



Environmental Energy Technologies Division

Lawrence Berkeley National Laboratory

Distributed Energy Resources

Industry Structure, Institutions and Regulatory Responses

Steve Corneli & Steve Kihm

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 - Reviews issues, evaluation criteria, approaches and draft reports



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Reports Underway So Far

1. *Distributed Energy Resources (DERs), Industry Structure and Regulatory Responses*. Steve Corneli (NRG) and Steve Kihm (Seventhwave)
<https://emp.lbl.gov/publications/electric-industry-structu>
2. *Distribution Systems in a High DER Future: Planning, Market Design, Operation and Oversight*. Paul De Martini (Newport Consulting Group) and Lorenzo Kristov (CAISO) <https://emp.lbl.gov/publications/distribution-systems-high>
3. *Performance-Based Regulation in a High DER Future*. Tim Woolf (Synapse Energy Economics) and Mark Lowry (Pacific Economics Group) – December 2015
4. *Distribution System Pricing for Distributed Energy Resources*. Ryan Hledik (The Brattle Group) and Jim Lazar (Regulatory Assistance Project) – December 2015
5. *Future of Resource Planning*. E3 and LBNL – March 2016
6. *Recovery of Utility Fixed Costs: Utility, Consumer, Environmental and Economist Perspectives*. LBNL, utility rep (TBD), John Howat (NCLC), Ralph Cavanagh (NRDC), Severin Borenstein (UC) – March 2016

Report #1

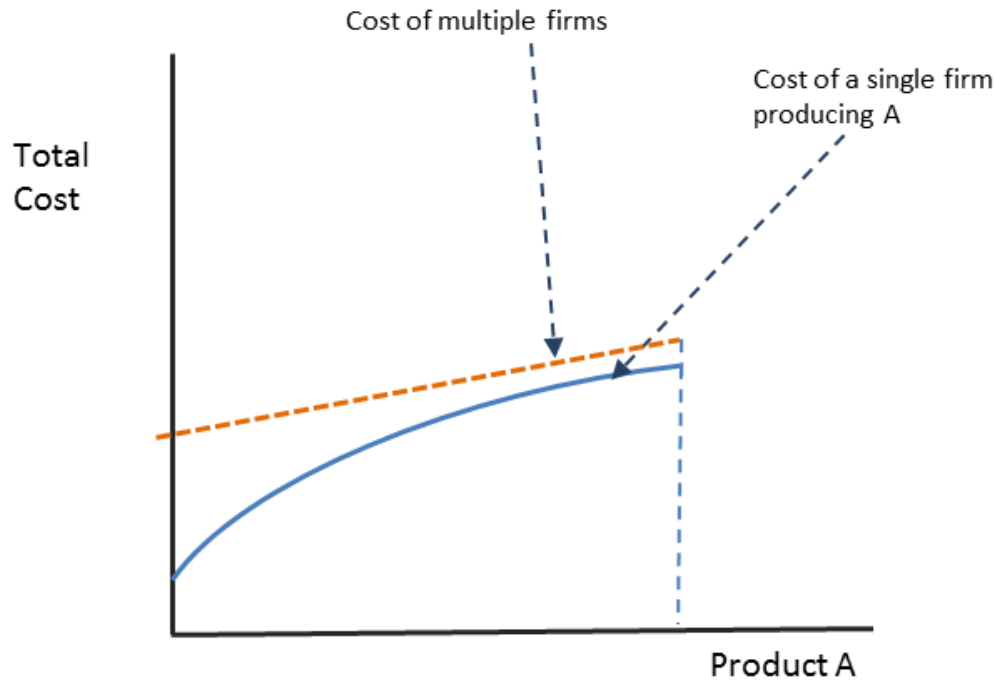
Distributed Energy Resources: Industry Structure, Institutions and Regulatory Responses

Steve Corneli is senior vice president for policy and strategy at NRG Energy, where he has served in various capacities since 2001. Before joining NRG, he worked as a utility consumer advocate in the Minnesota Attorney General's office and ran a family farm in Wisconsin. He has a master's degree in technology and environmental policy and policy analysis from the Humphrey Institute at the University of Minnesota, where he also did doctoral level coursework in applied economics.

Steve Kihm is principal and chief economist at Seventhwave, a think tank in Madison, Wis., and senior fellow at Michigan State University's Institute of Public Utilities. He has worked in the field of utility regulation for 35 years, including 21 years at the Wisconsin Public Service Commission. He has appeared as an expert witness in utility proceedings across the country, published reports and journal articles, and is co-author with Janice Beecher of the forthcoming book, *Risk Principles for Public Utility Regulators*. Steve holds a bachelor's degree in economics and master's degrees in financial economics and quantitative methods from the University of Wisconsin. He is a Chartered Financial Analyst.

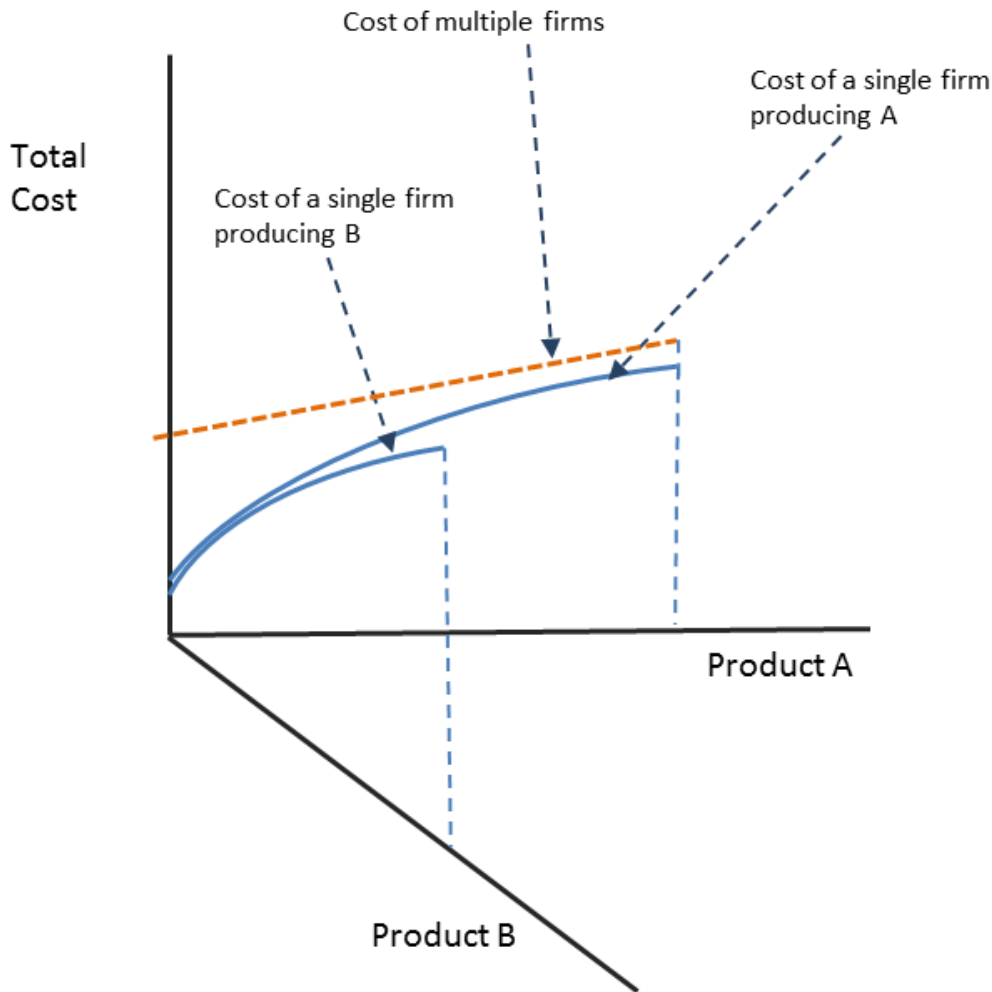
- How will high levels of DERs change the industry structure?
 - In particular, what will they do to the *natural monopoly characteristic* of the distribution utility?
 - What broader structural changes are likely in an industry with high levels of DERs?
- What do these changes mean for the ability of distribution utilities to profitably attract capital needed to maintain their networks?
- In light of these changes, what can utilities and regulators adapt to support needed network investment its broader public benefits in such a world?
- We developed a common set of tools to answer these questions and use them to see two different futures:
 - One where the utility plays a more passive, enabling role for competitive DERs. (Corneli)
 - One where the utility plays a more active role in developing, owning and aggregating DERs. (Kihm)
 - In both worlds, we see a common need to use DERs to reduce utility costs and increase the value customers with DERs can realize by continuing as network customers.

Natural monopoly



What makes a firm a “natural monopoly?”

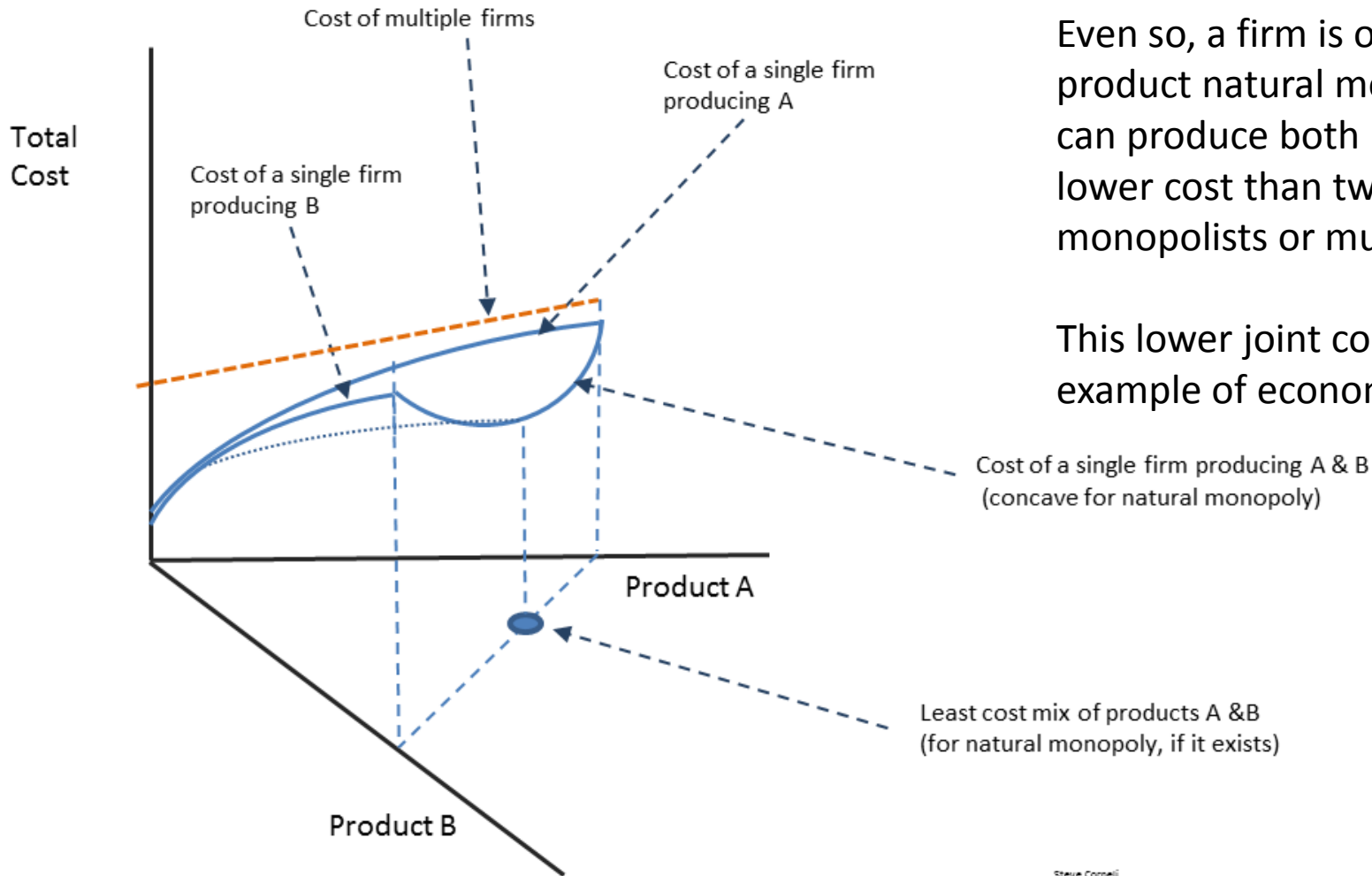
- Single firm can serve a market at lower cost than multiple firms.
- Typically produced by declining average costs due to strong economies of scope.
- But the deciding feature is whether the single firm is cheaper than multiple firms.



Many monopolies produce multiple products – making it a bit more complicated to determine whether a multi-product firm is indeed a natural monopoly.

Distribution utilities (and VIUs) are multi-product firms

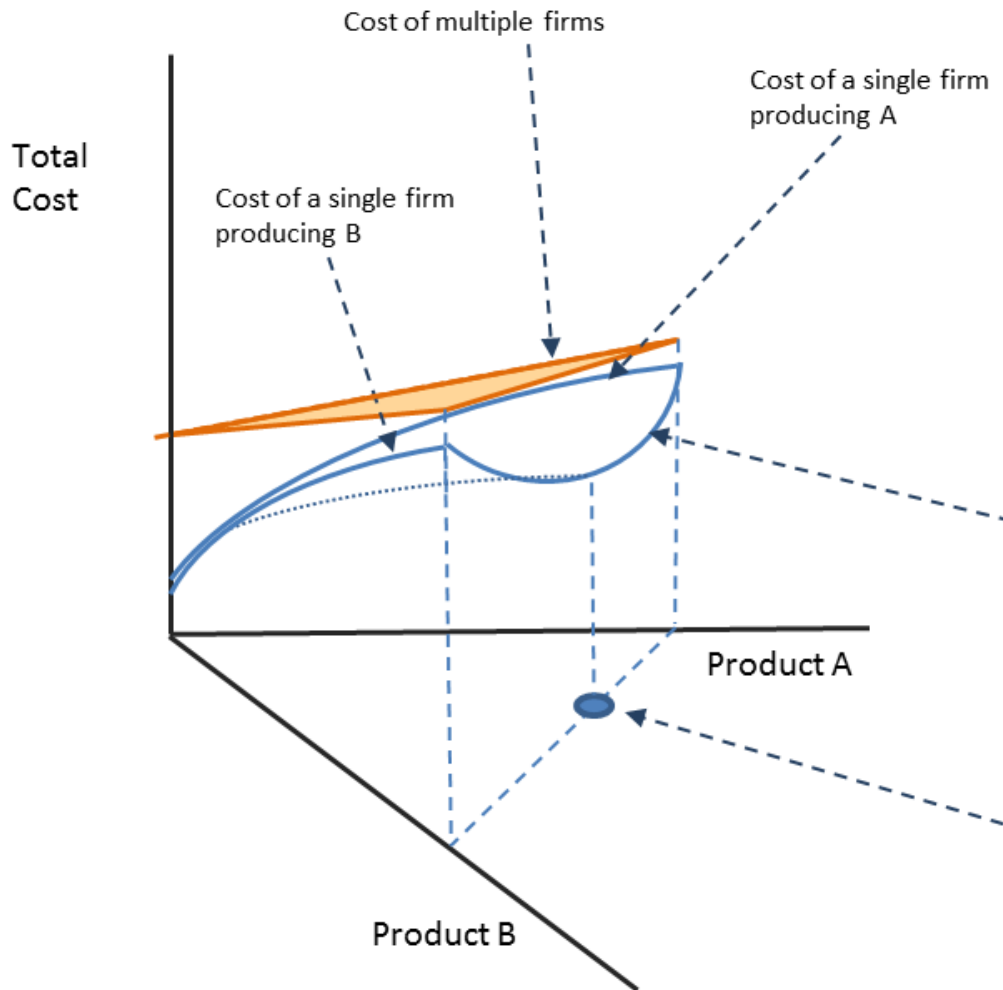
The first question is whether each product itself is a natural monopoly – that is, can a single firm produce that product at lower cost than multiple firms?



Even so, a firm is only a multi-product natural monopoly if it can produce both products at lower cost than two stand-alone monopolists or multiple firms.

This lower joint cost is an example of economies of scope.

Steve Cornelli



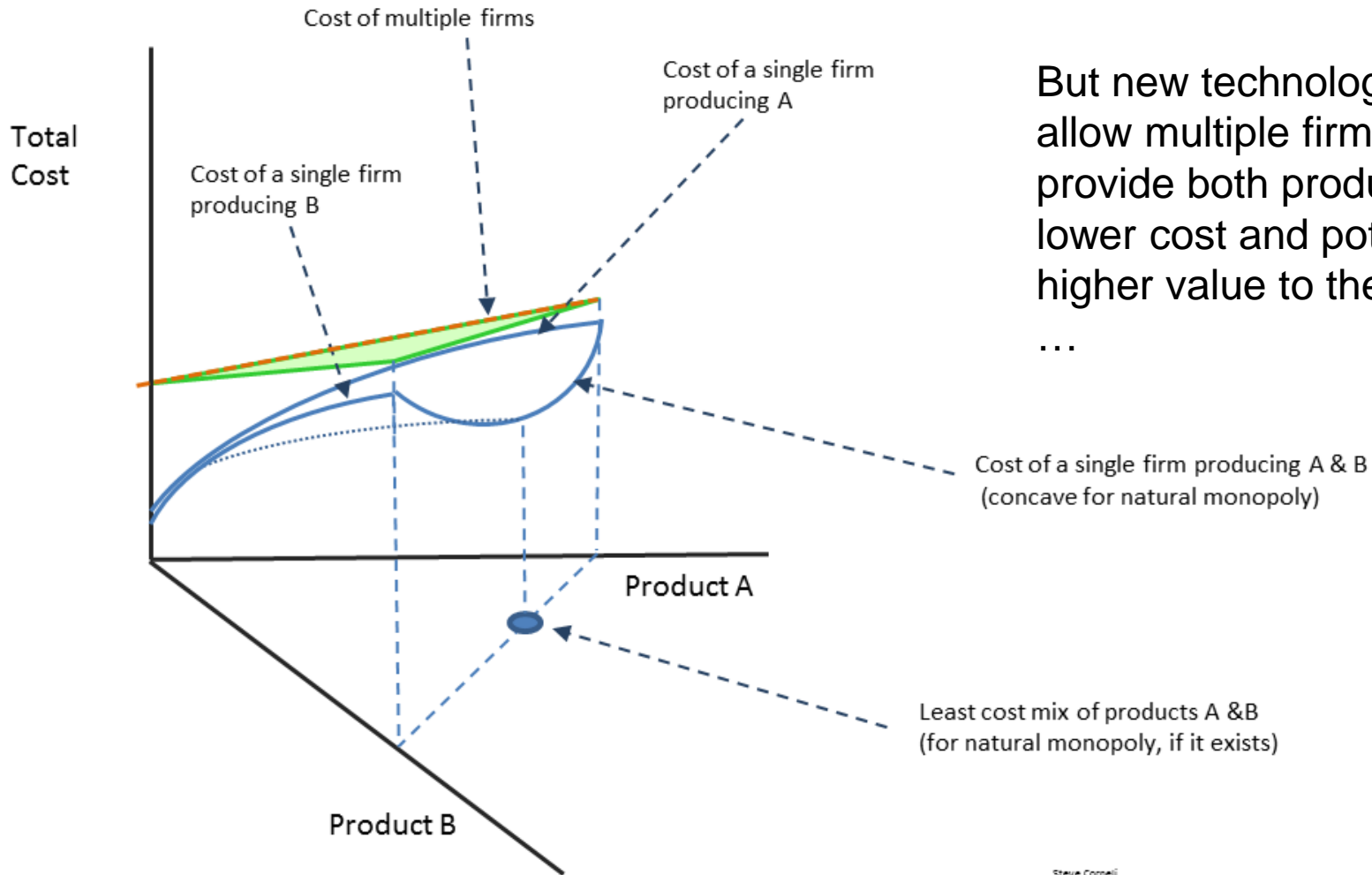
Only if all these conditions are met is the firm a natural monopoly.

If so, this is the classic cost structure Sam Insull created, and the standard policy response is exclusive service territories and cost of service regulation.

G & T are now usually seen as no longer natural monopolies, but we still think of distribution utilities this way.

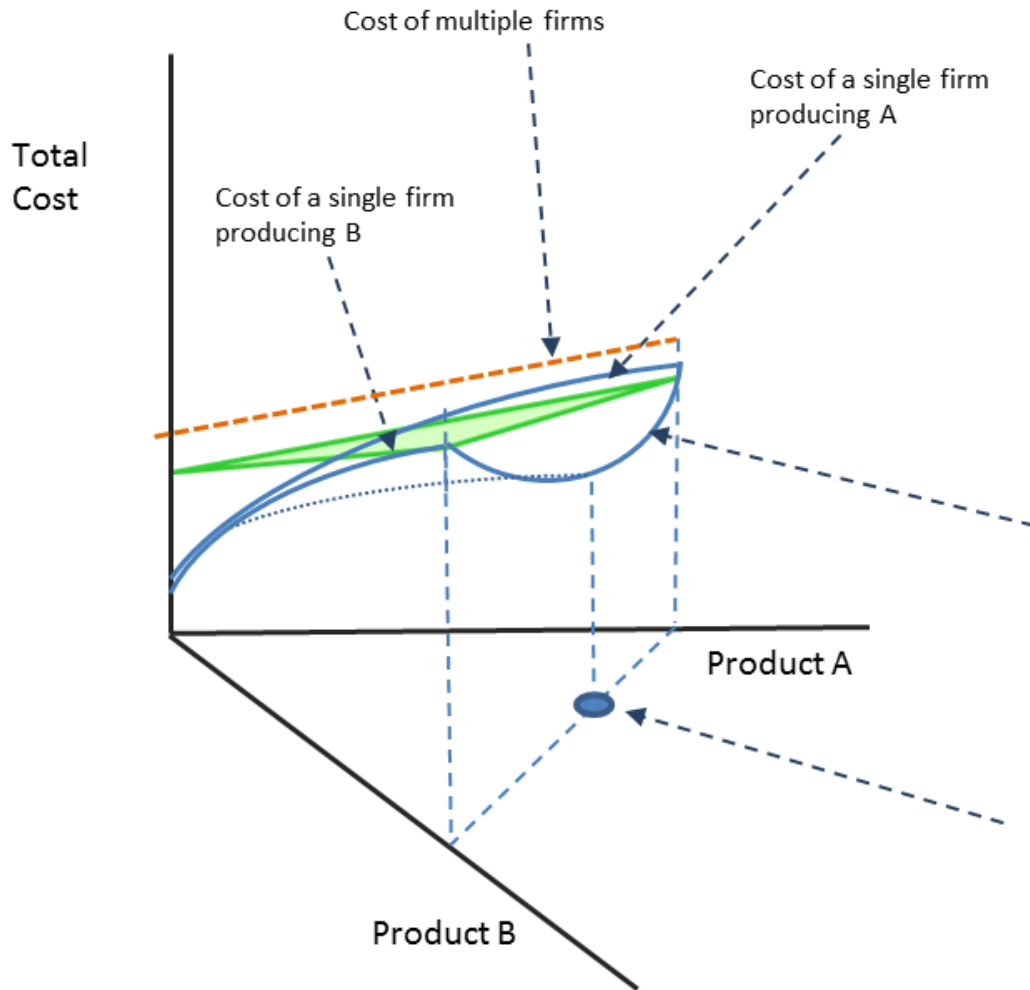
Least cost mix of products A & B
(for natural monopoly, if it exists)

Steve Cornell



But new technologies can allow multiple firms to provide both products at a lower cost and potentially a higher value to the customer

...



This can erode the natural monopolist's economies of scale cost advantages.

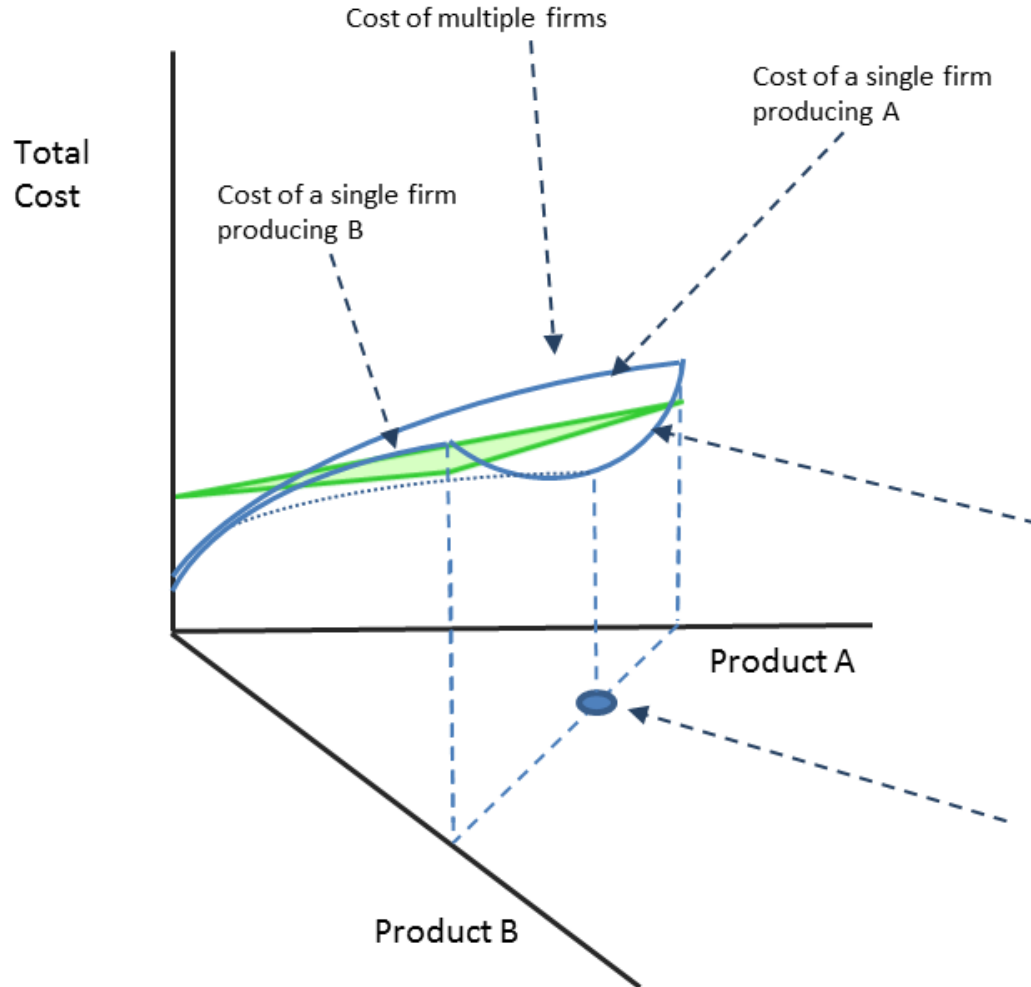
But it may not fully erode the natural monopolist's economies of scope cost advantages.

This raises three different candidates for the right policy approach:

- "Just get the prices right" and DERs will remain peripheral

Least cost mix of products A & B
(for natural monopoly, if it exists)

Steve Cornell



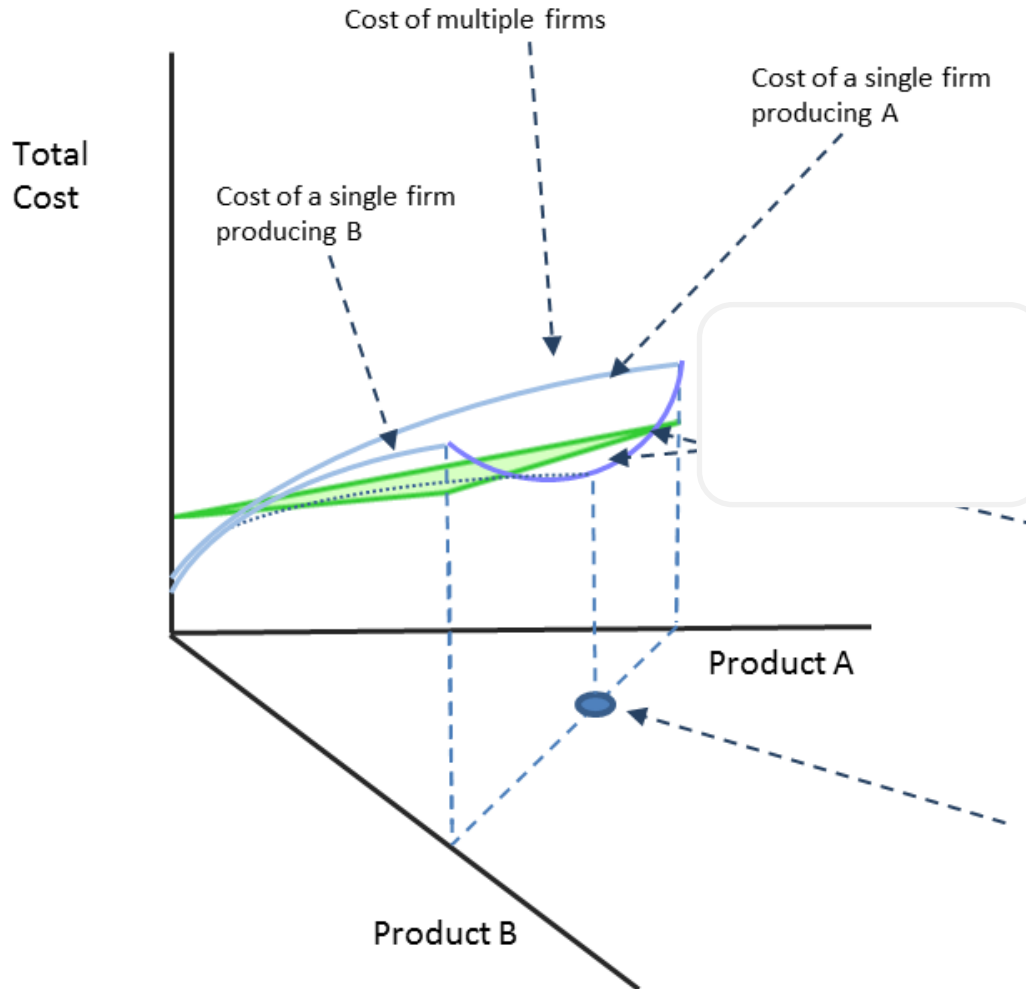
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This raises three different candidates for the right policy approach:

- “Just get the prices right” and DERs will remain peripheral
- Plug DERs into the regulated utility and let it continue to realize its economies of scope (Fox-Penner “energy services utility”)

Steve Cornell

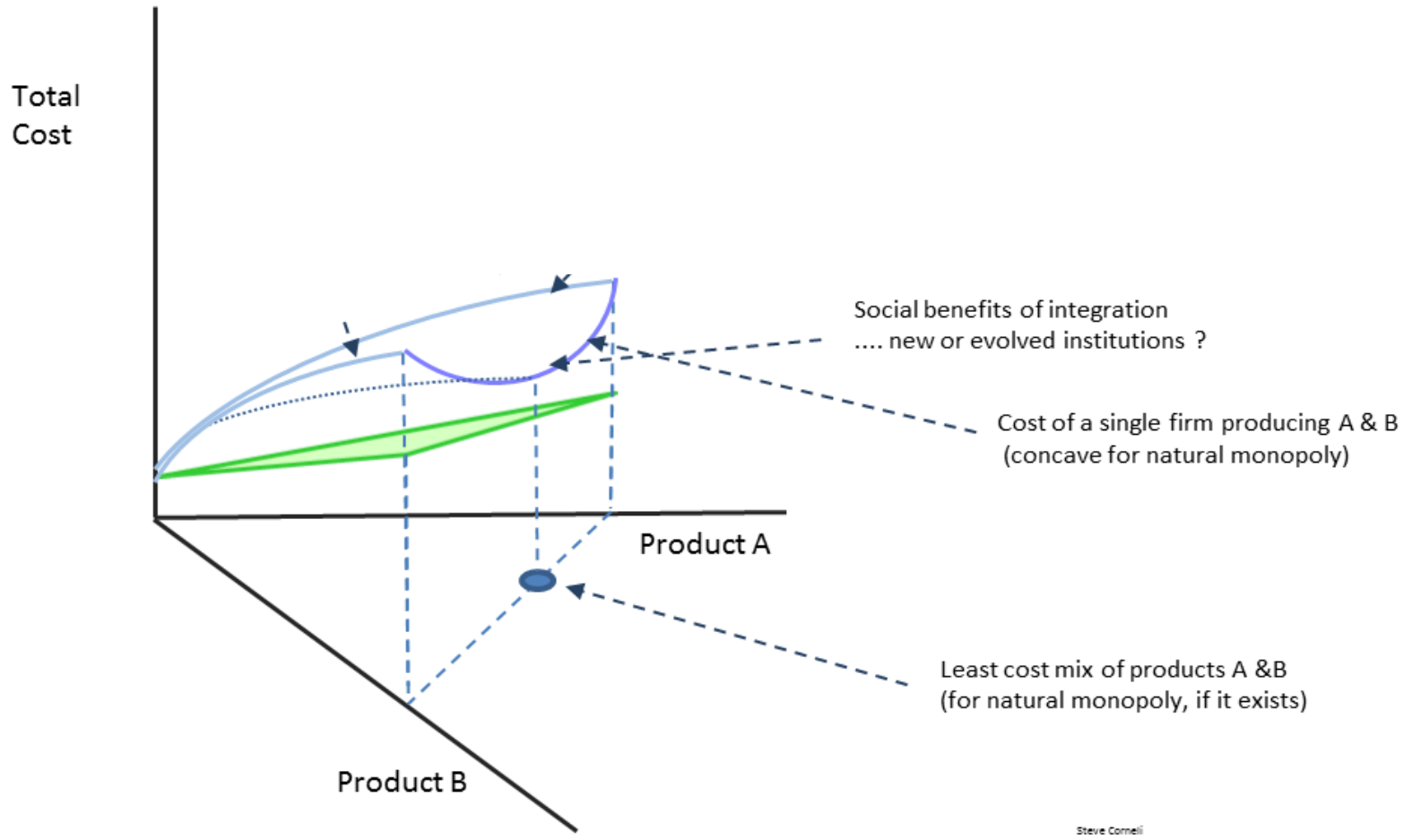


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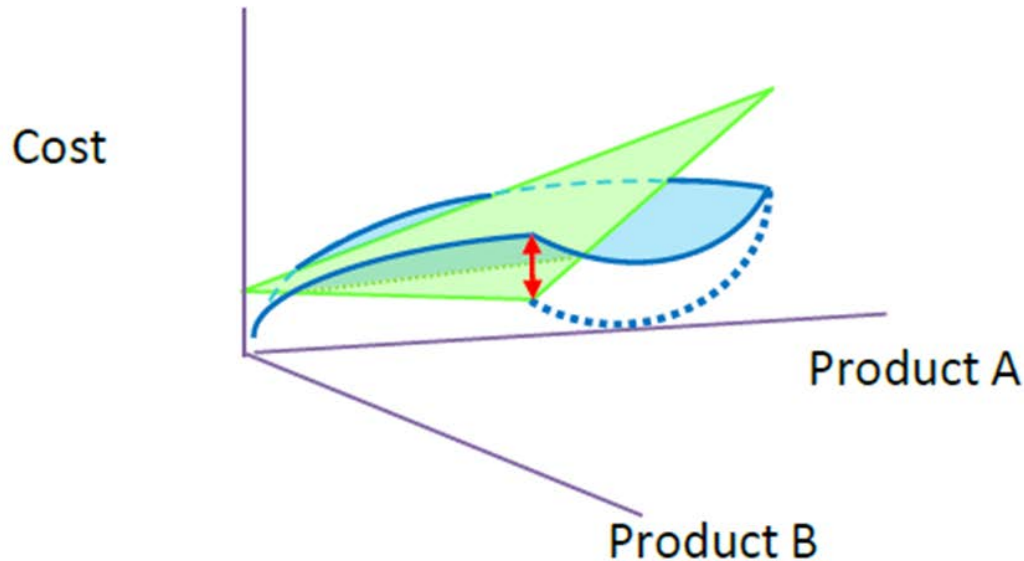
But it may not fully erode the natural monopolist's economies of scope cost advantages.

This raises three different candidates for the right policy approach:

- “Just get the prices right” and DERs will remain peripheral.
- Plug DERs into the regulated utility and let it continue to realize its economies of scope.
- A more dramatic transformation of the distribution utility to a lower cost network platform for DERs that supports continued scope economies or “social benefits of integration”. Structurally driven by dramatically reduced sales volume, no cost advantage over competitive DER providers, and higher demand elasticity. (Corneli view in this report)



Steve Cornell



It may be that one product (e.g., delivered capacity) could become highly decentralized due to cheap storage, DG and smart appliances, buildings, and cars...

... while energy delivered from the grid could remain cheaper than purely distributed energy.

In this world, the capacity delivery investments of the utility would shrink dramatically – but the ability to deliver relatively small amounts of energy could remain a natural monopoly.

The best policy for consumers would likely be cost-based natural monopoly delivery of grid energy, with competitive distributed capacity, and new or evolved institutions to provide the “social benefits of coordination”.

Industry Structure, Institutions and Regulatory Responses

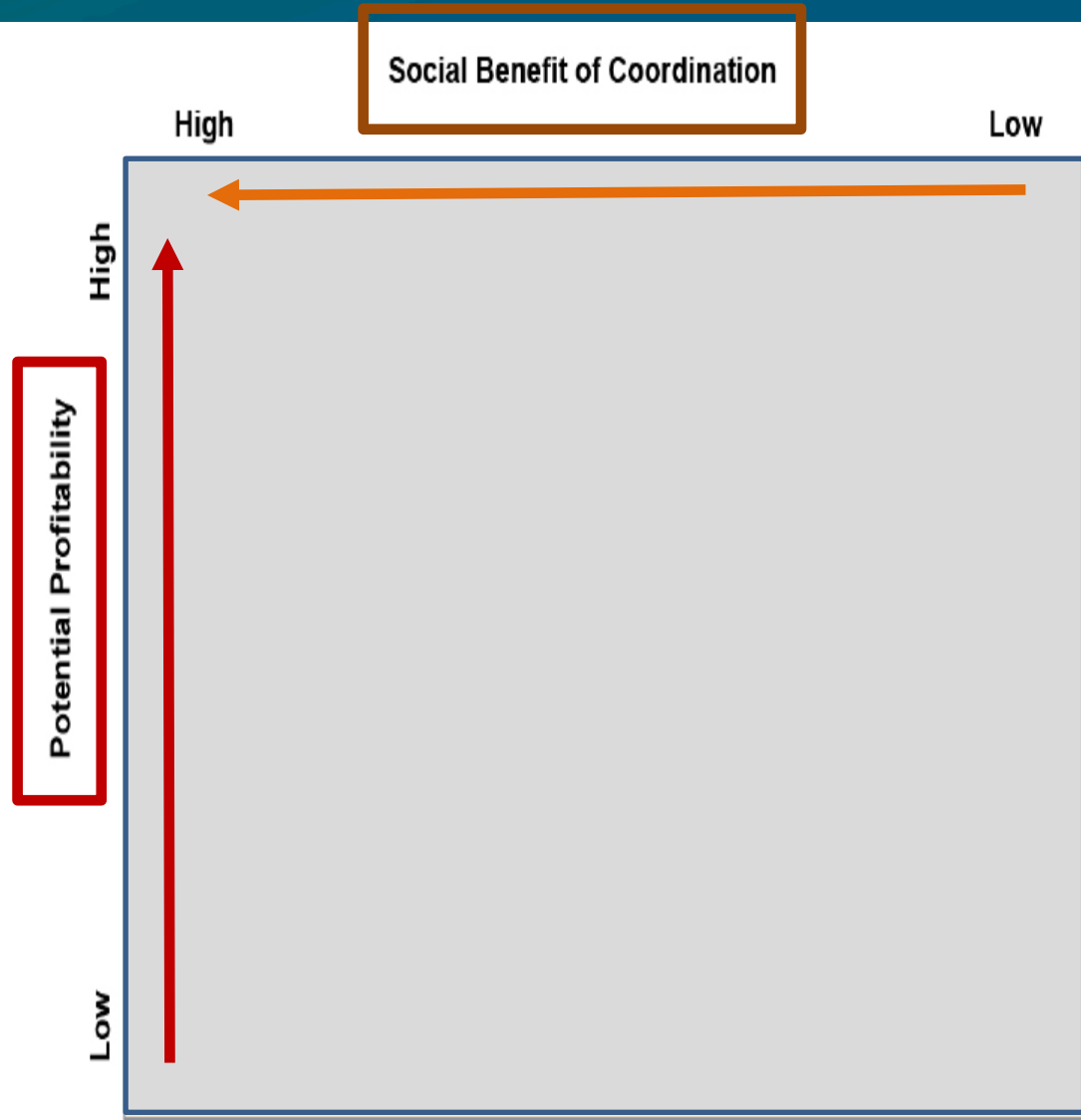


Figure 1. The PPSB Framework.

Insull's world

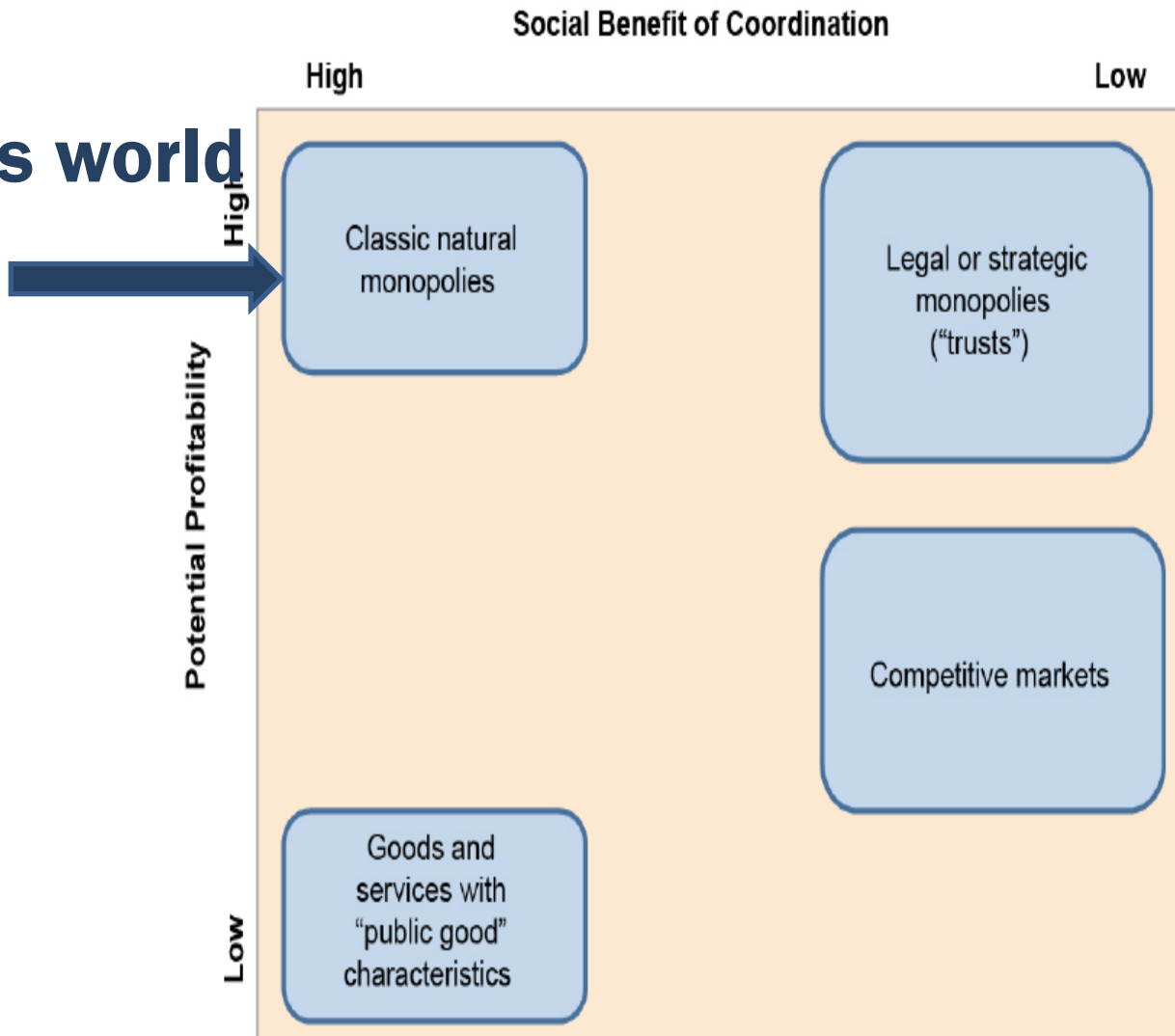


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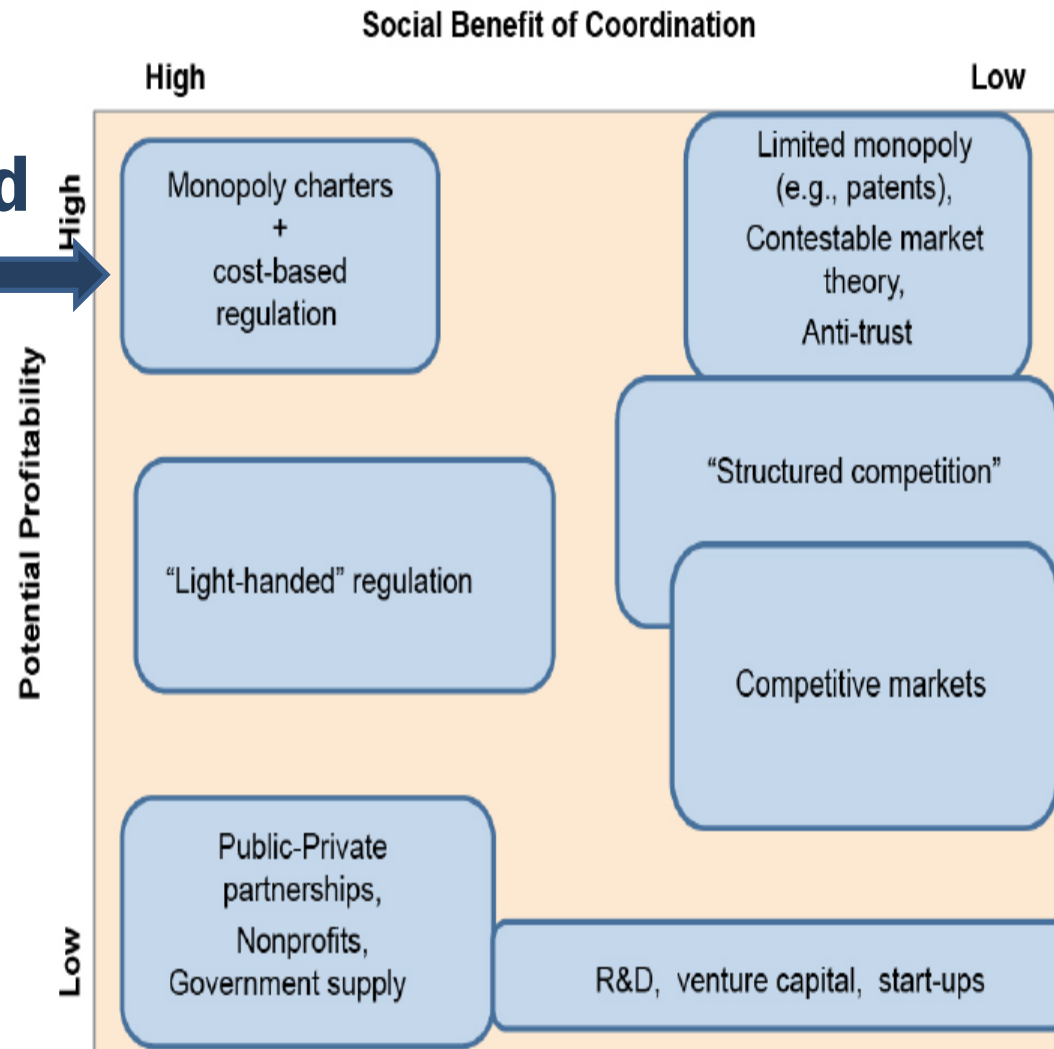


Figure 2. Policy and Institutional Responses in the PPSB Framework.

Evolving trends

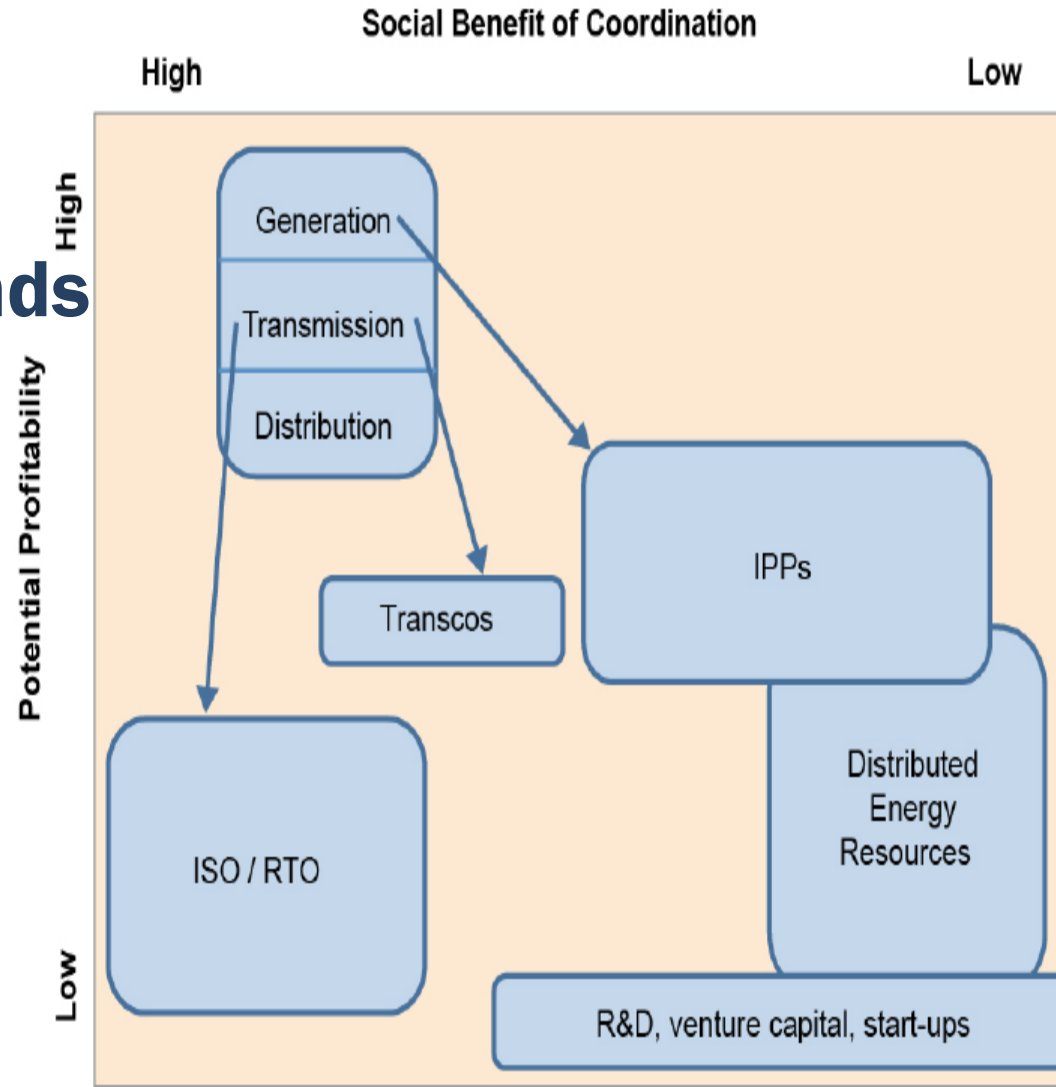


Figure 3. The PPSB Framework Applied to the Electric Sector.

Competition from DERs is starting to put pressure here

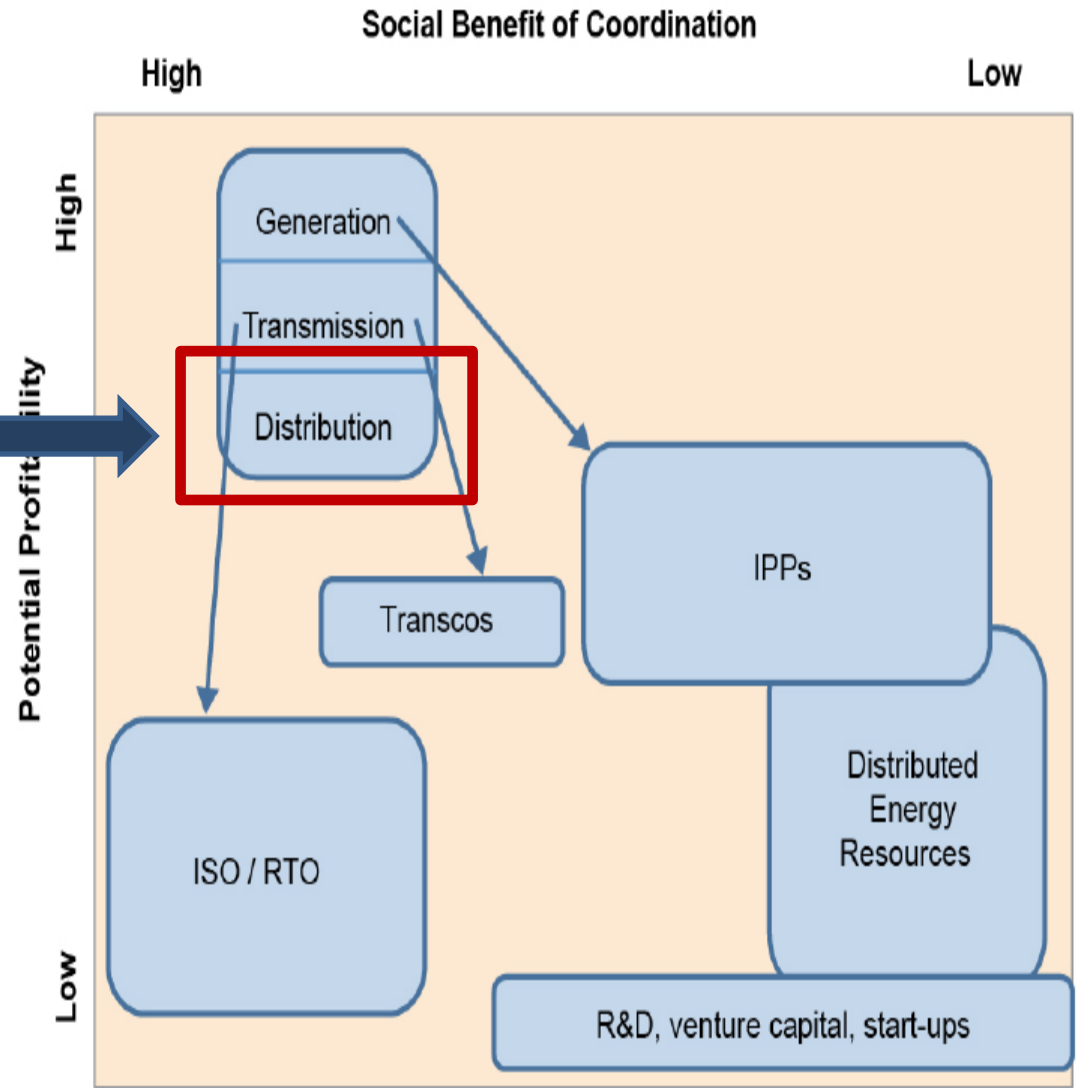


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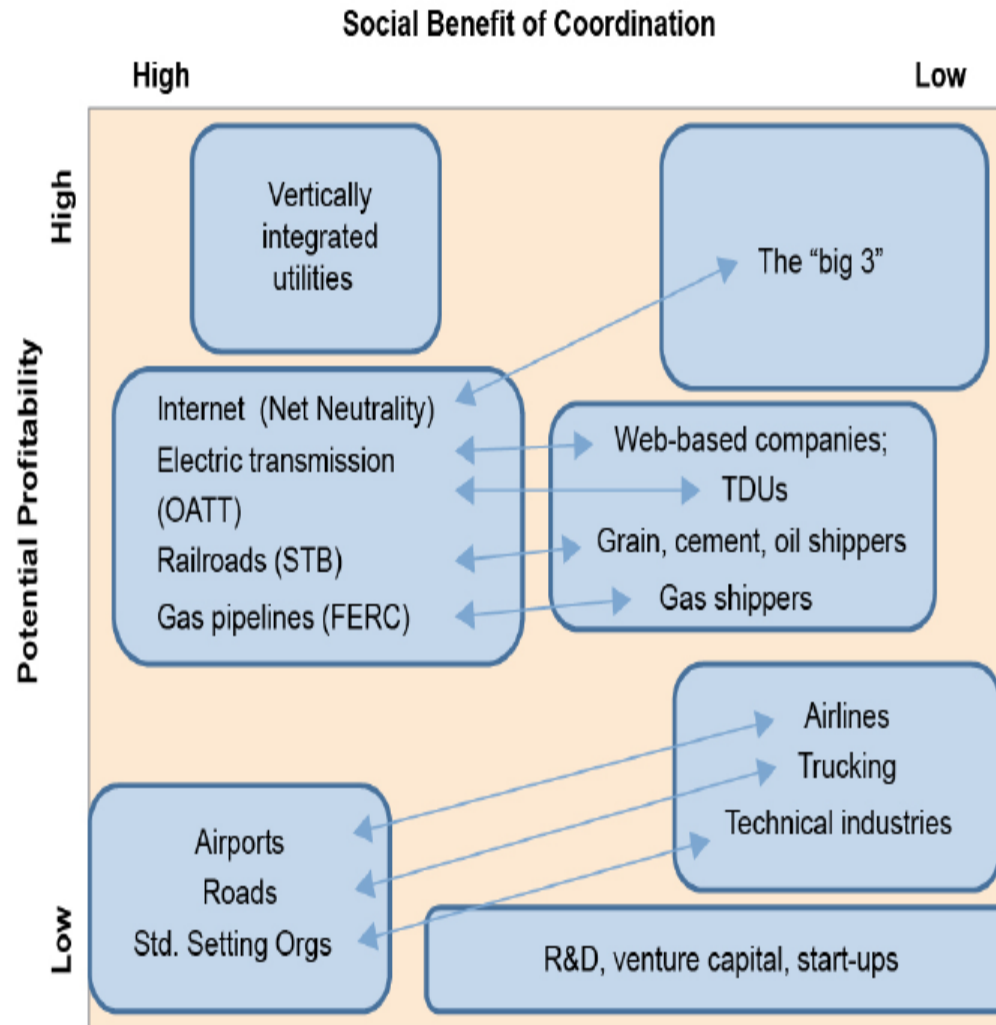


Figure 4. Vertical Integration Across Multiple Industries Illustrated by the PPSB Framework.

Insull's world

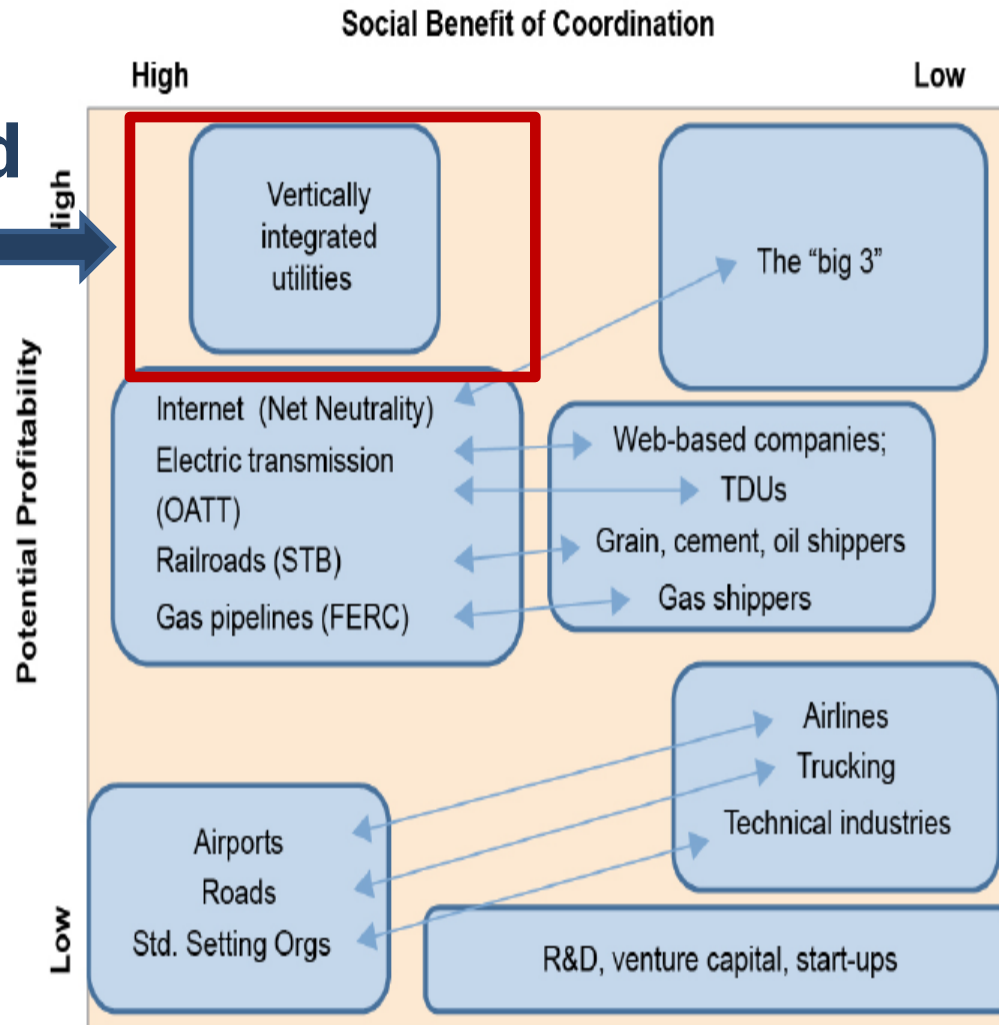


Figure 4. Vertical Integration Across Multiple Industries Illustrated by the PPSB Framework.

Vertical integration is the exception in competitive markets

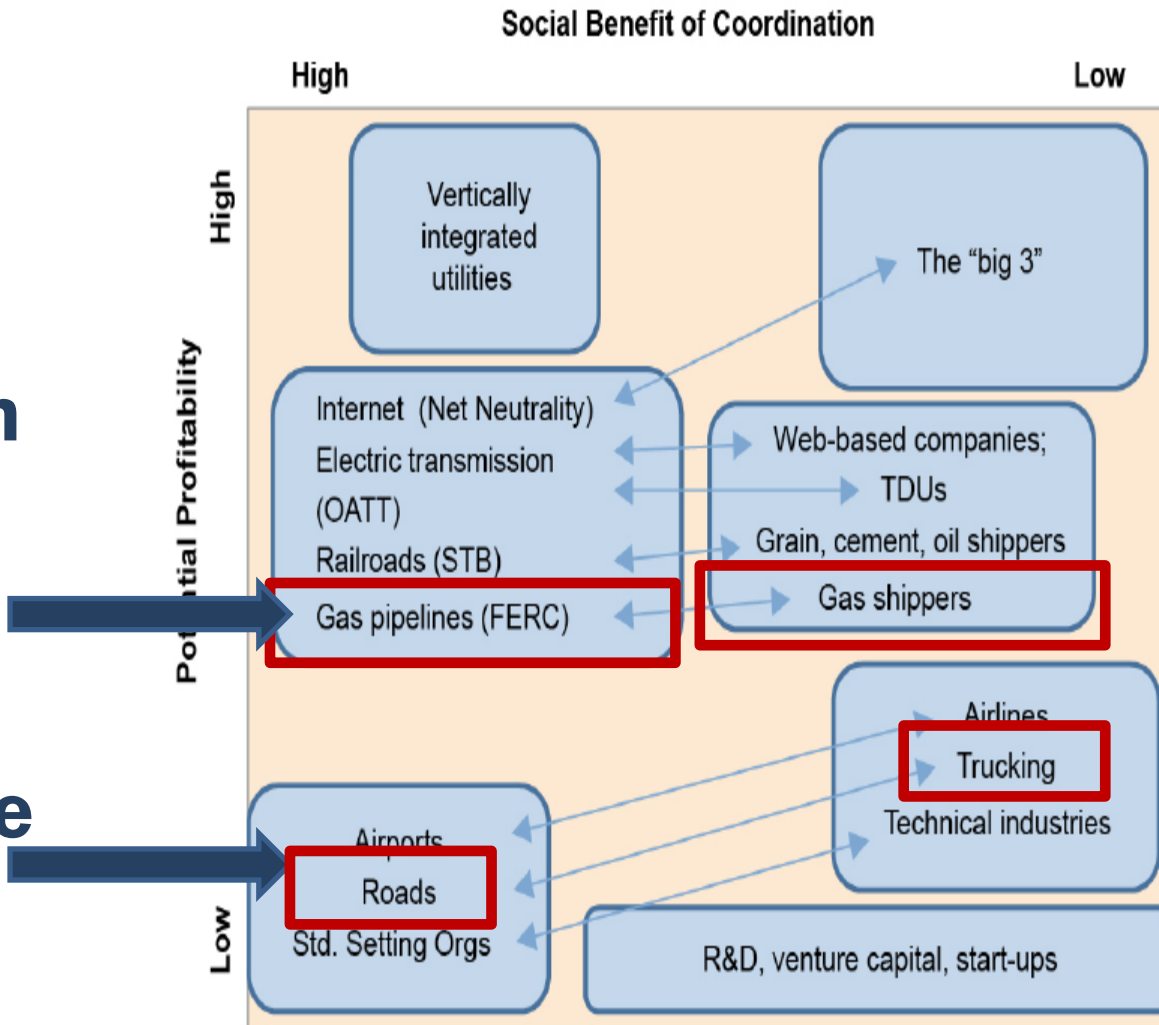


Figure 4. Vertical Integration Across Multiple Industries Illustrated by the PPSB Framework.

Key structural issues



Who owns them?



Who integrates them?

Kihm analysis

Should utilities enter DER
markets?

Would doing so create investor value?

*When the allowed **rate of return** is equal to the **cost of capital**, the stockholders **neither gain nor lose** when the firm enters a new market.*

Myron Gordon, *The Cost of Capital to a Public Utility*, Michigan State University Press (1974).

This is not a straightforward decision

*A decision to transition to a higher overall risk profile will likely involve **significant internal debate** and high **probability of negative reactions** from the financial markets and shareholders. This barrier may ultimately **be deemed insurmountable**—and as a consequence, new business alternatives may be **severely constrained**.*

Gregory Aliff, *Beyond the math: Preparing for disruption and innovation in the U.S. electric power industry*, Deloitte (2013).

Will regulators let utilities
enter DER markets?

In some cases the answer will be “no”

*Markets will thrive best where there is both the perception and the reality of a **level playing field**, and that is best accomplished by **restricting the ability of utilities to participate.***

Before the New York Public Service Commission, *Order Adopting Regulatory Policy Framework and Implementation Plan*, Case 14-M-101, Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision, Feb. 26, 2015, p. 67.

Kihm conclusion (large, investor-owned utilities)



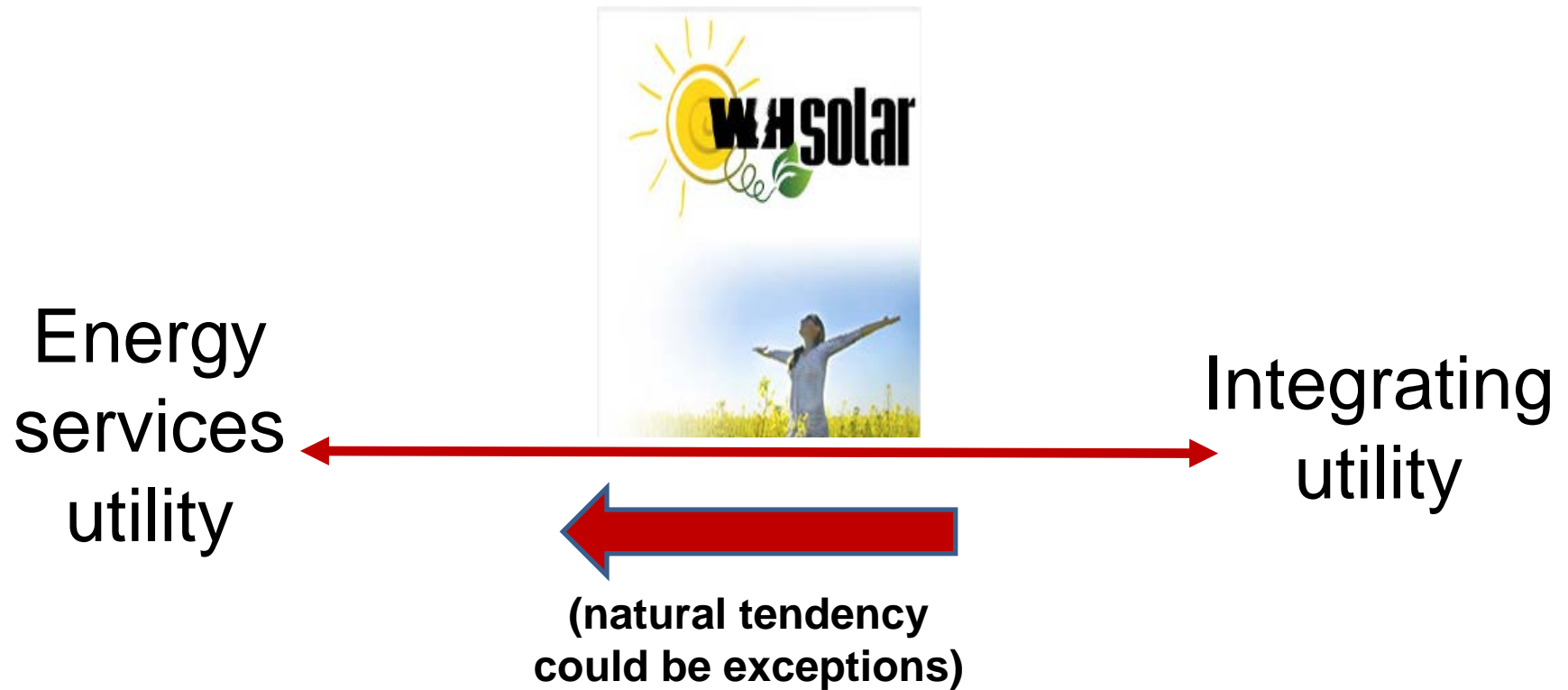
Energy services utility

Integrating utility



(natural tendency could be exceptions)

Kihm conclusion (smaller utilities)



Utility strategy: determining factors

- **Cost** (how high are utility costs -- relatively high cost utilities will invite competition)
- **Customer satisfaction** (does the utility have good relationships with its customers)
- **Regulatory policy** (what will regulators allow)
- **Financial economics** (what is the value proposition)

The industry will become more diverse in terms of utility purpose and strategy

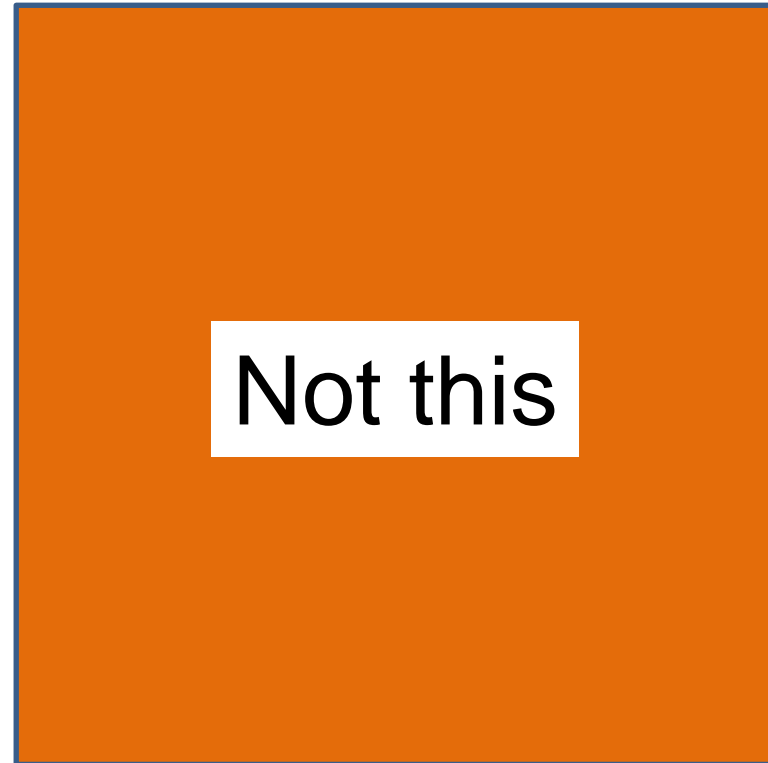


photo credits: Omaopio

“Consensus conclusions”

1. The main drivers of policy change are technology characteristics, firm cost structures and market characteristics --- none of these are controlled by utilities or regulators, all are a matter of facts (or bets on future facts).
2. As DERS become competitive in price and performance for many customers, utilities will face reduced sales volume, more elastic customer demand, and greater opportunities to substitute DER optimization for traditional utility assets and services.
3. Applying microeconomic and policy analysis tools makes it far easier to design business model, regulatory, and institutional approaches to manage these changes.
4. Key changes we foresee and approaches we recommend:
 - Dramatic reductions in the cost of regulated distribution networks will be sought by all stakeholders
 - Increased ability to integrate customer-facing DERs into that network and to unlock their 3-sided value proposition (customer, distribution utility, wholesale market / grid) will be essential to cost reductions.
 - Paying customers for optimized DER services to the distribution utility and grid can help motivate customers to remain connected to the grid and help pay for it.
 - Customer facing DERs can help utilities to achieve all these goals
 - The big difference in our views are who is best suited to drive the deployment of DERs and, especially, to manage their optimization.

For more information



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