Utility of the future: Future of utilities

Evolving business; evolving business models

Club Español de la Energia

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Madrid, Spain

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Menlo Energy Economics

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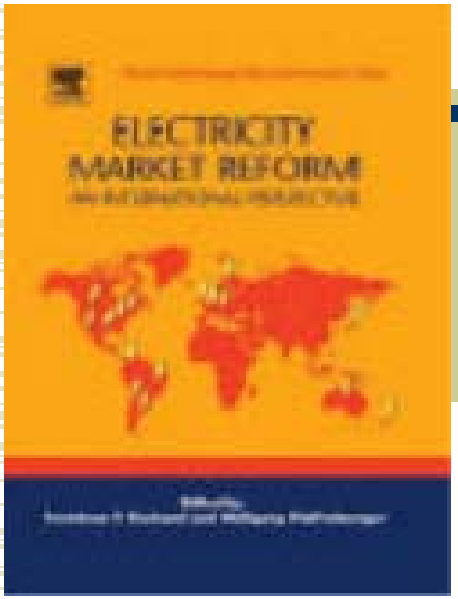
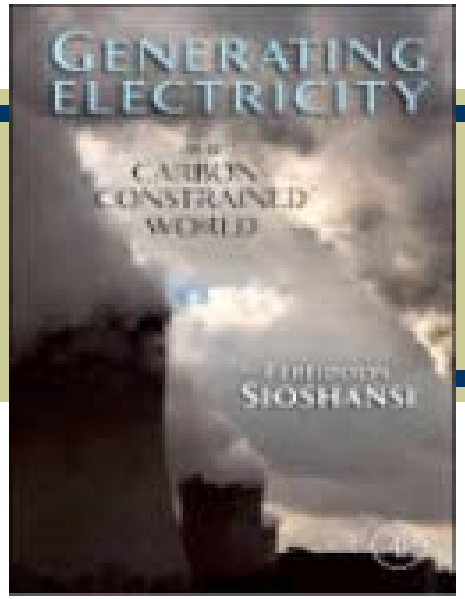
Thank you

- Thank you for invitation to speak
- Share views on a timely topic
- Gain from your feedback


ELECTRICITY
MARKET REFORM


GENERATING
ELECTRICITY
CARBON
CONSTRAINED
WORLD
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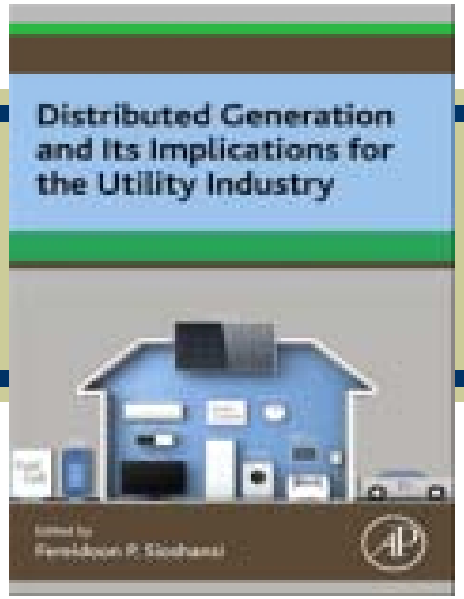
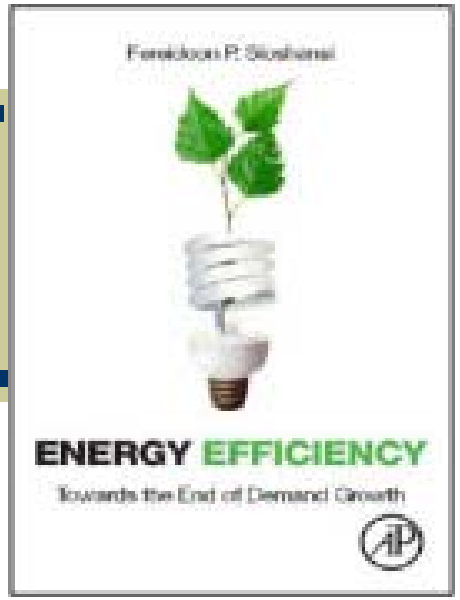
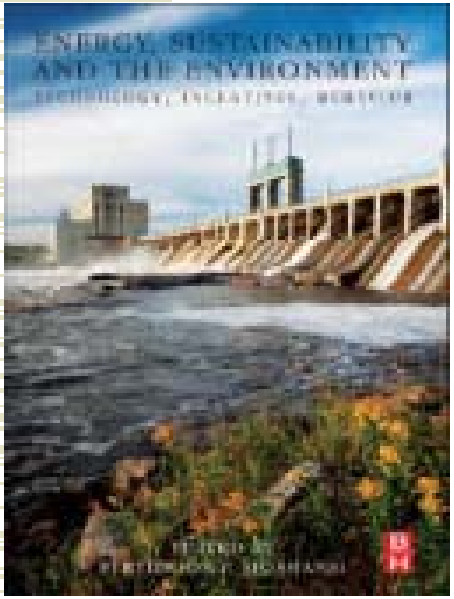
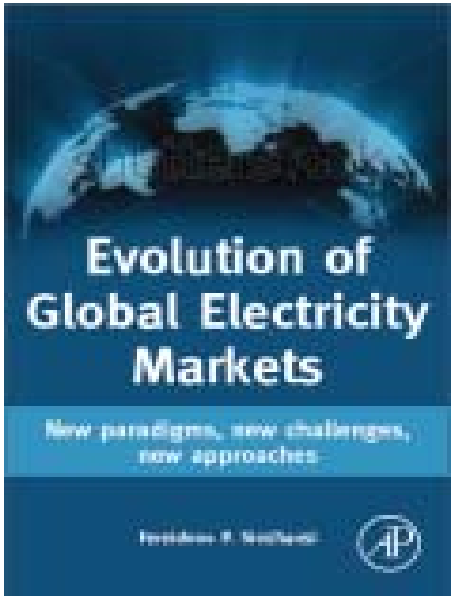
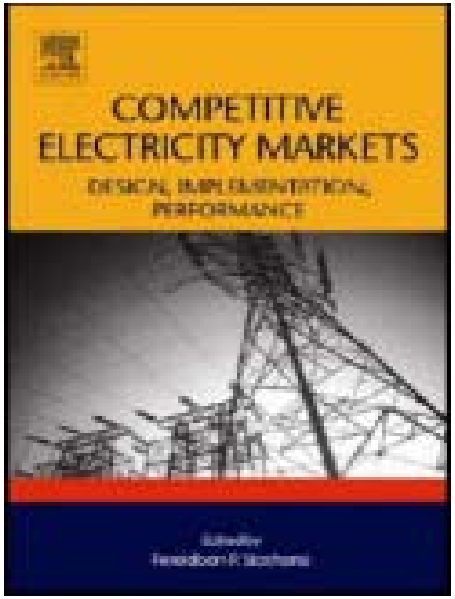
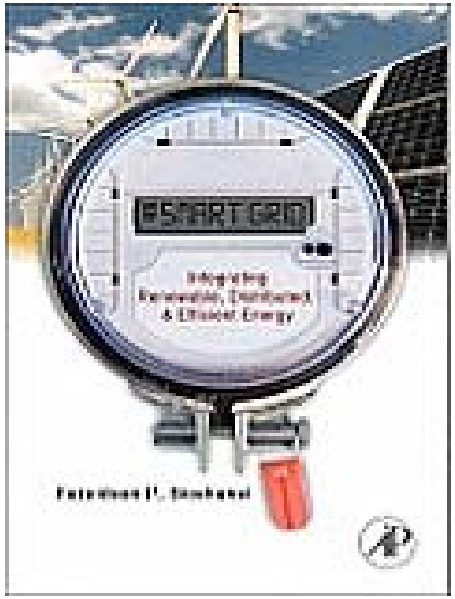

Distributed Generation
and Its Implications for
the Utility Industry


ENERGY EFFICIENCY

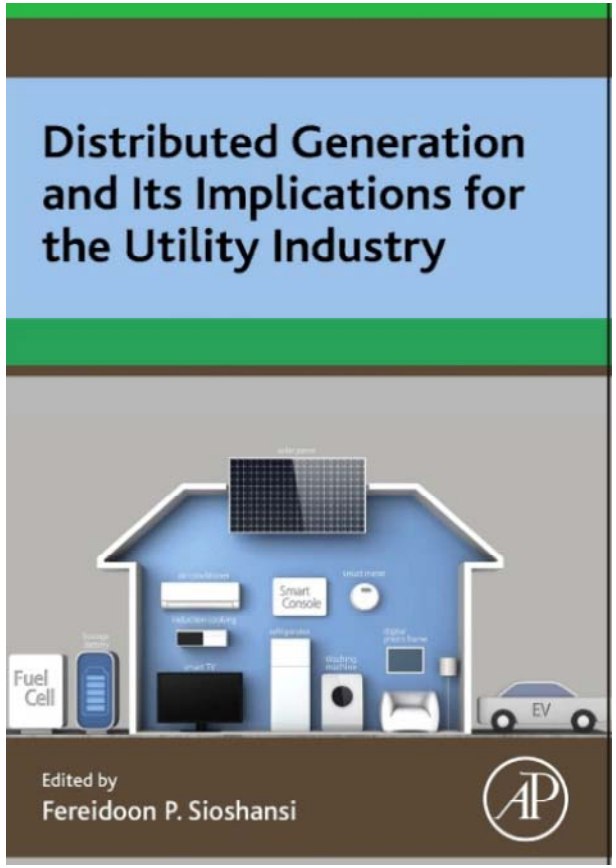

ENERGY, SUSTAINABILITY
AND THE ENVIRONMENT


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


COMPETITIVE
ELECTRICITY MARKETS


SMART GRID

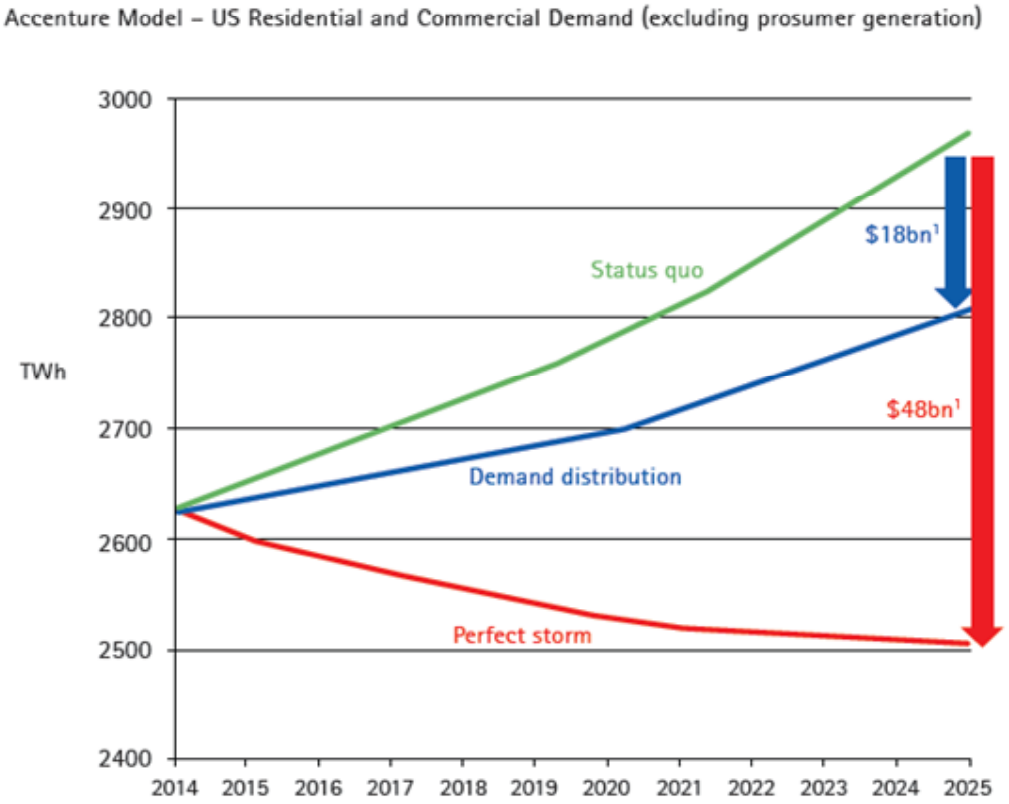
New business, new business model



Utility of Future: Future of Utilities

- What is CLEAR
  - Utility sector is *rapidly* changing
  - … traditional business/revenue model *unsustainable*
- What is NOT clear
  - How, when, or *will* incumbents respond?
  - … or will they be replaced partially or totally?
- Topic of interest
  - MIT study & many others
  - No race, no monopoly on ideas, no single/simple answer
- Outcome depends on many variables

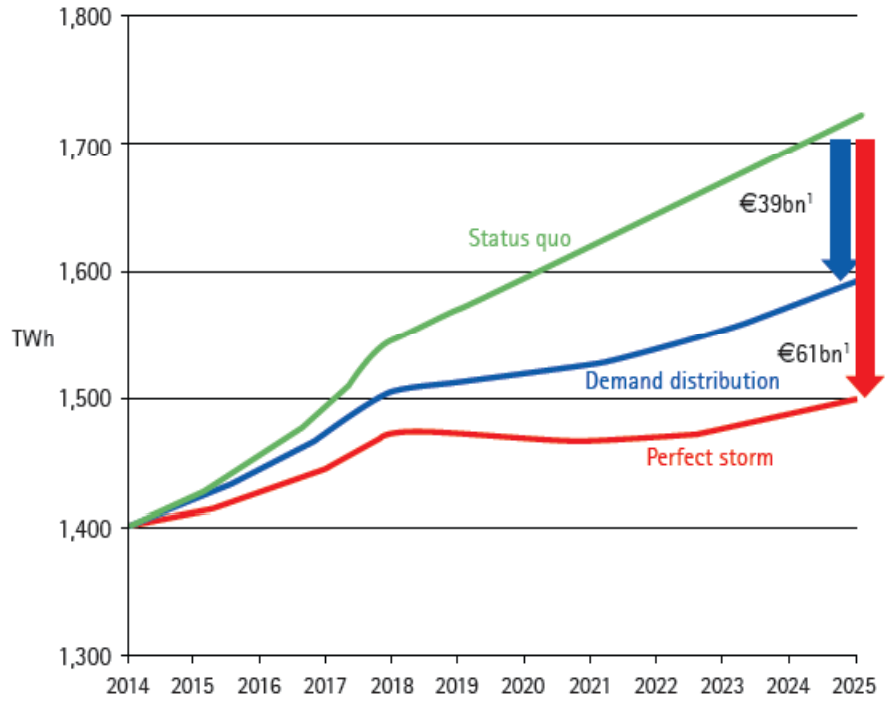
US scenarios
From bad to worse?



Source: How can utilities survive energy demand disruption, Accenture, 2014

European scenarios
Equally grim

Accenture Model – EU-10 Residential and Commercial Demand* (excluding prosumer generation)



*Belgium, France, Germany, Italy, Netherlands, Poland, Portugal, Spain, Sweden and the United Kingdom

¹ At current retail prices

Source: How can utilities survive energy demand disruption, Accenture, 2014

Drivers of change?

Focus on 3

- Slow/slowing electricity demand growth
- Growth of renewables/low carbon energy mix
- Technological advancements on customer side

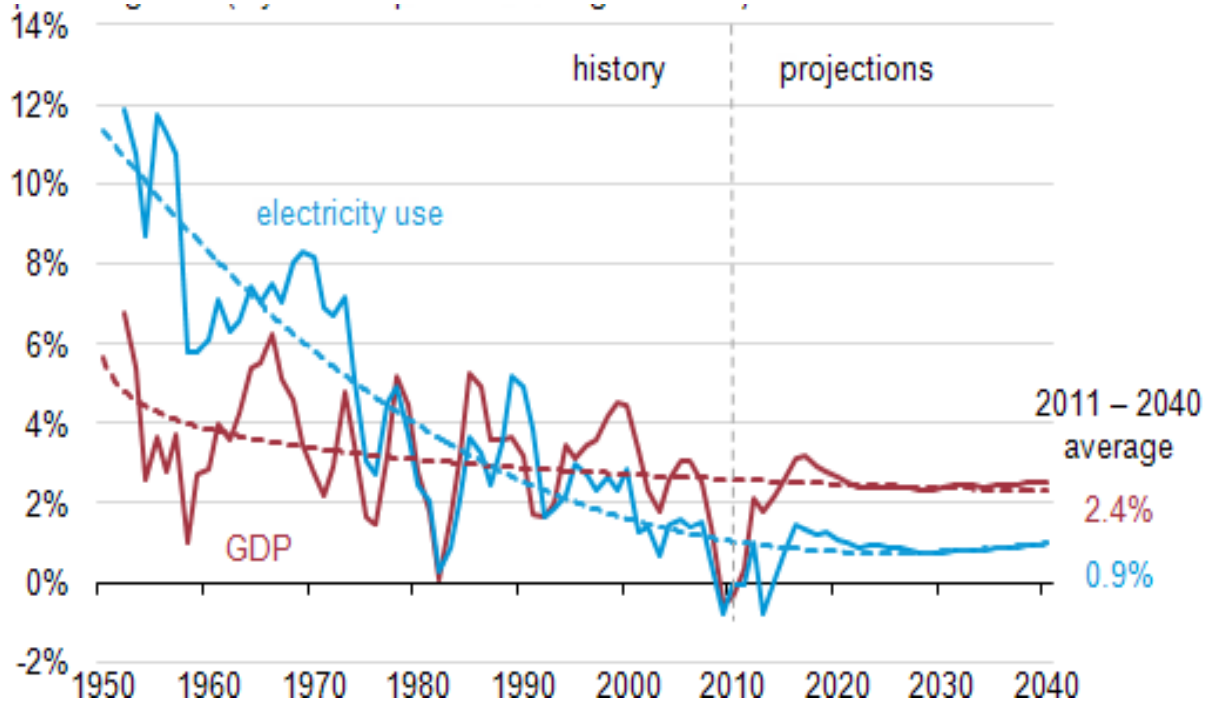
First
Why is demand falling?

- Main drivers
  - De-industrialization
    - Mature economies shifting to services & high-value added manufacturing …
    - … away from energy-intensive industry
  - Energy efficiency
    - Everything is getting more efficient
    - Buildings, lighting, HVAC, refrigeration, TVs, computers …
  - Distributed Generation
    - Consumers are increasingly self-generating
    - Accenture: $48 billion revenue erosion by 2025 due to DERs

“Decoupled”

Economic growth sustained w minimal electricity growth

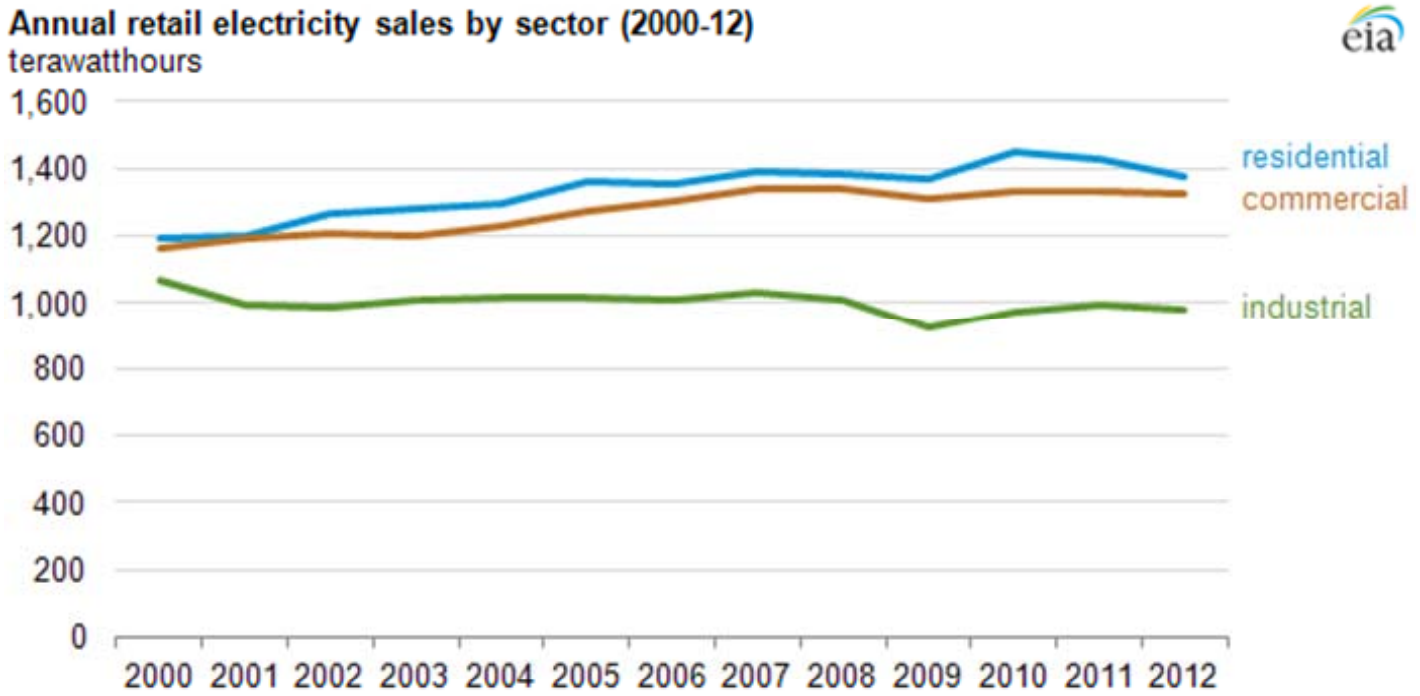
U.S. electricity use and economic growth, 1950-2040, percent growth (3-year compound annual growth rate) and trend lines



Source: U.S. Energy Information Administration, Annual Energy Outlook 2013 Early Release

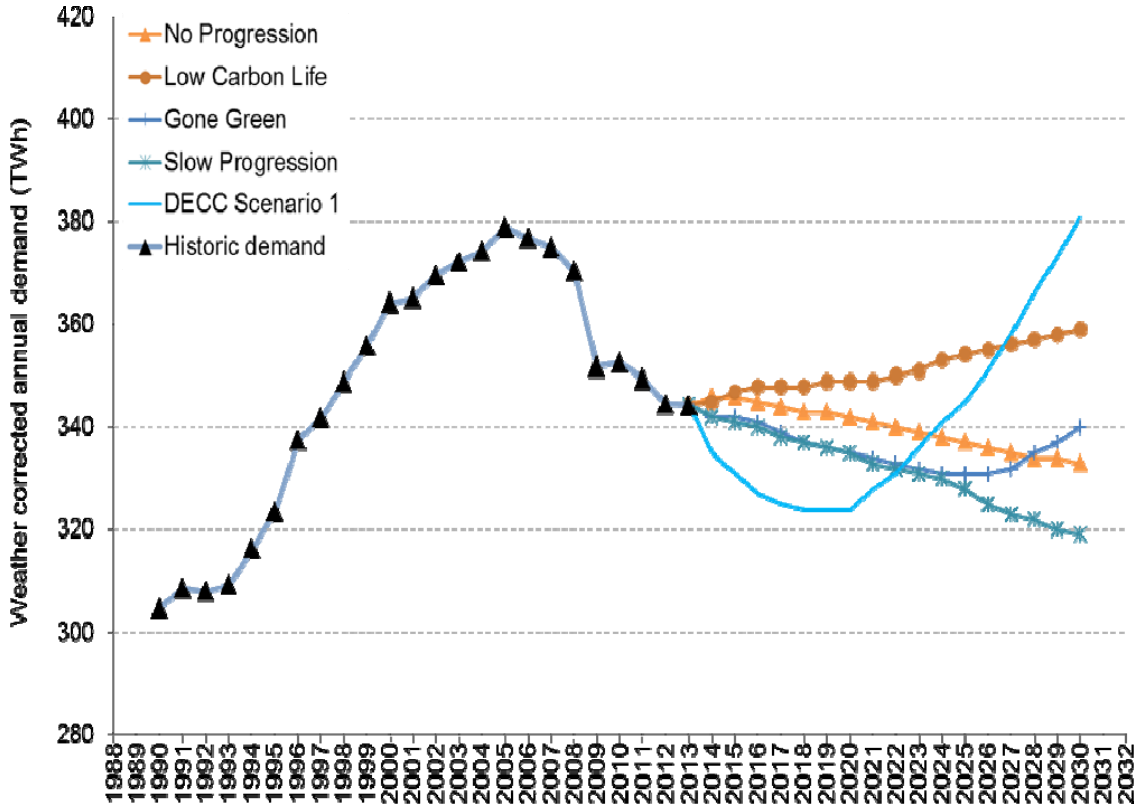
US demand flat in all sectors

No prospects for rebound except for transportation demand



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

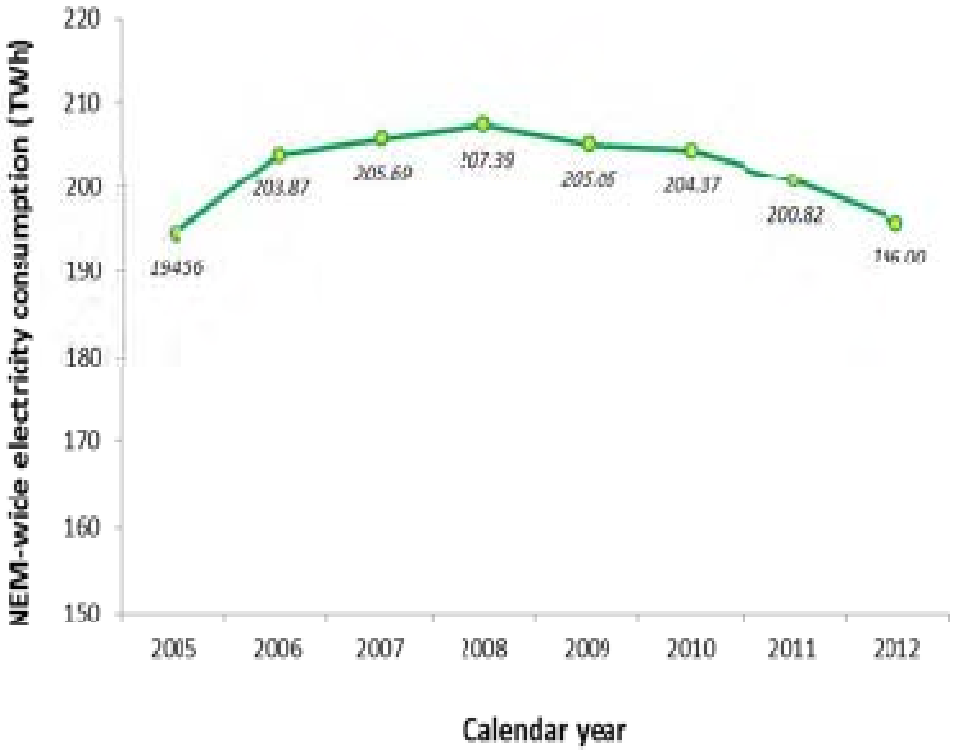
UK demand projections



Source: DECC

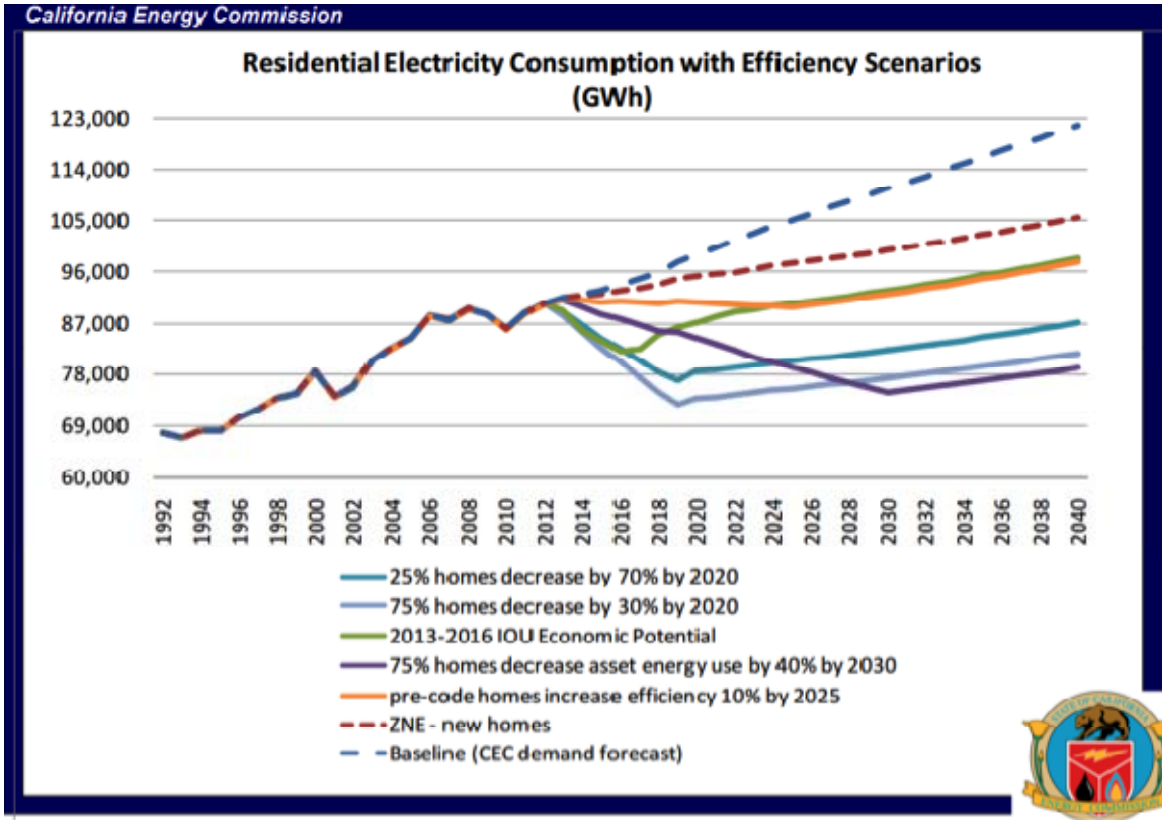
Declining demand in Australia

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



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

CA's future demand

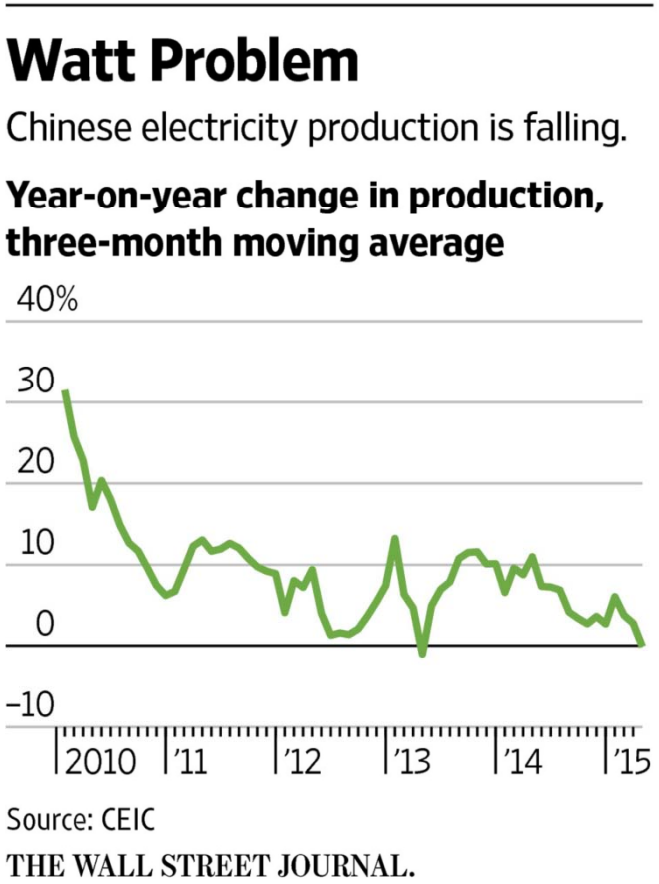


NY's future demand

Period	Avg. sales growth for period
1996-76	3.8%
1976-86	1.5%
1986-96	1.4%
1996-2006	0.9%
2003-2013	0.3%
2014-2024	0.16%

Source: NY Pub Service Commission, 26 Feb 2015

Demand growth disappearing even in China



Implications?

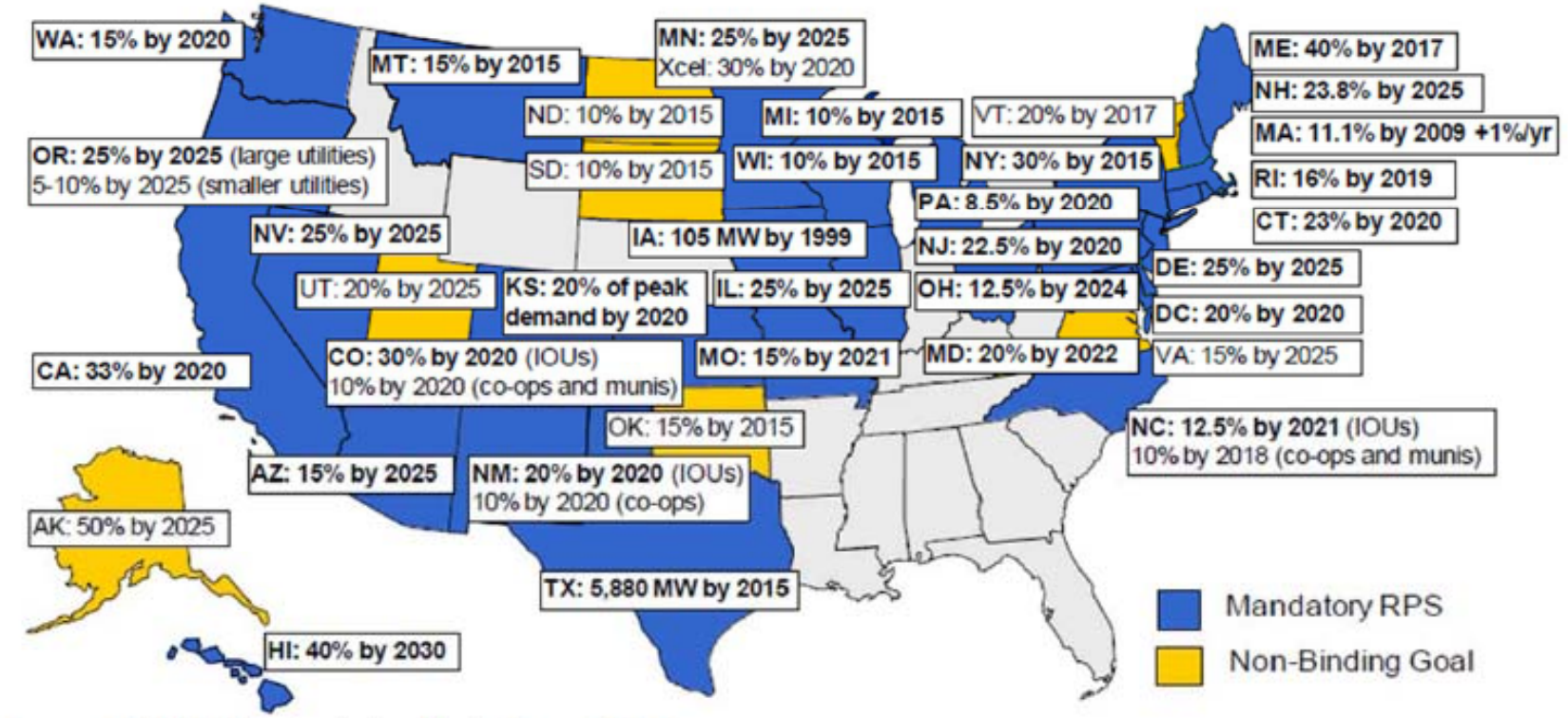
- End of utility “golden age”
  - Fixed & variable costs spread among fewer kWhs
  - Retail tariffs rise => even lower demand
  - “Death spiral” unless revenue collection model changes
  - Wireless telecom analogy
- Big problem in US
  - $/kWhr model no longer works
  - Adding fixed charges politically unpopular

Second
Why renewable flood?

- Why? Government mandates
  - Denmark: 100% renewable by 2050
  - Germany 85% by 2050 + nuclear phase out by 2022
  - California 33% by 2020; 50% proposed by Gov. Brown
- What for? Climate change, end of fossil age
- How?
  - US: **Renewable portfolio standards** (RPS)
  - Europe/Australia: **Feed-in-Tariffs** (FITs) + targets
- Latest twist: Renewables are plentiful & cheap!
  - Example 1: PPAs below 6 cents/kWhrs
  - Example 2: Merchant solar plants

Renewable Portfolio Standards

Renewable growth driven by mandates, not markets



Source: 2011 Wind Technologies Market Report, DOE

550 MW

Topaz Solar Farm, San Luis Obispo Ct, CA

392 MW CSP

BrightSource Energy plant, Ivanpah, CA

Source: California Energy Commission (CEC)

Implications?

- Thermal generators challenged on price
- Grid operators challenged on intermittency

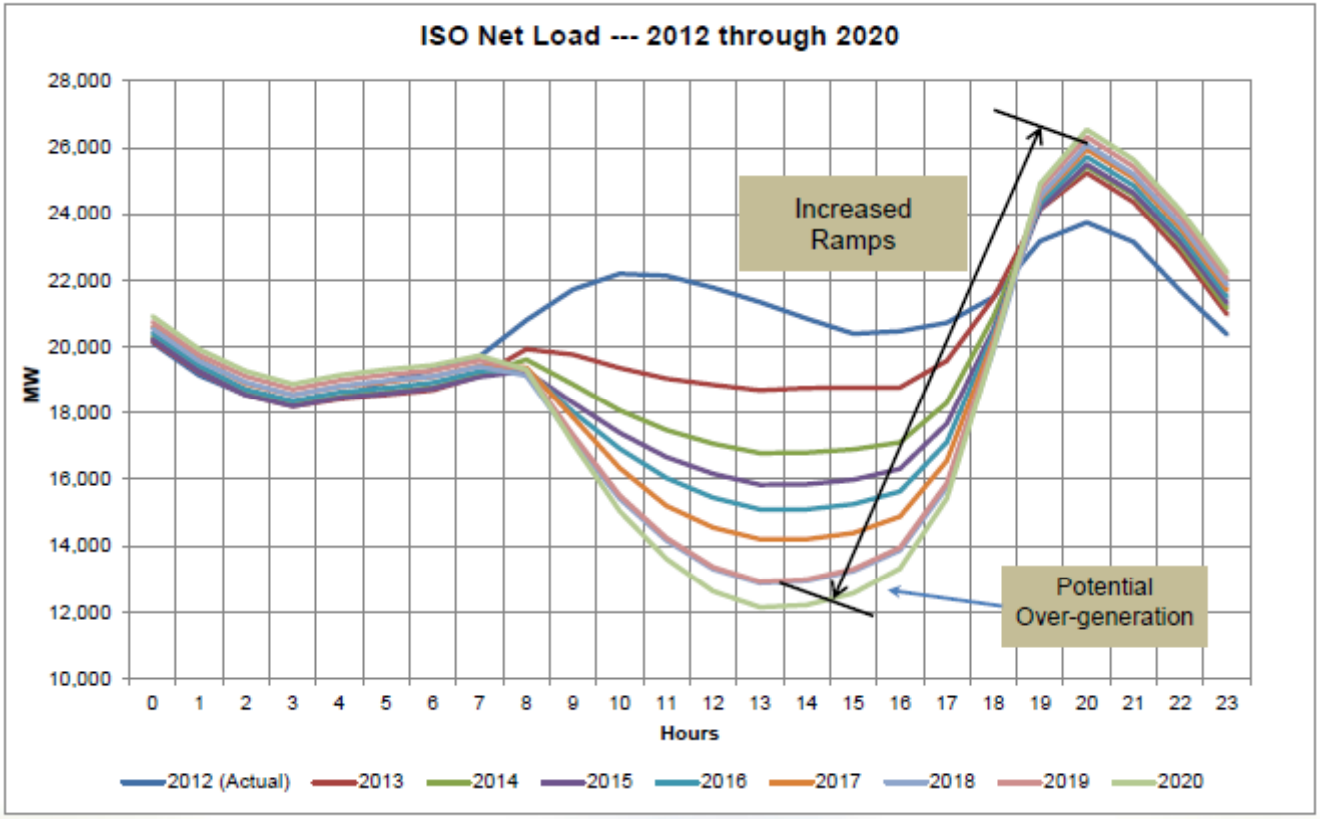
CAISO

Increasingly acting as an integrator

Source: CAISO

CA Duck curve

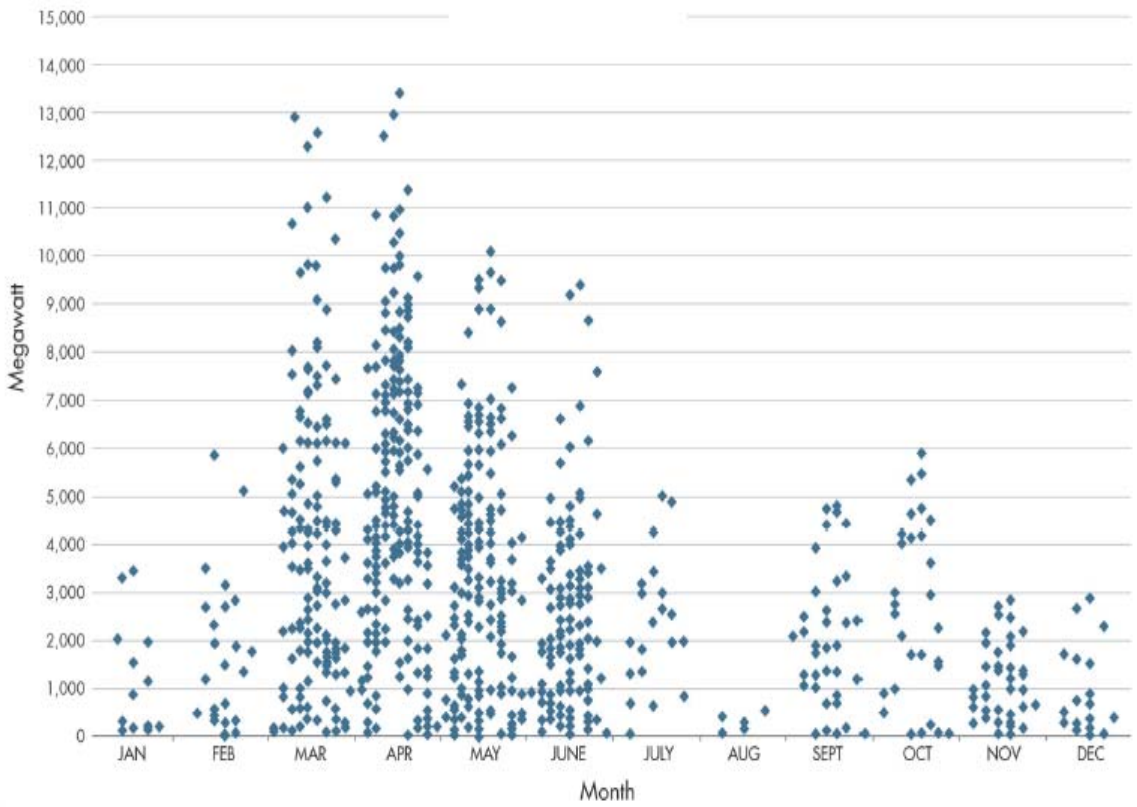
ISO's net load projection for 2012 through 2020



Source: CAISO Discussion of Markets, Mark Rothleder, 3 June 2014

Over-generation

CAISO projects increased frequency under 40% RPS by 2025



Third
Technical advancements

- Decentralization shifts power to “prosumers”
  - Distributed solar PVs
  - ZNE buildings/communities
  - Energy storage, EVs, charging infrastructure
  - Micro-grids, grid-assisted, grid parallel, off-grid

Rooftop power generators

Solar PVs near or at “grid parity” in many jurisdictions

Residential Retrofit

New Production Homes

Commercial & Public

Power Plants

Commercial rooftop PVs

DG at its best: “Generation on top of the load”

SunPower
628 kW

Conventional
410 kW

Thin Film
204 kW

SPWR → 150% kW

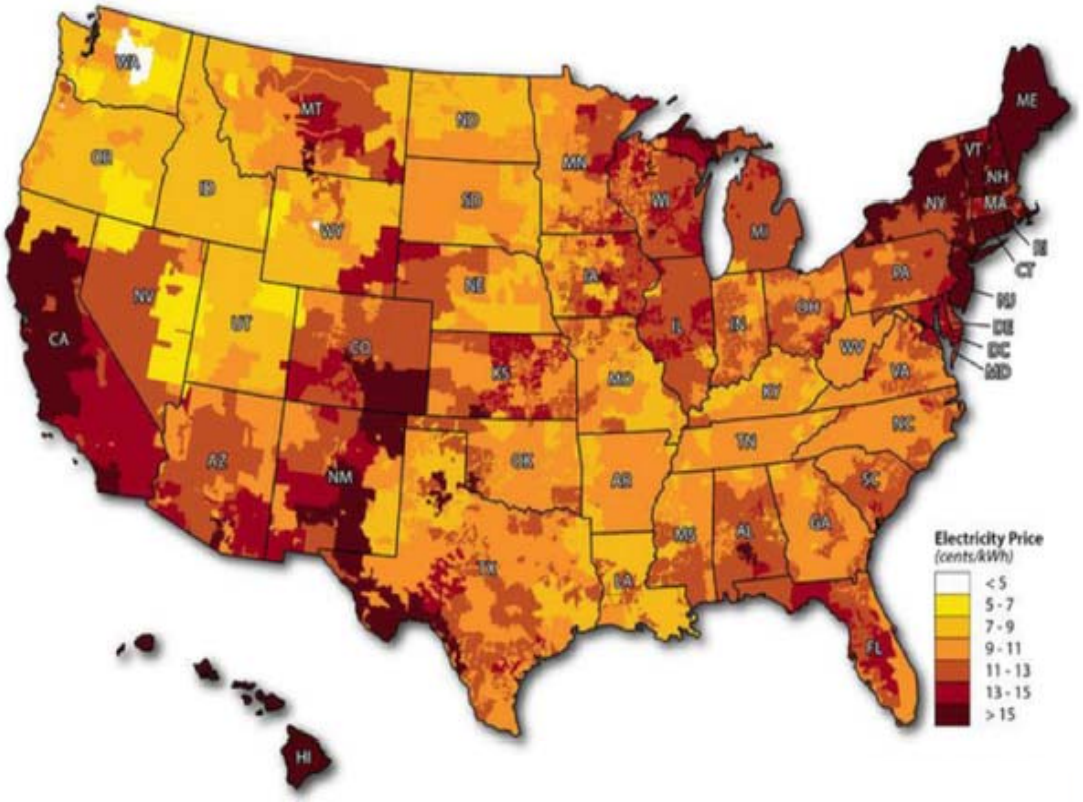
SPWR → 310% kW

Coming next: Solar tiles

Building integrated PVs commercially feasible within a decade?

Sunshine + High retail tariffs = PVs

Dark colors represent high retail tariffs where solar PVs would be attractive



Source: NREL

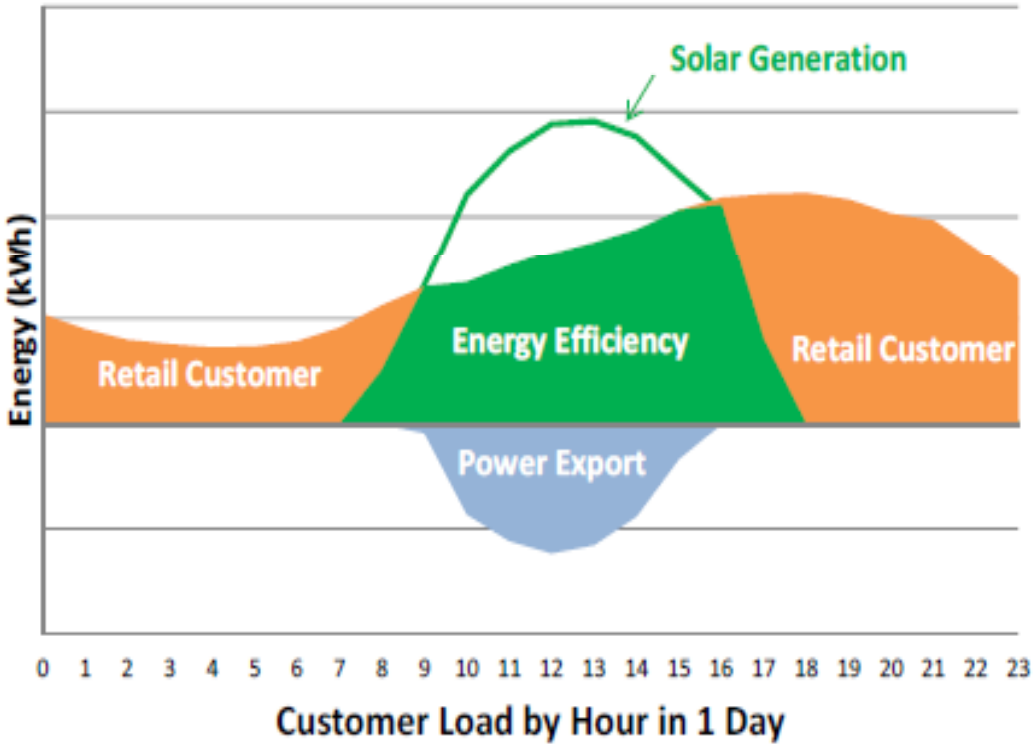
An offer few consumers can refuse

Implications?

- Rise of prosumers
  - Distributed generation is NOT for everyone
  - Emergence of “haves” and “have nots”
- Need for new business model

Consumers => Prosumers

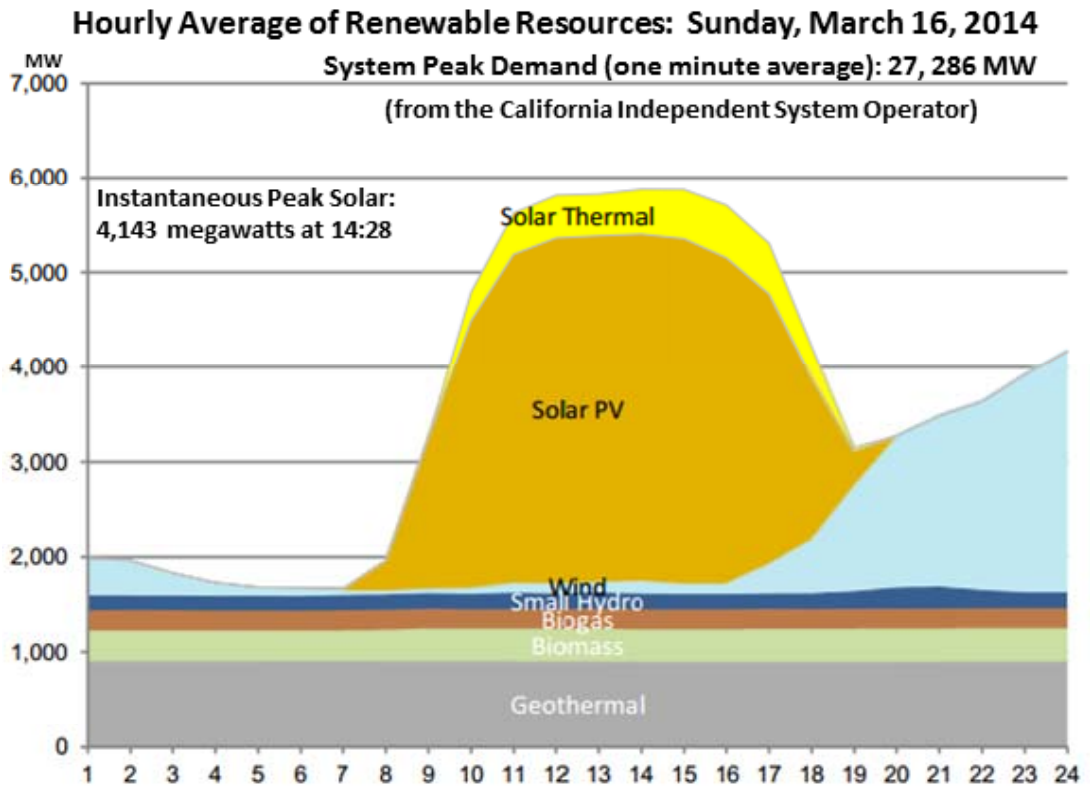
Bidirectional flow across distribution network



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

Mid-day sun = “over-generation”

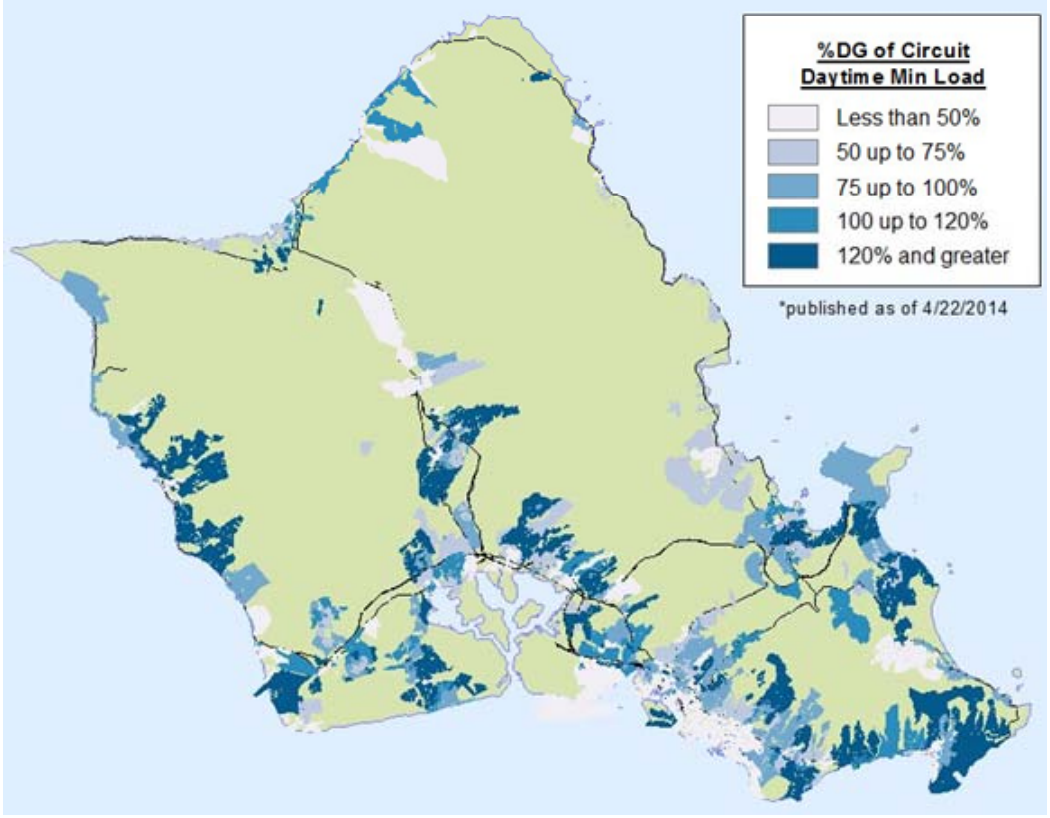
In many networks mid-day peaks have disappeared



Source: ISO

Circuits overloaded in Oahu

Distribution network stressed by rise of distributed generation



New roles/new rules

- NY
  - Define new role for DSPs & let market decide
- CA
  - Micro-manage evolution of market by tinkering in parts

What future for utilities?

- Future will be …
  - Grid light, distributed, ZNE, micro-grid
  - Integrated, it is not either/or
  - Not necessarily distributed
  - Is on the wall
  - Renewable & increasingly solar
  - Unpredictable & varies from place to place
  - Depends on regulation/policy
  - Bifurcated: Haves & have not, as in income inequality
  - On a platform

Energy independence!

Not a challenge physically; nor financially

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

NREL is ZNE

Office parks, shopping malls, hospitals, universities, whole cities

Source: NREL

Big customer, no revenues

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

Tesla: Battery on wheels

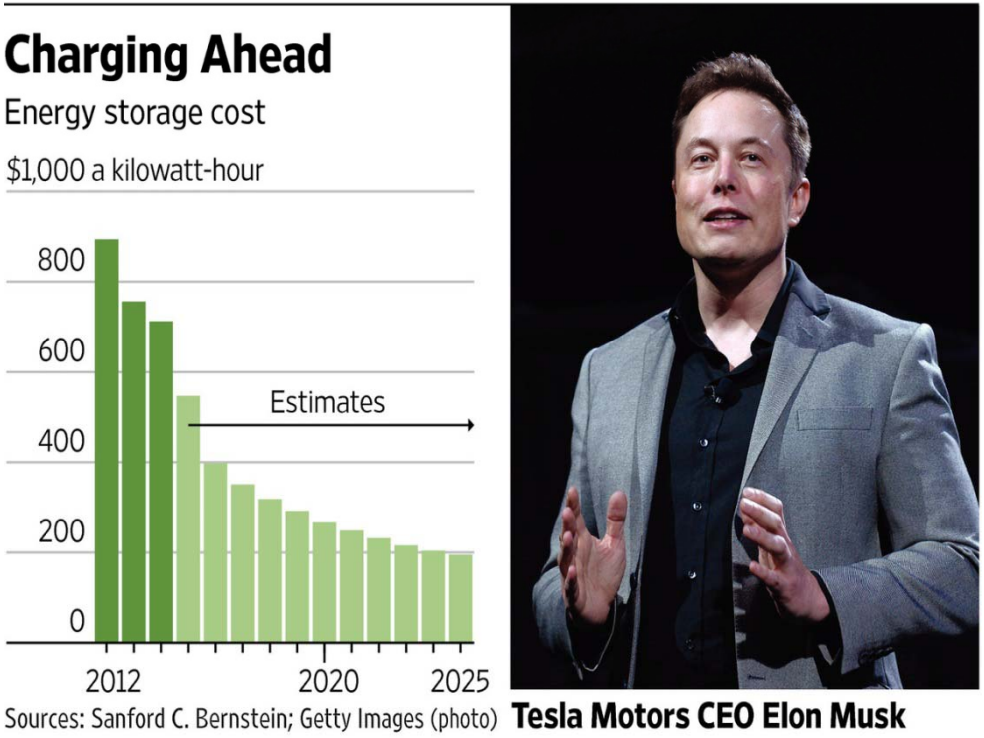
Storage not just batteries

Source: www.tesla.com

Tesla's Powerwall: Game changer?

Source: The Wall Street Journal 2 May 2015

Falling costs of storage?



Source: The Wall Street Journal 2 May 2015

Platforms & power of aggregation

- In “The Age of Platform: How Amazon, Apple, Facebook & Google have Redefined Business” Paul Simon defines:
- “A platform is an extremely valuable and powerful ecosystem that quickly and easily scales, morphs, and incorporates new features, users, customers, vendors, and partners. Platforms 1) embrace 3rd Party Collaboration; 2) foster Symbiotic, Mutually Beneficial Relationships; 3) move beyond Selling to Promote Customer Utility and Communications; and 4) become the Means for Rapid Adaptation.”
- Few examples of why/how this is relevant

Home energy management

Will Google/Nest be able to monetize HEM?

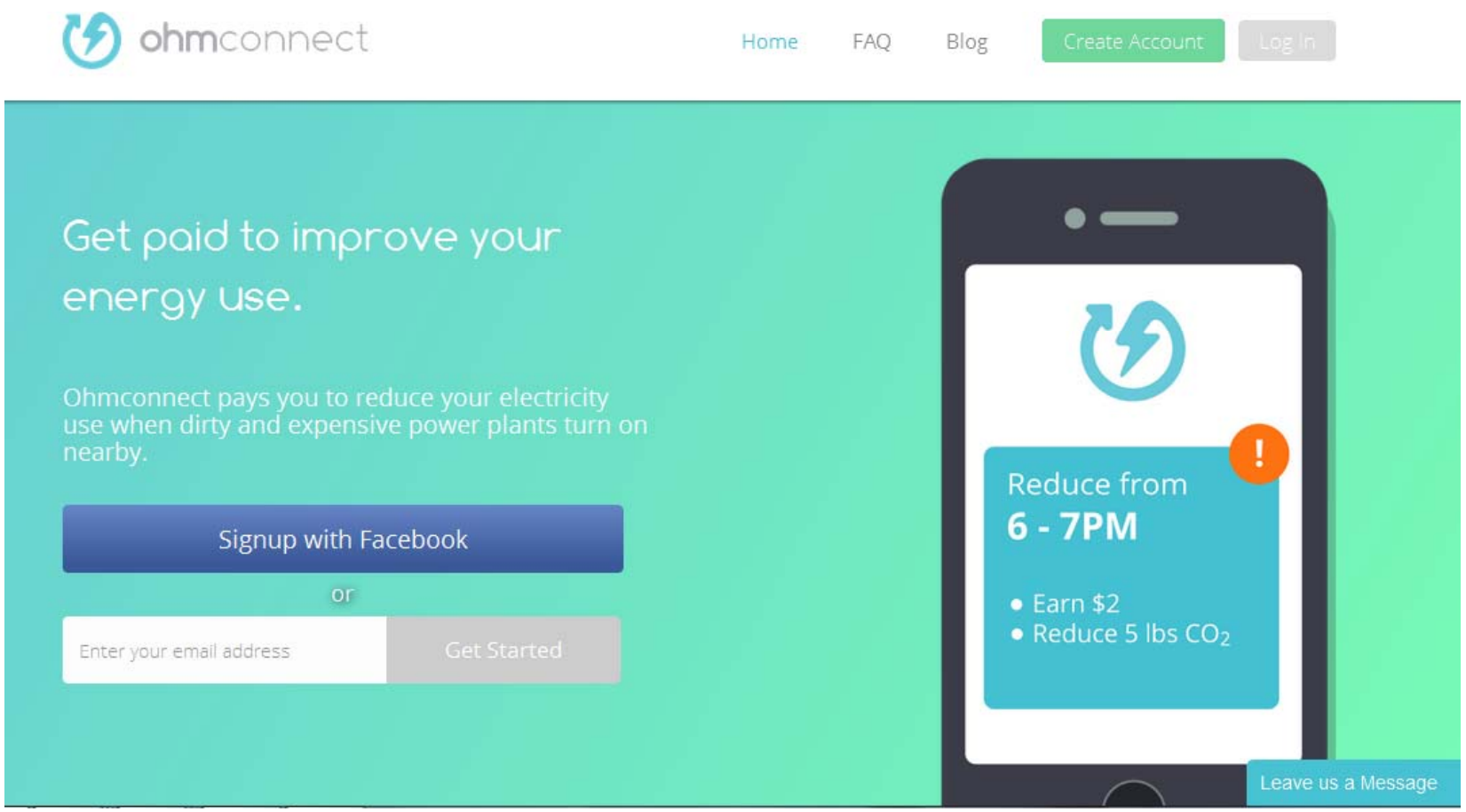
Source: Google.com

Think of it as Kayak

Consumers can increasingly find what the need & where to get it

Will DR move mainstream?

It is getting cheaper & easier to aggregate load



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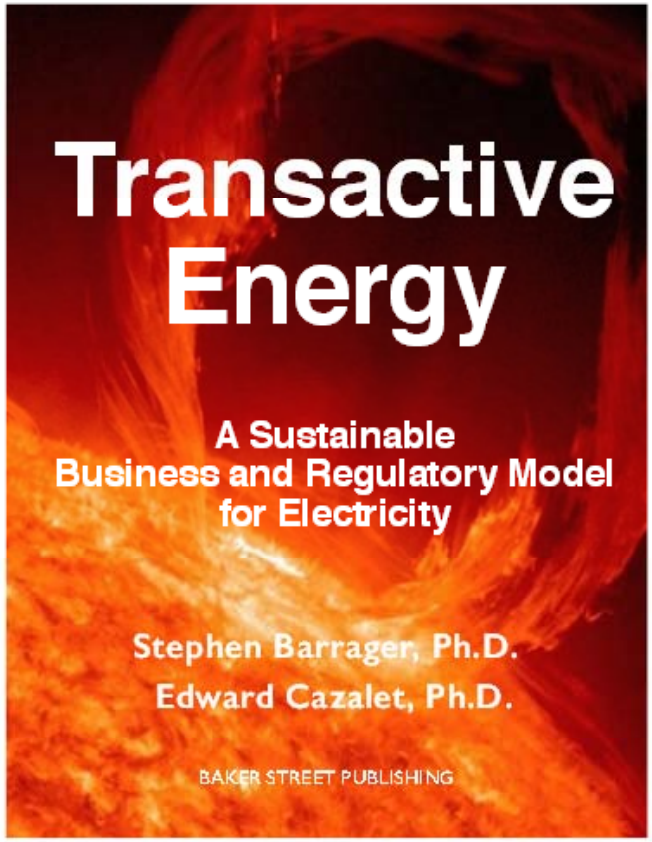
Consumer-to-prosumer?

Future prosumers will be able to “transact”



New electric company: Your home