From Effectiveness to Efficiency - The Value of Markets

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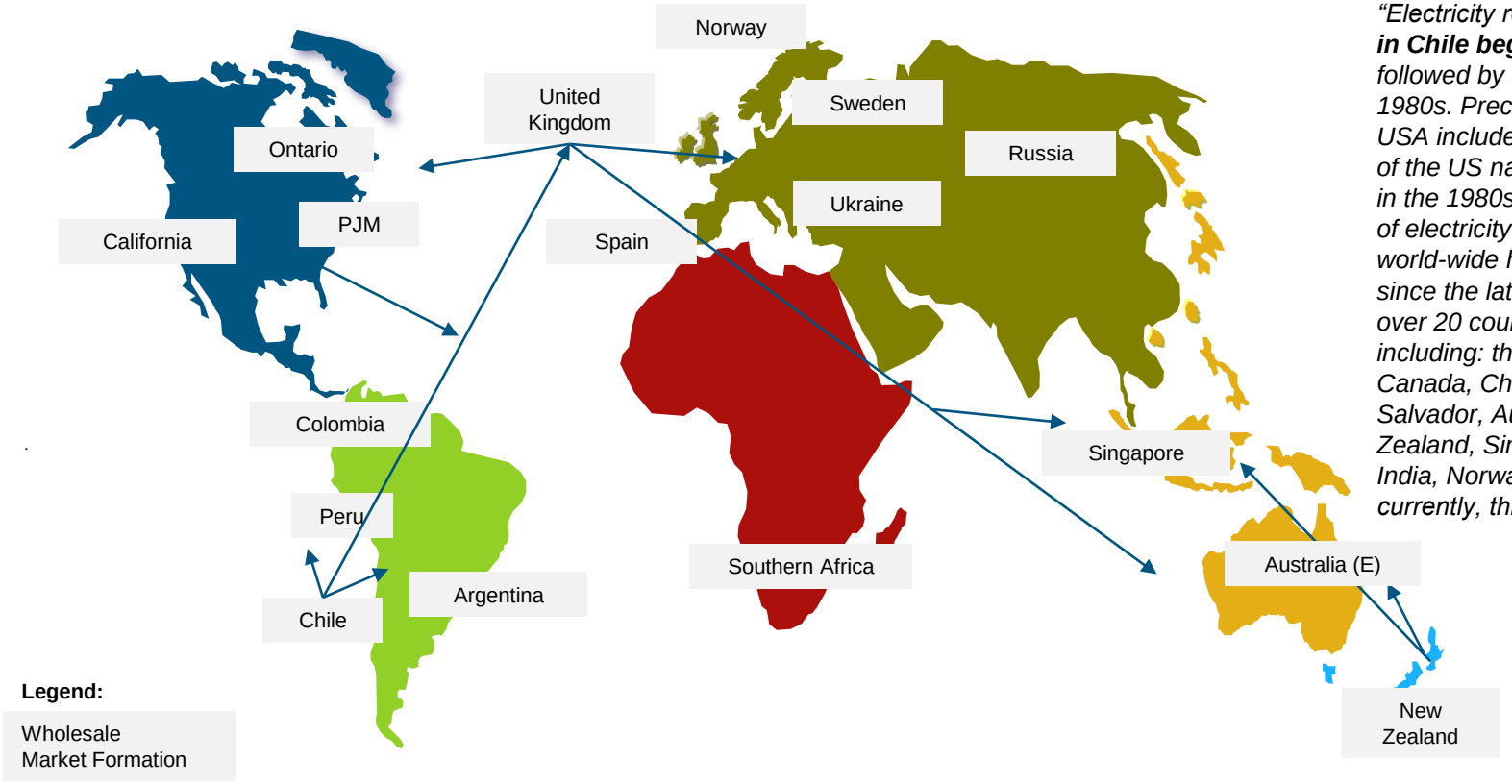
By 2000, international trends towards electricity reforms and liberalization were widespread and accelerating

2000



*"Electricity reform **commenced in Chile beginning in 1982**, followed by the UK in the late 1980s. Precursor reform in the USA included the restructuring of the US natural gas industry in the 1980s. A steady stream of electricity industry reform world-wide has proceeded since the late 1980s, involving over 20 countries to date, including: the UK, USA, Canada, Chile, Argentina, El Salvador, Australia, New Zealand, Singapore, (parts of) India, Norway, Sweden, and currently, throughout Europe."*

Many countries had started moving on from initial monopoly and IPP structures and adopted some form of offer-based electricity wholesale market

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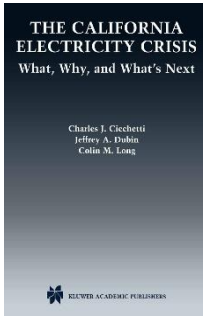
In 2001, however, the great promise of energy market reform collided with the realities of compromise and human imperfection

- Colossal failure of California's energy market
- ENRON's financial collapse and a refocus on the excesses of "trading"
- Suspension of Ontario's market reforms when initial prices surged
- A change of government, union resistance, and cancellation of further reforms and planned privatization in Korea
- Polarisation on zonal vs nodal prices in eastern Australia or Europe
- Seemingly perpetual reforms and reviews in many markets
  (UK: Pool → NETA → BETTA → …)



Yet….we learn…

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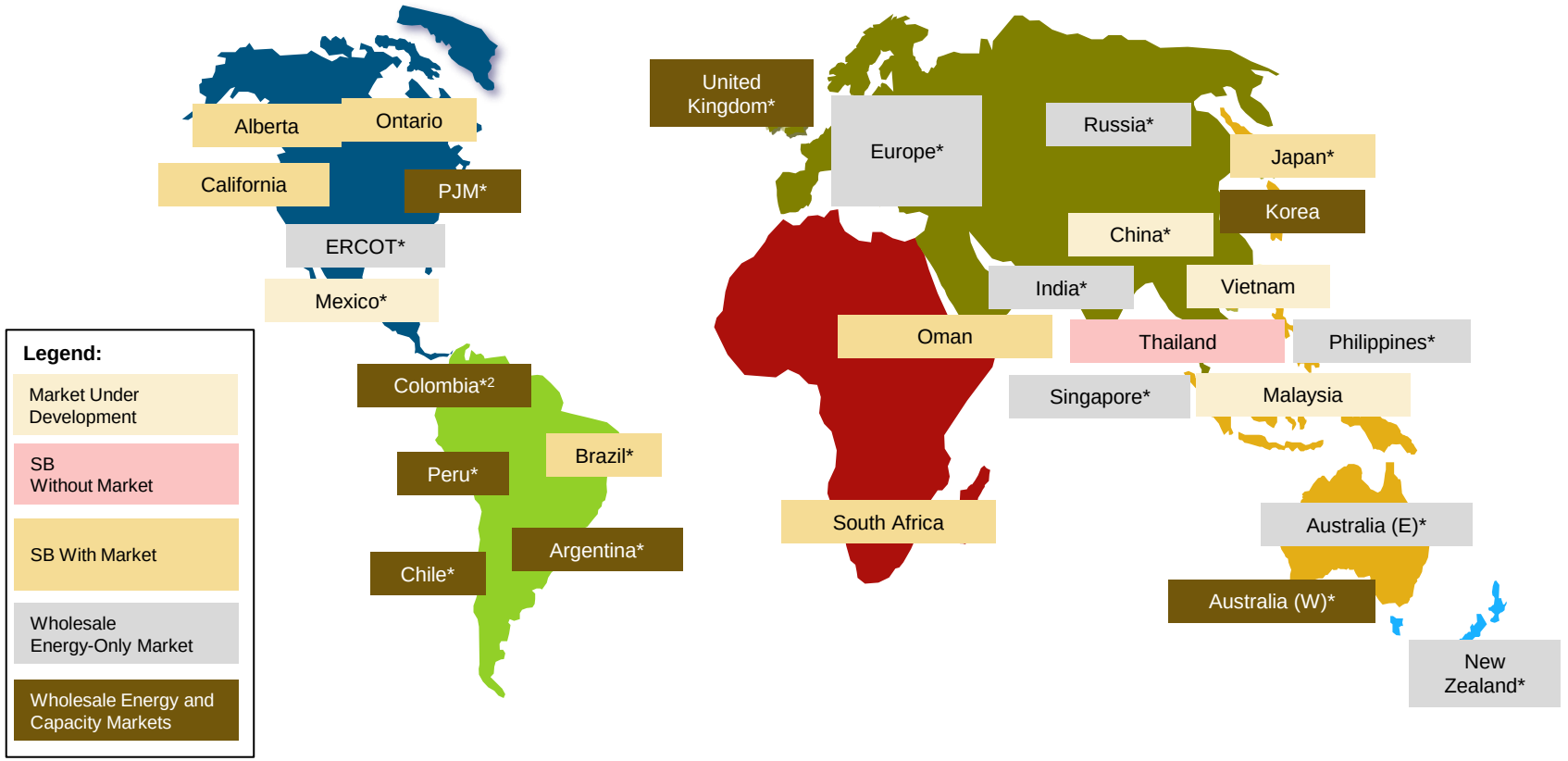
Yet, the challenges of central planning continued to grow. The benefits of more agile markets increased. We got smarter and smarter.

Today



More sophisticated and functionally tailored markets and regulatory arrangements are becoming the norm almost everywhere

* At least some retail choice
1. In November 2016 Alberta recently approved AESO's recommendation to develop a capacity market
2. Colombia has a Reliability Charge scheme that replaced the capacity market in 2006

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Why have so many adopted various aspects of electricity market reform?

A core challenge for all electricity systems is between monopoly provision and market operations

Centralised	Decentralised
• Mandated • Access is Limited / Gated / Closed • Arbitrary pricing may destroy value • Central planning for execution and commitment is more burdensome as complexity increases • Choices are limited (and choices may not make economic sense) • Effectiveness prioritised • Not necessarily more reliable	• Voluntary • Open access • Non-discrimination • Central planning for information and guidance • Choices limited only by economics • Spending your own money • Market-based (marginal cost) pricing • Efficiency prioritised subject to reliability constraints

Inspiration : https://scholar.harvard.edu/files/whogan/files/hogan_accc_073021.pdf

The central question answered by electricity reforms has always been “how to allow more stakeholders the opportunity to make more decisions for themselves”

It's not engineering vs economics. It's engineering with economics.

Engineering vs Economics

Long Term PPAs

- Physical world is independent of economics
- Economic market design ignores physical realities
  - Unconstrained dispatch and pricing
  - Limited system detail
  - Limited connection between market design and reliability standards and parameters
- So simple it can be explained using PowerPoint
- Contracts (PPAs) are written such that they impose (or attempt to impose) constraints on actual dispatch
  - "your plant serves my load"
- The market does not reflect what is going on in the physical world
  - Curtailment is uncertain and often surprising
  - Inefficient dispatch is commonplace but difficult to prove
  - Value-destroying power flows

Engineering with Economics

Contracts for Differences

- Economic world mapped to physical world
- Economic market respects unique aspects of electrical power flows
  - Unit commitment and operational constraints
  - Grid constraints
  - System security and safety constraints
  - Resource adequacy standards are clearly defined
- If it matters, it's in the model and the model becomes as complex as it needs to be
- Contracts are written flexibly such that they do not constrain the physical world
  - "you sell power to me"
  - (whether you generated it or not)
- If something can be done more flexibly or less expensively than is written into a contract, the stakeholders have the ability to "use the market"

Get the engineering right, it's secure. Add the economics, it's also efficient.

Why move from PPAs to CfDs

Contracts in the “pre-market” days were often seen or treated as physical

- You are dispatched to meet contract obligations even if buying from the market would have been less expensive
- You might be prevented from selling to the market even if you could have provided lower cost power

The brilliance of markets is that they teach us to be flexible and adaptive where we would otherwise be tempted to be rigid and restricted

- Why would you want to dispatch if something else is cheaper
- Why would you want to be denied an opportunity to be dispatched if you are cheaper?

Electricity markets that faithfully reflect underlying physical characteristics have proven incredibly resilient and robust

- Capable of handling some of the highest concentration of intermittent renewables
- Setting best practices in terms of planning, dispatch, and resource adequacy assurance
- Greatest opportunities for flexibility and agile resource development

PPAs are often treated “physically” and are expected to be dispatched specifically to meet the contract
Treating contracts as physical obligations almost always introduces inefficiency in system operation

CfDs are flexible contracts that do not constrain the operation of the physical system

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The realization that physical system operation and commercial contracting can be different but related was a key turning point in early thinking about markets

- Price formation and definition is about **mapping commercial aspects** of the market **to the underlying physical structures** and **performance characteristics**
- Over time, and since the beginning, the **degree to which physical constraints are given proper representation** in the market design, is the key direction of progress

When Margaret Thatcher proposed a privatized, competitive electricity market, **nobody knew how it would operate but everybody assumed it would be a contract market much like any other**. The Public Electricity Suppliers (PESs) – the regulated retailing arms of the Regional Electricity Companies (RECs or distcos, then called Area Boards) – would have bilateral contracts with generators (gencos) to cover their total loads; the gencos would sell all of their output under bilateral contracts; and the National Grid Company (NGC) would be paid a simple fee to move the energy from gencos to their contract customers.

[…]

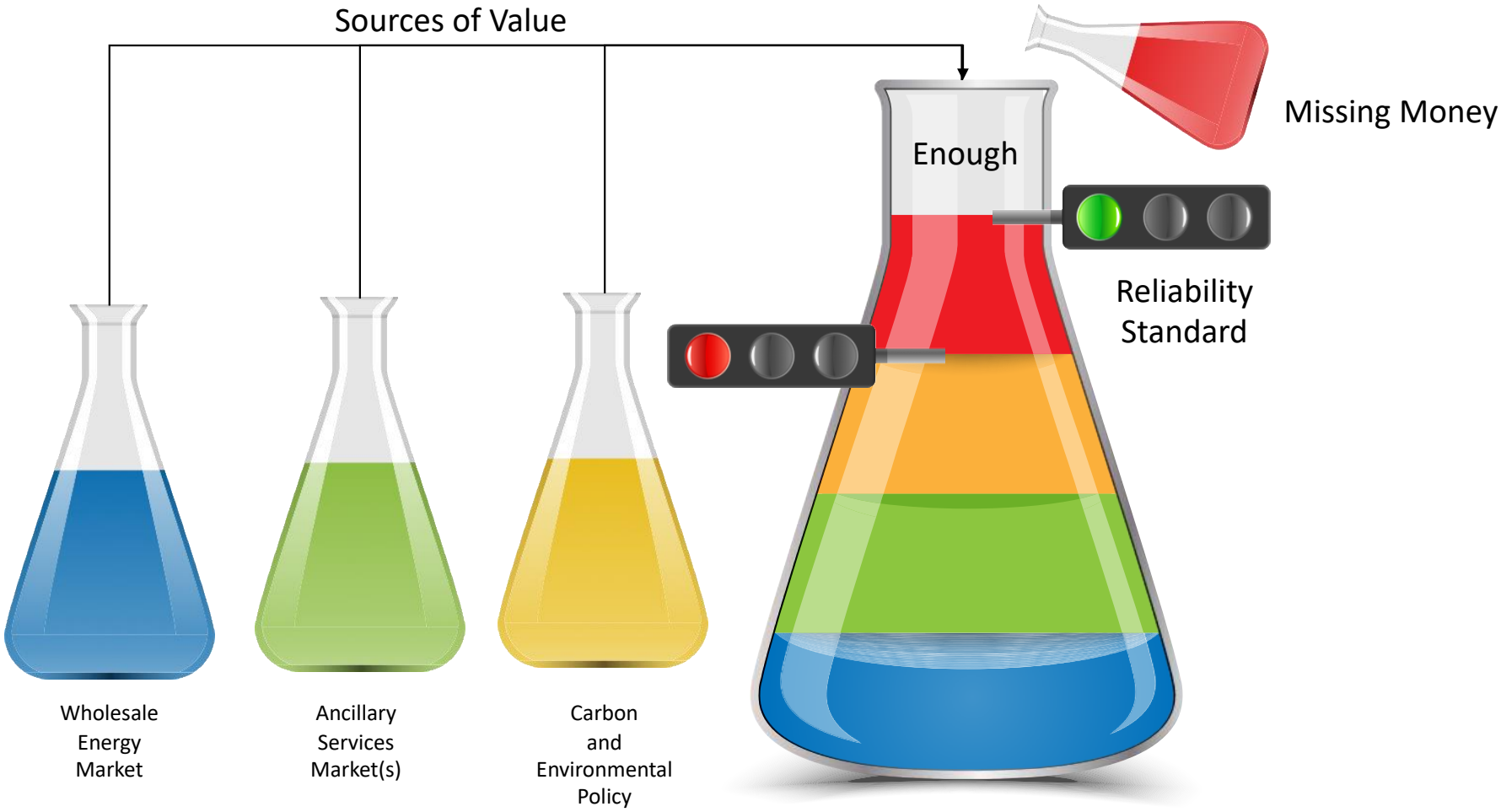
The RECs and gencos formed a Contracts Working Group (CWG), a Settlements Working Group, a Regulatory Working Group and some others. There was no Pool Working Group or Market Rules Working Group, **because nobody thought a pool or centrally organized spot market was needed**. The main action was in the CWG, which was to decide the details of the all-important contracts.

[…]

The gencos could not accept the PESs' demand for set-by-set, performance-determining contracts, because **no genco could be sure that operating a specific unit as specified in the contract would be economical or even possible at any time**. The gencos wanted what they called “firm” contracts, under which they would receive capacity and energy payments in exchange for meeting each PES’s total load any way they pleased; in US terms, these would have been full- requirements contracts.

Source; Larry Ruff, “Origins of the Original UK Pool”, 1989 and as re-circulated in 2001

If there is missing money in a market design, a capacity mechanism is probably necessary



Capacity mechanisms provide a source of value related to the insurance value of generation resources – can a generation or demand response or storage resource perform "as needed when needed"

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Capacity mechanisms address 'missing money' challenges in market design

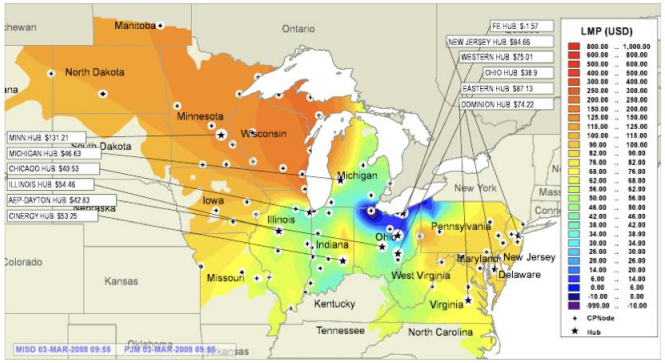
- **What is missing money?**
  - Missing money is when a market design does not support the revenues required to support the reliability standard the market is intended to achieve.
  - Suppose a reliability standard is very high (such as it is in Singapore, where the required minimum reserve margin is at least 27 percent) in order to maintain a very high expected system performance. How can an energy only market support investment at such level that some capacity will almost never be needed?
    - Prices must be potentially very very high – introducing price volatility.
    - Otherwise the market may not support the revenues investors would require for them to willingly build capacity at such a high reserve margin. They might prefer to wait until energy prices firm up, which could occur at much lower reserve margin levels.
    - But at much lower reserve margin levels, policy makers would consider the market to be failing and would want to intervene.
- **How do capacity mechanisms help to address missing money?**
  - A capacity mechanism can be used to extend a payment for "available" capacity whether or not that capacity is generating electricity. Payment for availability is the major difference between markets with capacity mechanisms and 'energy-only' markets.
  - By determining an amount of payment for availability under different market supply and demand conditions, capacity mechanisms provide an instrument to support resource adequacy (RA) to meet policy-targets for reliability.
- **Some key elements of a capacity market?**
  - In our experience a key issue is to determine how much credit to give to a generation, demand, or storage resource for its potential role in providing "capacity" when needed. This is the question of capacity 'value' eligibility.
  - Any capacity mechanism must then have a scaling arrangement whereby the value paid for capacity is higher when capacity is scarce and is lower when capacity is plentiful. This scaling arrangement is the 'demand curve' and is determined through analysis and consideration of multiple factors. It is determined through modelling of effectiveness taking into account a number of qualitative factors.
  - Capacity that fails to perform as expected will tend to face a penalty or a clawback of capacity value received.
  - Capacity value is determined for a period in the future to give time for supply to be developed as needed.
  - The capacity instrument or credit is often a 1 year at a time instrument, but longer-term arrangement are also possible.

Capacity mechanisms can be price-based or quantity-based – no one size fits all

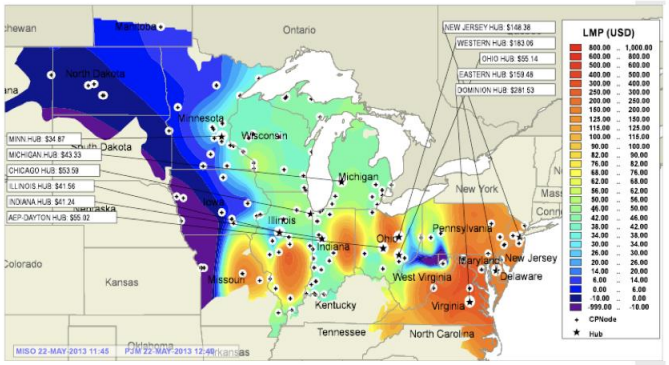
Ensuring the physical system is properly represented in market design becomes more important as less flexible resources become more prominent in a system

NETWORK INTERACTIONS — Locational Spot Prices

RTOs operate spot markets with locational prices. For example, PJM updates prices and dispatch every five minutes for over 12,000 locations. Locational spot prices for electricity exhibit substantial dynamic variability and persistent long-term average differences.



Minnesota Hub: $131.21/MWh. First Energy Hub: $-1.57/MWh. March 3, 2008, 9:55am



Missouri MPS -$71.25, Dominion Hub $281.53. May 22, 2013, 12:40pm.

From MISO-PJM Joint and Common Market, ++http://www.jointandcommon.com

It matters can matter increasingly where responsive capacity is located – capacity markets need to have a locational element as well

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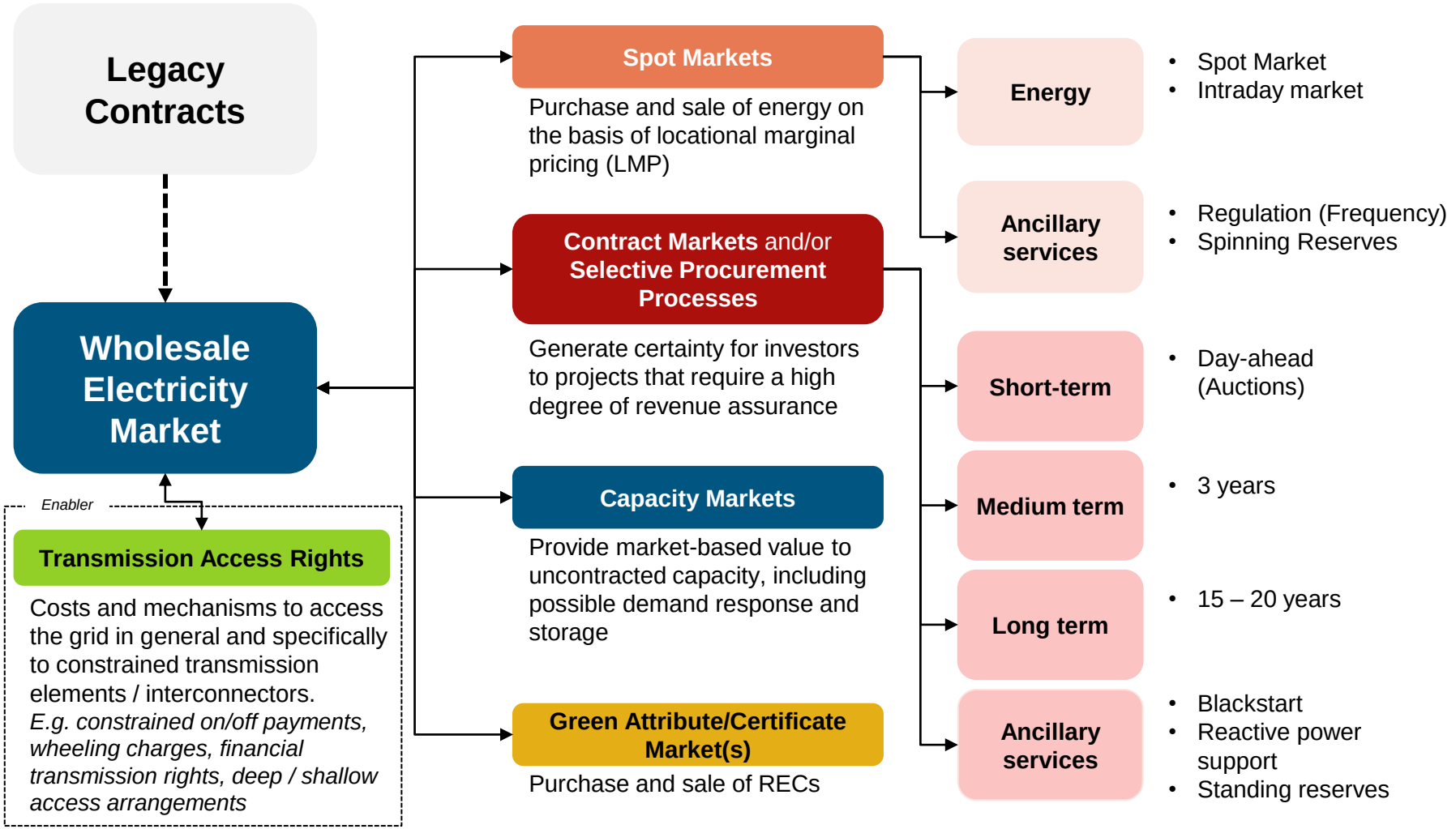
Capacity mechanisms are one part of the overall picture – energy, ancillary services, and green attribute markets all work together to signal value



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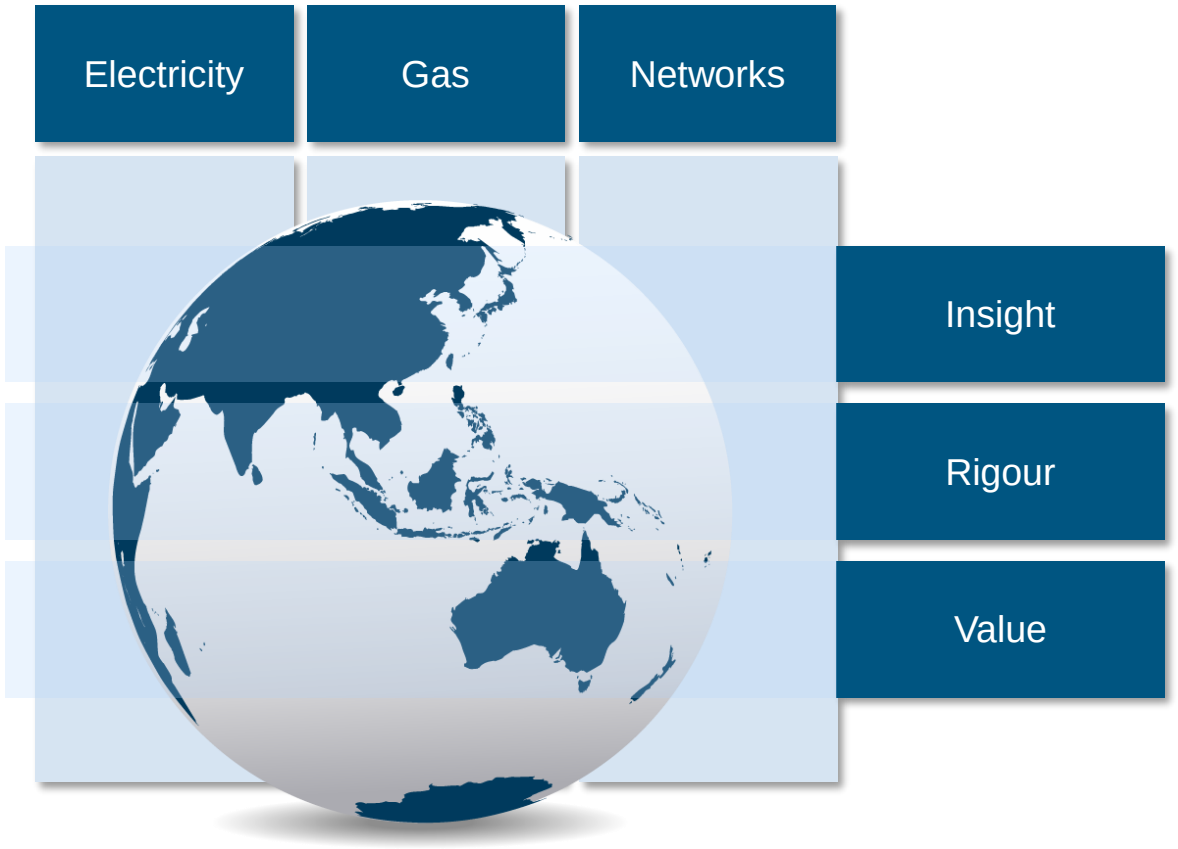

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