Impact of distributed generation

on utility business model

UNSW

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Kensington, NSW

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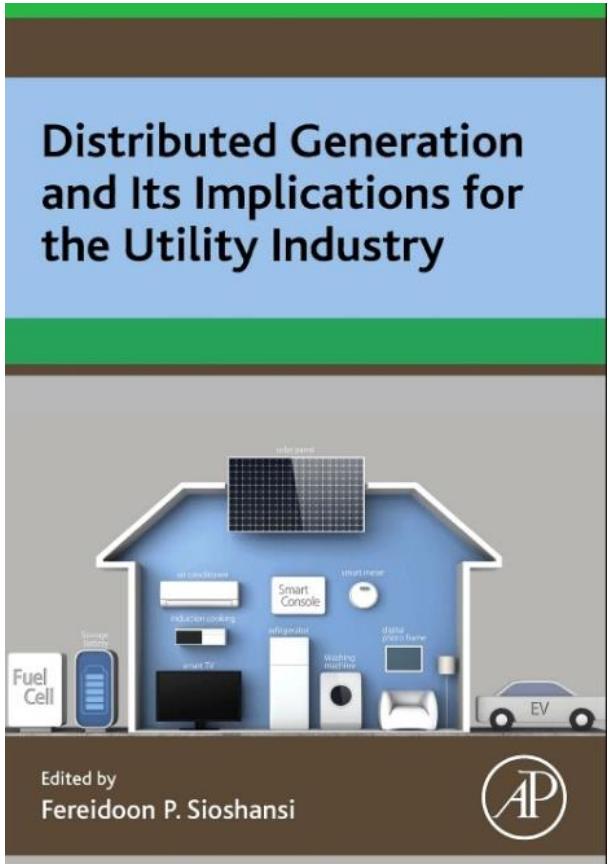
Thank you

- Always a pleasure to be back at UNSW
- Annual pilgrimage to CEEM
- Thanks to Iain MacGill for the invite
- Look forward to future collaborations

June 2014


Distributed Generation and Its Implications for the Utility Industry
Smart Console
Fuel Cell
EV
Edited by
Fereidoon P. Sioshansi
AP

Milk Analogy

- Suppose people cut back on drinking milk …
  - Perhaps due to rising prices/alternatives
- … and everyone raises a goat or a cow …
  - Perhaps due to backlash against centralized forming
- … produce more milk than consumed …
- … supermarket obliged to buy excess milk …
  - Perhaps due to new legislation to support distributed milk
- … and pay a credit for every excess gallon
  - At price equal or better than retail price of milk

Under such a scenario

- What would happen to
  - Commercial dairy farmers & processing plants?
  - Dairy delivery network?
  - How would milk be priced in such an environment?

This *is* precisely happening

Substitute “electricity” for “milk”

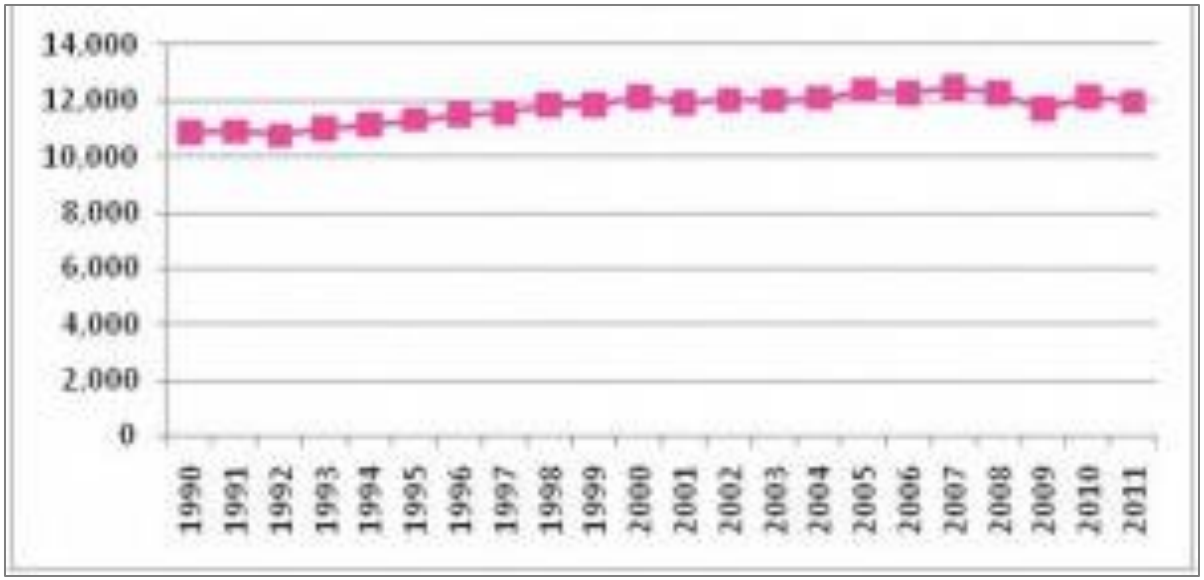
- Consumers use less electricity …
  - … because energy efficiency is a relative bargain …
  - … many are putting PV panels on the roof …
  - … produce more electricity than consumed …
  - … utility is obliged to buy excess electricity …
  - … pay a credit for excess kWhrs
  - It gets worse
    - Price of self-generation keeps on falling; tariffs rise
    - New technologies allow storage/micro-grids, HEM, etc

What happens to …

- Generators with large thermal plants?
- Grid operator?
- Distribution company?”
  - Especially in markets such as Australia where dis-integrated
- To “utility” industry?
  - Which ever way we define it?

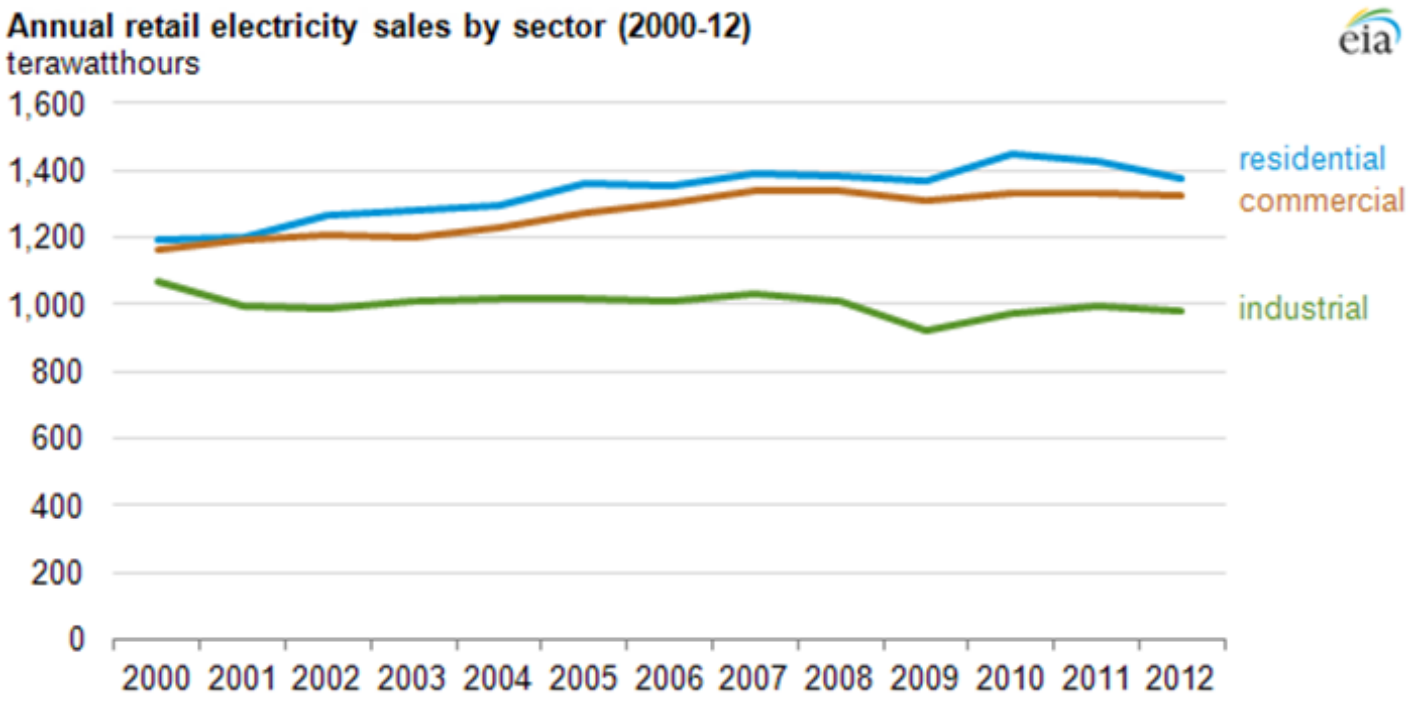
Not drinking more milk

US per capita electricity consumption 1990-2011, kWh/pp



Source: Smart Grid Watch, *How fast is U.S. electricity consumption growing?* April 6 2012

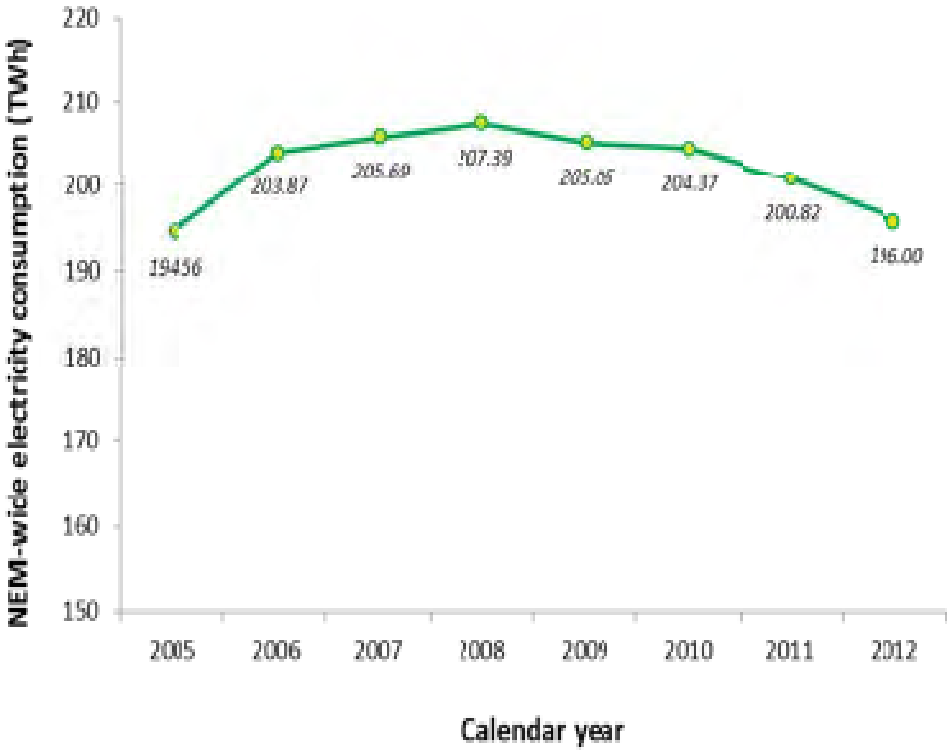
Not growth in any sector



Source: Americans are buying less electricity. That's a big problem for utilities Brad Plumer, The Washington Post, 23 Dec 2013 based on data from EIA

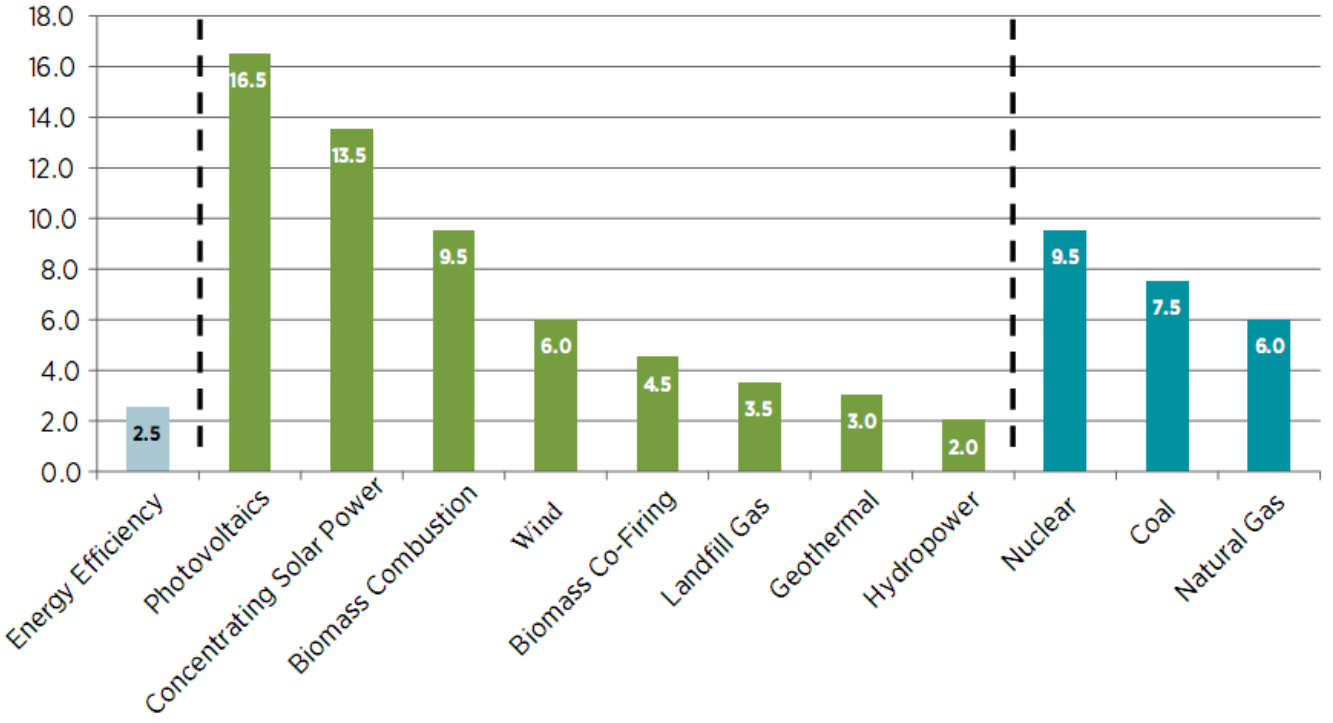
Australia's demand growth

Elect. consumption in Australia's NEM, 2005-12, in TWhrs



Source: AEMO data; graph courtesy of greenmarkets.com.au

Negawatts cheaper than megawatts



*** Includes current federal & state level incentives, natural gas price is assumed at $4.50/MMBTU**
Source: US Renewable Energy Quarterly Report, ACORE, Oct 2010

Goat on every roof

Residential Retrofit

New Production Homes

Commercial & Public

Power Plants

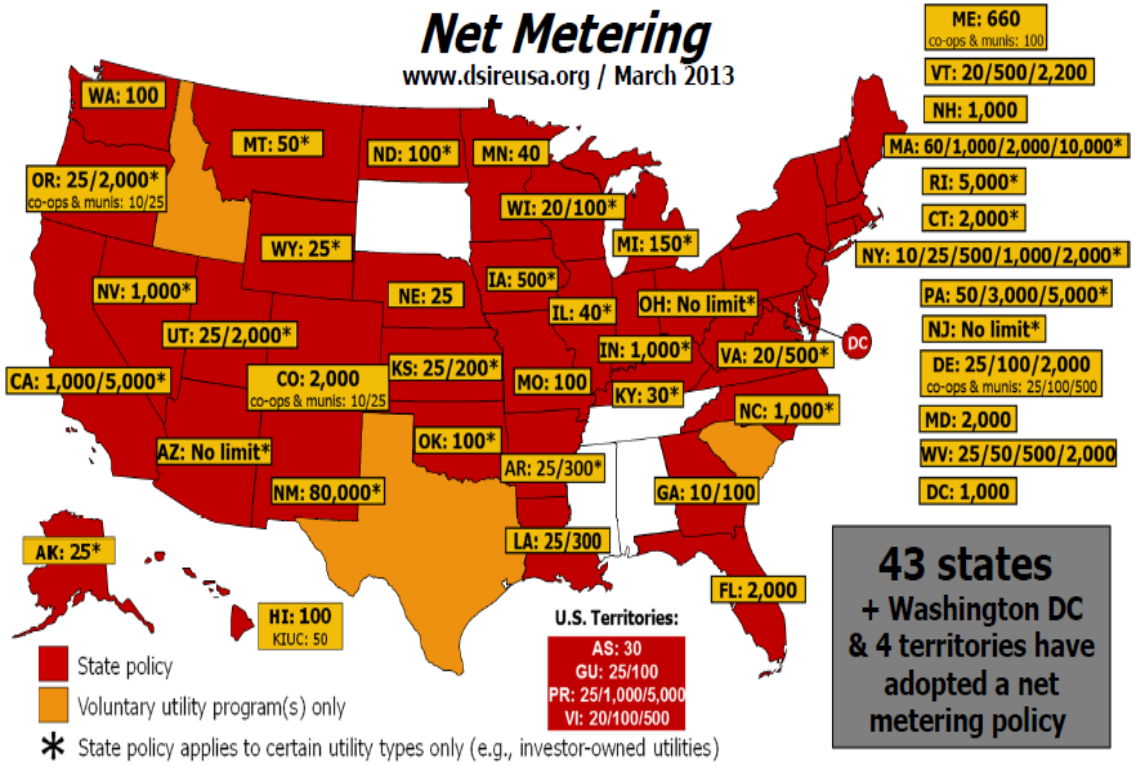
Decentralized

Next: solar tiles

Source: Mike Swanston, Energex

Credit for excess milk

Net metering spreading across the land



Source: DSIRE USA

Main message

- Revenue erosion serious & imminent
  - Today: QLD, Germany, HI, CA
  - Tomorrow: Virtually all high tariff OECD countries
- Traditional business model unsustainable
  - Fixed tariff applied to volumetric usage inappropriate
- Regulation out of synch with reality
  - System is broke & not clear how to fix it
  - Regulators in a no-win position

Fighting solar lobby not good strategy

Not easy to be a regulator

- Regulators were “invented” to protect consumers against abusive monopolies
- They find themselves “saving” monopolies
- Taxis vs. Uber
  - Will same fate apply to solar PVs?

Outline

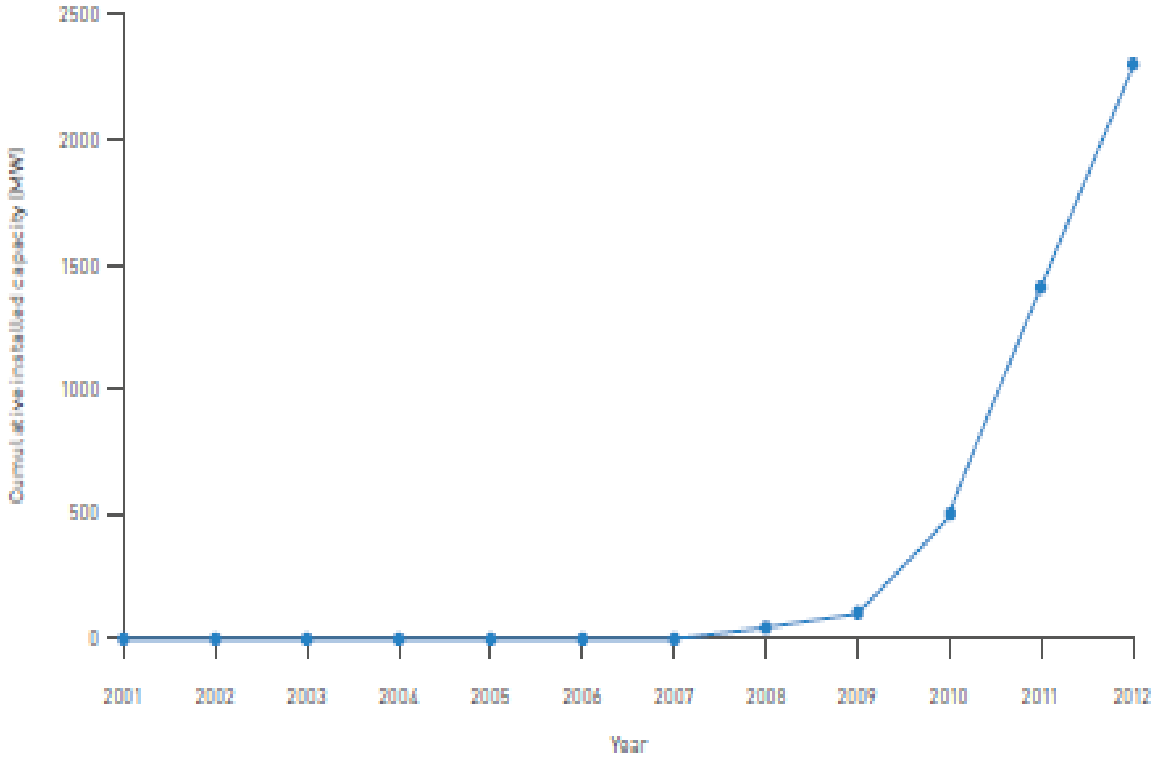
- I Scale/scope of problem
- II Main drivers
- III Revenue insufficiency
- IV How to fix the problem?

Problem?

Source: The economics of grid defection: When & where distributed solar generation plus storage competes with traditional utility service, Rocky Mountain Institute et al, 2014

Australian PV uptake

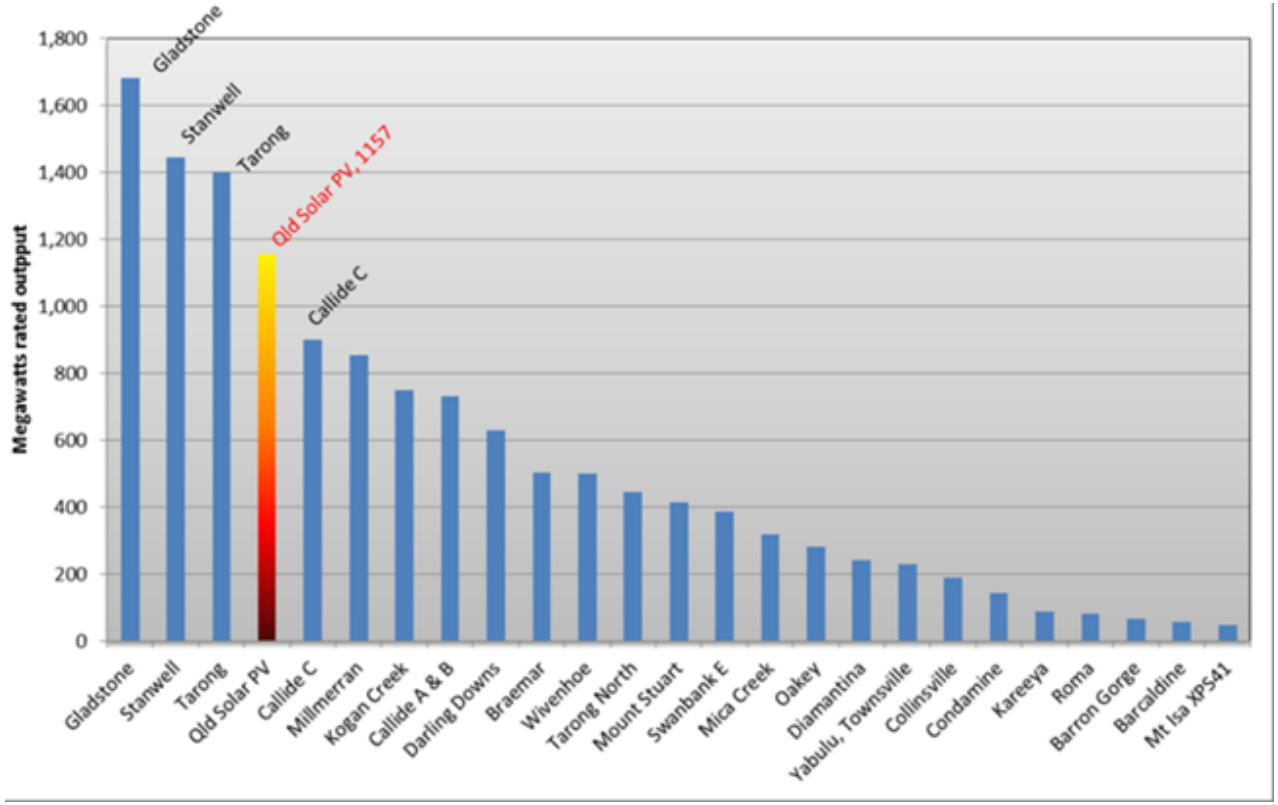
Cumulative installed capacity of solar PVs in Australia, 2001-2012, in MW



Source: Clean Energy Council of Australia

PVs 4th largest source of capacity in QLD

Capacity in MW, April 2014



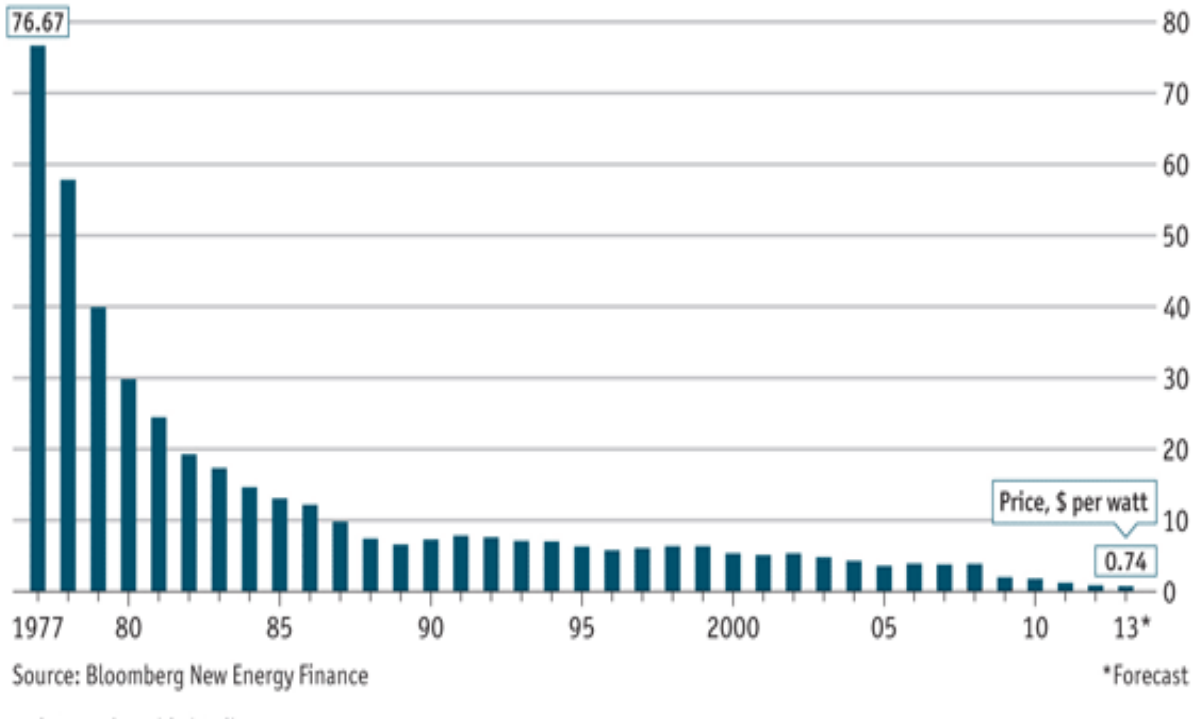
Source: Mike Swanston, Energex

Main drivers

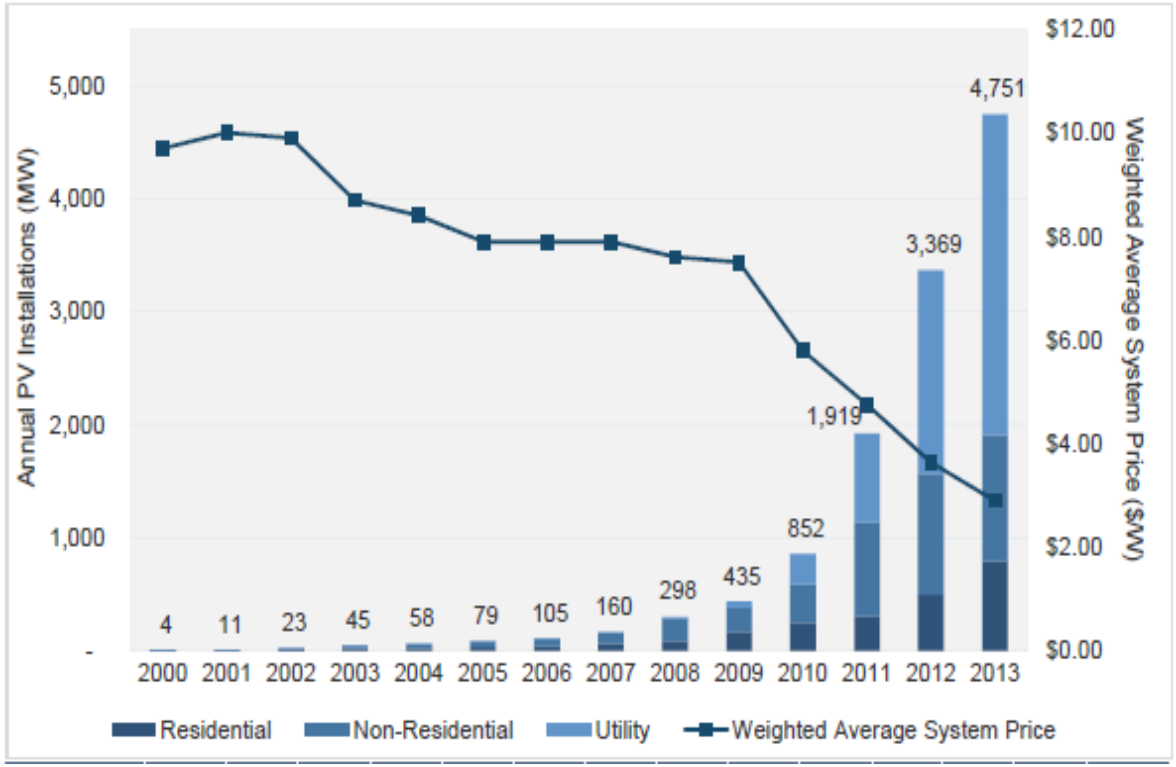
- Grid parity
- Renewable/DG subsidies; FiT policies
- EE/Zero net energy/passive buildings/codes
- Storage technology & cost
- Home energy management

Solar PV prices keep falling

Price of solar PVs, 1977-2013, in $/W



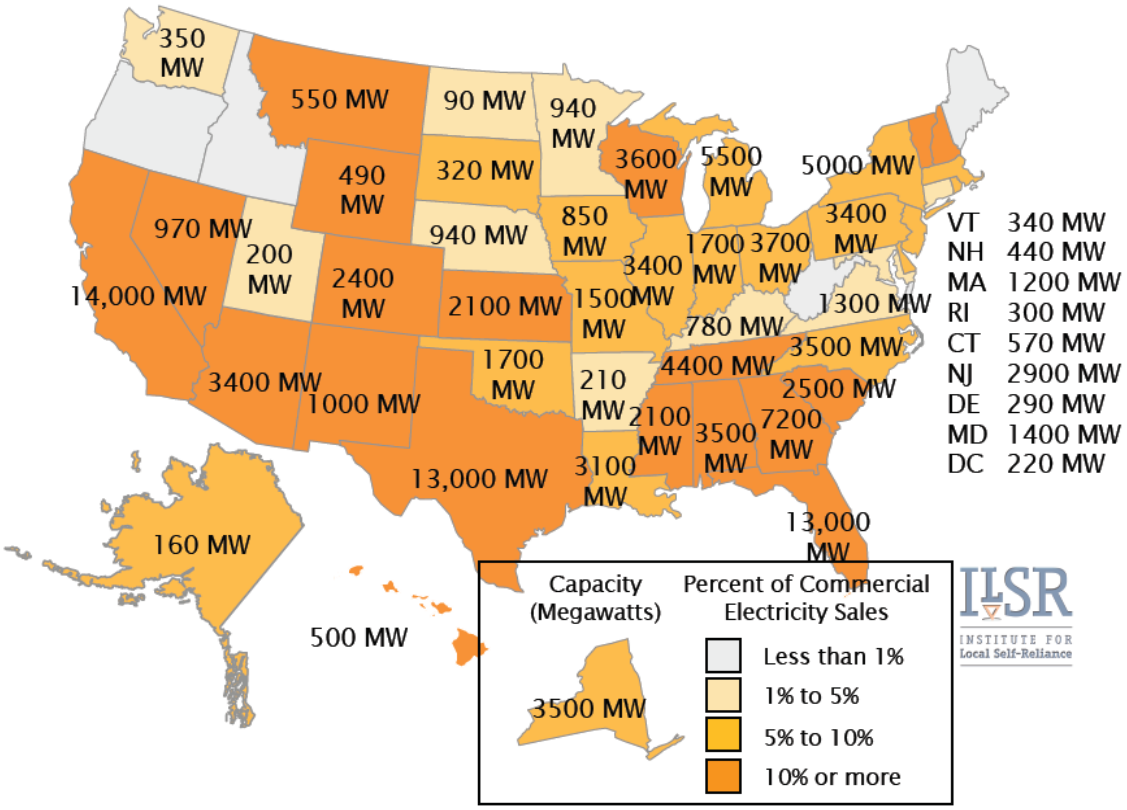
Falling costs, rising installations



Source: US Solar Market Insight Report, 2013 in review, Exec Summary, GMT Research & SEIA

Solar grid parity

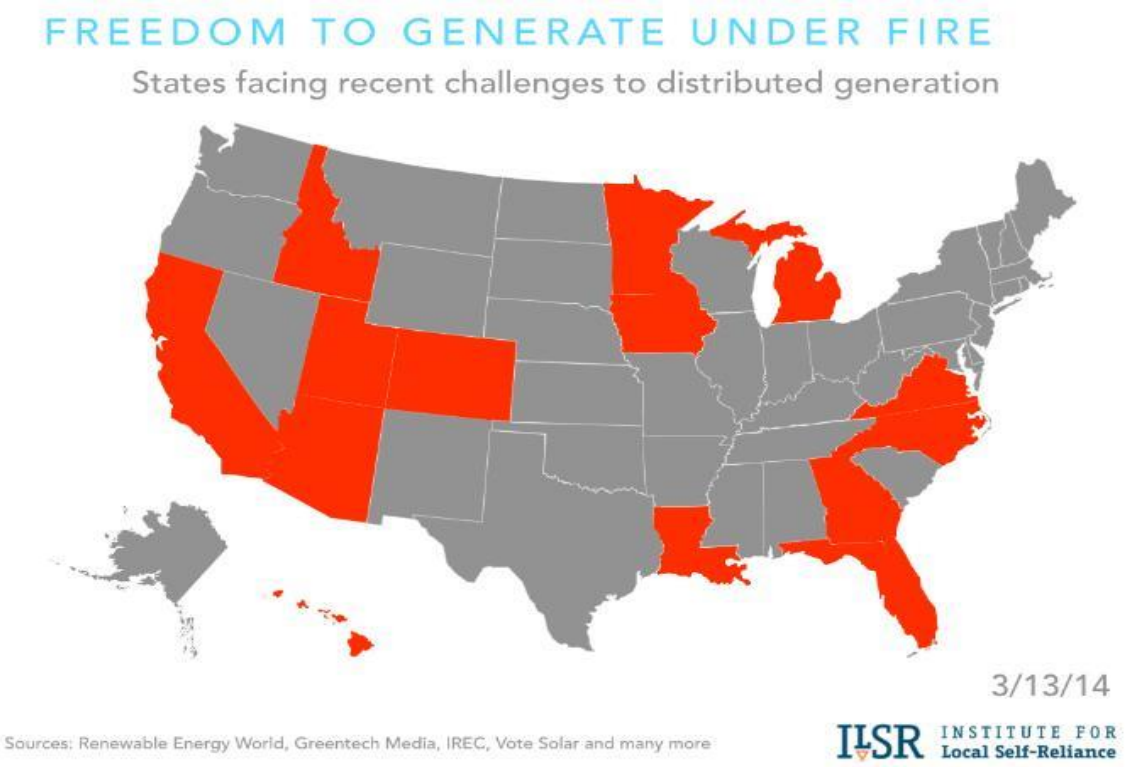
Energy Potential from Unsubsidized $3/W Commercial Solar (Capacity and % of Sales)



Source Commercial Rooftop Revolution, Institute for Local Self-Reliance (ILSR), Dec 2012

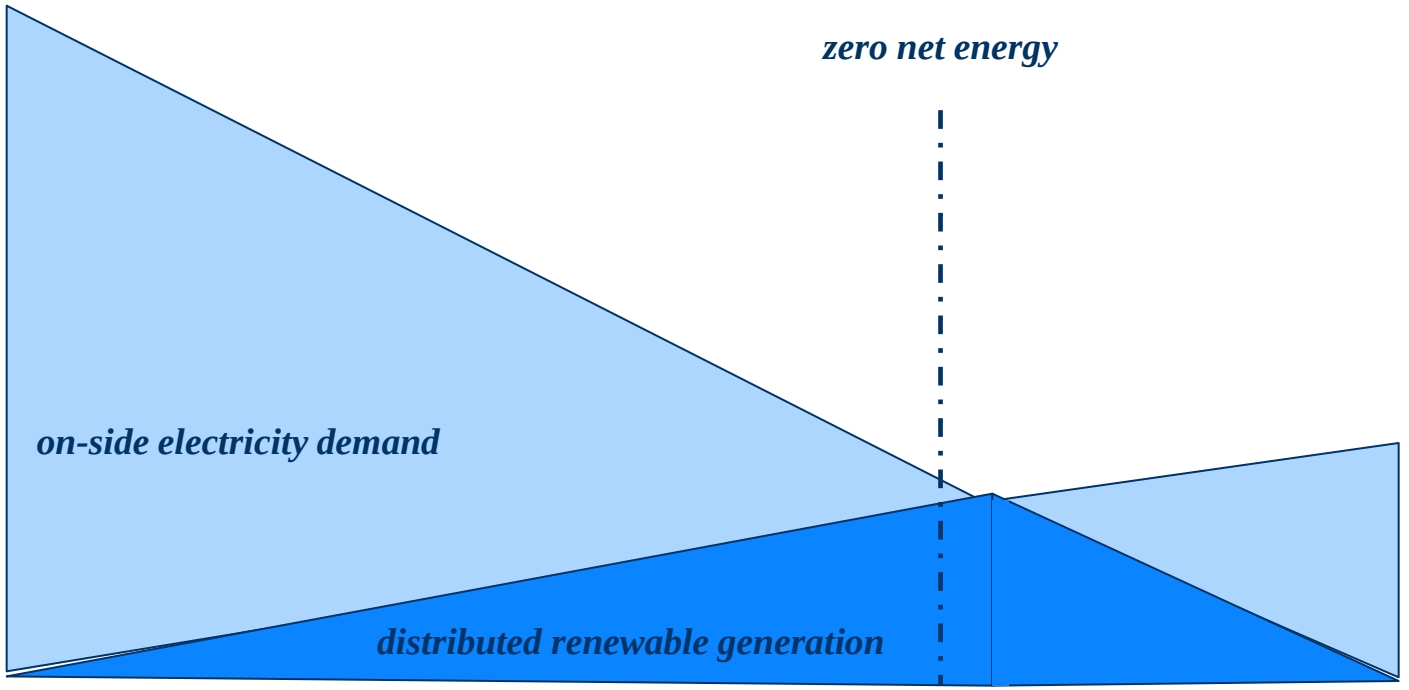
Key NEM battlegrounds

States where net energy metering (NEM) laws are challenged



Zero Net Energy

Applies to *new* residential buildings in 2020; commercial 2030



Big customer, no revenues

Apple’s new office building under construction in Cupertino, CA

NREL is ZNE

Source: NREL

More to come

Source: NREL

Tesla

Looks pretty, travels far, not as expensive as Lamborghini

Source: www.tesla.com

Home energy management

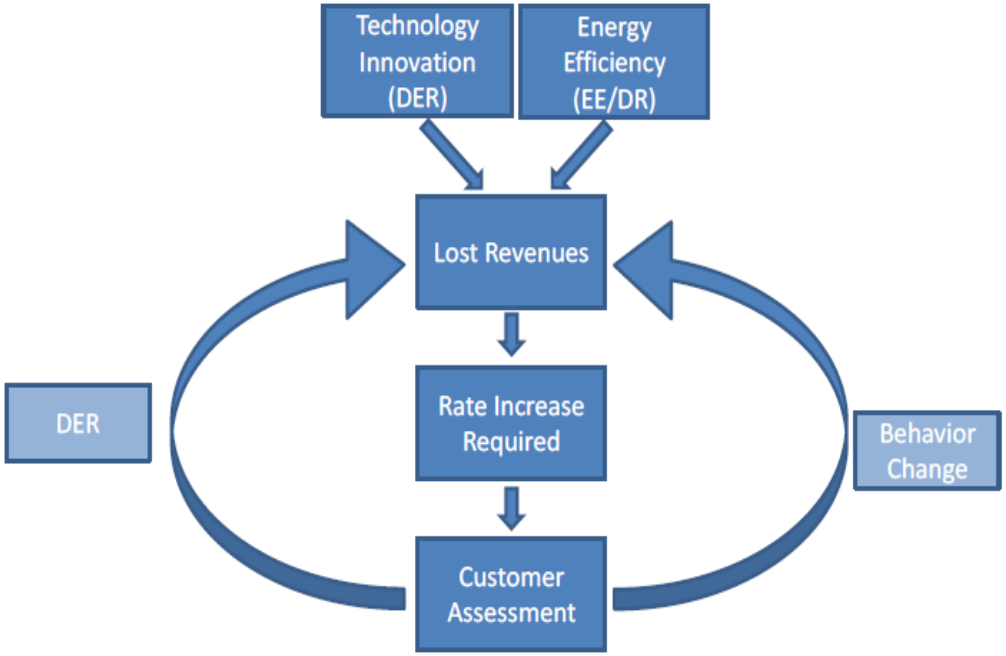
Source: Google.com

Why US utilities are in panic?

Edison El. Inst.: NEM “Largest near term threat to industry”

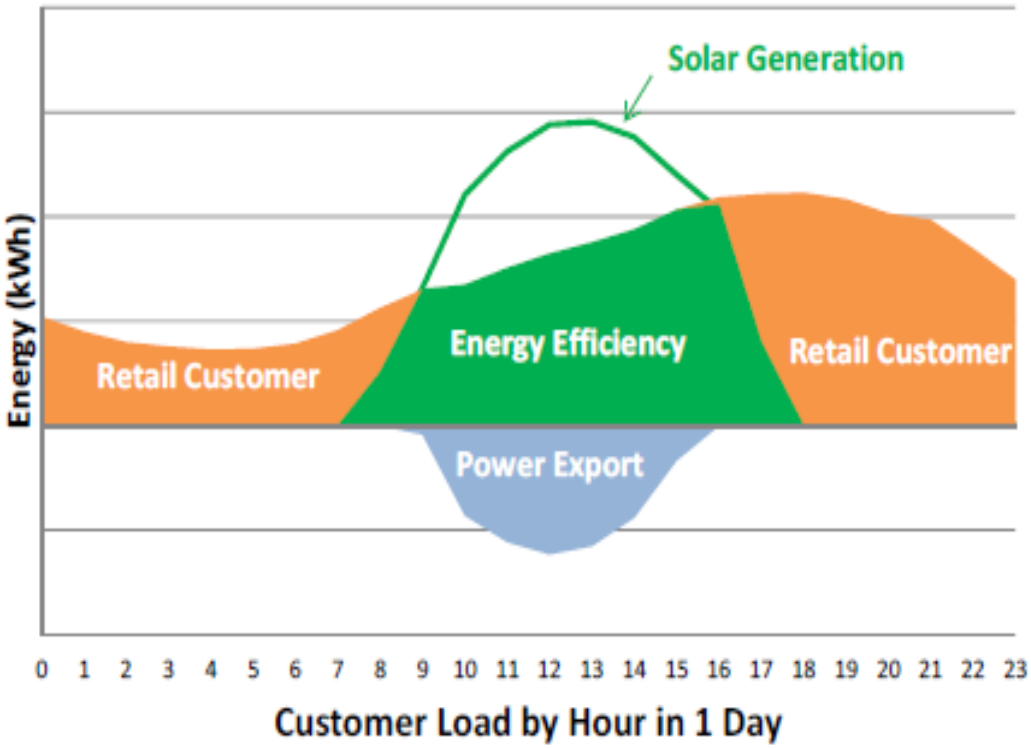
Add to your vocabulary: Disruptive Energy Resources (DER)

Vicious Cycle from Disruptive Forces



Source: Disruptive challenges: Financial implications and strategic response to a changing retail electric business, Edison Electric Institute, Jan 2013

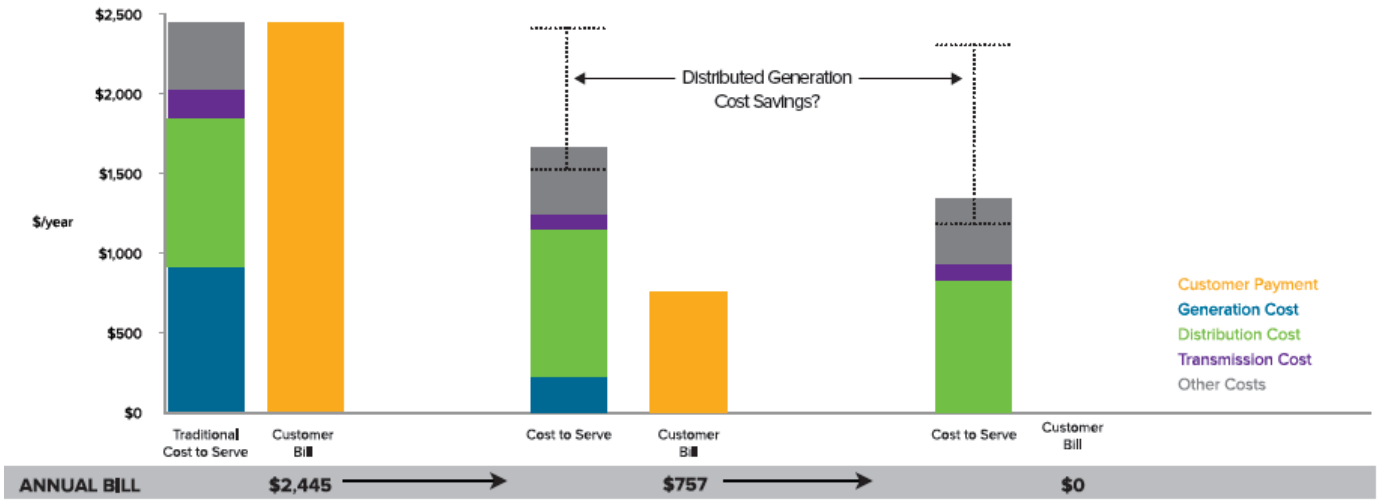
Consumers become *prosumers*



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

Vanishing revenues

For ZNE/DG customers bills vanish, the costs don't



Traditional, Full Service Customer

This customer, whose load profile is average for the type of residential customer likely to install DG under NEM, pays for her electricity on PG&E's E-1S schedule. On average, the utility fully recovers its costs.

Distributed Generation Customer

The customer installs a PV system that meets part of her annual energy use. Under current rates, the utility is likely to under-recover its costs to serve such a customer, but the results depend on usage, load shapes, and other factors.

Zero Net Energy Customer

The customer installs a PV system that meets ALL of her annual energy use. The utility receives no revenue even though the customer still uses to the utility's network as a battery.

Source: Net energy metering, RMI, Mar 2012

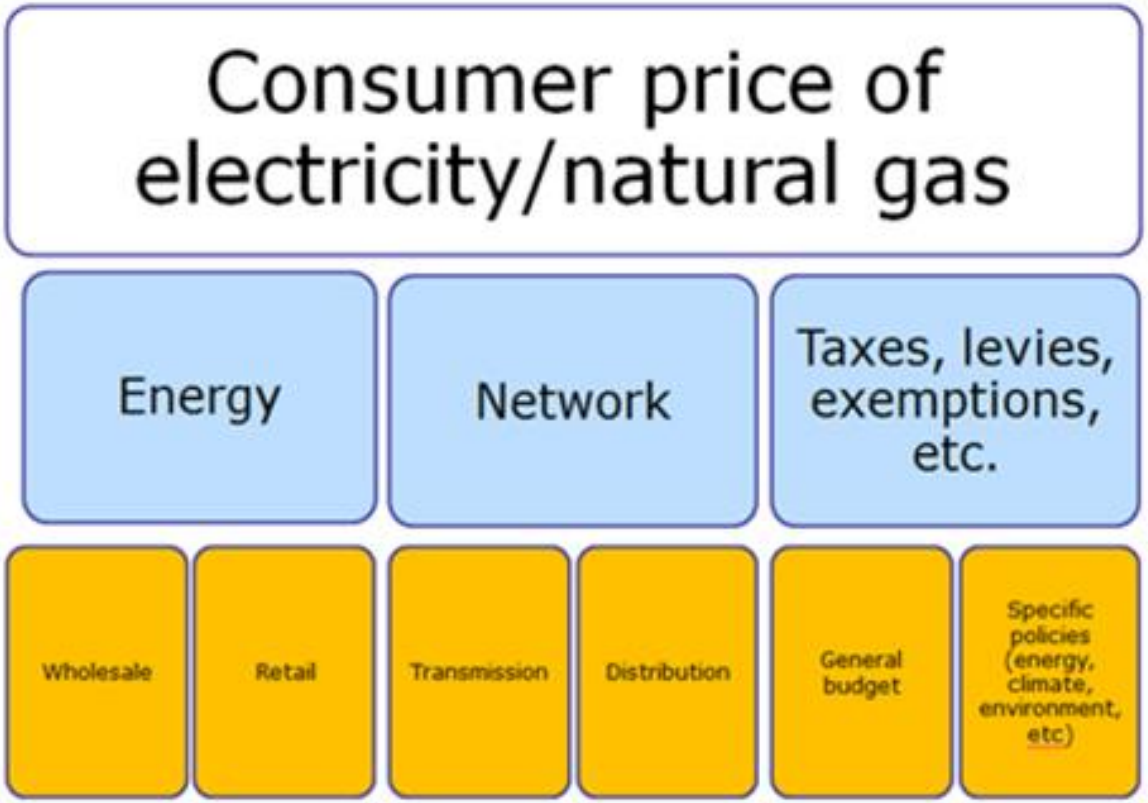
New value proposition

- What do prosumers want?
- How much are they willing to pay?
- Telecom analogy
  - Ubiquity/universal coverage
  - Bandwidth/speed
- Prosumer equivalent?
  - Capacity to upload/download to grid
  - Reliability/backup/balancing service

New regulatory paradigm?

- First: Re-align revenues & costs
  - Over 60% for US residential consumers
  - Currently little or no fixed monthly fees
- Second: Electrons flow in all directions
  - Collect a toll at the gate, regardless of flow
- Third: Back-up & reliability highly valuable
  - Stand-by fees based on value derived/cost imposed
- Fourth: Action on customer side of meter
  - Don’t stifle product & service innovation

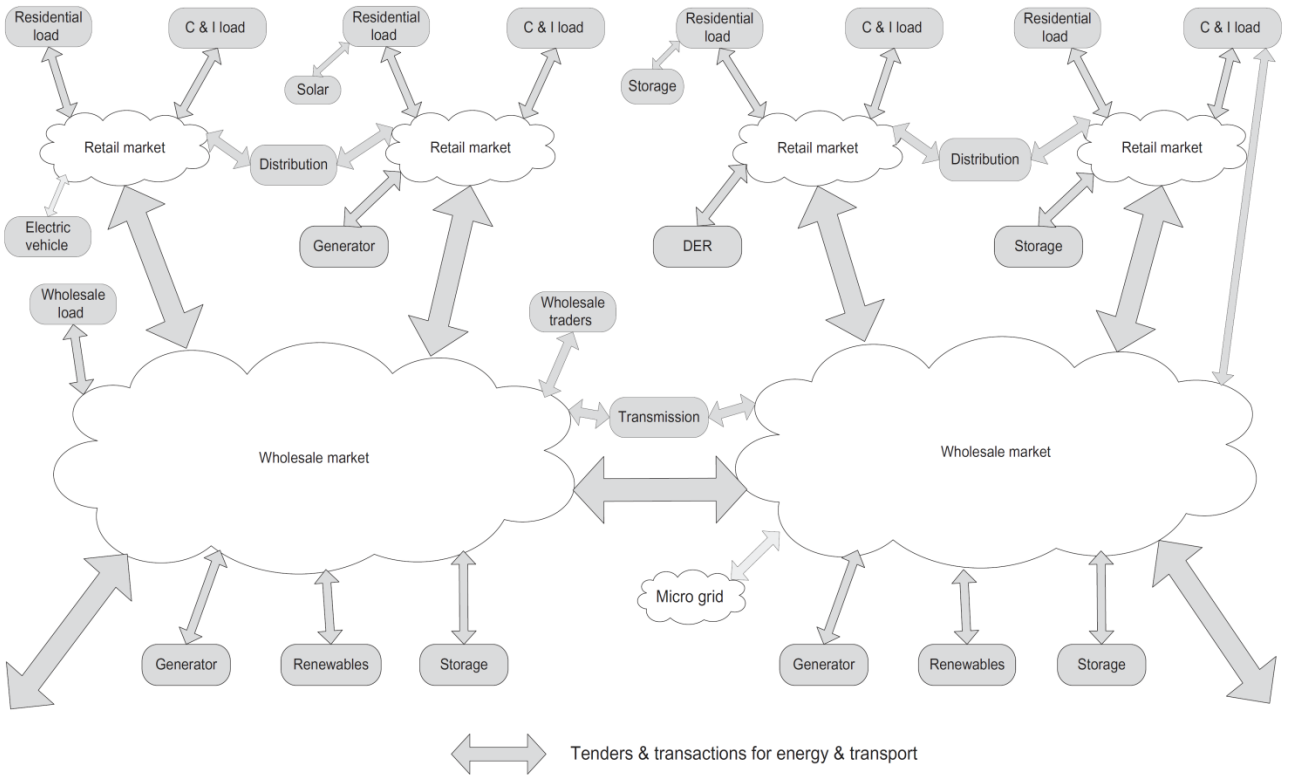
Back to basics



Source: Energy Costs & Prices in Europe, EC, 2014, Brussels

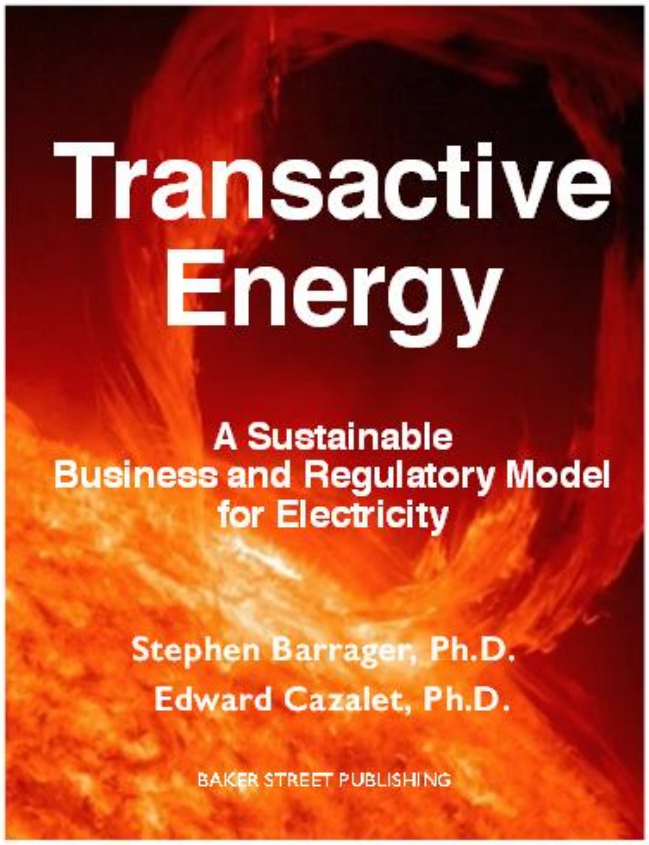
Transactive tariffs

Who buys/sells what from/to whom & when?



Source: ISO

Future is transactive



Transactive Energy

- Check websites below
- https://www.dropbox.com/s/yxv56z1hq7fjvd5/TransactiveEnergyBookSample1.pdf
- http://www.slideshare.net/barrager/transactive-energy-keystone-of-sustainable-electricity-markets

Future volume?

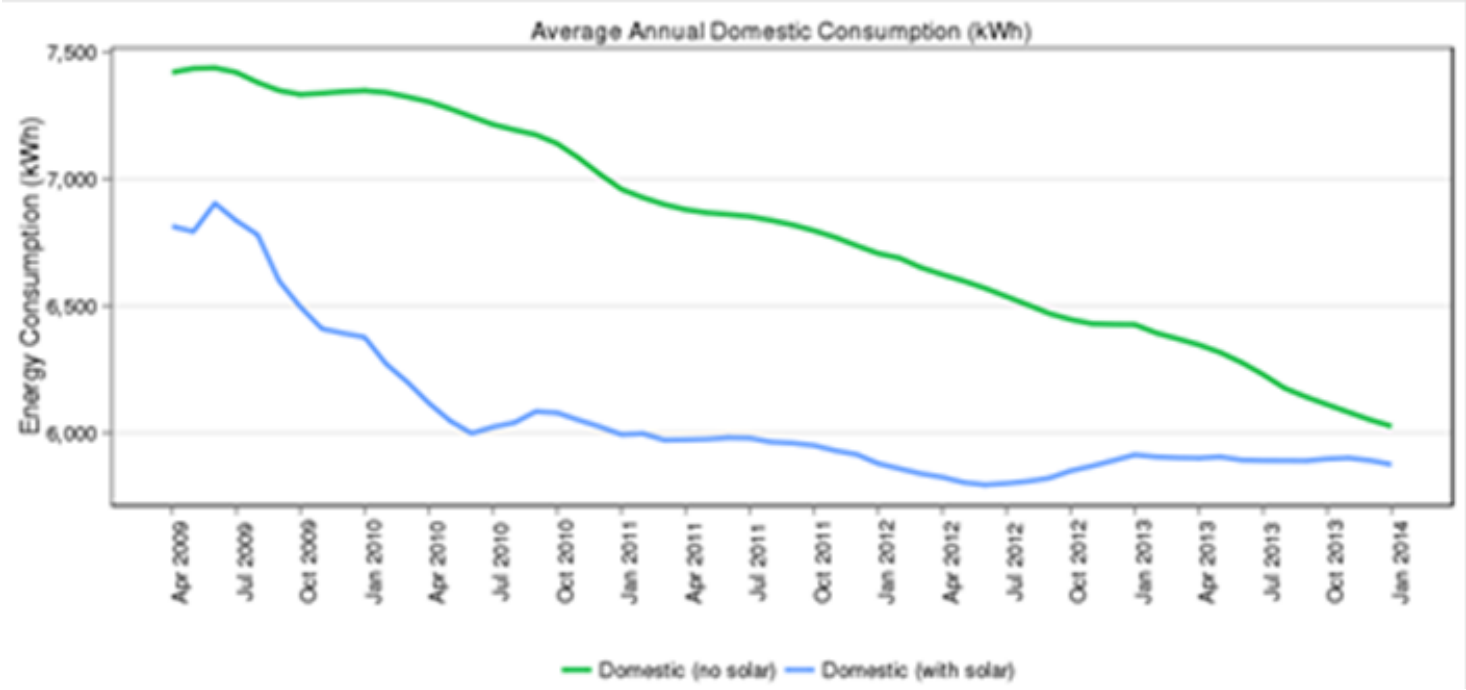
- Utility 2.0
- Disruptive technology
- Future business models
- Distribution company of the future
- Interface between ISO/Dist. Company
- New regulatory models/paradigms

Thank you

- Happy to answer questions

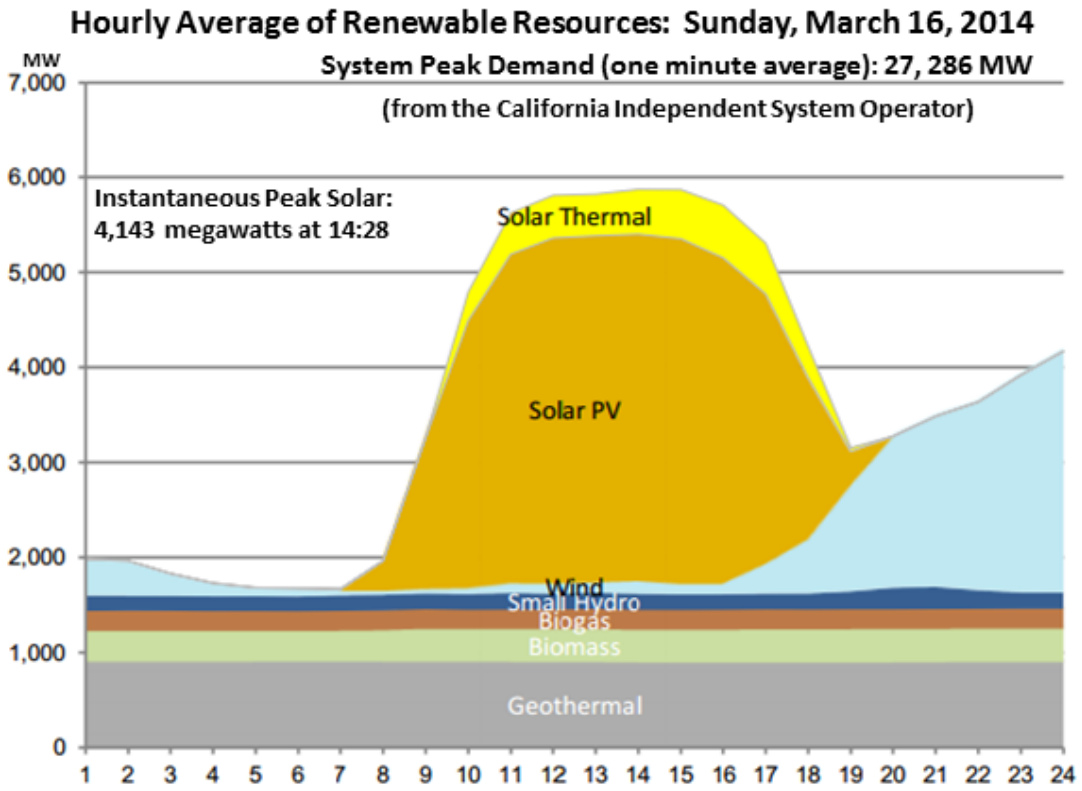
Lower consumption, solar & non-solar

Residential consumption in QLD, solar (blue) *and* non-solar (green) customers



Source:

Where is the Mid-day peak?

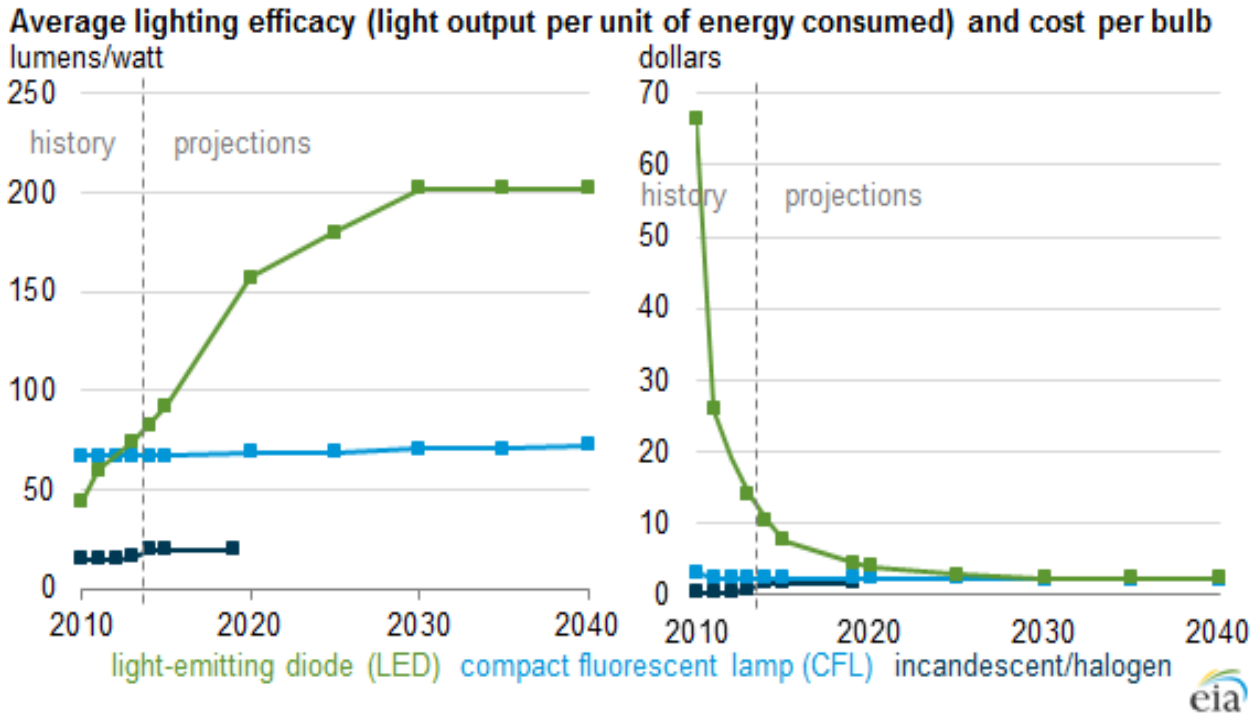


Source: ISO

Example

- First:
  - $60+/mo Min monthly connection fee regardless of usage
- Second:
  - 5 cents/kWh crossing customer meter in both directions
- Third:
  - A service charge based on maximum in/out capacity
- Fourth:
  - Technology neutral regulation

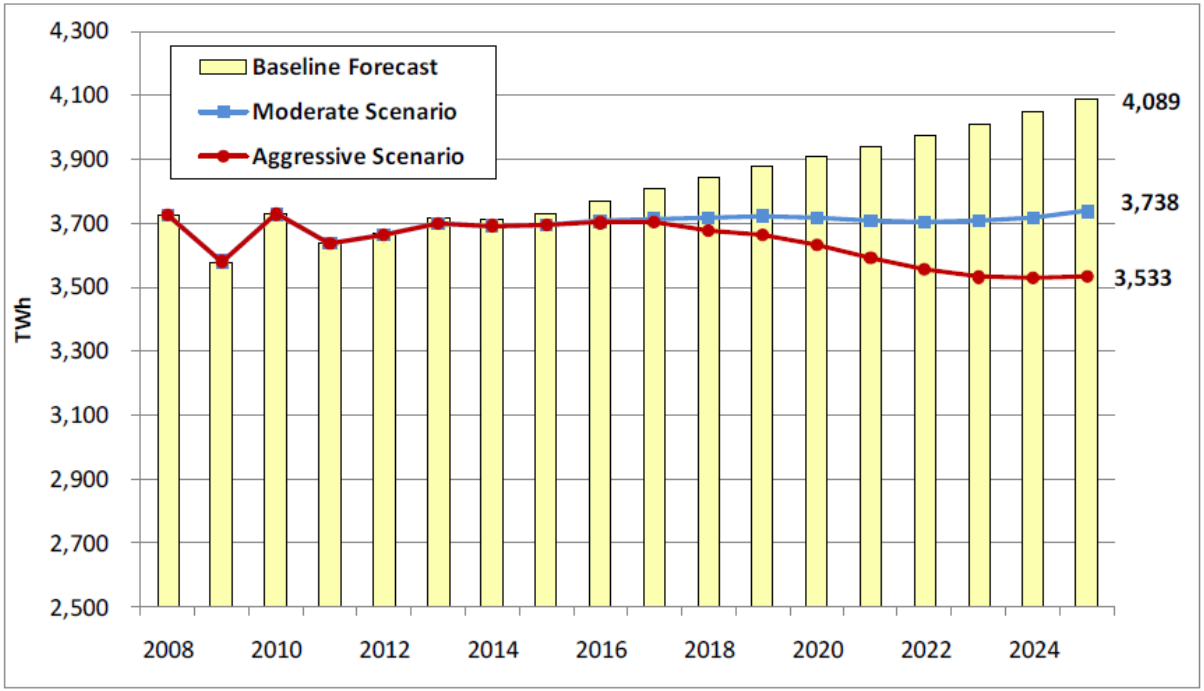
25% of load cut in half



Source: US Energy Information Administration, Annual Energy Outlook 2014 Early Release

Future US demand growth?

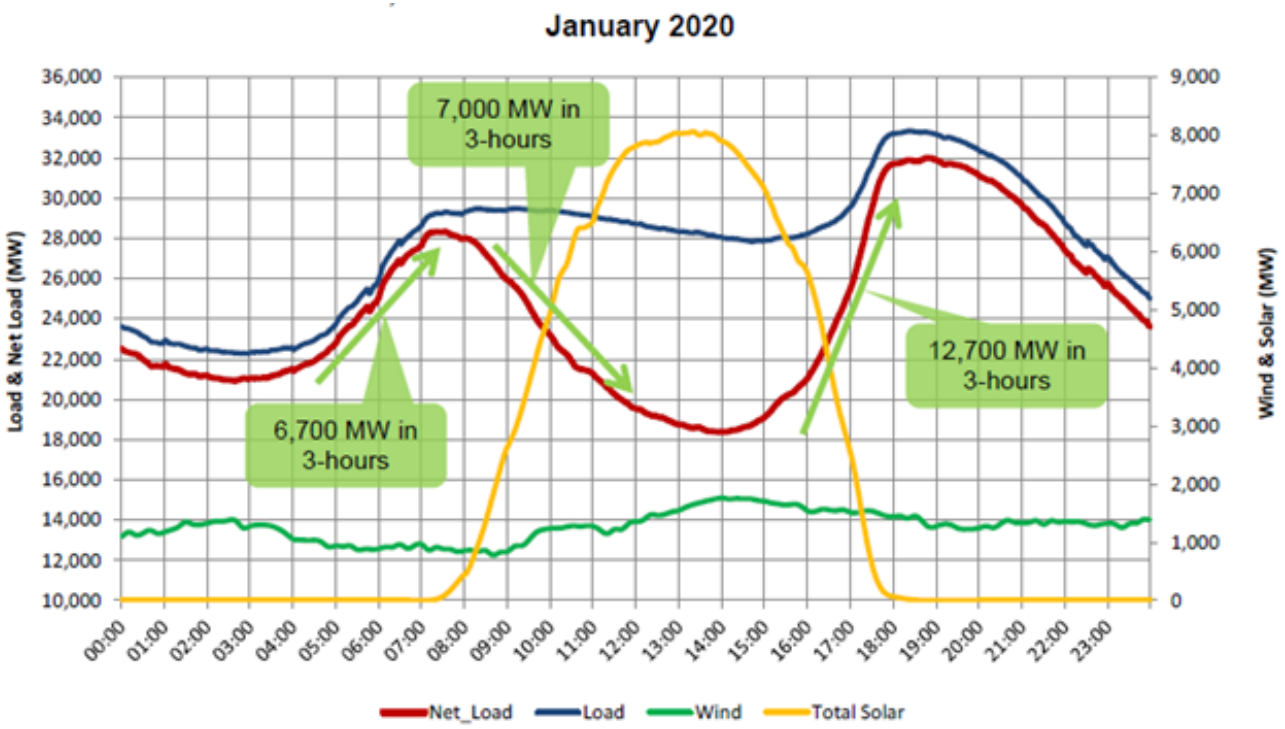
Flat or declining



Source: IEE white paper, May 2011

Price responsive demand

13 GW ramping in 3 Hrs



Source: Maintaining Bulk-Power System Reliability While Integrating Variable Energy Resources – CAISO Approach, Nov 2013

Distributed Energy Resources

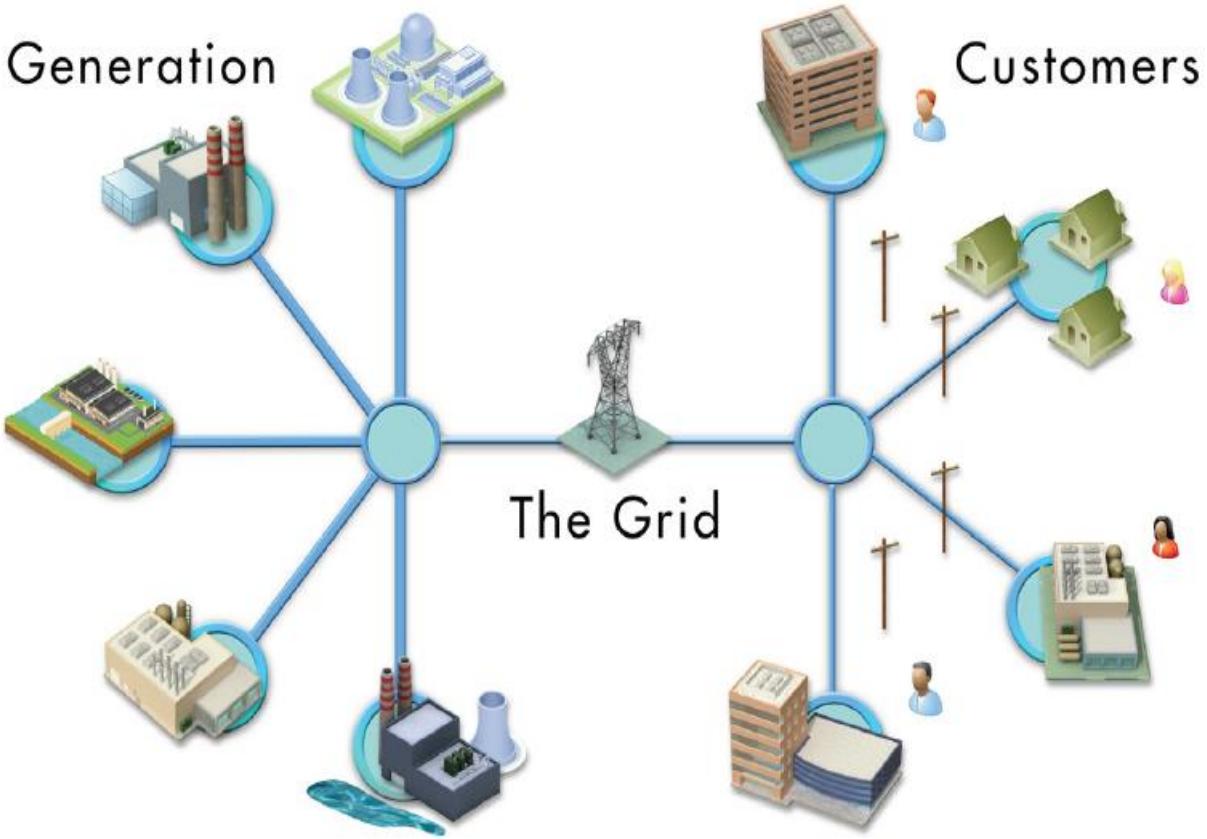
- Two sided coin
- Head: Consumers use fewer kWhrs
  - Negawatts cheaper than megawatts
- Tail: Consumer becoming “prosumers”
  - Self-generation feasible & cost-effective
- Outcome?
  - Revenue erosion
  - Unsustainable business model
  - “Utilities” & “Regulators” caught off-guard

Traditional paradigm

4 key words

◆ Generation	Centralized
◆ Flow	One way
◆ Tariff	Volumetric
◆ Demand	Inflexible

Utility centric paradigm



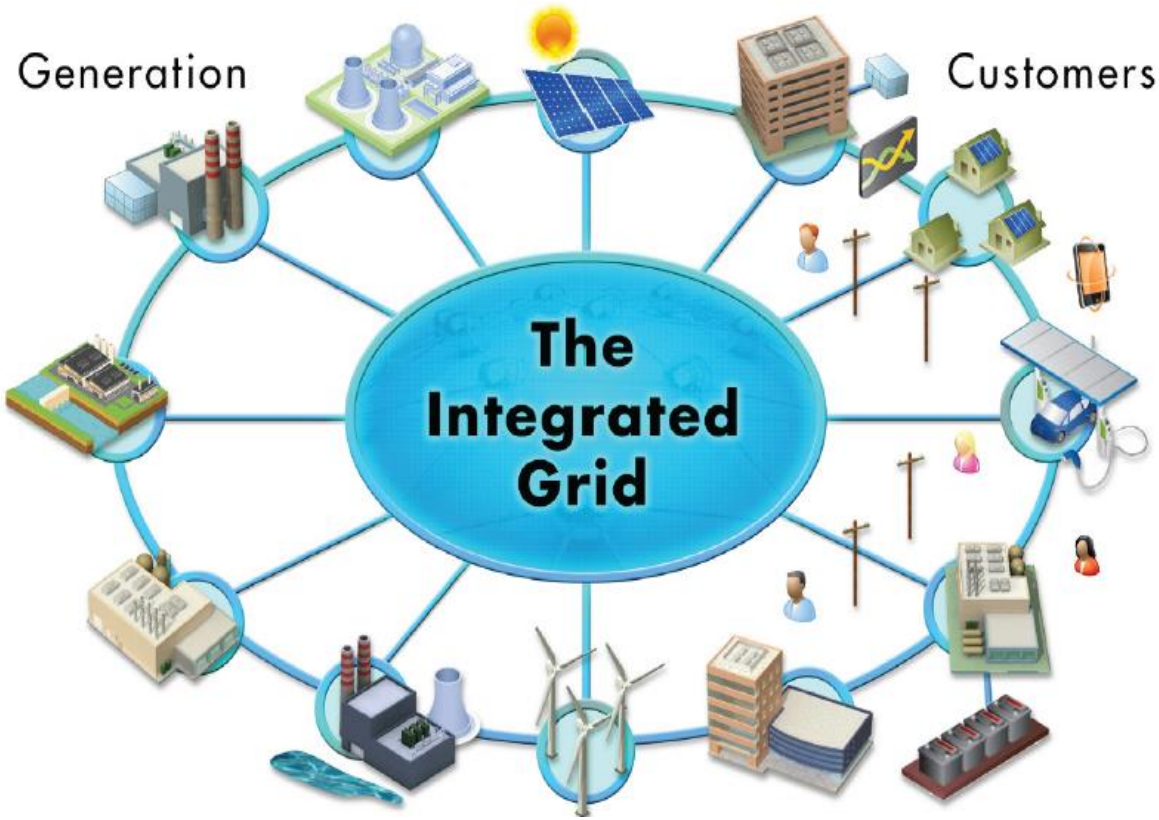
Source: The integrated grid: Realizing the full value of central & distributed resources, EPRI, Feb 2014

Emerging order

6 key characteristics

	Old	New
◆ Paradigm	Centralized	Decentralized
◆ Generation	Dispatchable	Intermittent
◆ Flow	One-way	Bi-directional
◆ Customers	Consumers	"*Prosumers*"
◆ Tariffs	Volumetric	Transactive
◆ Demand	Inflexible	Price-responsive

Tomorrow's grid



Source: The integrated grid: Realizing the full value of central & distributed resources, EPRI, Feb 2014

Challenged

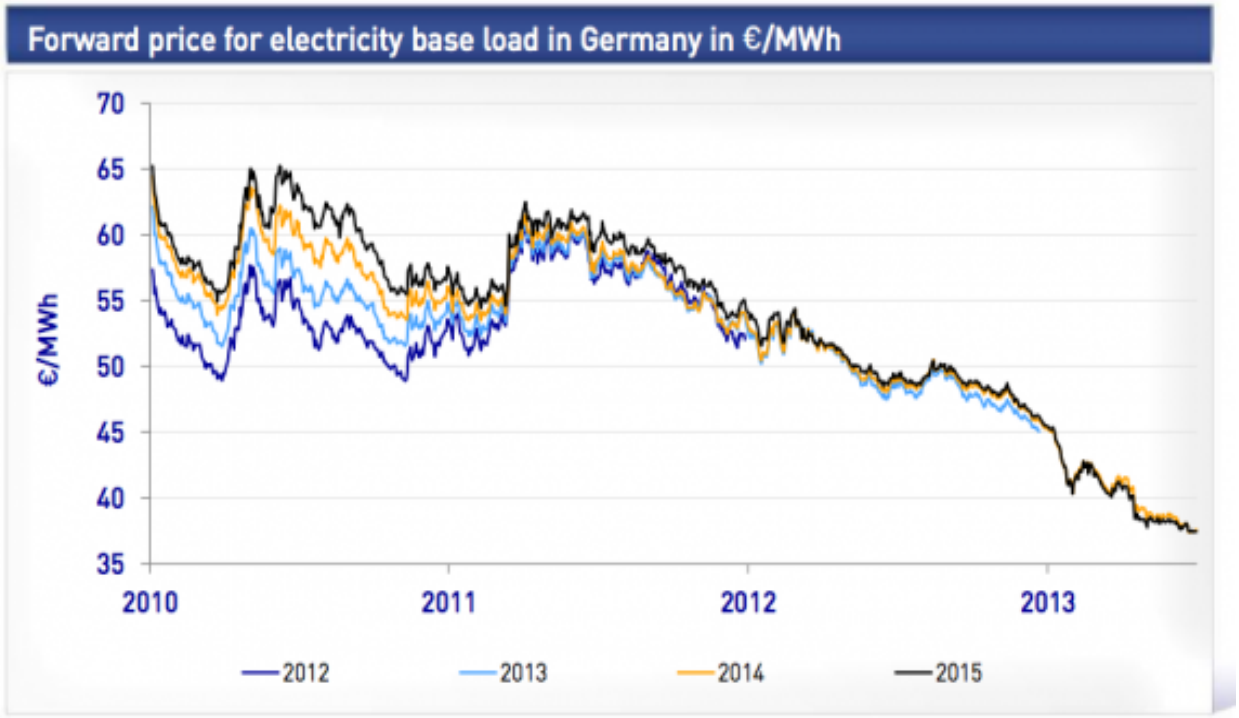
SOS signal from an art gallery in Brussels

Source Utilities CEO's of top European utilities at the unprecedented joint press conference, 11 Oct 2013: Powerhouses of innovation, Eurelectric, May 2013

Falling share prices

Source: Financial Times, 14 Feb 2014

Depressed wholesale prices



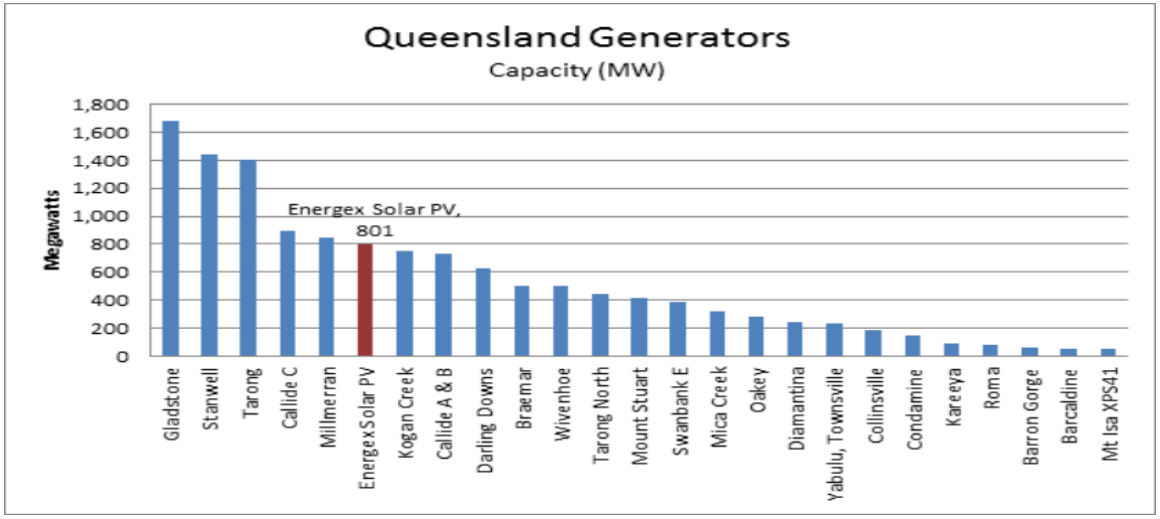
Source

World's largest CSP

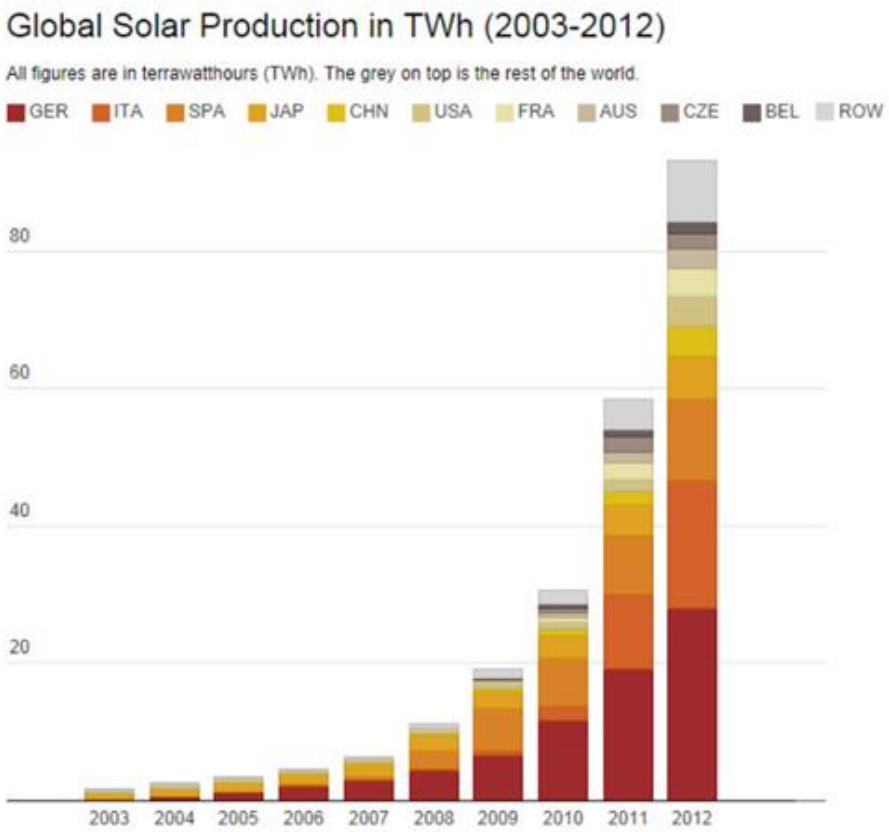
Source: California Energy Commission (CEC)

Sunny Queensland

Rooftop solar PVs 6th largest generation source in QLD



Global solar



Source: Graph appeared in numerous publications in Dec including Renew Economy on 9 Dec 2013