Aggregation & Optimization of Loads, DG & DS As virtual micro-grid

4th Int'l Hybrid Pwr. Syst. Workshop

23 May 2019

Crete

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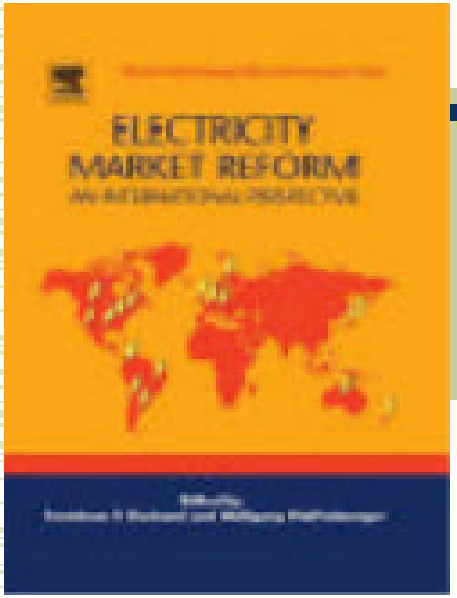
Menlo Energy Economics

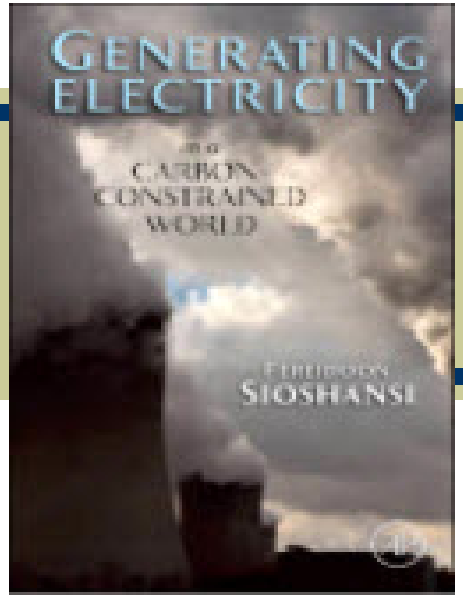
San Francisco CA

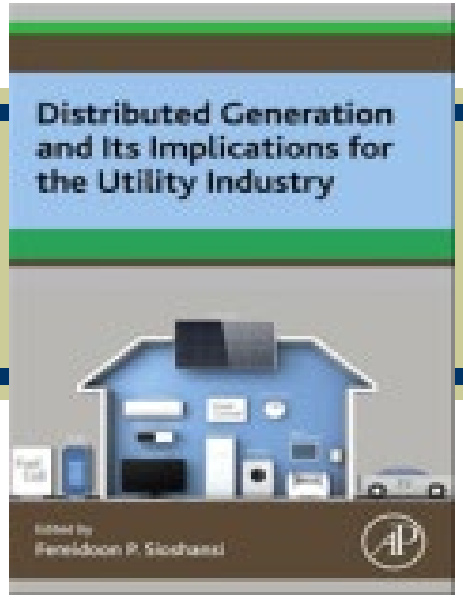
www.menloenergy.com

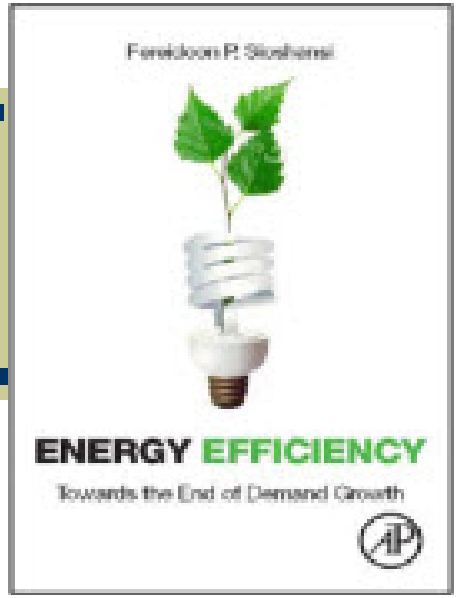
Outline

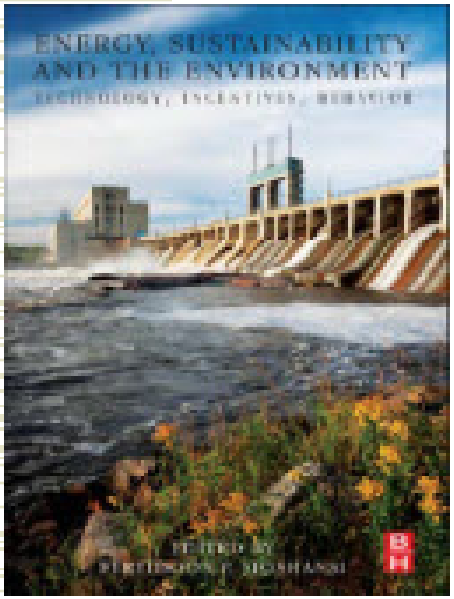
- Introduction
- Significant trends
  - Consumer stratification
  - New demand-side technologies
  - Enablers & new business models
- Implications?

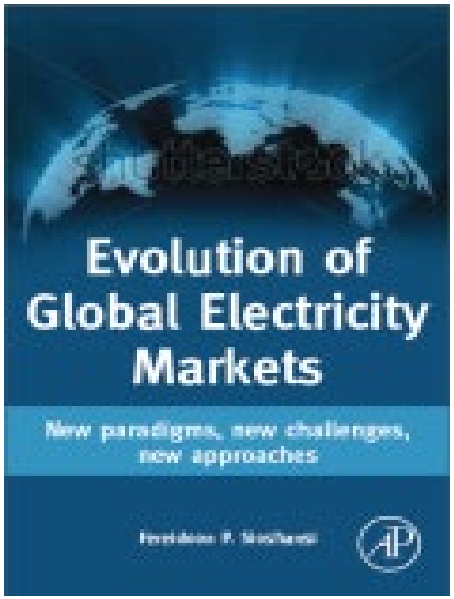

ELECTRICITY
MARKET REFORM

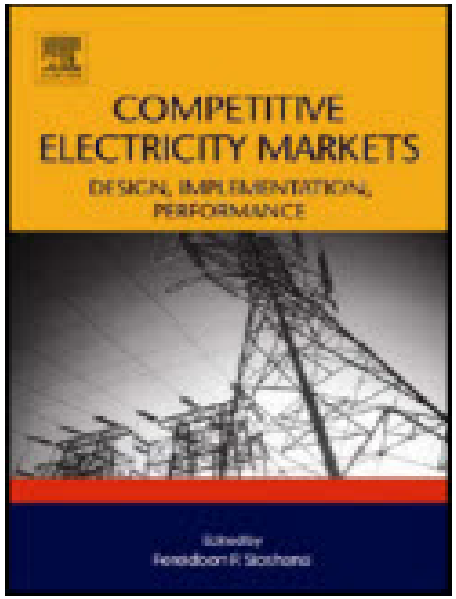

GENERATING
ELECTRICITY
CARBON-
CONSTRAINED
WORLD
SIOSHANSI

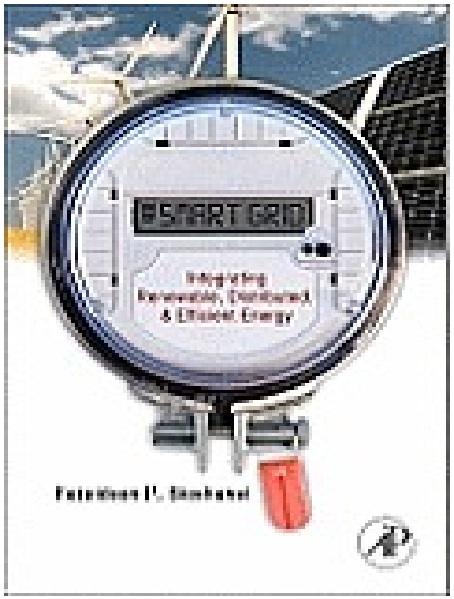

Distributed Generation
and Its Implications for
the Utility Industry
Fereidoon P. Sioshansi


Fereidoon P. Sioshansi
ENERGY EFFICIENCY
Towards the End of Demand Growth


ENERGY, SUSTAINABILITY
AND THE ENVIRONMENT

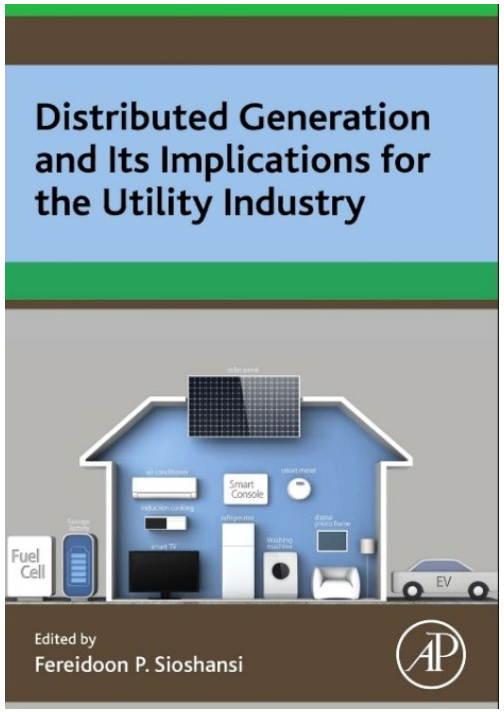

Evolution of
Global Electricity
Markets
New paradigms, new challenges,
new approaches

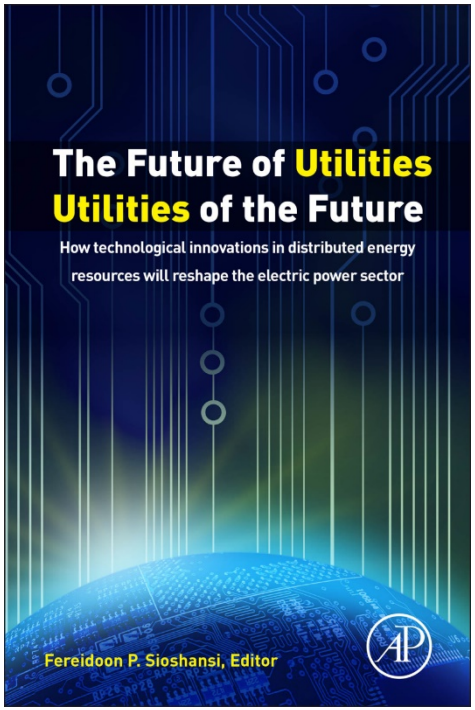

COMPETITIVE
ELECTRICITY MARKETS
DESIGN, IMPLEMENTATION,
PERFORMANCE

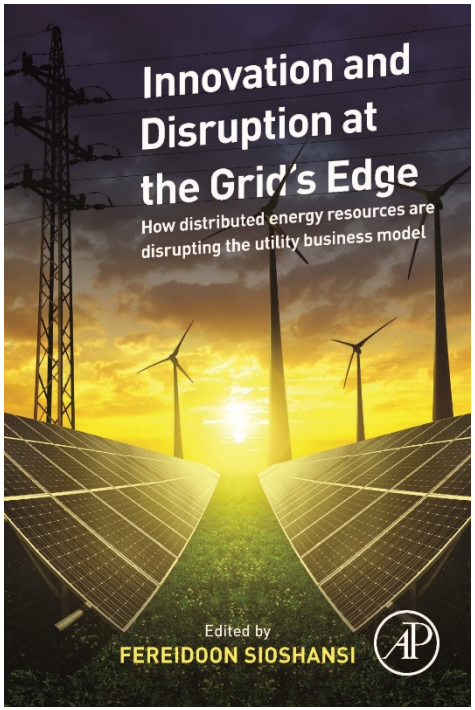

SMART GRID

Last 3 volumes

relevant to today's discussions







Consumer, Prosumer, Prosumager

How service innovations will disrupt the utility business model

Edited by
Fereidoon Sioshansi

Behind & beyond the meter: How aggregation & optimization of loads, DG & storage will disrupt utility business

- What's behind-the-meter?
  - Dist. Gen
  - Dist. storage – any & all
  - EVs
- Trading, aggregation & optimization
  - Trading platforms, P2P trading, blockchain
  - Virtual Power Plants (VPPs)
  - Micro-grids, grid-parallel, grid-assisted
  - Integrated energy services

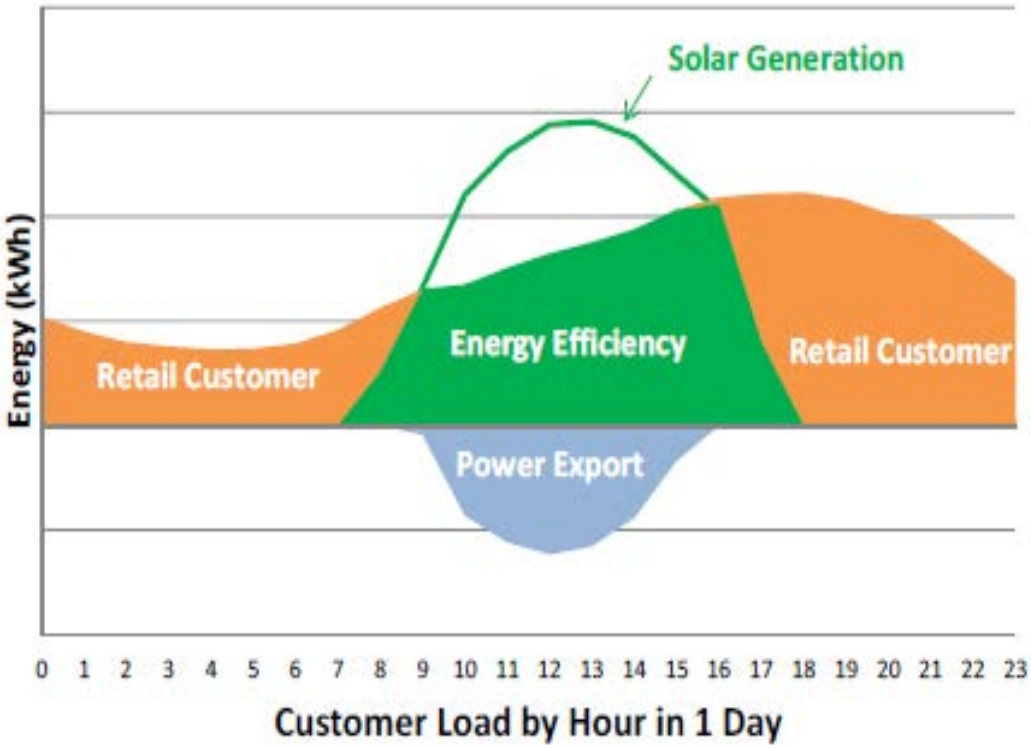
Consumer stratification

- Consumers have options
  - Self-generate (solar PVs)
  - Store (batteries, water tanks, EVs)
  - Trade
  - Join or form an “energy community”
- Enabled by
  - Aggregators who can optimize a portfolio of BTM assets
  - P2P opportunities thru platforms, VPPs, blockchain

Distributed generation

700,000 solar homes in CA, 2+ million in Australia

Consumer => Prosumer



Source: Evaluating the benefits and costs of NEM laws in California, prepared for Vote Solar, Jan 2013

Next: Distributed storage

Source: Tesla

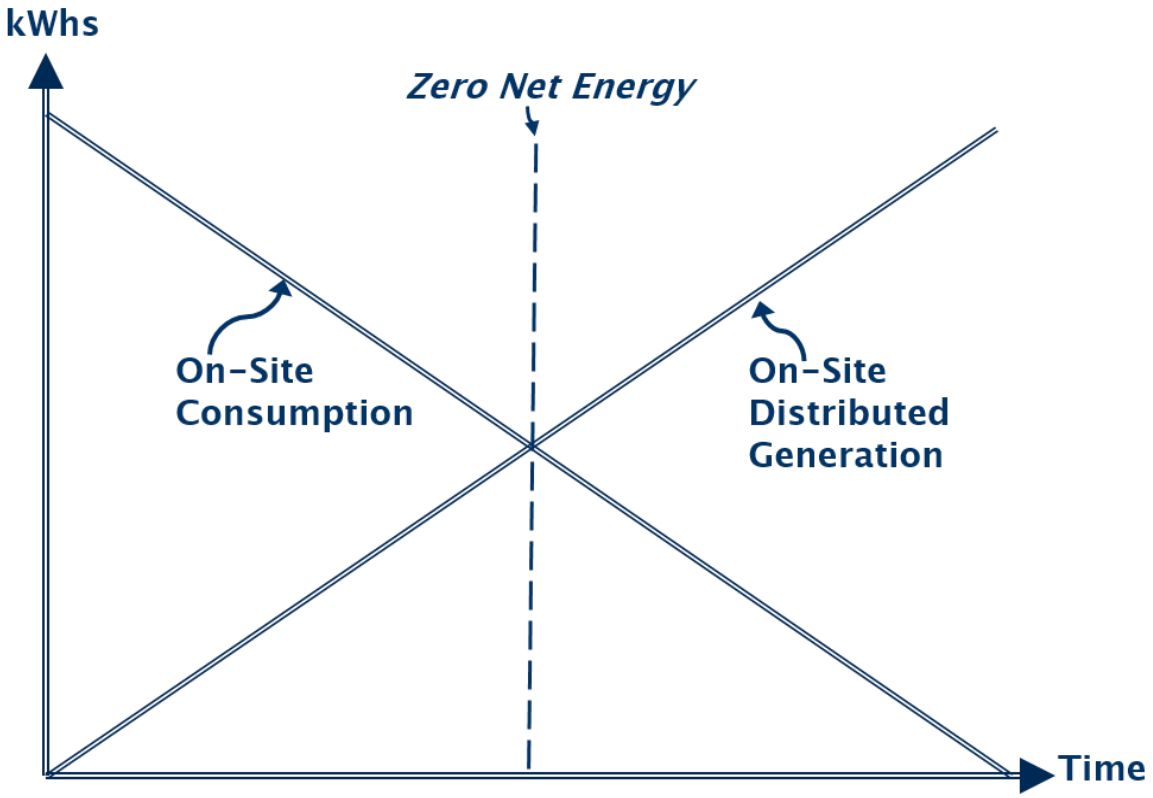
Prosumer => Prosumager

Just add storage

Source: The Wall Street Journal 2 May 2015

Zero Net Energy

New California building code starting 2020

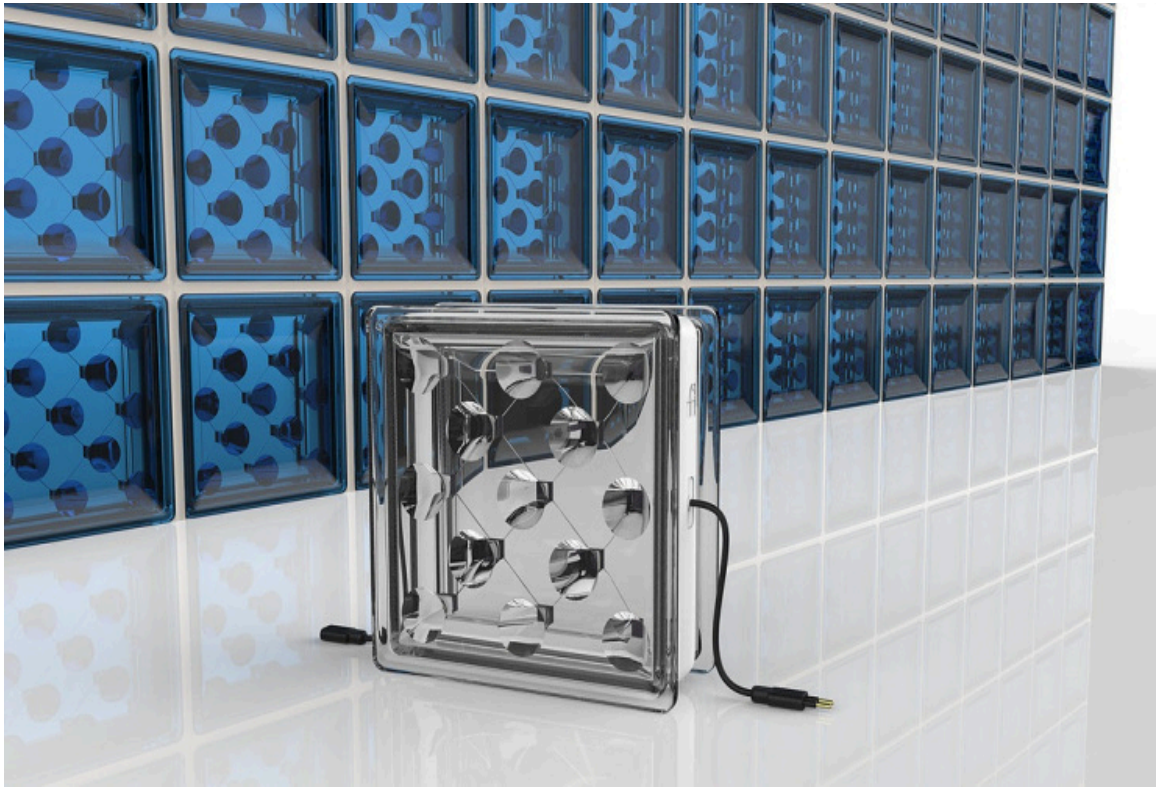


ZNE buildings

Generate as much energy as consumed

Source: Onyx Solar newsletter, Nov 2018

Solar block



Source: Univ. of Exeter

Solar window

”Clearly electric”

Source: solarwindow.com

CBD as powerhouse

Entire exterior of buildings can generates power

Source: Skanska

ZNE office

Apple’s headquarter is ZNE micro-grid

New demand-side technologies

- Emergence of stand-alone devices that
  - Generate
  - Store
  - Consume electricity …
  - … with little or no connection to the T&D network
- Highly disruptive
  - Rise of the “nonsumers”

Generate & store where you use

Self-contained bus stop in Zaragoza, Spain

Source: Onyx Solar newsletter, Nov 2018

Cut the cord?

Only woks when it’s sunny

Source: SolarPad.com

No cord, no network

Stand-alone lightpole

Stand-alone parking meter

House boat

Free solar EV charger

EV charging

Huge opportunity if we can get it right

Integrated?

Tesla energy: Generation, storage, consumption, mobility

Source: Tesla unveils residential solar roof and new Powerwall battery, Utility Dive, 28 Oct 2016

New electric company: Your home

Wall Street Journal 21 Jan 2015

“Nonsumer”

No meter: use what you can generate & store

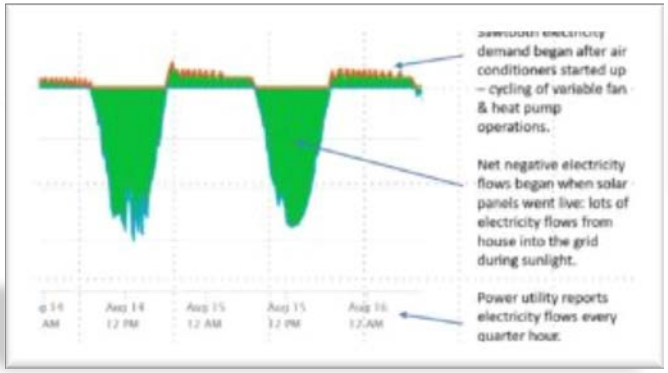
Source: Off Grid Electric

Power sharing

Micro-grids offer great potential

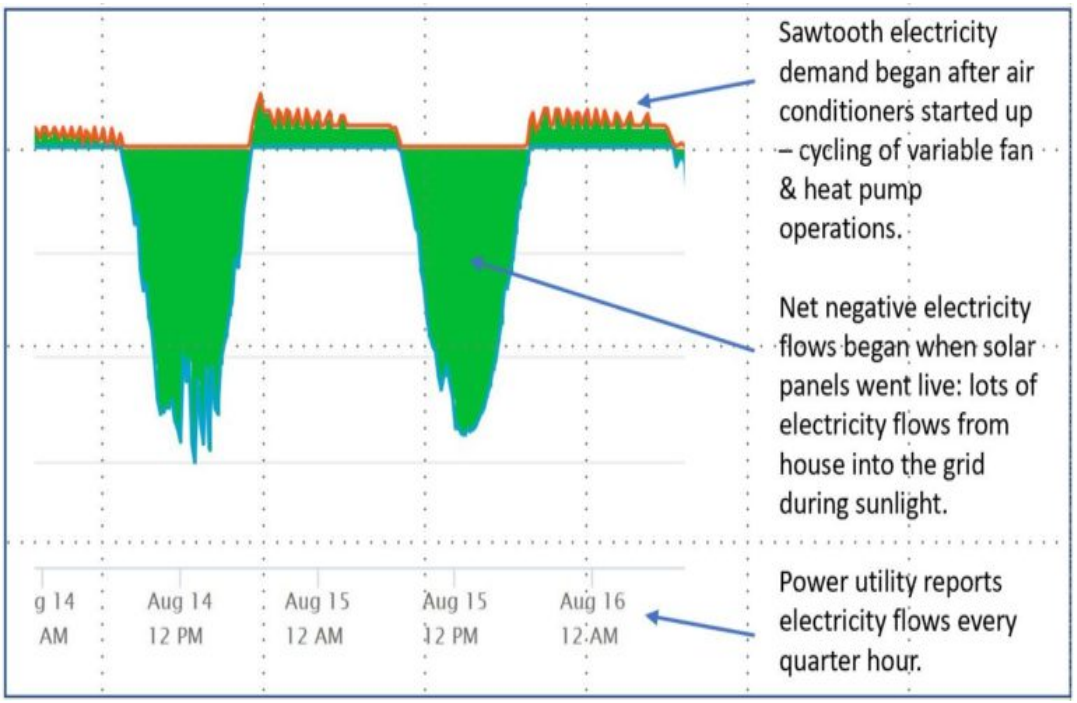
Nonsumer example
Ben Schlesinger's ZNE home

- Goal: Affordable low carbon lifestyle
  - Ground source heat pump
  - 18 kW of rooftop solar
  - 3 Tesla Powerwall batteries
  - 2 Tesla EVs
  - Plus thousands in HVAC, lighting, appliances, gadgets
- Charge EVs from the sun
- More on website http://bsaenergy.com/wordpress1/


demand began after air conditioners started up – cycling of variable fan & heat pump operations.
Net negative electricity flows began when solar panels went live: lots of electricity flows from house into the grid during sunlight.
Power utility reports electricity flows every quarter hour.
Aug 14 12 PM
Aug 15 12 AM
Aug 15 12 PM
Aug 16 12 AM

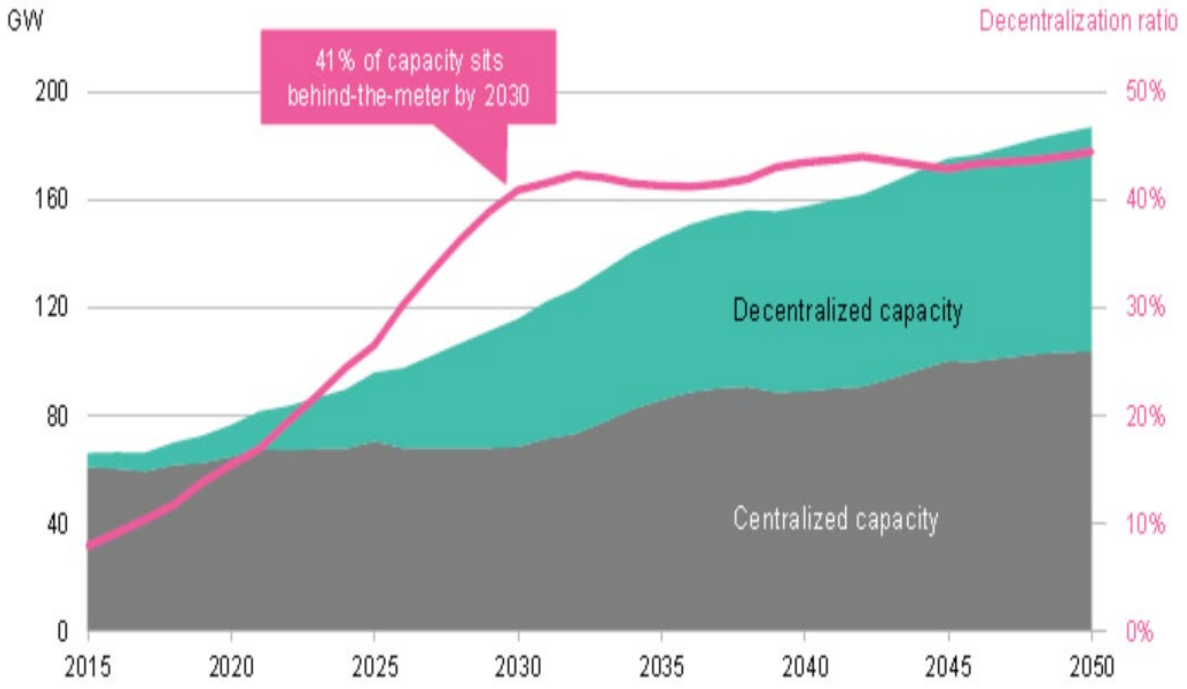
Ben Schlesinger's house

Net load centers



Source: http://bsaenergy.com/wordpress1/

2+ million Australian solar roofs



Source: Annabel Wilton, BNEF, presented at Australian Clean Energy Summit, Sydney, July 2018

It is already happening

Sales not same as consumption

- CEC's 2030 demand forecast for California, GWhs

	2018	2030
Consumption	260,000	340,000
Sales	260,000	290,000

Enablers & new business models

- P2P trading
- Platforms
- VPPS

“My EV, your PV?”

Any solar roof can be an EV charging point

Value is in the platform

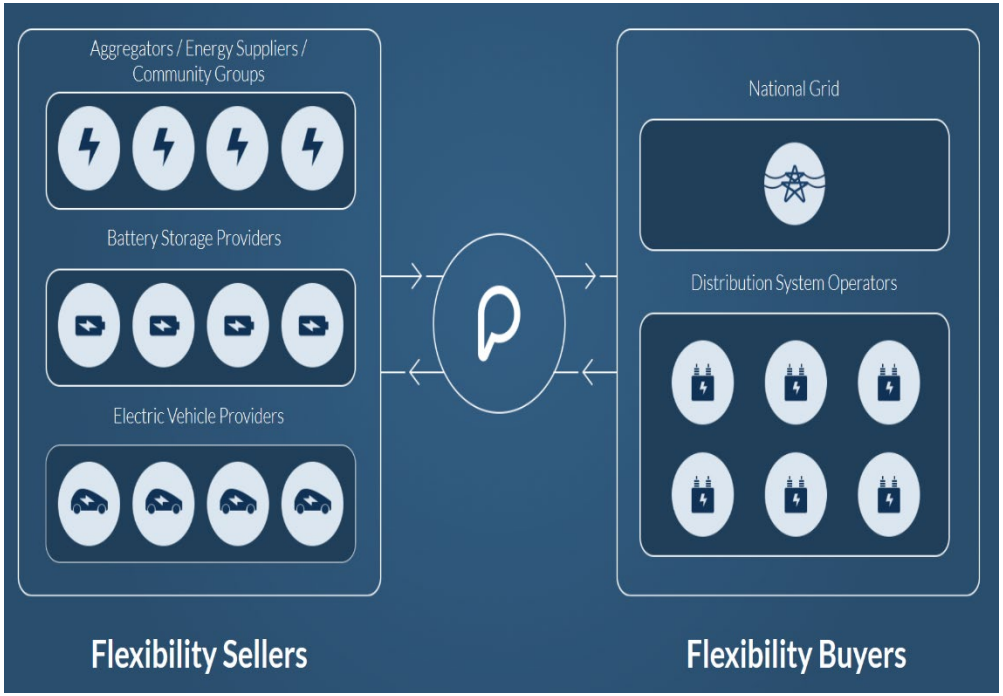
25-30% profit margin in flower order business

What makes platforms valuable?

Creating an electronic marketplace

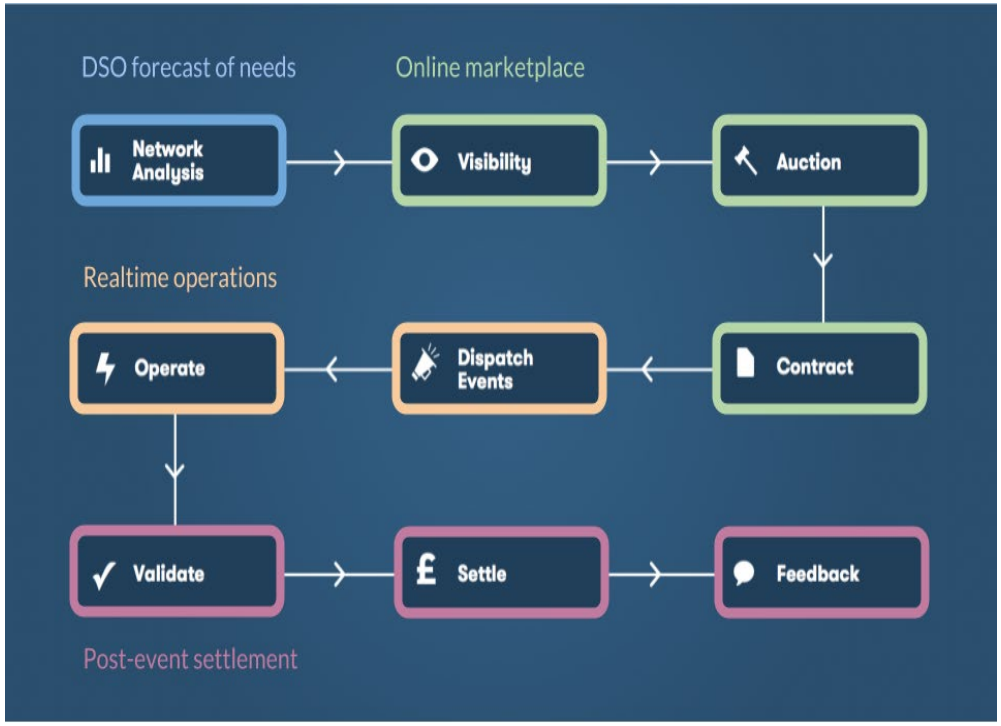
Bring buyers & sellers together

Piclo's platform allows trading of flexibility services



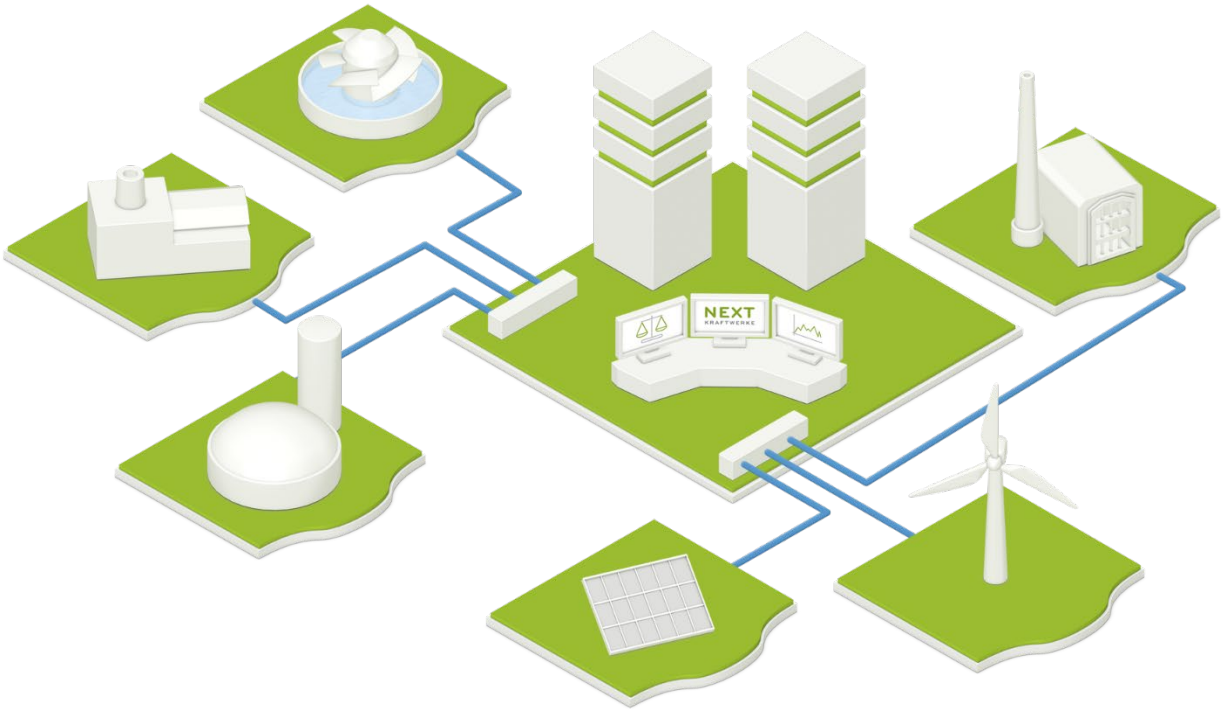
Streamline tedious transactions

No hassle, no paper



Virtual power plants

Germany's Next Kraftwerke: 4.5 GW, 5,400 participants



Source: Next Kraftwerke

“Keynote speaker”

Smart, connected, voice activated gadgets

Source: Amazon

Who is in this space today?

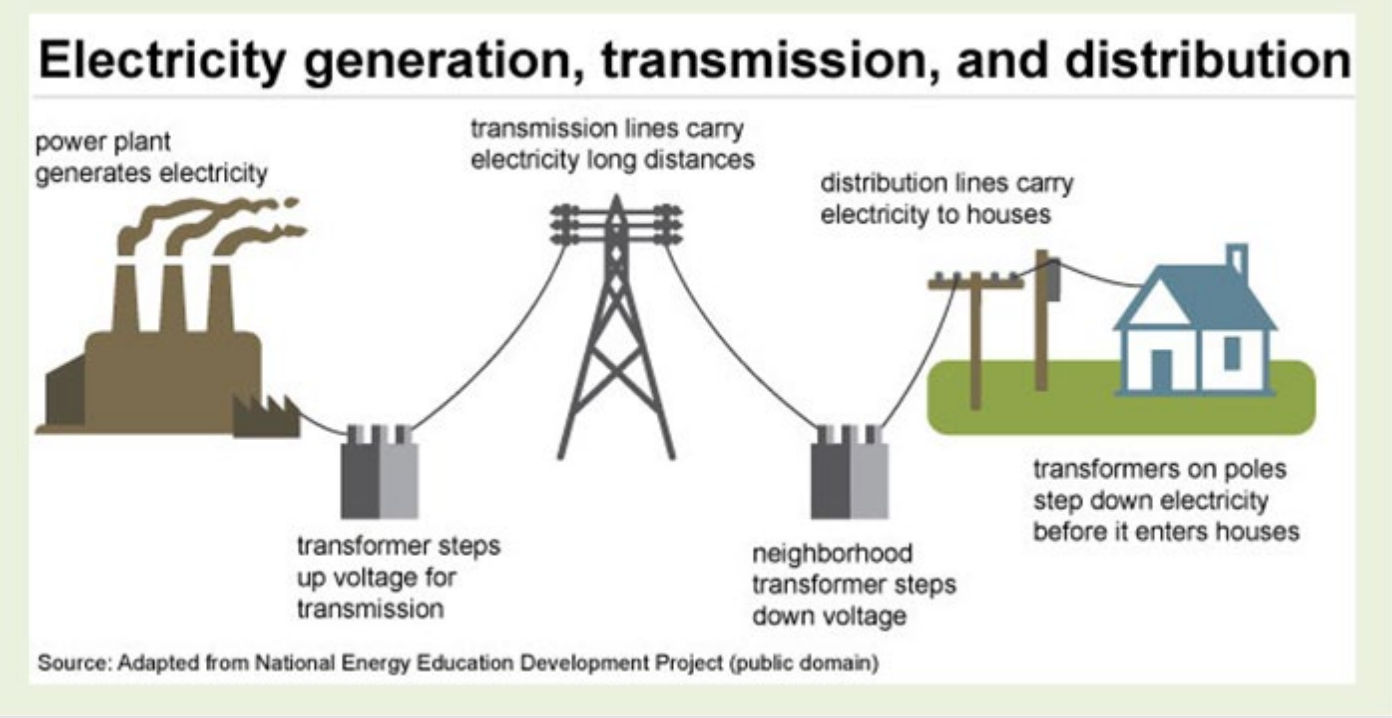
TESLA

sonnen

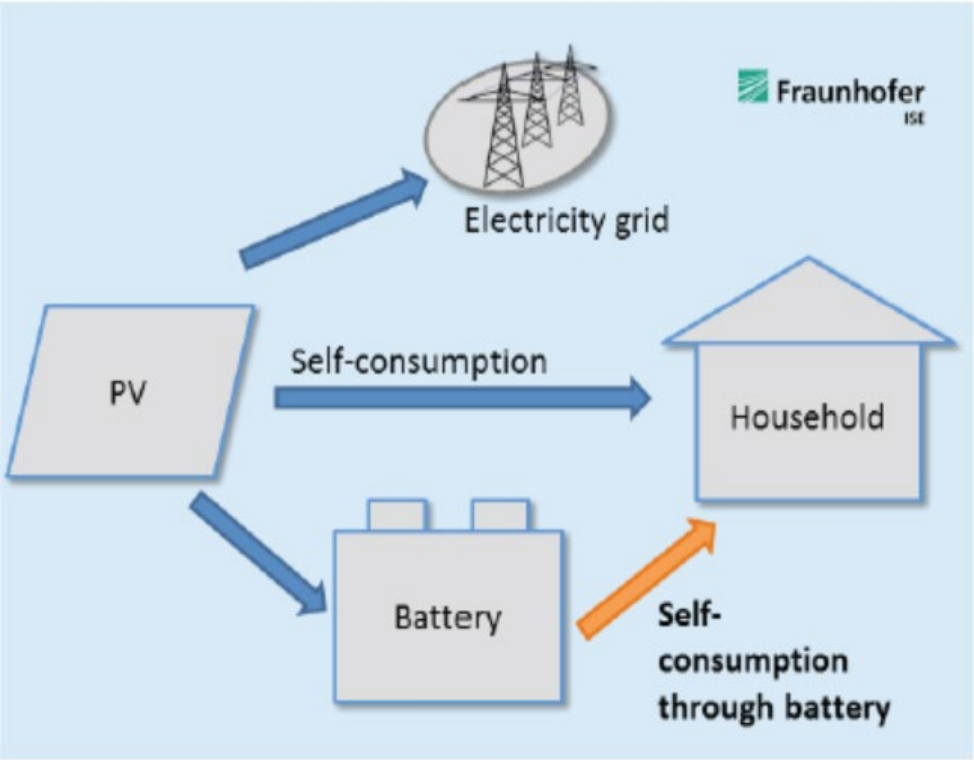
Advanced Microgrid Solutions

stem

Implications?

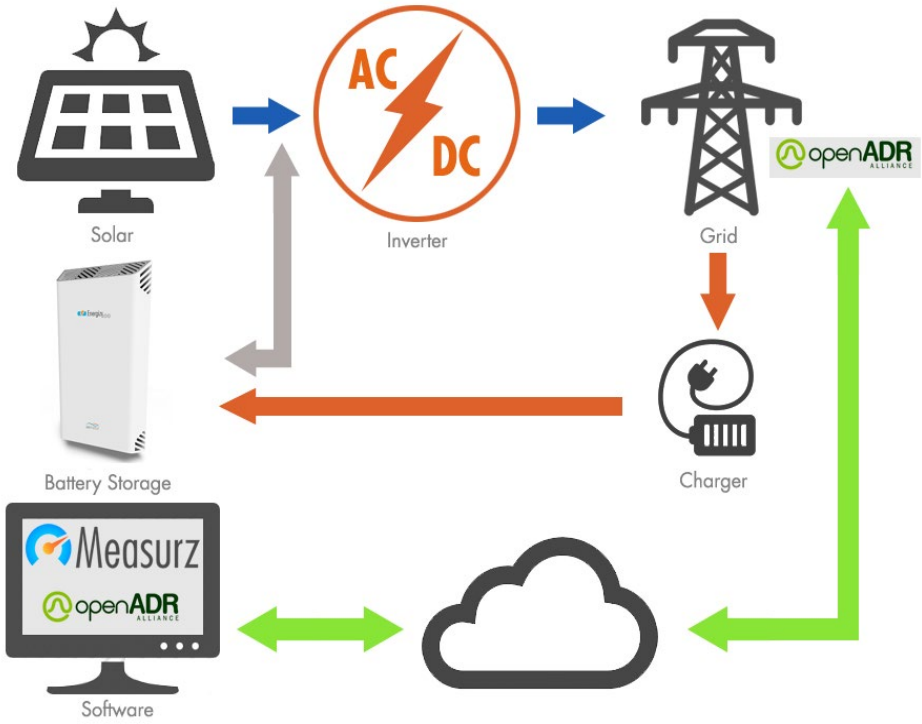


Will it look like this?



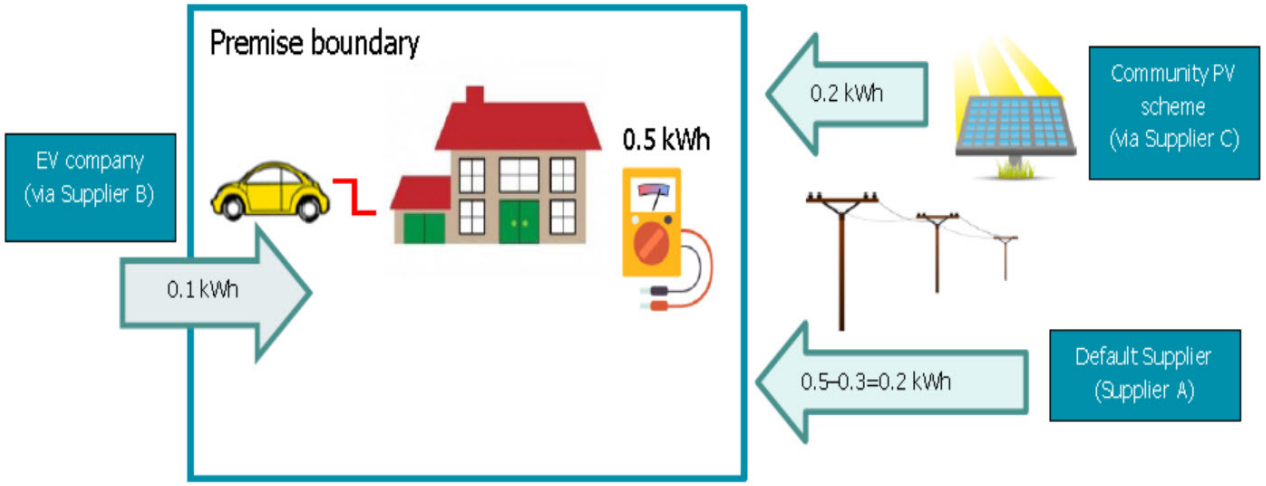
Source: LCOE: Renewable energy technologies, Fraunhofer Inst., Mar 2018

… or future in the cloud?



Source: JLM Energy

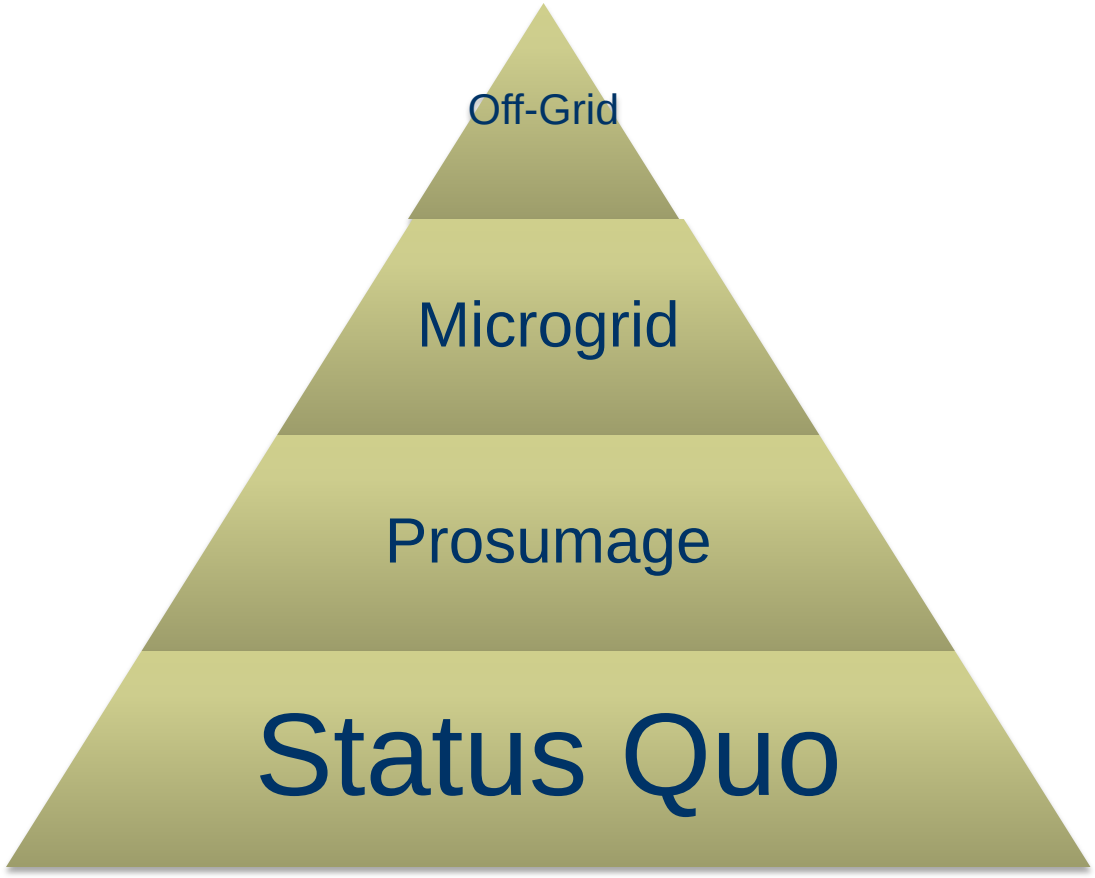
… or multiple suppliers?



Source: Elexon

Customer stratification

Over time, consumers will self-select what works best



Emerging interfaces

Different needs => relationships

Consumers	All kWhs delivered thru existing network Bundled, regulated tariffs
Prosumers	Fewer *net* kWhs from network Mostly need back up power
Prosumagers	Even fewer net kWhs
More exotic?	Communities of “nonsumers” enabled by AI/intermediaries