LESSONS TO THE EUROPEAN POWER SECTOR FROM THE USA

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Chaire Electricité - Paris Dauphine Seminar
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RWE
The energy to lead

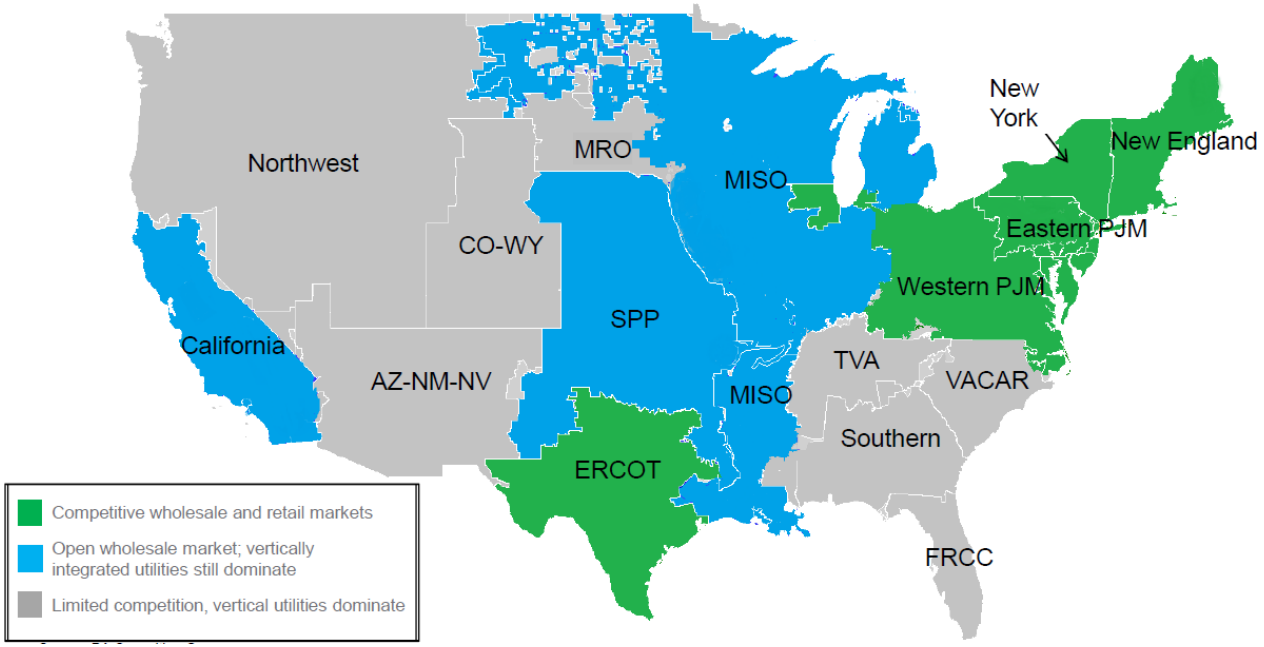
Contents

1. Selected USA institutions and indicative European counterparts

Federal / EU level	 	 
	U.S. DEPARTMENT OF ENERGY	EUROPEAN COMMISSION Directorate-General for Energy
	FERC FEDERAL ENERGY REGULATORY COMMISSION	COMPETITION
	EPA United States Environmental Protection Agency	European Commission Environment
	NERC NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION	entsoe Reliable Sustainable Connected
US State / Country	California Public Utilities Commission	Bundesnetzagentur Bundeskartellamt Offene Märkte | Fairer Wettbewerb

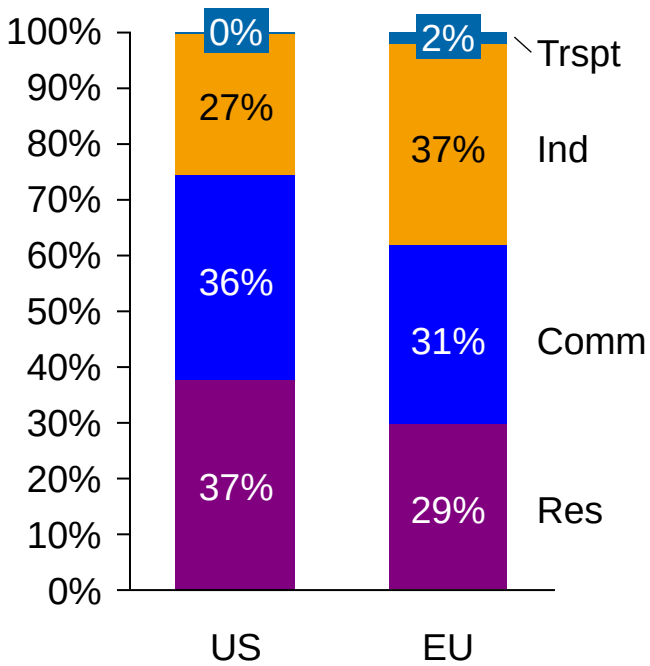
Note: The US has RTOs / ISOs with not direct EU equivalents

2. US system - no single market but 49 states and ca. 15 regions with own regulations etc.

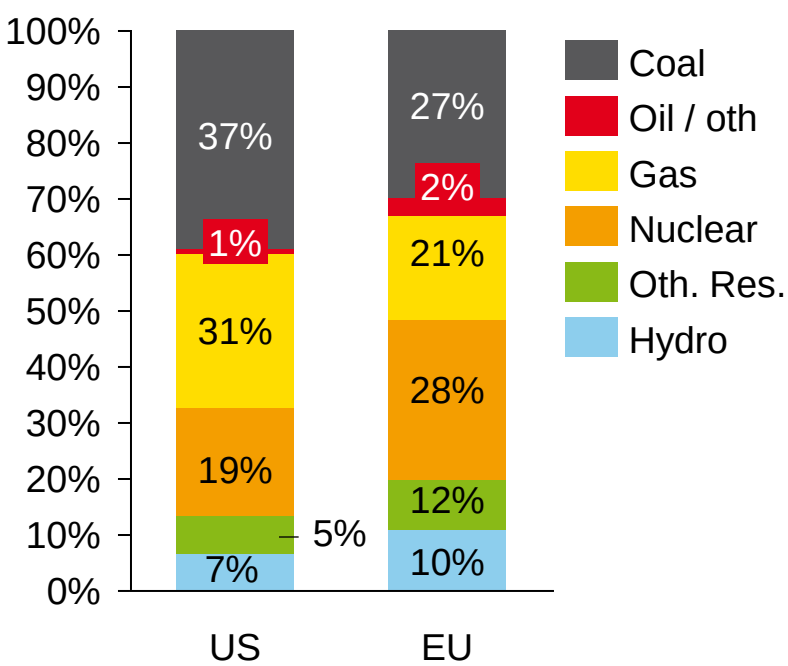


- In deregulated states ISOs run wholesale markets / ancillary services and dispatch plants
  - e.g. PJM (13 state - 800 TWh), CAISO (California - 230 TWh), ERCOT (Texas - 330 TWh)
  - Each has a “Market monitor” - some independent, some part of the ISO
  - CA no longer has vertically-integrated utilities
- Infrastructure relatively aged and supply security lower than in Europe - SAIDI 100-200 min / yr

3. Demand and generation mix



TWh:	3700	2800



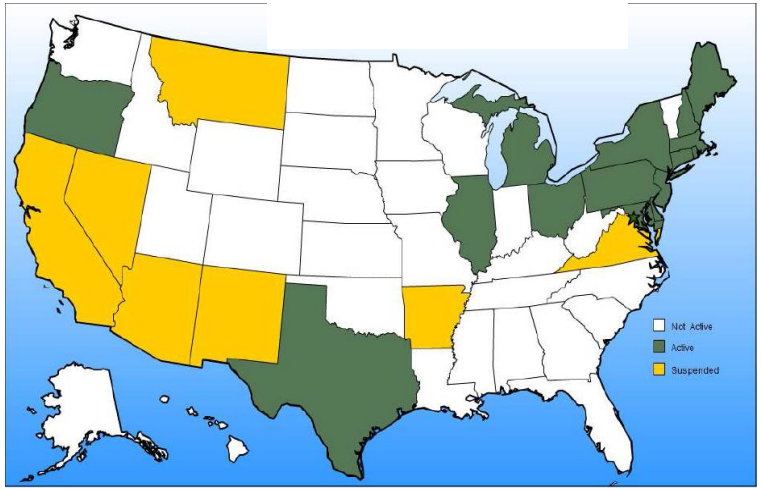
TWh:	4000	3300

- Demand: air conditioning important dimension in US; otherwise demand essentially static
- Generation: high US gas share due to shale effect

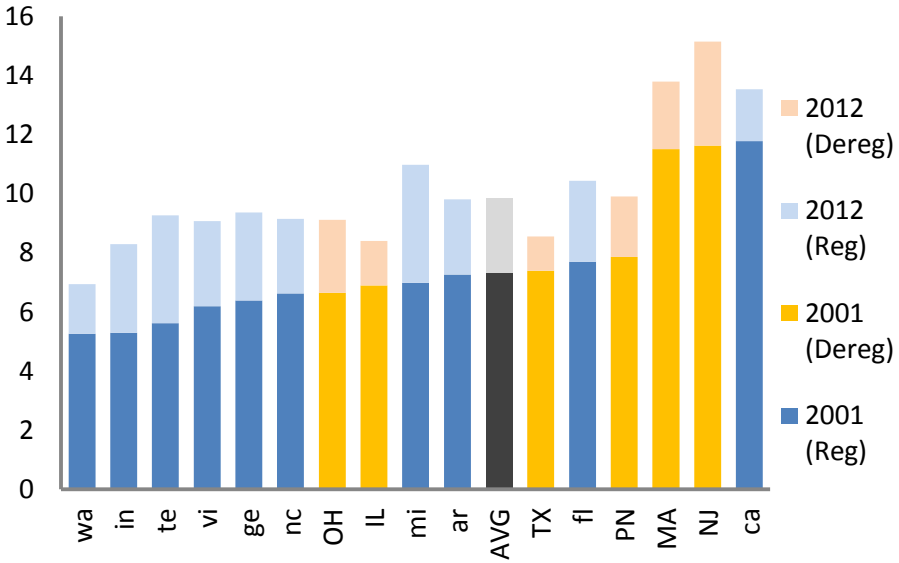
Sources: US - EIA 2014 data; EU - IEA Balances 2012 data

4. Deregulation driven by wide price differences but process has stalled

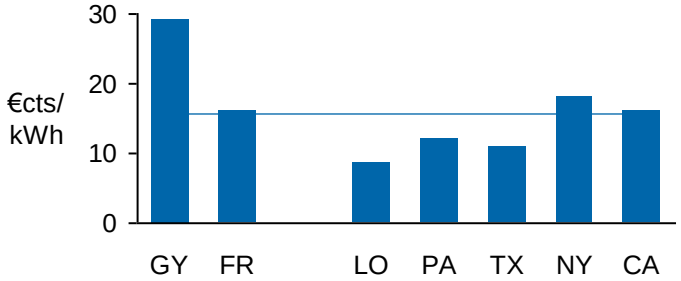
Electricity Restructuring by State



Household rates in 2001 & 2012 (cts/kWh)



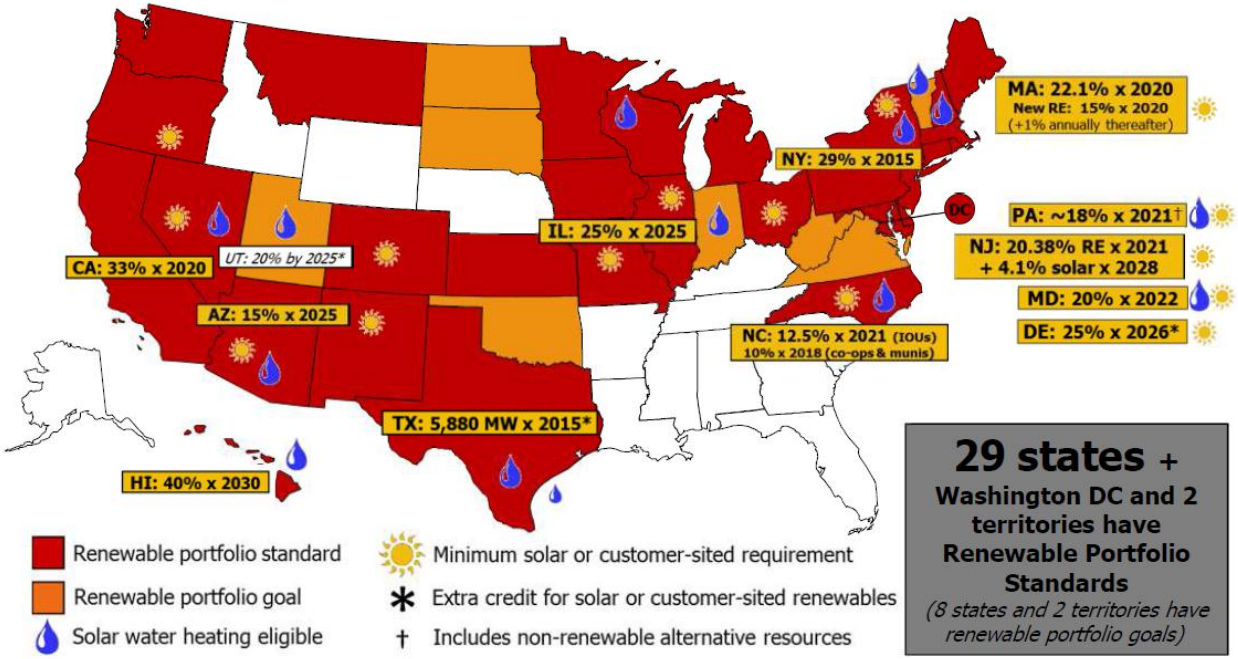
Household prices in GY/FR vs. US States



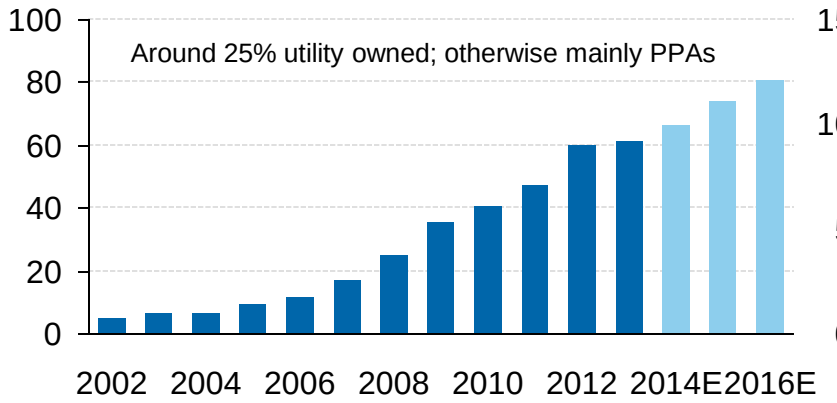
- Since deregulation price range in relation to average prices has not changed significantly
- Some states (e.g. Texas) have seen big benefits of liberalisation

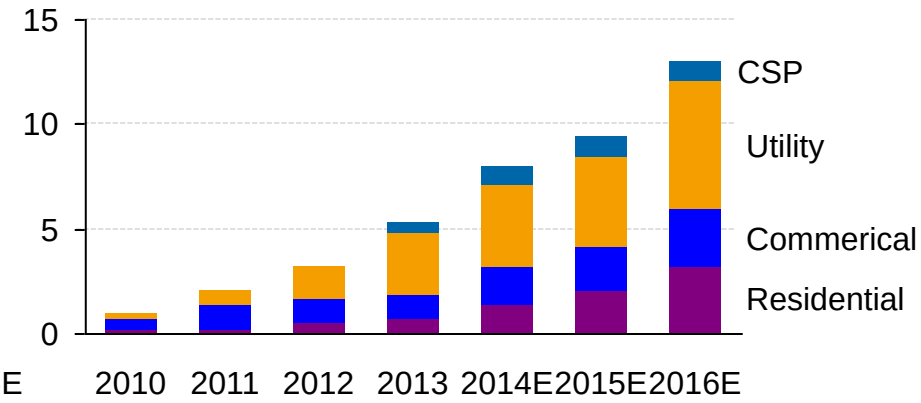
5. Renewables support through tax-credits, portfolio standards and state-subsidies

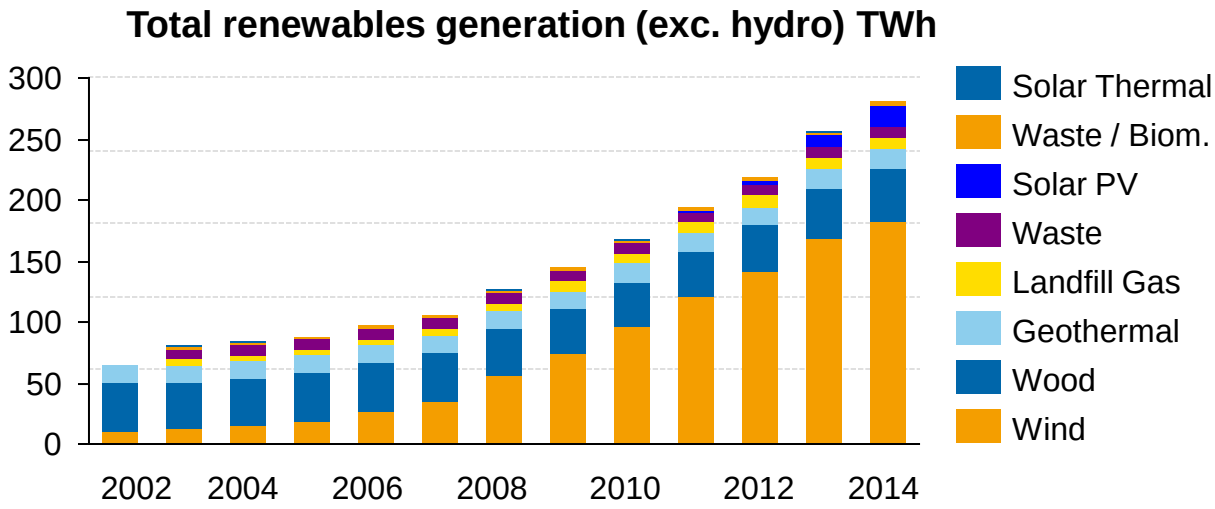
- Renewables incentivised mainly by 2.5 cts / kWh Production Tax Credits (wind) and 30% Investment Tax Credits (solar); some states also have own support systems
- Consumer prices hardly impacted (partly because of rate-impact caps)
- Wind PPAs now $ 25-30/MWh (wholesale $25-55/MWh) and solar increasingly competitive
- Renewable portfolio standards exist in many states but not at national level



Renewables capacity and total generation



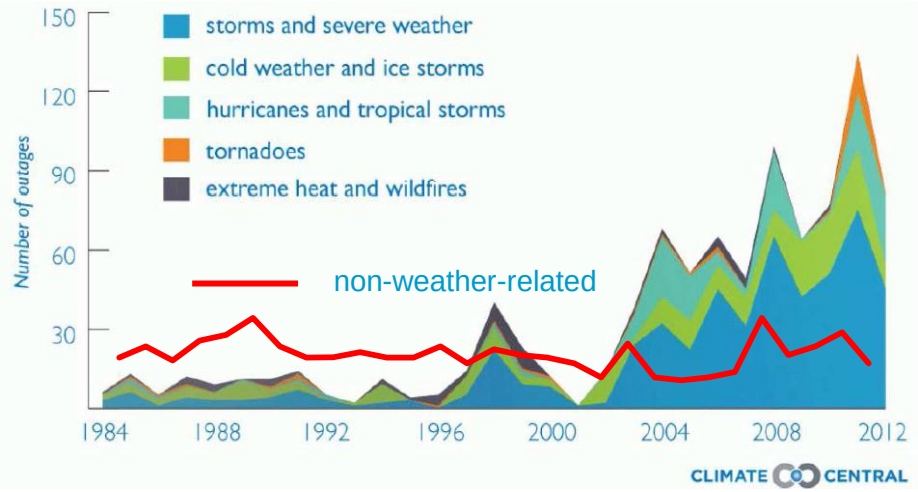




- Renewables in 2012 had 5.4% share of generation exc. hydro and 12.1% with hydro
- **Max of 40% by 2050** expected - still trying to secure some contribution to decarbonisation from nuclear plants

6. Supply security emphasized by extreme weather events and rising cyber-attack concern

Extreme weather causing more major (> 50,000 customers) power outages



Extreme weather

- New York lost power for a week in 2012
- Polar vortexes in 2014 - brought PJM to brink - price caps of only $1000 / MWh, since raised to 2500 / MWh
- Cost of outages $ 25 - 50 bn p.a.
- Law strengthened to increase sanctions against utilities for weather-outages
- Plants with onsite energy resources may have security value over gas plant with interruptible contracts

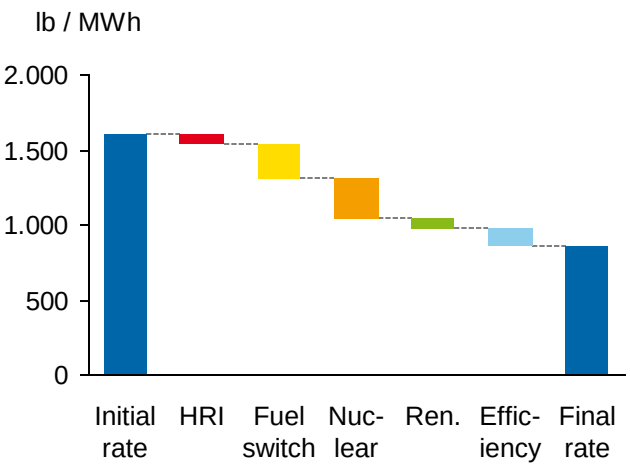
Cyber attacks

- *"amongst gravest security dangers"*
- Incidence growing rapidly

7. Emission reduction: the EPA's 2014 Clean Power Plan

- EPA announced plan in June 2014 to reduce CO_2 emissions 30% 2005-2030 (12% achieved by 2012)
  - Bottom-up state-specific plans based on achievability
  - Some states already had own targets / systems
- Five instruments foreseen to meet target
- Three-way flexibility: technology, policy mechanisms, geographic scope (states can join compliance groups and introduce trading systems)
- Potential court challenges to plan - e.g. exceeding authority, or costs not justified
- Industry challenges:
  - Power prices will depend upon approach adopted
  - Companies and RTOs operating in several states could be faced with a patchwork portfolio
  - Approach in neighbouring states could affect operations

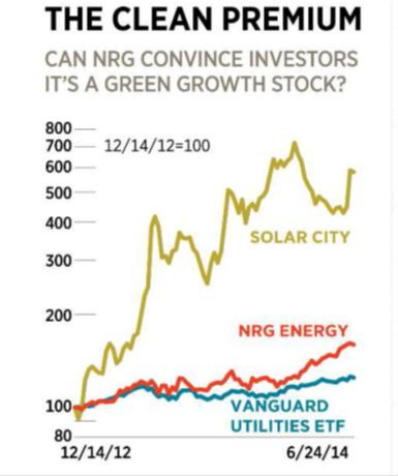
Example : Georgia Heat-rate reduction 2012-30



Contents

1. New business models and new market entrants - what the utilities are doing

- Different challenges for different types of company: ESCOs, T&D, Merchant generation
- Challenges for conventional utilities:
  - Flat or declining demand
  - Growing conflict between obligation to serve and ability to recover costs
    - Raising rates to cover costs can drive customers off grid - death spiral
  - Non-gas plants (coal, nuclear) under pressure due to cheap gas and wind; merchant plants without good PPAs in trouble
  - NRG #1 challenge - business model to compete with telecom companies!
- What they are doing:
  - Investing in renewables (partly to meet portfolio standards)
  - Looking at offering new services including various solar projects
    - unsure what advantages over new entrants and whether services will make money
  - Struggling for a “clean premium” on the equity market



2. New market entrants and their metamorphosis

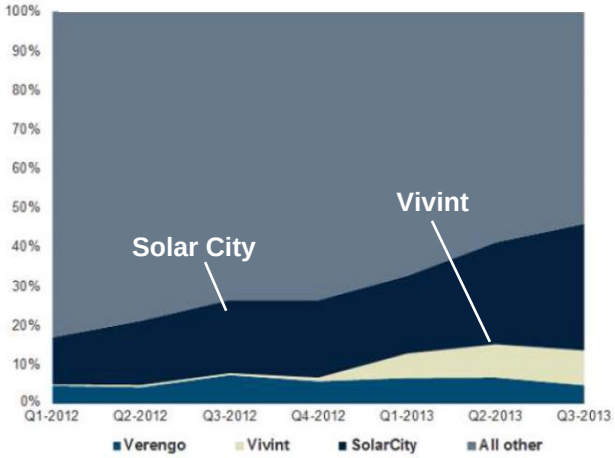
Telcos / home security

Data managers / aggregators

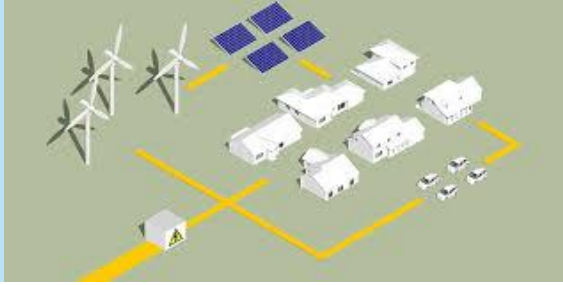
Solar companies / leasing

EV Manufacturer / Battery procurer

US PV Installation Market Share

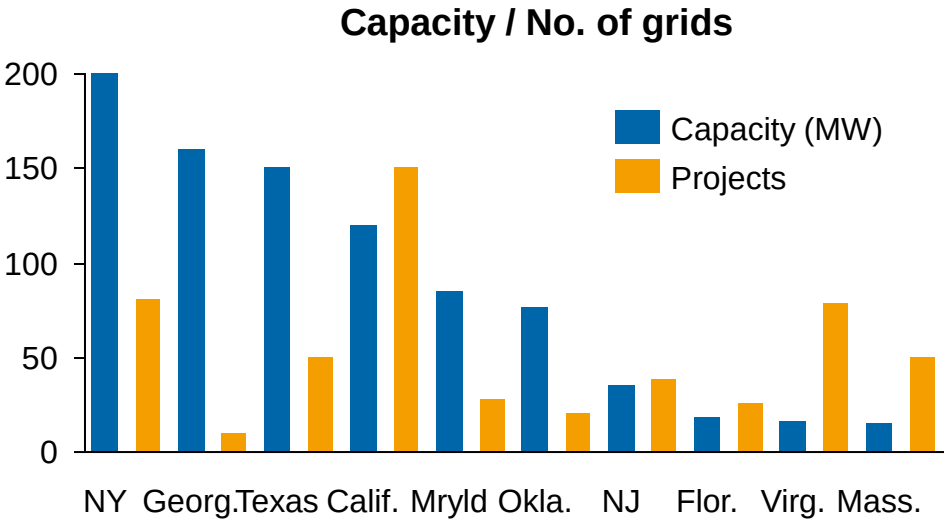


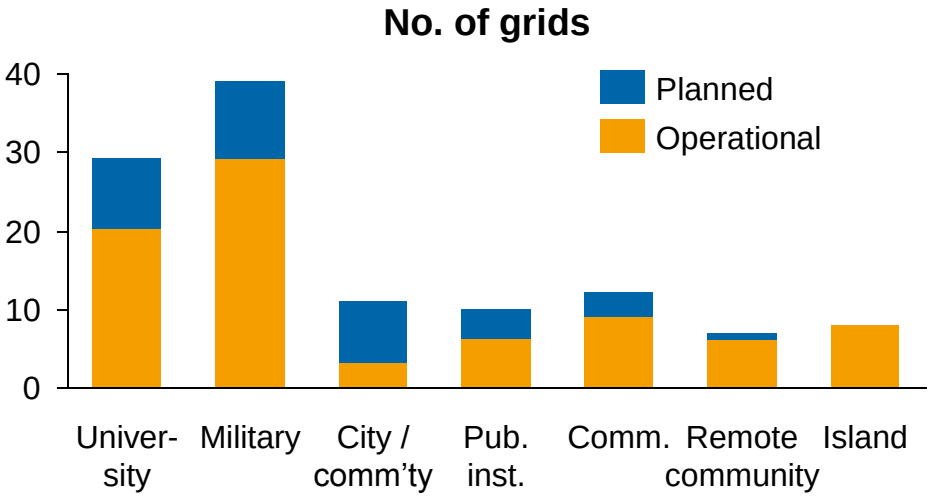
3. Microgrids - currently a niche market



- Definition: local grid of 2 - 40 MW either independent or linked to main grid
- Mainly based on fossil fuels gas / diesel. but with PV share growing
- 81 microgrids (govt. funded) -1050 MW
- Forecast to reach 1850 MW megawatts 2017 and maybe 6 TWh by 2020
- Interest depends upon rate level in state and concern for reliability
- 97% of utilities see microgrids as a viable business opportunity

- Three key trends:
  1. Communities / public institutions build their share
  2. University / military grids grow
  3. Commercial 3rd-party owned grids enter market





Example: a microgrid for a community with 4000 captive users - the first “green” jail

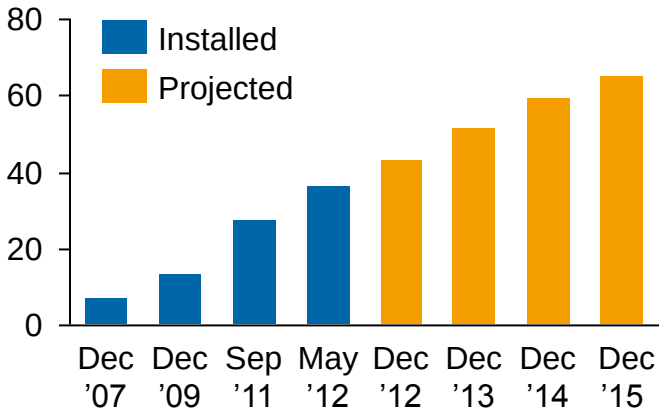
- 1.2 MW rooftop solar PV system
- 1 MW fuel cell power plant with heat recovery facility for hot water and space heating
- Five 2.3 kW wind turbines
- Two 1.2 MW emergency backup diesel generators
- 2 MW advanced energy storage system
- 12 kV sub-cycle static disconnect switch
- “Islanding” capability
- Electric power export and import capability
- CERTS smart grid control logic

4. Solutions for free-riding on the grid

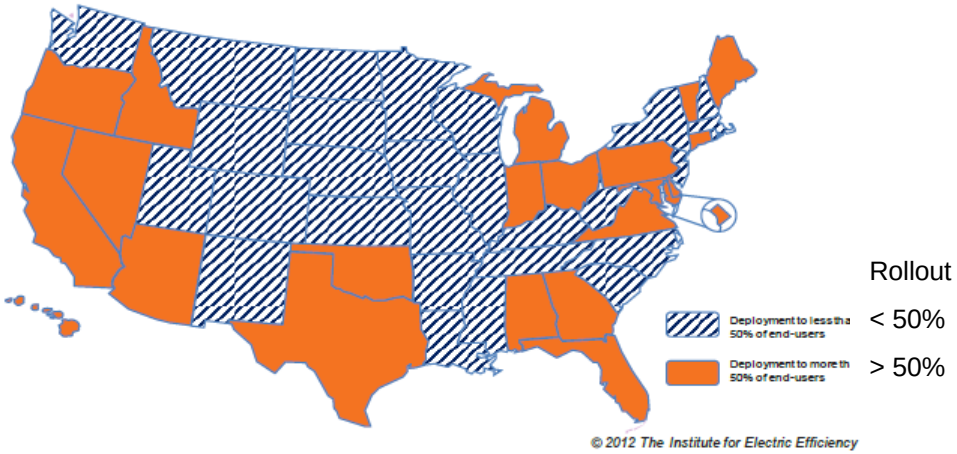
- Net-metering is big problem and widely propagated - but strong resistance even from Republicans: TUSK - Tell utilities solar will not be killed
- Problem is low fixed cost in consumer tariff (generally < $5 / mth or even < $ 1 / mth) - struggle to increase - should be $ 25 -40 / mth
  - Specific need for different tariff for two-way consumers
- Study on the **value of the grid** by Innovation Electricity Efficiency (IEE - Edison Foundation)
  - Based on what it would cost customer to self-provide technical equivalent of grid services
- Solutions
  1. Redesign retail tariffs to make them more cost-reflective
  2. Charge DG customers for gross consumption under normal tariff and separately compensate customers for on-site generation (based on its actual value to grid)
  3. Impose T & D standby charges on DG customers
  4. Put DG customers in different rate class e.g. charge DG customers 70 cts/kW of DG/mth
  5. Novel tariff: $ 50 / mth fixed cost and 1 ct / kWh to flow power either way

5. Smart Meters and Big-data Mining

Smart meter installations - mn



Smart meter deployment by state



- In 2012, 533 U.S. utilities had 43 mn. advanced ("smart") metering infrastructure (AMI)
  - ca.89% were residential installations
- Nearly 100% roll-out in CA and TX
- By end of decade most US homes will have SMs
- In 10 years worldwide there could be 800 mn. smart meters vs. 64 mn. now

Source: Institute for Electric Efficiency and FERC

Green Button - Federal standard - leaves Europe standing…

- Standard format for both Smart Meter and AMR (automatic meter reading)
- Provide customers with easy / secure access to information in a consumer-friendly format
- Customers can securely download own detailed data with a click "Green Button" on websites.
- Green Button initiative officially launched in January 2012
- To date 35 utilities / electricity suppliers apply initiative covering 36 mn. homes

What is Green Button?

Green Button is a secure way to get your energy usage information electronically.

Learn
Learn about your energy use and its environmental impact.

Analyze
Conduct virtual energy audits that can cut costs for building owners and speed up retrofitting.

Save
Get customized tips for saving money on your energy bill.

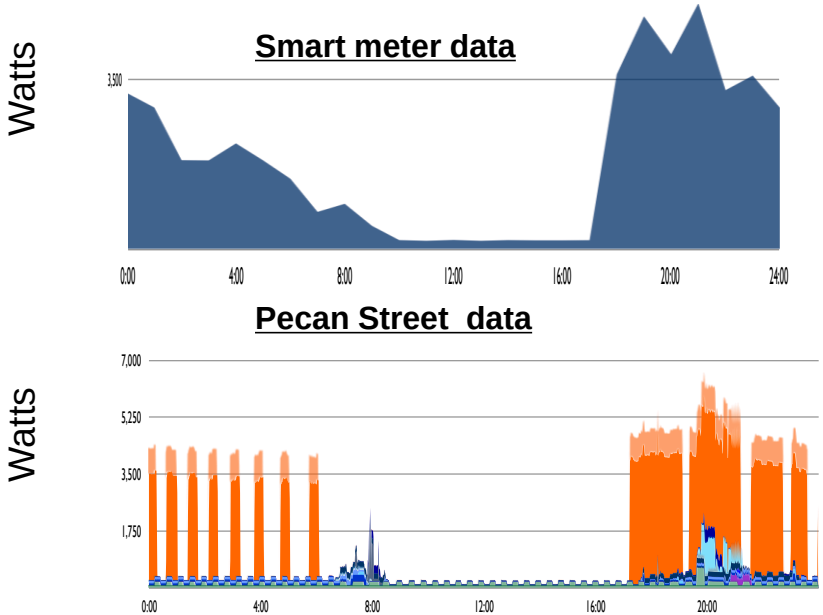
Build
Create tools for businesses and consumers using Green Button data. Start with the Developer Guide

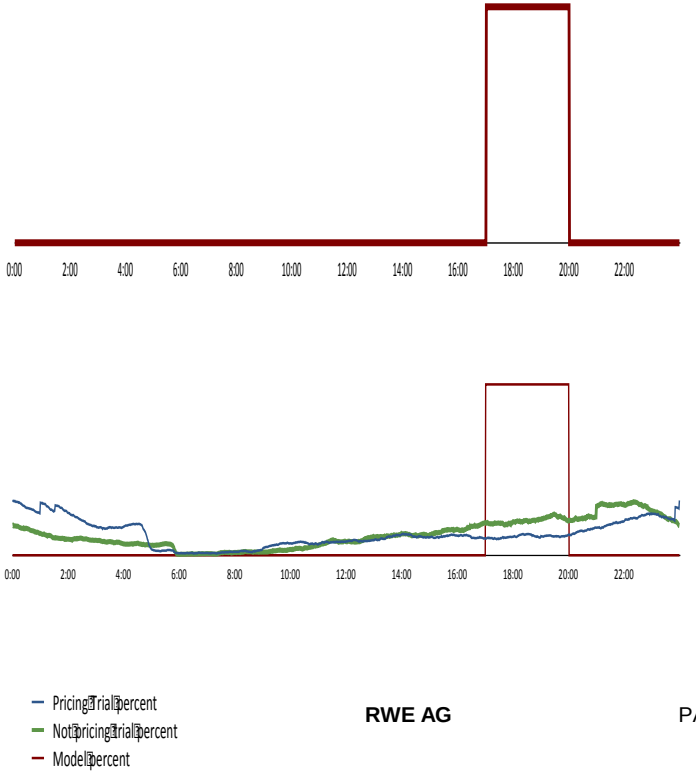
Pecan Street Project - Mining Data

- Texas has highest density of Electric Vehicles in the US
- Pecan Street Project studies with 1 minute granularity all forms of energy and water use
- Neighbourhood project - 200 homes with 5.5 kW panels and Plug-in EVs

Household demand: 15 min vs. 1 min

Charging of EVs - assumed vs. actual





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NY - REV

REV reforming the energy vision together

I. Why it‘s important for Europe and NY power basics

II. Background, essence of proposal and timetable

III. Distribution Service Platform Provider

IV. Regulatory Reform

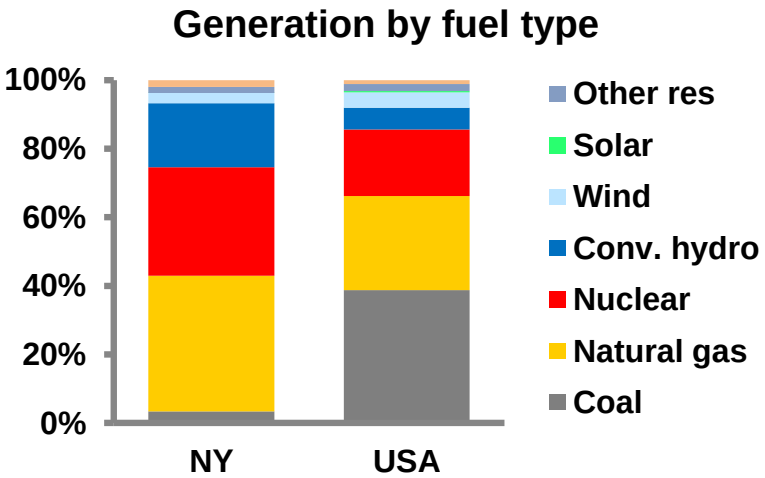
V. Open issues and views of utilities

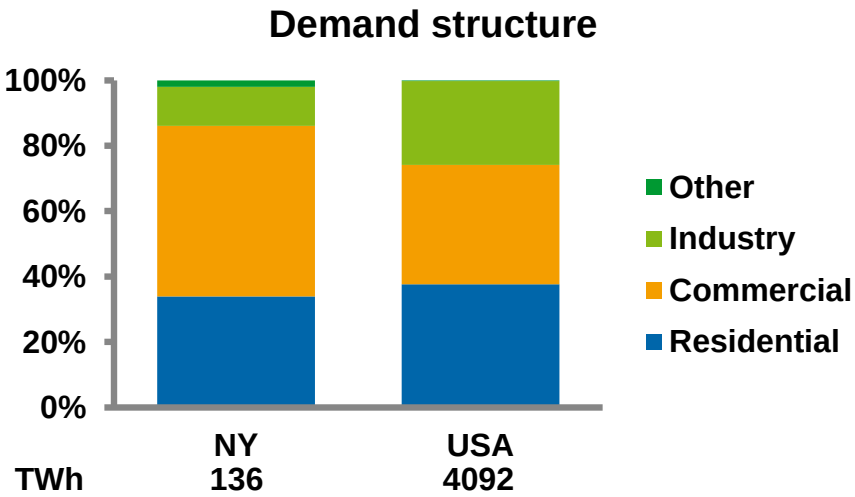
I. The New York REV - three reasons why it‘s important for us

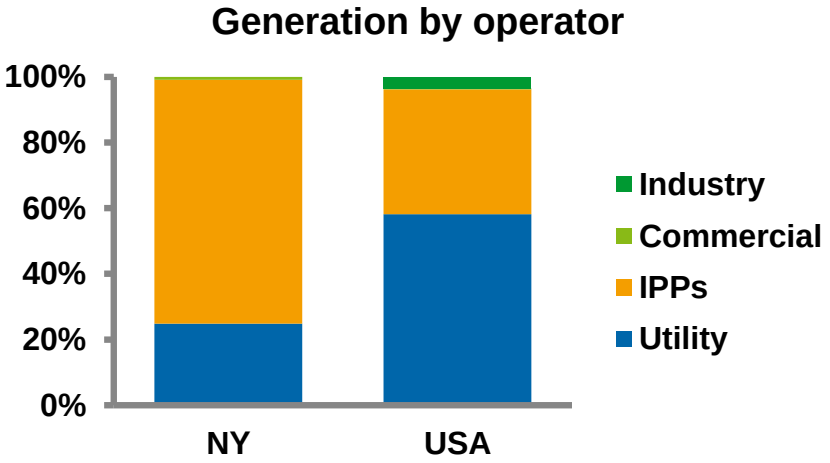
1. Seeking to **reinforce the future of the utility** (wires)
   - ensure adequate financing
   - should not be cheaper for „customers“ to leave grid
   - add a new role (remunerated) to compensate for reduced income from wires
2. Introducing new rules into the hitherto poorly defined game of who does what in decentralised system - aggregators, HEM etc.
3. Huge political capital and resources invested - centre of attention and potential model for rest of world - important learning opportunity (including from what may not work easily / at all)

Power basics in New York and the USA

Key data (2014)	GW / mn
Population	19.8
Total capacity	38.0
Renewables / wind	6.2 / 1.7
Import capacity	2.1
Demand response	1.2
Peak demand	33.7
Reliability required / available	39.4 / 41.3







Source: EIA Electricity Browser - 2014 Data

II. Background to proposal

- Long-outages due to Hurricane Sandy in 2012
- Increased customer reliance on high-quality (zero downtime) power (Wall Street)
- Cost pressure - need to replace aging infrastructure and meet rising peak-demand - $ 30 bn. for generation / infrastructure and $ 10 bn. for clean energy
- Consumer prices - NY has 4th highest in US (60% above average) $cts 19.3 / kWh
  - no entity has responsibility for ensuring total rates are as low as possible or reducing system peak
  - business customers also objecting to on-costs linked to residential support
- Electricity price volatility due to increasing use of natural gas for power generation
- Need to reduce emissions and meet EPA targets
- Developments in DG / info systems challenge incumbent systems
  - risk of reaching cross-over point - self-reliance would be cheaper than grid
- NY wants to be a leader in redesigning the utility

Essence of the concept

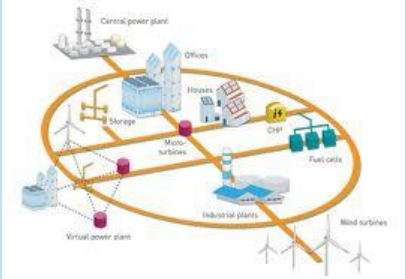
New York State Public Service Commission

- Starting point: existing grid objectives - low cost, reliability and universal access - to be maintained but new technology given more chance
- Managing peak demand (due to more HVAC) is the key - so demand response and distributed generation coincident with peak demand will be core
- Essentially a distribution initiative - source of power outages, prospective need for high investment and key to integration of renewables (ISO concept at DSO level); but substantial impacts at wholesale level
- Ensure long-term financial viability of utilities; help them make transition into renewables world without destructive dynamic decline / system fragmentation
  - new sources of revenue to compensate for decline from conventional activities
  - should not be cheaper for (almost all) customers to go off-grid
- Reduce monopoly-component of utilities and continuing capex on infrastructure
  - susbstitute by competitive, entrepreneurial providers so that distributed energy resources (DER) become part of it: accelerate role of new technology
  - utility incentives to do job well and earn; move from „reluctant to motivated“ actor

Essence of the concept (ct)

- PSC will aim to find common denominator across system resilience, carbon reduction, lower rates and new technology
- Drive utilities towards more transparency - price signals for both capacity and energy
- Cost-benefit analysis (CBA) - at heart of concept (utility investment vs. Distributed Energy Resources (DER)) but treatment of externalities is critical
- Distributed service providers platform (DSPP) is tool to integrate DER and harness full capabilities; DER to help moderate evening ramp (Two-way cop or air-traffic controller of grid)
- REV should not be a drag on but rather stimulus to economy (green jobs etc.)
- NYPSC can‘t influence the hard costs (equipment procurement) but can influence the soft costs e.g. financing and installation
  - Wants to achieve scale and avoid bits-and-pieces to realise goals

III. The Distribution Service Platform Provider (DSPP)

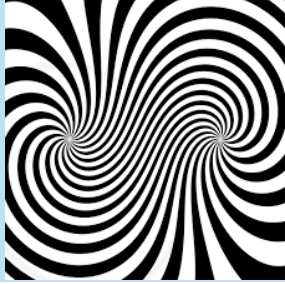


- Lies at heart of new system
- Ensure information symmetry between utility, customers and third parties
- Will permit price / value discovery of different DER, which can also depend upon their location
- May dispatch DER directly or allow third parties to do so
- Will require a new skill set, most closely found in trading activities

Who will do what?

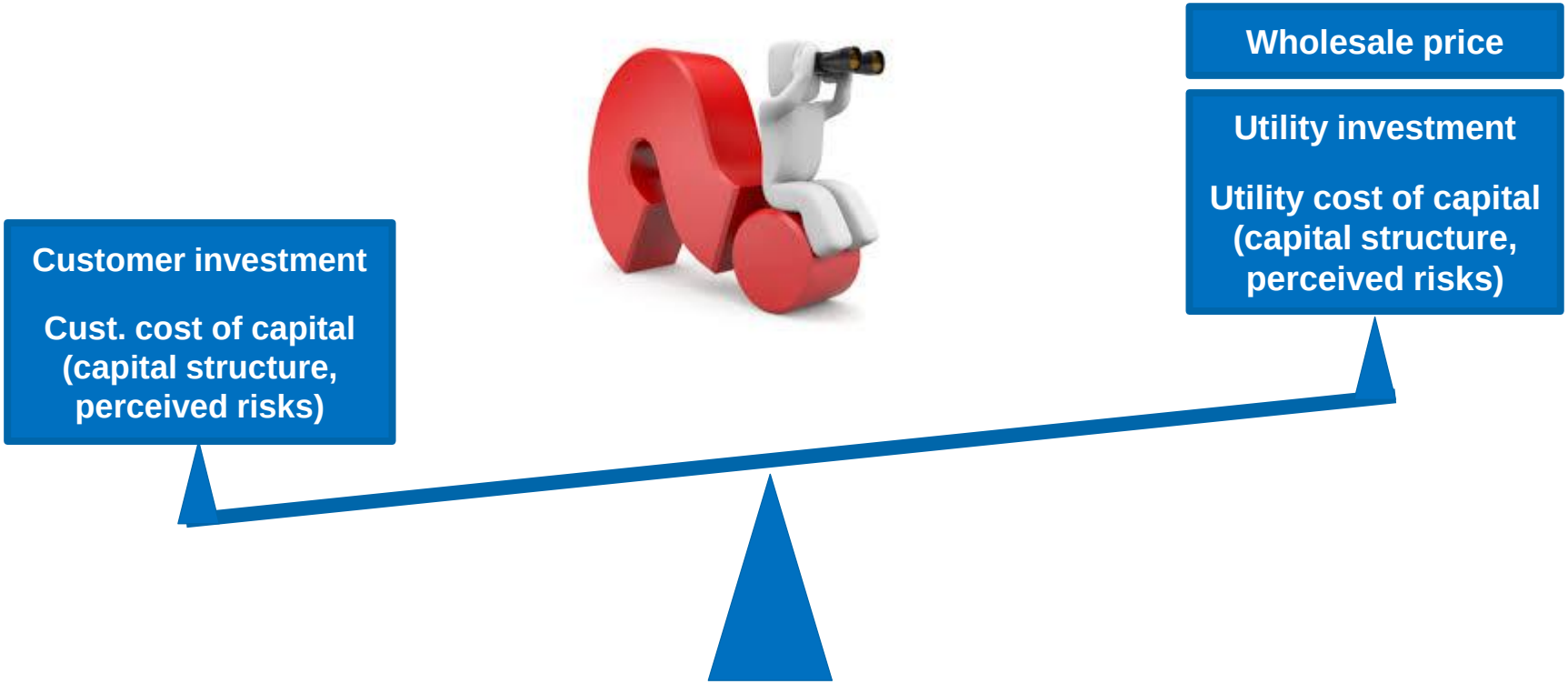
- Most controversial issue relates to role of utilities
  - need to balance financial strength against excessive market power
  - utilities will be responsible for operating the DSPP; but firewall needed!
  - only non-regulated utility affiliates may own DER, although competitors protest: utilities have so many advantages - not worth their while
  - uncertain whether utilities be able to add more solar within their rate base - solar suppliers maintain they can do it all themselves
  - no assets behind the meter can belong to RAB unless for social/system benefits
  - can they find different ways to exploit their brand and earn as data custodian?
- Proposed to have demonstration projects (more business model than technology) which can go into the rate-base
  - ConEd affiliate proposed a smart grid in Pomona) and NYSEG/Iberdrola a green demonstration city (Micro REV)

„Animating“ the market



- Entails developing a common currency for utility network investment and DER
- Determine full value to system of different DERs
  - Idea of market for each element (efficiency, demand-response, DG)
  - Can be locationally-specific according to network constraints
- Alternative would be to run pilot-projects (tender process) and subsequently integrate most successful examples
- Cost-benefit analysis (CBA) - at heart of concept (utility investment vs. DER)
- Treatment of externalities is critical; value of carbon is key input
- RES costs above wholesale prices in most parts of the country (without subsidies) - questionable whether other benefits compensate for the higher costs
  - try to avoid explicit subsidies for RES
- Market approach will introduce additional risks - how well will new players cope?
- Is it a market like Ebay, but with real-time pricing?

Animating the market - can it be achieved?

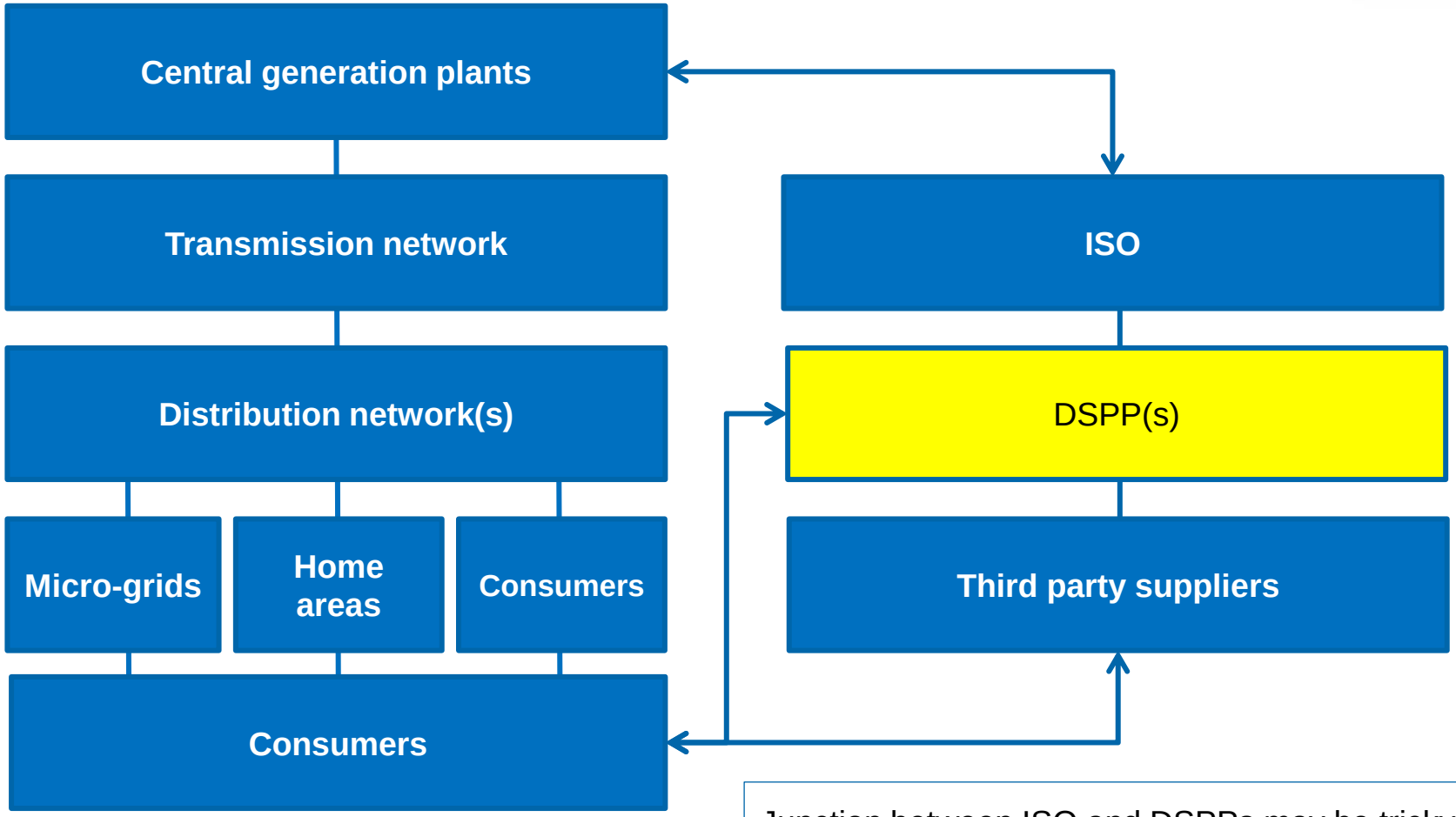


- Major challenge to reduce a particular system need (e.g. coping with increased peak or higher renewables feed-in) with a common currency

Technology choices

- Choice of communications and control widening continuously
- Focus first on required functionalities and then on technology
- Smart-meters have not yet been chosen by PSC - believe there a may be cheaper „fit-for-purpose“ alternatives; also vocal group opposing on health / privacy grounds
  - A 100% roll-out of smart meters would need $ 5 bn
  - Prefers to allow entrepreneurs to propose solutions rather than embedding smart-meters in rate base which could soon be obsolete (E.g. a telecom co. had expressed interest in providing back-bone, rate-based communications)
  - Issue of whether to cover all customers or only those engaged with smart devices / responding to price signals

How it all fits together



Junction between ISO and DSPPs may be tricky

IV. Rate structure reform

- Identified as critical part of project to drive correct behaviour both from utilities and customers
- NY State introduced standby-charges 10 years ago based on pure cost-causation
  - There are now 20,000 former customers off-grid located within several large developments
- Hourly pricing rates are mandatory for customers above 300 kW;
  - by statute not allowed for mass market (most smart meters in US are not used for TOU pricing)
- REV looking to achieve dynamic management within a context which includes variable pricing

V. Key questions to solve

- What basis for compensating utility to act as DSPP operator?
- How to compensate utility for promoting energy efficiency?
- What kind-of pricing? TOU or dynamic pricing (including CO_2 content in hourly supply mix)
  - Tariff structure should be used to engage consumers in a new way and encourage the utility to manage the new entity
- Balance between tariff structure, technology structure and business models
- Skill-sets required to run DSPP - so far not generally present in utilities

Utilities‘ view of concept

- Is REV in NY 5 years too early? Renewables penetration is low
- „Concept without much analytics behind it, so far“
- What will actual costs be to customer?
- Contradiction between „cost-of-service“ model and expensive renewables
- Don‘t understand „animating the market“ - 100 unknowns and only 3 equations
- Need significant technical leaps to accept higher back-feed levels in distribution
- Want to ensure that they have lead roles when all details resolved
- Generators/ retailers concerned that wire utilities could gain at their expense
- The truly transformative aspects will be hardest to realise
- Storm-resilience imperfectly reflected in pricing: hard to see how to achieve
- Carbon price discovery? NYS is already a member of RGGI

Contents

Generic headline issues comparing US with Europe (draw on wider US meetings)

1. Different ways of changing the generation level / mix and decarbonising
   - CA specific „load orders“, RES subsidies, market methods - NY REV & EU ETS
2. View that liberalised markets are being pushed to the limits
   - Challenge of zero-cost renewables in WS market
   - Death-spiral started in Germany with generation but in US with the wires
   - CA / NY to reinforce financial position of utilities as good PPA counterparties
   - Public Power Producers claim good results in regulated market - prices etc.,
3. Experience and views on capacity markets; comparison with energy-only market
   - Mainly popular with generators whilst others question value-for-money
   - Divergent views on whether a separate „flexible“ capacity product is required

Headling issues (ct)

4. Role and ownership of distribution grids
   - Become more like ISOs? Links to TSOs?
   - Rules needed for new games - aggregators, virtual power plants etc
   - With new technology where are correct limits for „natural monpoly“; how can different elements of system be built / financed at lowest cost?
   - Plug-an-play approach to permit optimal integration of RES
   - Will they be bought-up by municipalities and socialised like other infrastructure?
5. Some concern about integration of renewables and system stability at 50% levels
6. Approaches to changing end-customer price structure
   - Most focus is on time-of-use pricing with time-bands and critical-peak pricing
   - Most utilities see need to increase fixed costs (at least for DG customers)
7. Smart-meters - will other forms of technology offer a better benefits / cost ratio?

THANK YOU FOR YOUR ATTENTION

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