

Permissionless Innovation in Electricity: The Benefits of Experimentation

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Economics for Energy Workshop, Madrid, 2015



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Questions I'll pose today

- How does **innovation** (smart grid & distributed generation) affect distribution business models?
- How does **regulatory design** (and thus the distribution business model) affect the emergence of new innovations, services, and markets, such as the residential solar market in the US?
- Is there a more useful **theory of competition** in which we can ground regulatory practice?
- What does an **experimentation**-based theory of competition imply for innovation, for business models, and for regulatory institutional design?

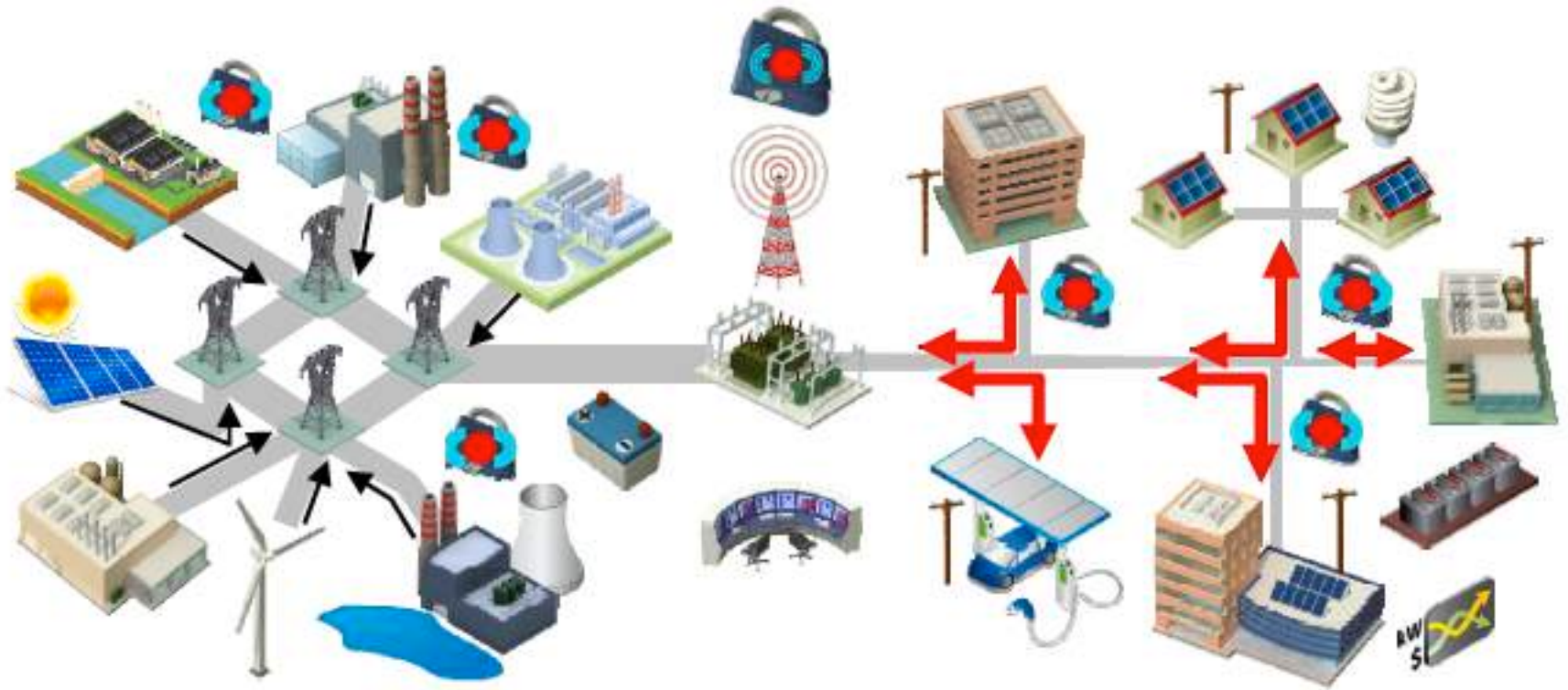
Punch line:

Retail competition

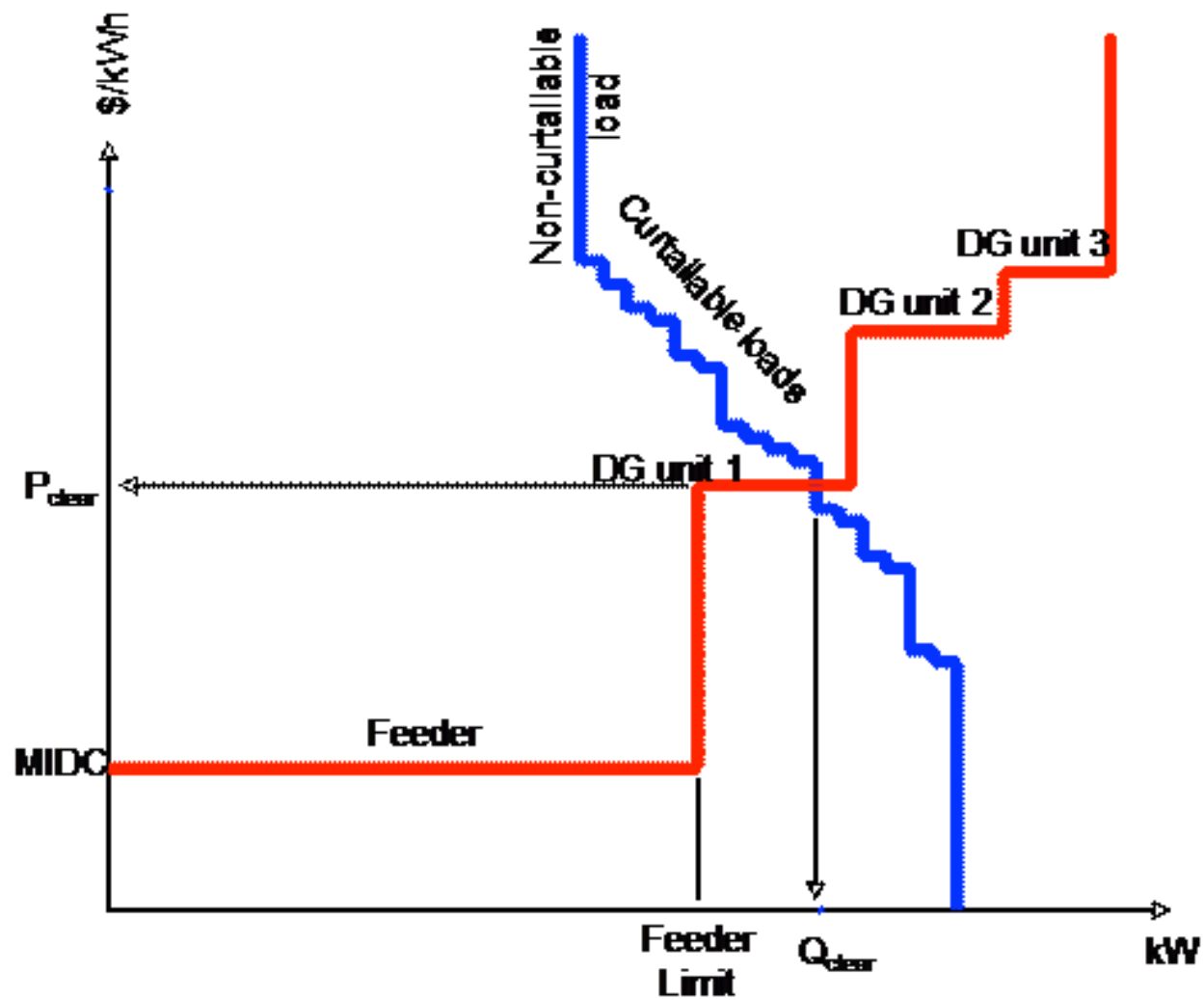
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Technology-agnostic, performance-
based environmental policy

Smart grid: physical and transactive



Source: EPRI (2011)



How could smart grid & DG change distribution business models?

- Apply Coase: SG tech => reduced transaction costs, reduced economies of scale & scope => increased potential feasibility & value of retail competition
- Digital technology enables
 - More transparent and timely information
 - Automation of human preferences and decisions
- Retail function not a natural monopoly
- Unbundling



Source: Obituary, *New York Times* 4 Sept 2013

How does digital technology change this landscape economically?

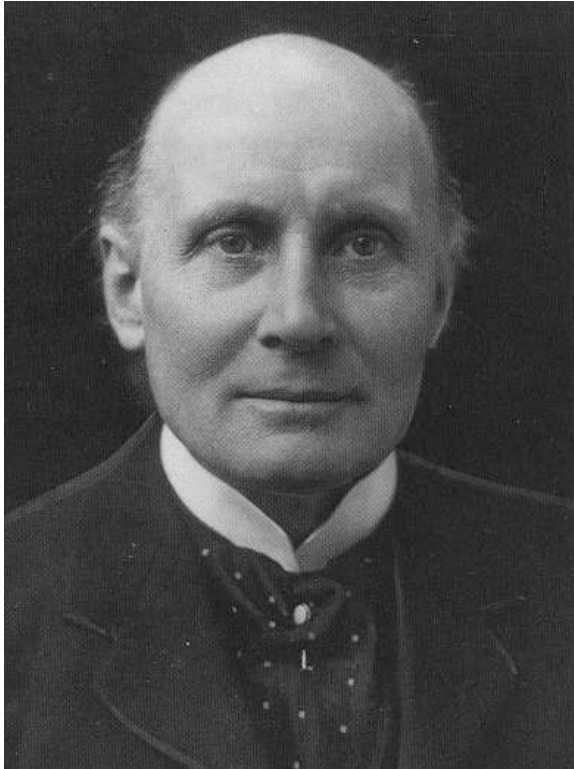
- **Cost** of providing reliable transmission and distribution
- New, different **value propositions** to consumers
- Paying for smart grid **investments**
 - Who decides which investments to make?
 - Who pays the costs?
 - How to weigh operational, environmental, consumer benefits
- Focus on two types of **changes**, already in process pre-SG
 - Unbundling
 - Changing role of distribution company, changing business models

New, different consumer value propositions-1

- ... because the value proposition is not **only** the kwh
- Product **differentiation**
 - Making more money by selling less power is possible
 - Conservation, satisfying green preferences
 - Examples
 - TOU
 - Dynamic pricing
 - Time differentiated: RTP, CPP, PTR
 - Green/grey mix
 - Service bundles – home entertainment, home security, home health care
 - Price discrimination's mutual benefits to consumers and producers
 - Apps – innovation at the edge of the network
- Digital **transactive** technology enables **automation** – reduces transaction costs

New, different consumer value propositions-2

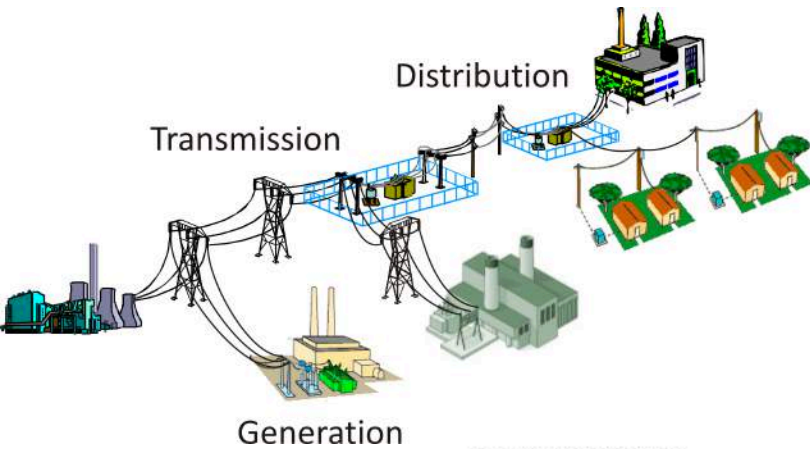
- **Reliability**/supply security as a **differentiated** product, not a uniform administrative definition
- Small-scale DG **interconnection**
 - Residential solar
 - Electric vehicles
 - **Market-connected** DG as a network of distributed storage
- Microgrids
- Agent **heterogeneity**: scale, location, identity
 - Agents can be **buyer or seller** depending on context, prices, opportunity costs at that time and place with that local knowledge



“Civilization advances
by extending the
number of important
operations which we
can perform without
thinking of them.”

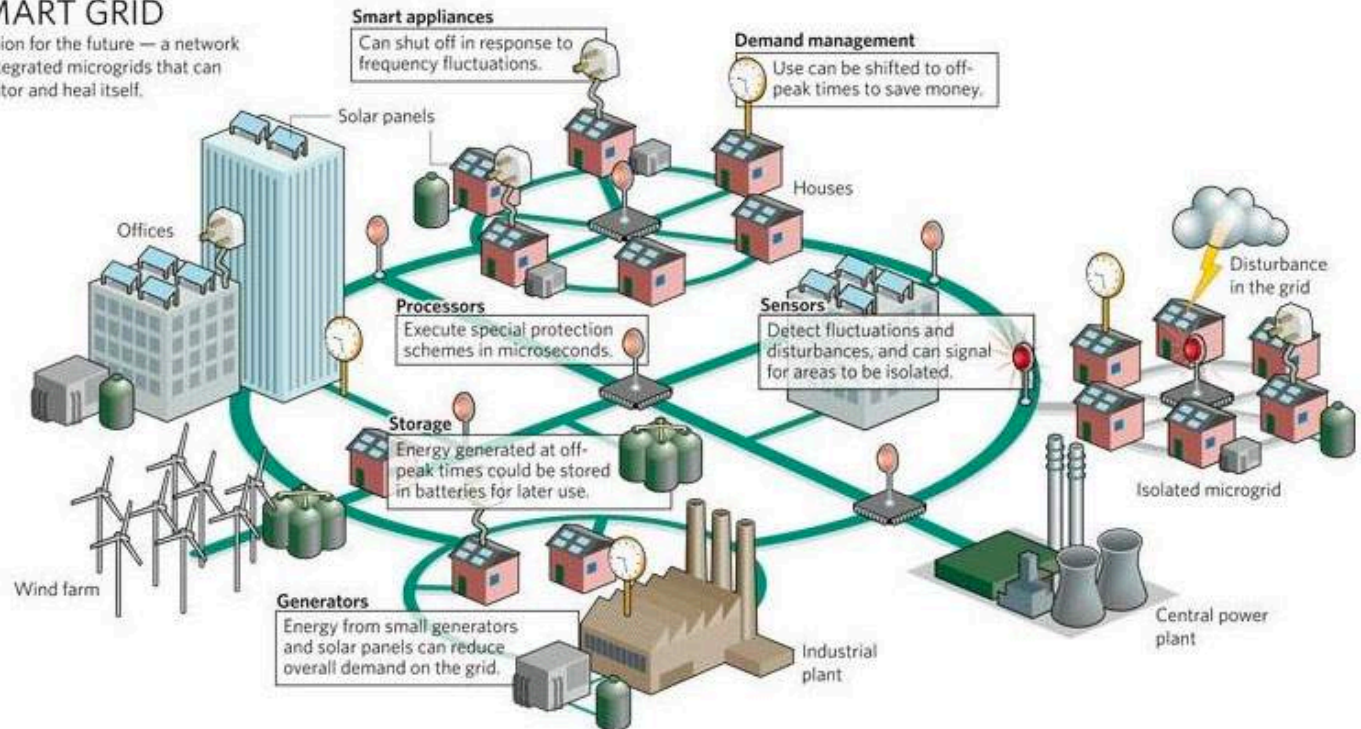
-Alfred North
Whitehead

Digital innovation at the edge of the network



SMART GRID

A vision for the future — a network of integrated microgrids that can monitor and heal itself.



Financial and technological innovation in solar



“The market will get what the market wants, which is low-cost electricity. If you are standing in the way of that tide, good luck.” – Danny Kennedy, Sungevity

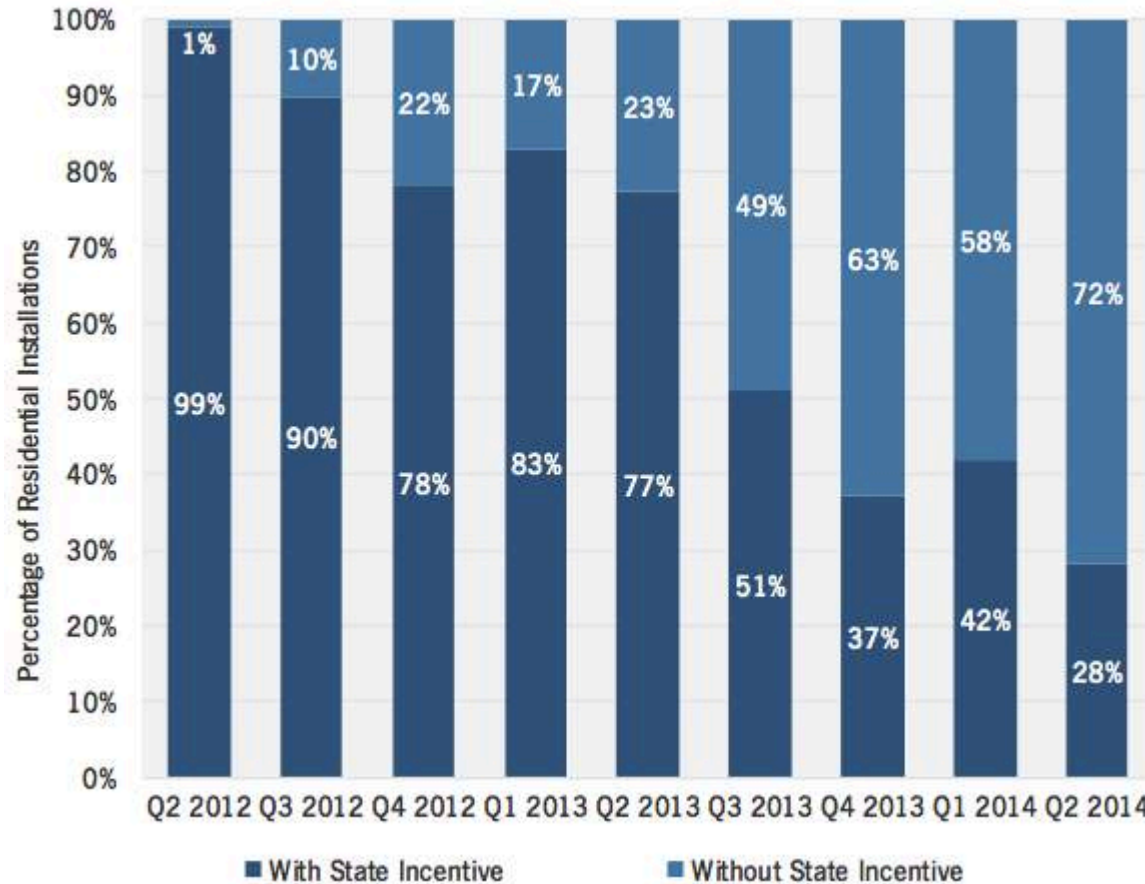
NYT Magazine 9 Aug 2012

Residential retail solar is growing

- Post-PURPA (1978)
- PV cost reductions
- Smart grid technologies
- Financial innovation
- Government policies

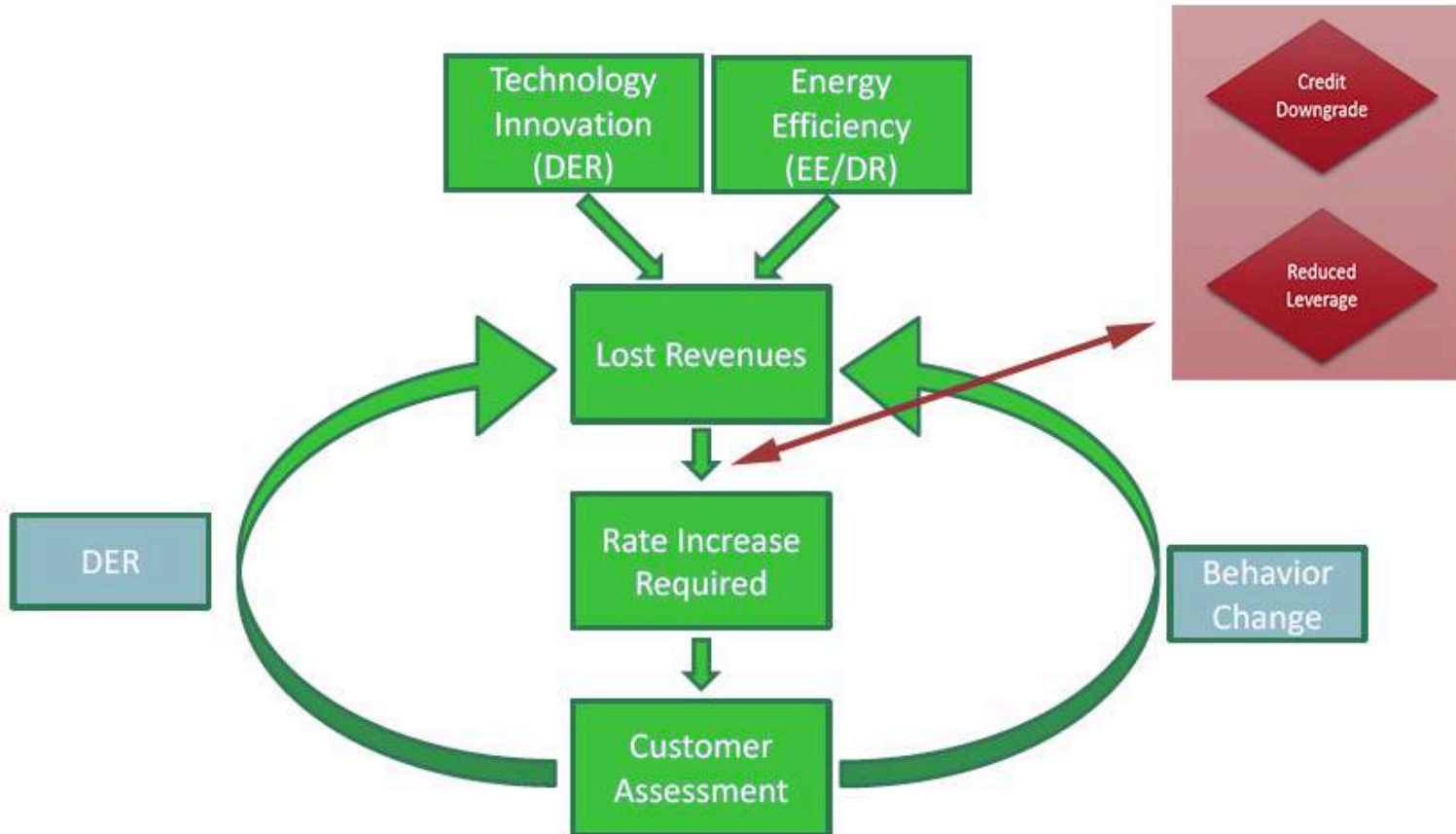


California residential solar installations without state incentives



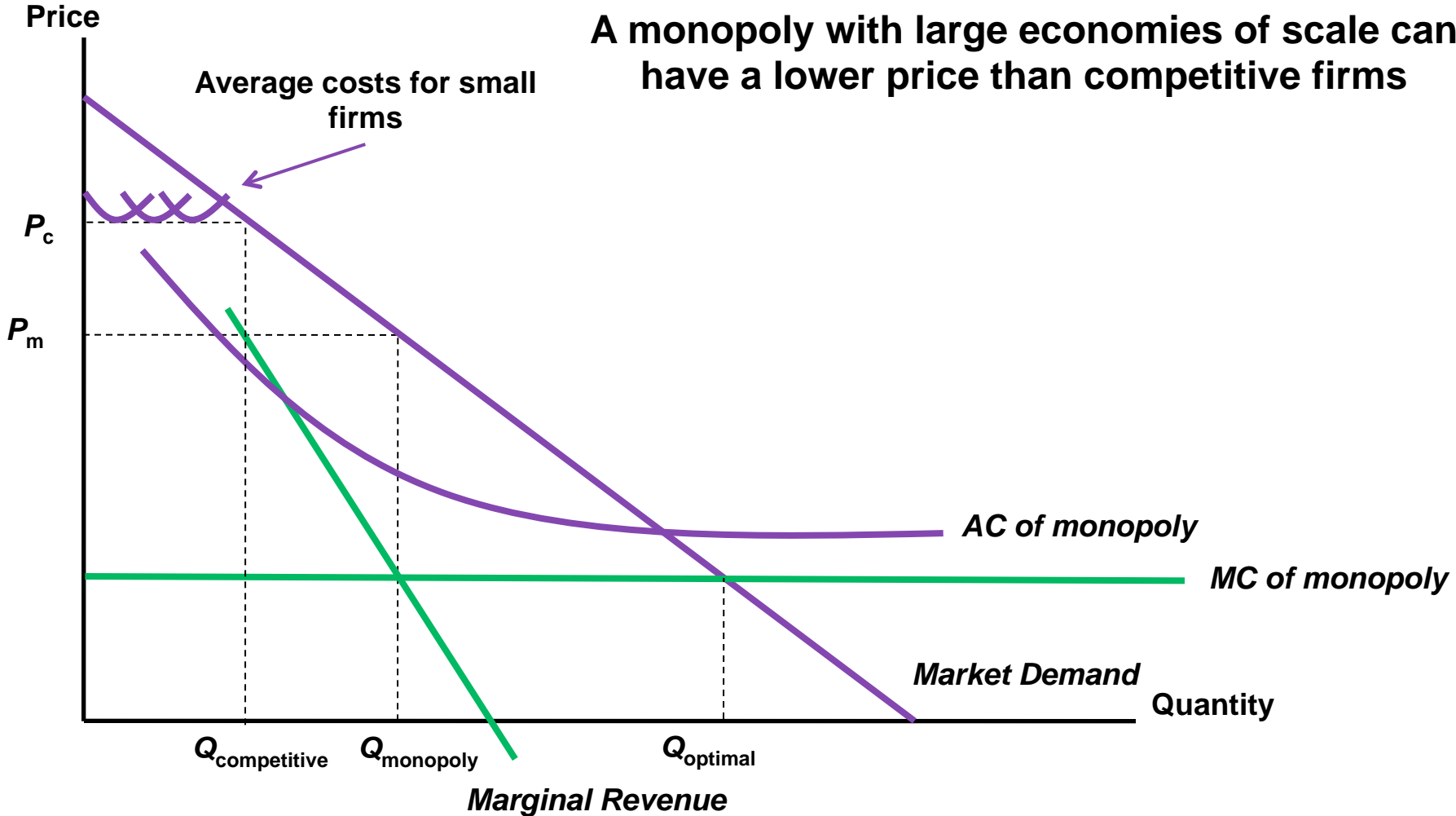
The “utility death spiral”

Vicious Cycle from Disruptive Forces



Static model underlies regulatory theory, practice, institutions

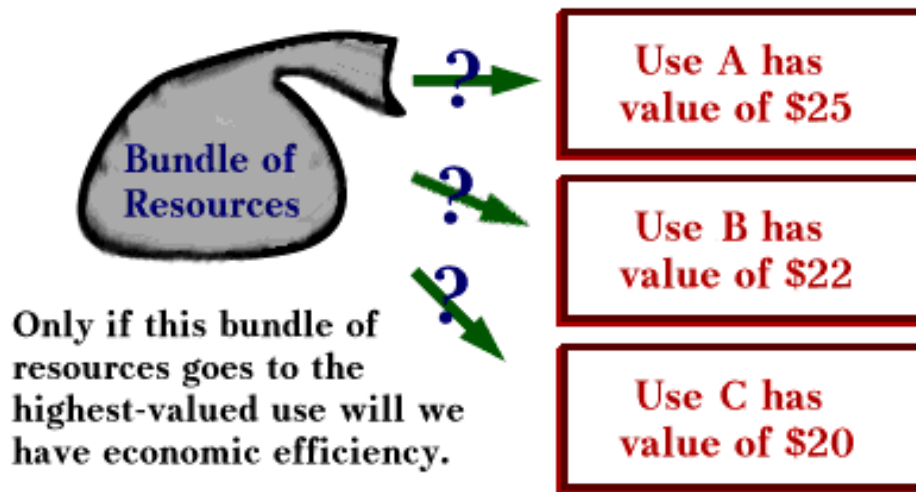
A monopoly with large economies of scale can have a lower price than competitive firms



Is this still a useful model in a dynamic economy?

- Theory is static and institutions/practice are built upon static theory
 - **Schumpeter**: entrepreneurship, innovation, product differentiation, and economic growth, creative destruction
 - Market processes do not create long-run value by getting to $P=MC$; they do so through **experimentation** and learning through trial and error
 - Political economy critique, VHV: “... a serious deficiency of regulation seems to be that it often **fails to ‘disappear’** when the natural monopoly does.”
- Epistemic critique – the **knowledge problem**
 - **Hayek** (1945): market processes aggregate diffuse private knowledge, and centralized processes cannot replicate those processes or outcomes
 - A price is a **signal wrapped in an incentive**, and it emerges from market processes, not from administered cost recovery

Is regulatory theory and practice suitable to evolving policy issues?



Economic efficiency

Environmental quality





You are here

What regulatory institutions are compatible with this complexity and with evolving policy objectives?

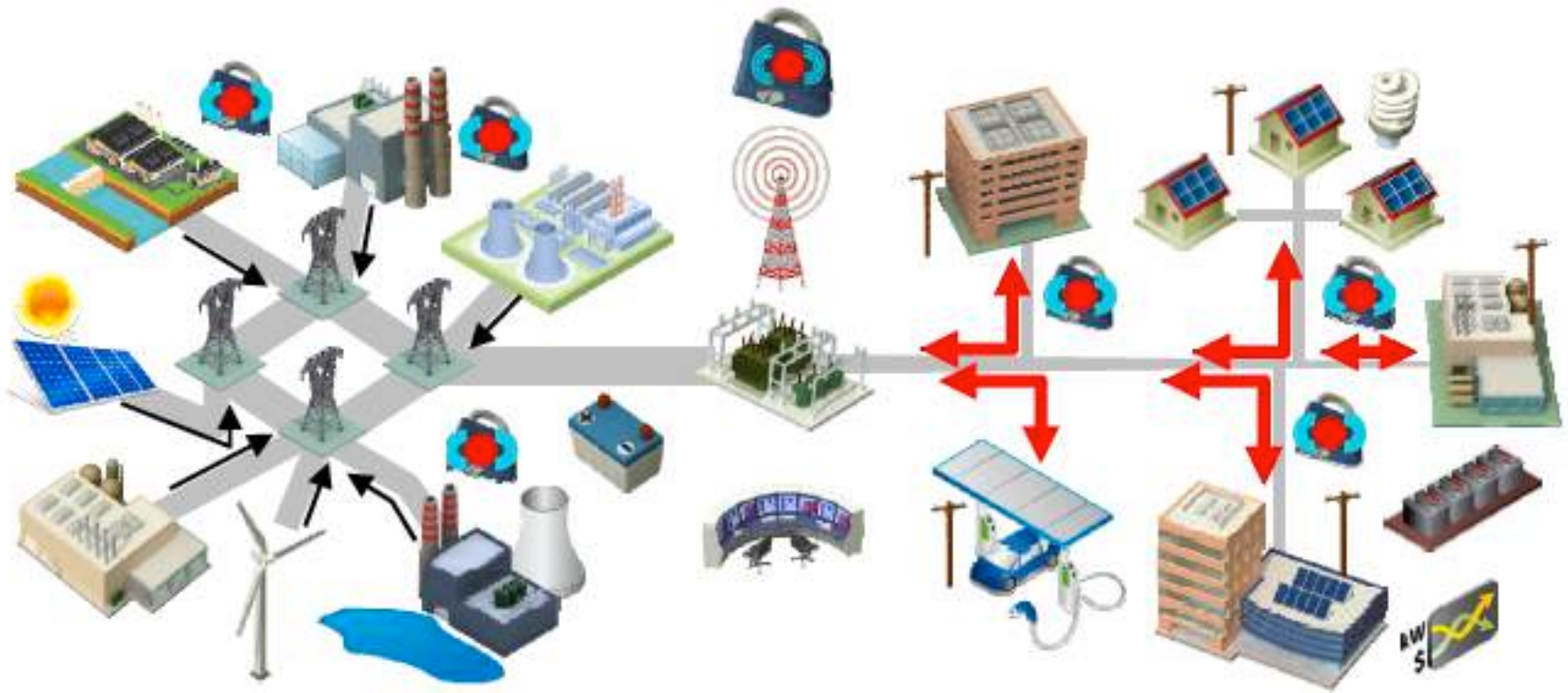
Hypothesis: policies enabling experimentation fit a dynamic economy



Why? Experimentation

- Is part of the process of value creation through **creative destruction**
 - Product differentiation, bundling, change market boundaries, rivalry among differentiated bundles
 - New entrants are most likely to risk their resources doing so
 - **Schumpeterian** disruptive entrepreneur
- Is essential to **entrepreneurial discovery** of new knowledge, leading to value creation when innovation does not rely on regulatory permission
 - **Kirznerian** equilibrating entrepreneur (with a dash of **Hayek**)
- Epistemic context: the knowledge relevant to coordination across individuals and across economic and environmental objectives is **dispersed, private, often tacit**, so regulatory mandates cannot replicate it

A platform business model: Permissionless innovation in electricity?



Source: EPRI (2011)

Proposal: Physical + digital platform business model

- **Technology** platform
 - Common core, heterogeneous periphery
 - Open interface standards
 - Loosely-coupled interoperable system of systems
 - Distributed digital sensing and communication
- **Economic** platform
 - Facilitate mutually beneficial connection
 - Heterogeneous agents with distributed knowledge & intelligence at the edge of the platform
- **Organizational** structure
 - Firm
 - Industry
- Compatible & enabling **regulatory** institutions
 - Competition around the platform
 - Open interoperable standards

New York Reforming the Energy Vision (REV) proposal

- Staff proposal from NY Public Service Commission
- Policy objectives include consumer-centric approach, markets, climate, alongside reliability and cost-effectiveness
- Proposal: Incumbent utility as a Distributed System Platform (DSP)
 - Enable heterogeneous agents to connect
 - Involves utility ownership of generation and storage technologies for reliability and market liquidity purposes
- Interoperability, non-discrimination, action orientation

Institutional design: Gardener, not engineer

“If man is not to do more harm than good in his efforts to improve the social order, he will have to learn that in this, as in all other fields where **essential complexity** of an organized kind prevails, he cannot acquire the full knowledge which would make mastery of the events possible. He will therefore have to use what knowledge he can achieve, not to shape the results as the craftsman shapes his handiwork, but rather to **cultivate** a growth by providing the appropriate environment, in the manner in which the **gardener** does this for his plants.”

-F.A. Hayek, Nobel address, December 1974

Conclusions

- SG+DG **innovation** catalyzes two organizational changes in the electricity industry
 - **Unbundling** the vertical supply chain
 - The changing role & **model** of the distribution company
- Experimentation is essential to the dynamic market process, but **absent** from regulation's **theory of competition** regulation
- The future utility business model as a physical + digital **platform** with permissionless innovation may yield other revenue streams as the value of the wires network diminishes over time
- The regulator's role should be as a **gardener**, not as an engineer – **retail** competition, **tech-agnostic** renewables