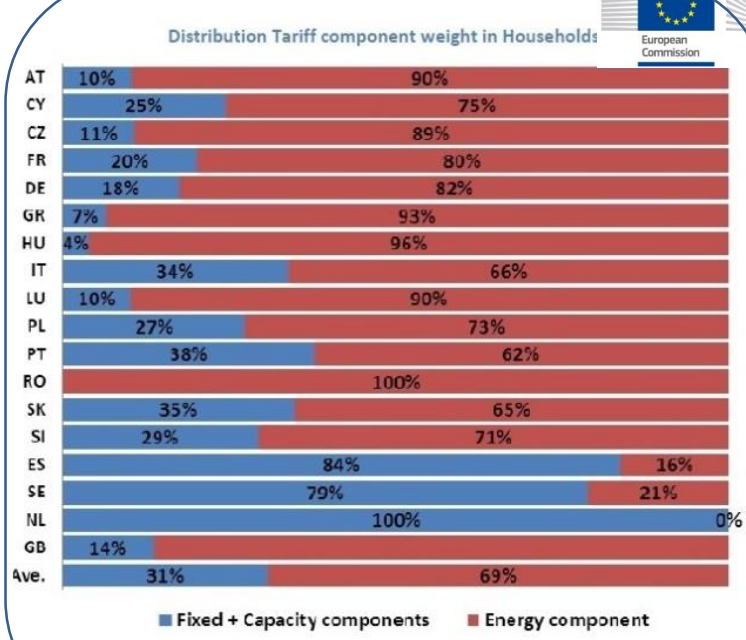
journal homepage: www.elsevier.com/locate/eneeco

Energy Economics 54 (2016) 108–122

Distribution network prices and solar PV: Resolving rate instability and wealth transfers through demand tariffs

Paul Simshauser

Griffith University, Brisbane, QLD 4111, Australia



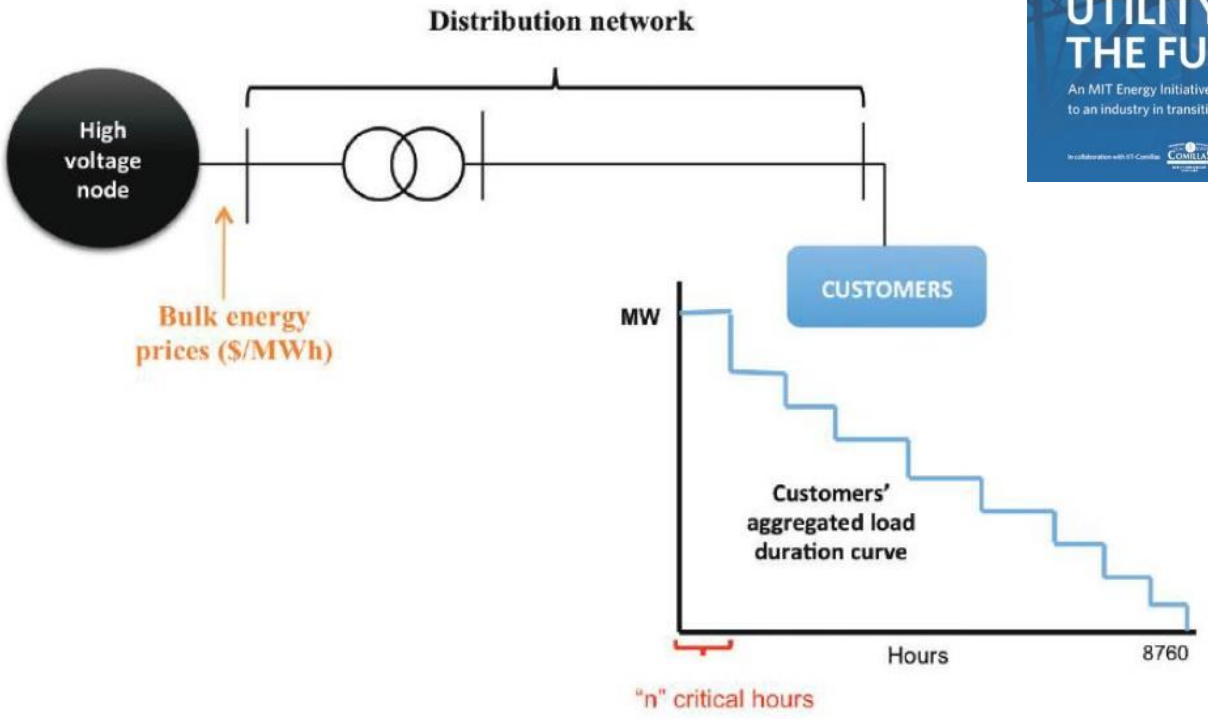
EC, 2015. "Study on Tariff Design for Distribution Systems."

Least-cost tariff design in theory

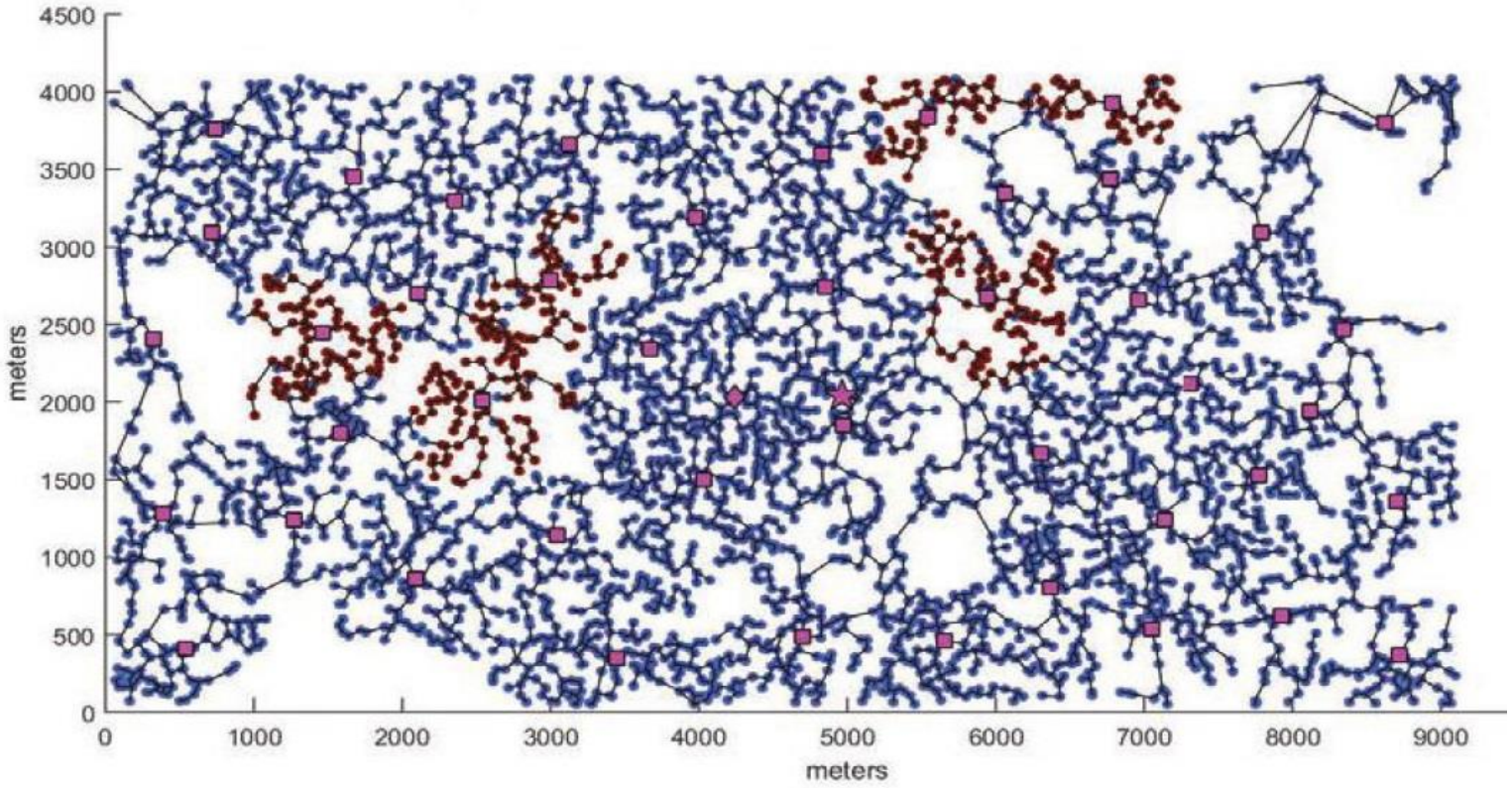
Tariff as coordination tool instead of merely allocative function

Cost-reflective:

Forward-looking-peak-coincident capacity charge set equal to the LTMC



Critical peak pricing in reality?



Regulatory principles?

Least-cost network tariff with 3 standard options: €/kWh, €/kW and/or €/customer

Many difficulties are faced when implementing a distribution network tariff, two important ones are:

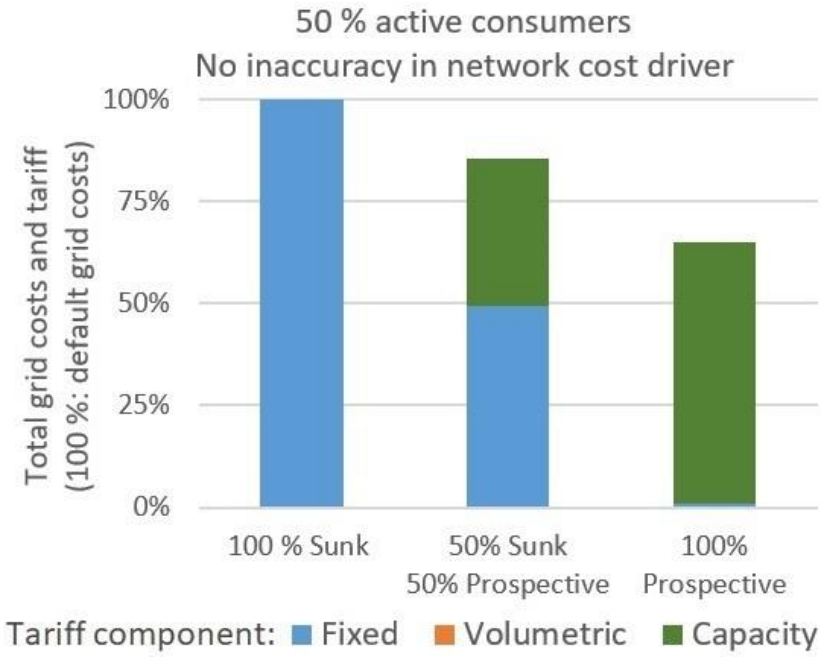
- **Implementation issues with cost-reflective tariffs**: Not having a perfect proxy for the network cost driver(s)

- **Fairness**: Tariff re-design and gains made by active consumers cannot be at the expense of passive consumers

Research question

In a world with active consumers, how to design the least-cost distribution network tariff while being faced with these two different real-world constraints?

Least-cost network tariff with 3 standard options: €/kWh, €/kW and/or €/customer



50 % active consumers – Results compared to the default case (=no DER & volumetric network charges)		No inaccuracy in network cost driver proxy
Total system costs	100 % Sunk grid costs	0.0 %
	50 % Sunk & 50 % Prospective	-1.4 %
	100 % Prospective grid costs	-6.8 %

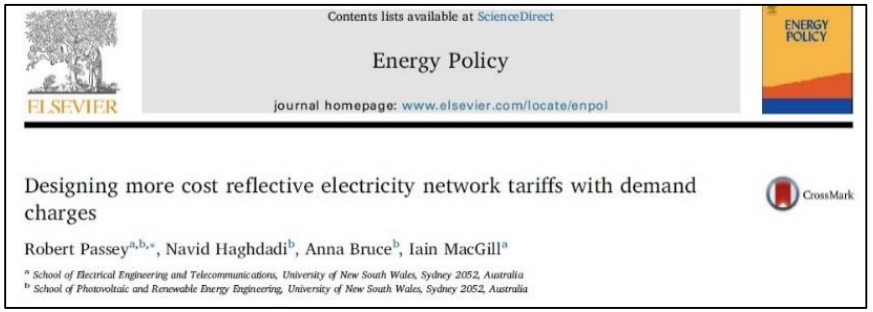
The avoided grid costs > Cost of DER adoption

- *Perfect implementation of cost-reflective charges (€/kW)*
- *Active consumers can invest in **solar PV and batteries***

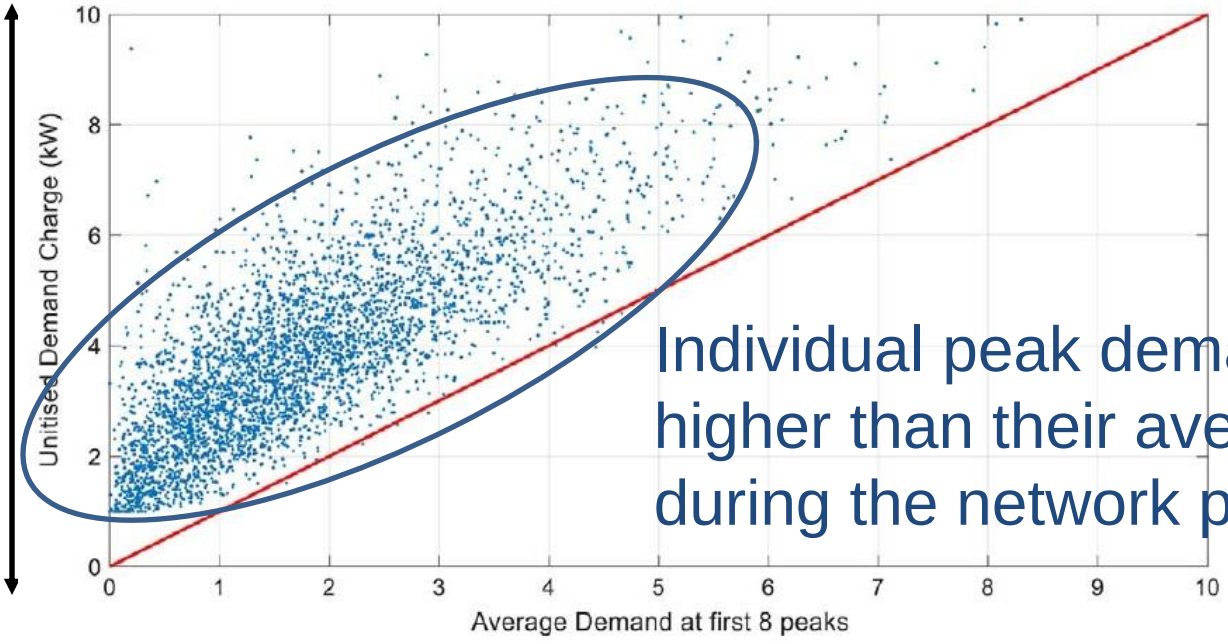
1th practical difficulty:
Implementation of cost-reflective tariffs

Implementation cost-reflective network charges

- Individual capacity-base charge
- Applied in all months
- Minimum 1 kW payment



Proxy for what consumer pays

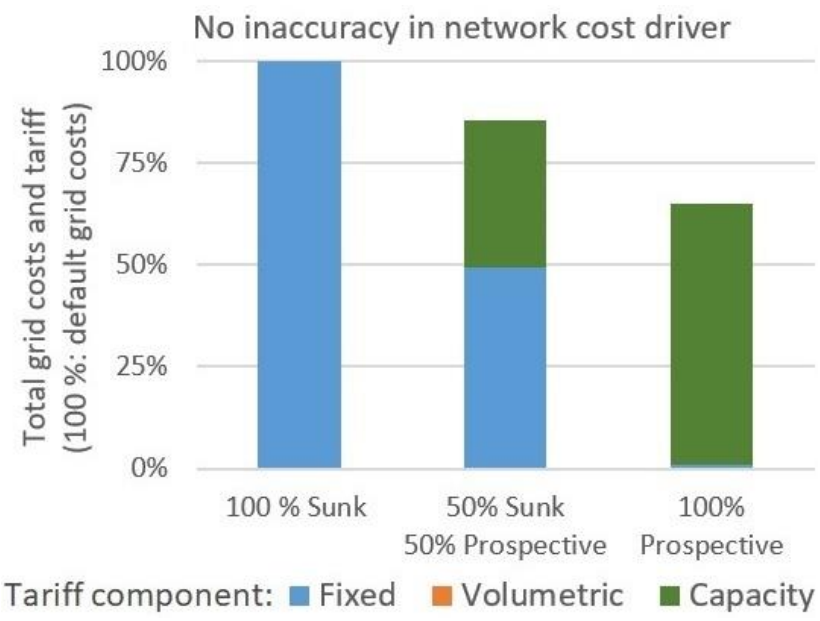


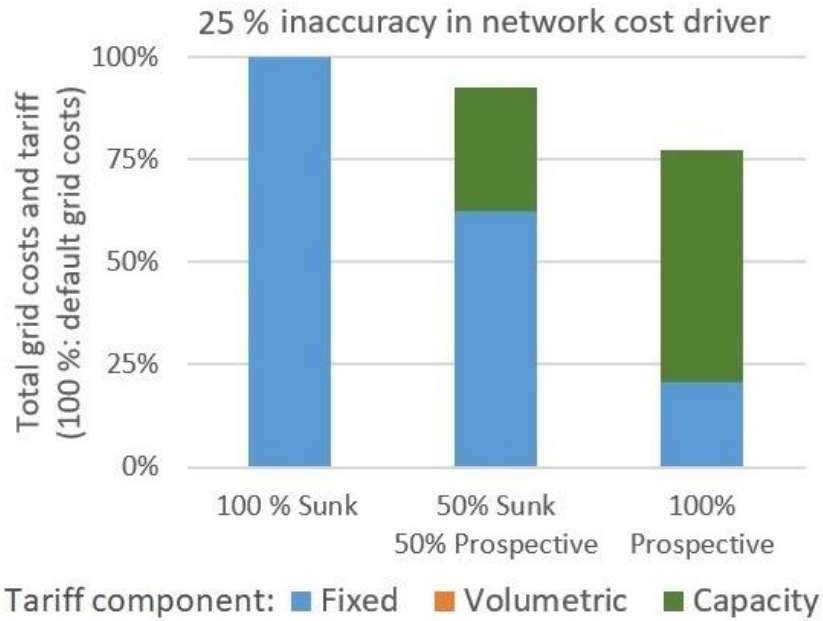
Individual peak demand a lot higher than their average demand during the network peaks

Proxy for what consumer contributes to the cost

Least-cost tariff

Including an inaccuracy in the proxy of the network cost driver





- *Inaccuracy in proxy the network cost driver*: individual consumer peak reduction does not result one-on-one in system peak reduction

- *Active consumers can invest in solar PV and batteries*

Least-cost tariff

Including an inaccuracy in the proxy of the network cost driver

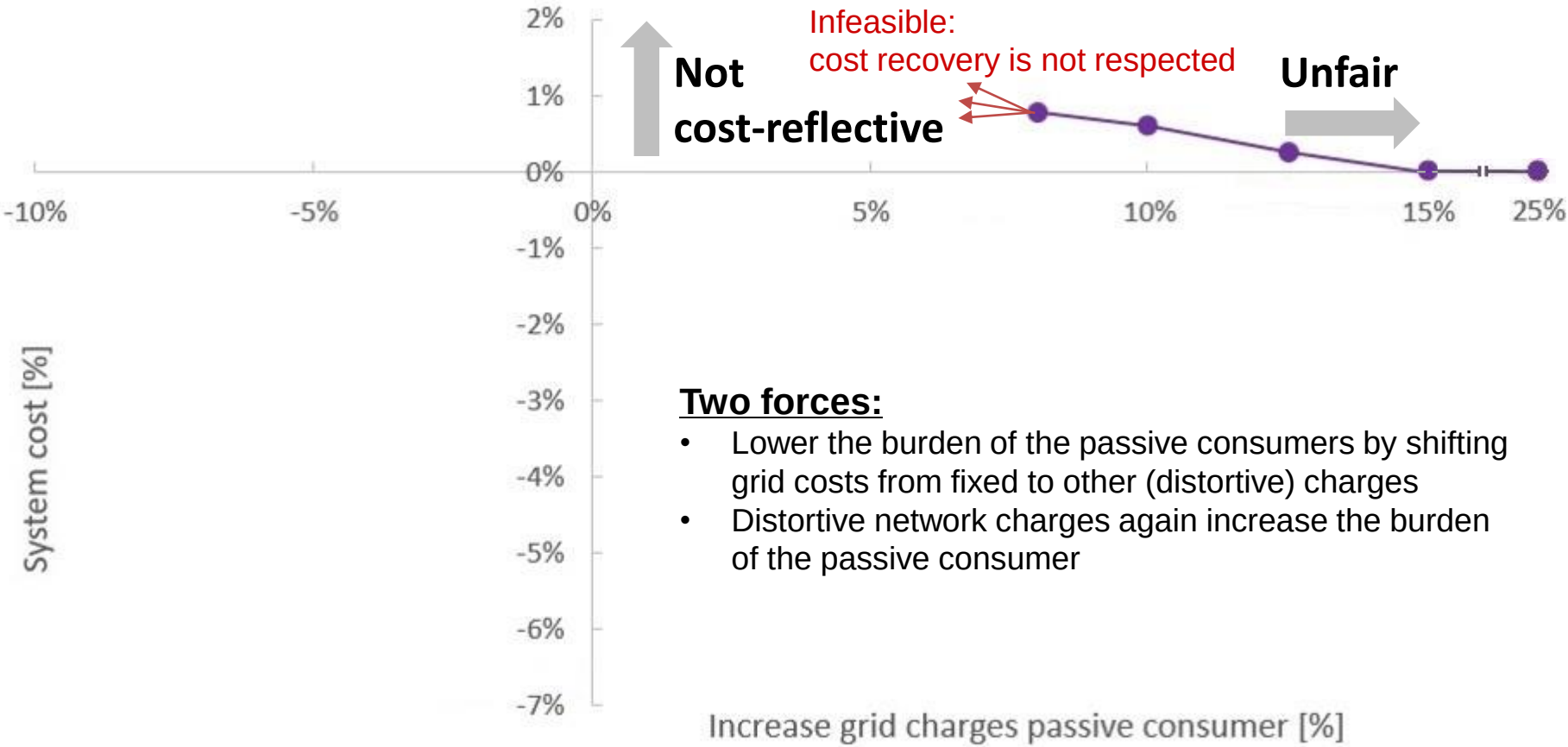
50 % active consumers - Results compared to the default case (= no DER & volumetric network charges)		No inaccuracy in network cost driver	Inaccuracy in network cost driver	
			Least-cost	Ignoring uncertainty
System costs	100 % Sunk grid costs	0.0%	0.0%	0.0%
	50 % Sunk & 50 % prospective	-1.4%	-0.3%	-0.1%
	100 % Prospective grid costs	-6.8%	-4.0%	-3.7%
Network charges passive consumers	100 % Sunk grid costs	25.0%	25.0%	25.0%
	50 % Sunk & 50 % prospective	12.6%	15.6%	15.9%
	100 % Prospective grid costs	0.0%	7.0%	10.9%

- *Inaccuracy in proxy the network cost driver*: individual consumer peak reduction does not result one-on-one in system peak reduction
- *Active consumers can invest in solar PV and batteries*

2nd practical difficulty: Fairness

Cost-reflectiveness vs fairness trade-off

Sensitivity regarding grid cost structure



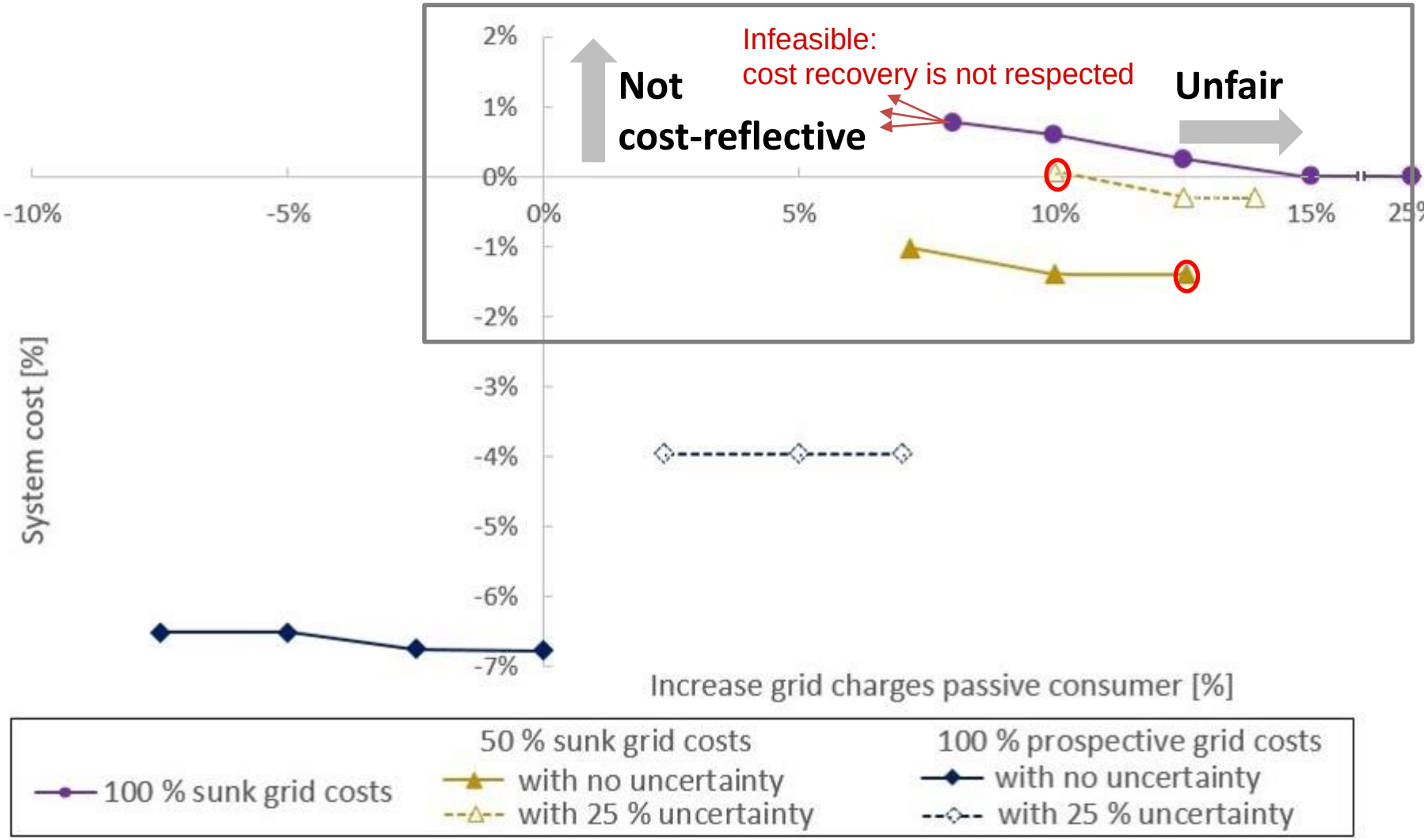
Two forces:

- Lower the burden of the passive consumers by shifting grid costs from fixed to other (distortive) charges
- Distortive network charges again increase the burden of the passive consumer

- *Subject to grid cost recovery*

Cost-reflectiveness vs fairness trade-off

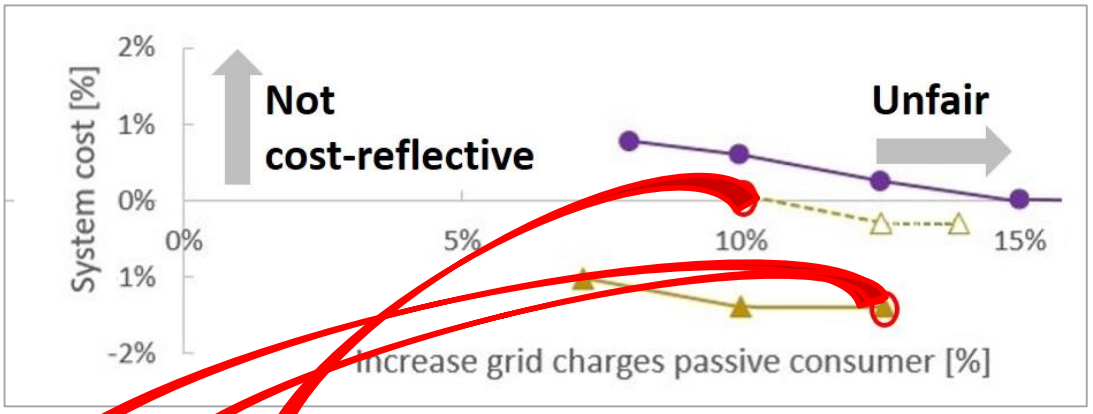
Sensitivity regarding grid cost structure



- *Subject to grid cost recovery*

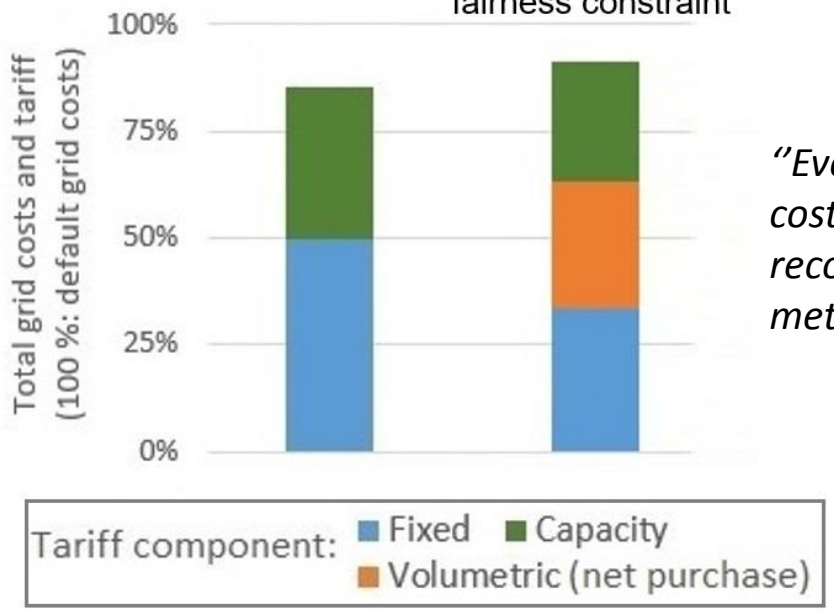
Cost-reflectiveness vs fairness trade-off

Looking at the tariffs behind



Theory

Uncertainty plus fairness constraint



''Even if volume is not a network cost driver it can make sense to recover part of the cost by (not-net metered) volumetric charges''

Conclusions and policy implication

- The two difficulties have a significant impact on the least-cost network tariff design
  - Smartly departing from the 'theoretical' least-cost tariff limits welfare loss
- Interaction between the implementation issues and fairness
  - When not anticipating imperfect implementation, the system costs will increase plus the fairness issues will aggravate
- Results depend on the state of the grid
  - *Many grid investments still to be made*: both active and passive consumer can profit
  - ***Mainly sunk grid costs*: smaller passive consumers always worse off – other tools than 'standard tariff options' needed**
    - Differentiated fixed charges
    - Taxation active grid users: controversial
    - Specific low-income programmes
    - Recovery of full grid costs through electricity bill?

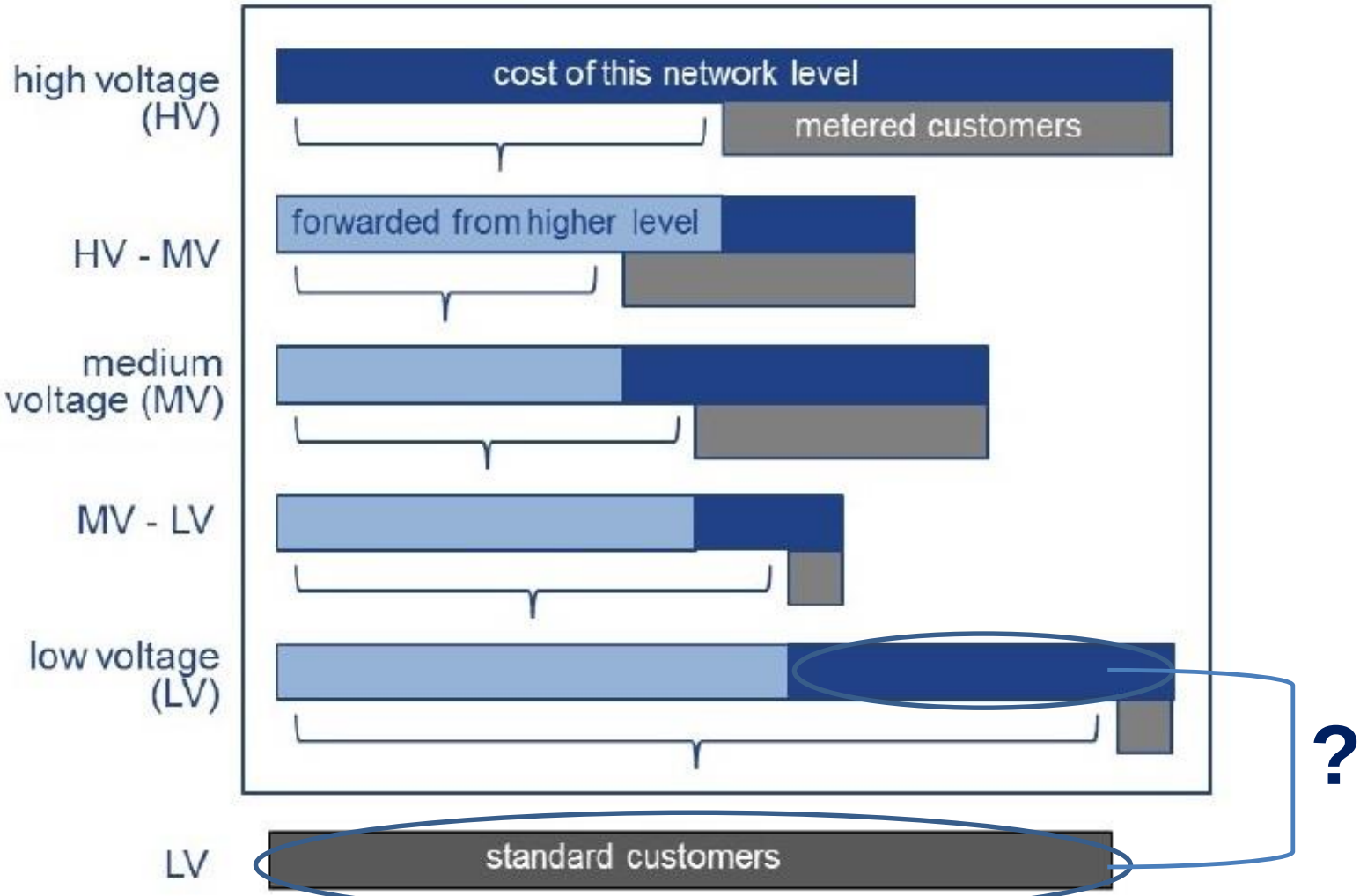
Three thoughts beyond least-cost distribution network tariff design in theory and practice

1/ What about fairness other than between domestic consumers?
E.g. the cascading principle

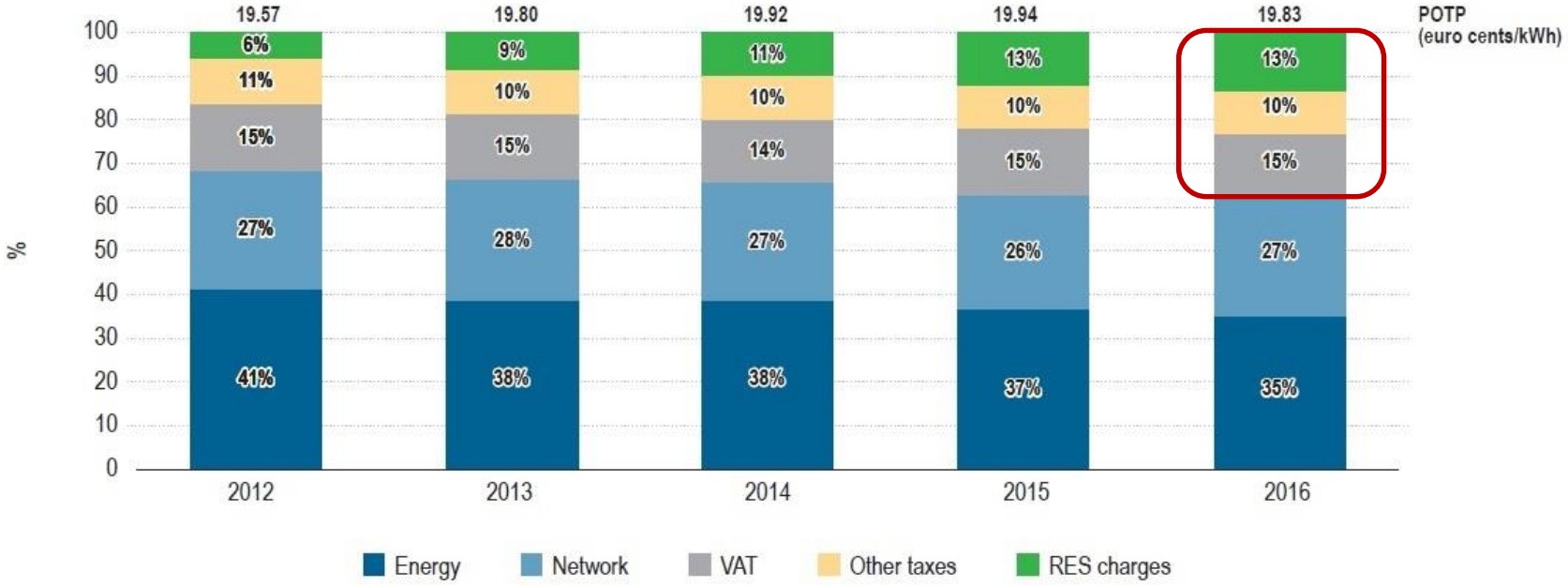
Brandstätt, Christine; Brunekreeft, Gert; Furusawa, Ken; Hattori, Toru

Working Paper

Distribution planning and pricing in view of increasing shares of intermittent, renewable energy in Germany and Japan



2/ What about the recuperation of taxes and levies through the electricity bill?



3/ Is support for energy efficiency, and rooftop-PV a design principle for network tariffs?

Jim Lazar
MARCH 26, 2018 AT 9:13 AM

Jim Lazar
Senior Advisor
Email: jlazar@raponline.org

This is a very disappointing post.

First and foremost, "infant industry" subsidies exist for an important reason: to stimulate a new industry that has promise to help all of us. We did it with land grants to the railroads; we did it with air mail subsidies to the airlines; we did it with

Lucas Davis
MARCH 26, 2018 AT 9:27 AM

BerkeleyHaas

All these benefits you get also with grid-scale solar, and at a much lower cost per kwh.

The future direction of network tariff structures

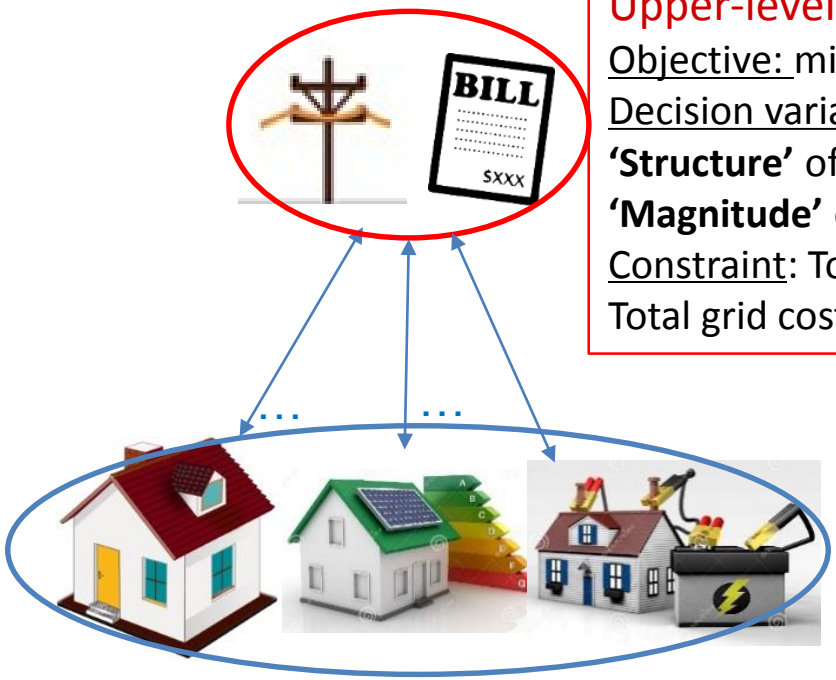
Tim Schittekatte and Leonardo Meeus

Contact: tim.schittekatte@eui.eu

Annex

Setup game-theoretical model: bi-level

NLP, turned into MILP



Upper-level benevolent regulator

Objective: minimization of the total system costs

Decision variables:

'Structure' of the network tariff (volumetric, capacity, fixed)

'Magnitude' of the coefficient

Constraint: Total grid costs = network charges collected

Total grid costs= sunk grid costs + incr. grid cost**coincident demand*

MPEC, reformulated as MILP

LP

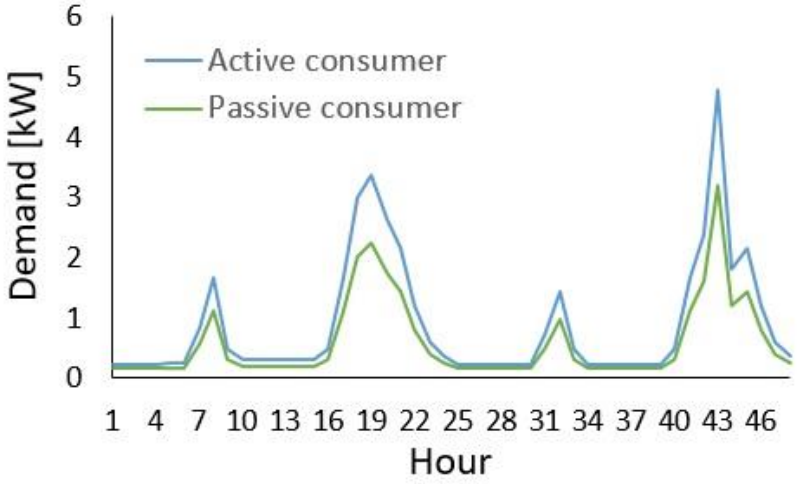
Lower-level self-interest pursuing consumers (active and passive)

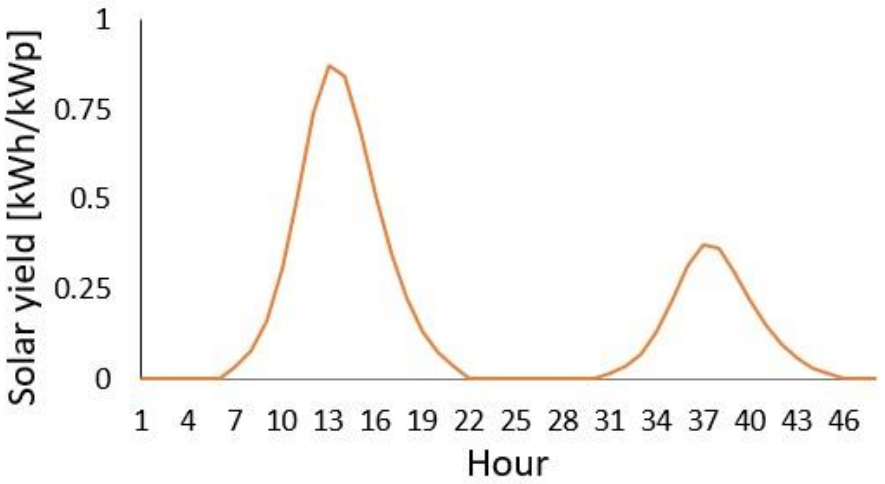
Objective: minimization of the total costs (bill + investment) to satisfy their electricity needs

Decision variables: Possibility to invest in distributed energy resources (DERs), PV and batteries

Constraint: Fulfillment of individual electricity demand

Data

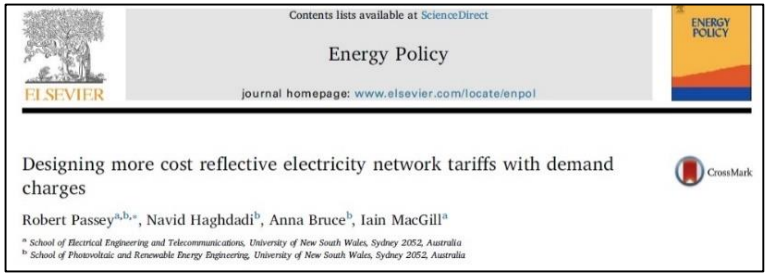




- Slightly smaller passive than active consumer
- Relatively cheap technology cost: batteries and solar PV
- Baseline 'as-it-was': nobody reacts (fit-and-forget) and network charges are volumetric, ≈ 35 % of the total bill

Implementation cost-reflective network charges

- Coincident capacity-base charge
- Applied only in summer and winter
- No minimum payment



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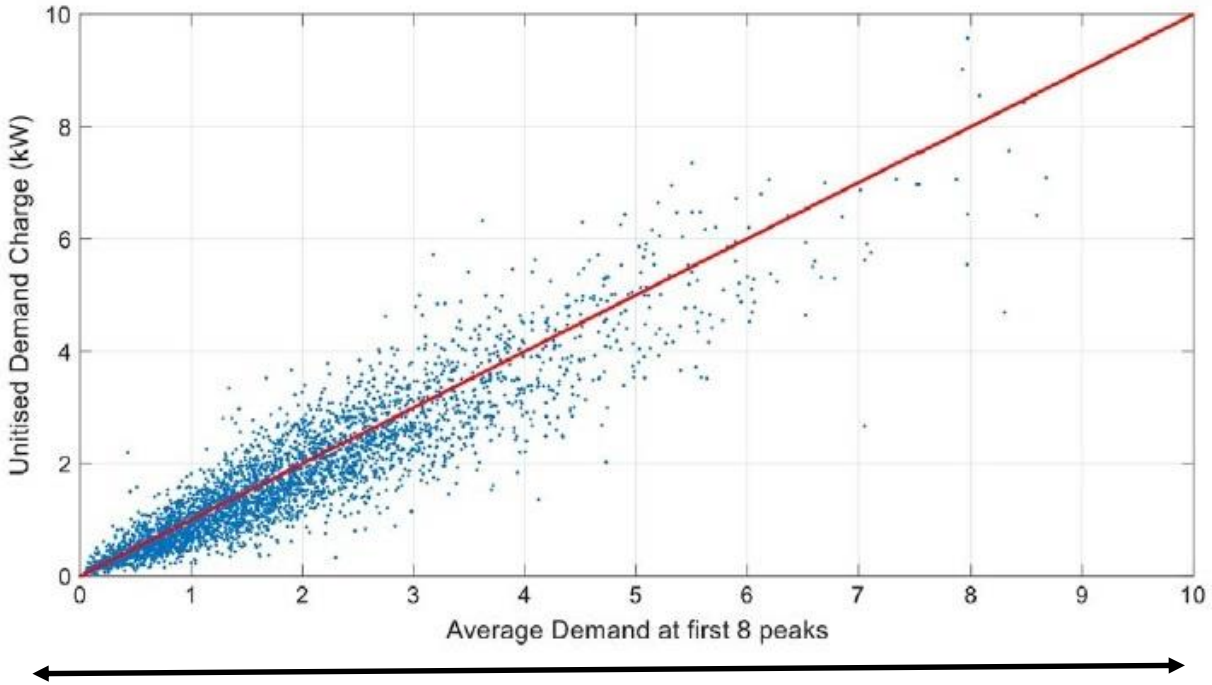

Proxy for what consumer contributes to the cost