

Grupo Millennium Hispaniola



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An Attraction from the Hispaniola
Presented at the Third Annual
Carnegie Mellon Conference on the
Electricity Industry



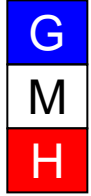
A Generative Dialogue to Reach the End-State of the Electricity Industry

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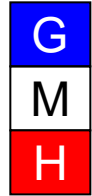
BS '68, MS '71 & PhD '72, all from Cornell University. Valued IEEE Member for 36 Years.

Research and practice areas, and interests: Electricity without price controls; Systems architecture; Systems thinking; Retail marketing; Customer orientation; Information systems requirements and design; Market rules; Contract assistance.



Outline

- Introduction
 - Technological Revolutions, Generative Dialogue & On the Conference
- Main Issues
 - Development Path and Possible End-States
 - End the Debate and Start a Generative Dialogue Towards Electricity Without Price Controls
 - Dominican Republic Potential
- Conclusions and Recommendations



Introduction: Technological Revolutions

- Dr. Carlota Perez identified 5 technological revolutions
 - Industrial revolution was first.
 - Carnegie's huge Bessemer steel plant introduced 3rd revolution
- Stanley Klein's 1998 observation - electric restructuring is "fundamentally an information technology event"
- Dr Pérez adds: "...these new technologies provide the potential for modernizing the whole productive structure and for raising the general level of productivity and quality to a higher plateau."
- EWPC was shown to be the winning market architecture and design under [Playing with Fire - Part I](#) and [– Part II](#).

I am glad to be here at CMU to suggest a generative dialogue to get the power industry in the 5th revolution

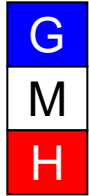


Introduction:

Why a Generative Dialogue (GD)?

- While debating, people operate downloading and reloading rehearsed messages. They know what is “true” and they don’t need to “listen” openly to what the other writes or have to say (A. Kahane, “Solving Tough Problems: an open way of talking, listening, and creating new realities.”)
- Under a GD, the aim is different as “listening” is very important. The object is to tackle complex problems to learn from an emergent future, when it is not possible to come up yet with a right solution based on the past, because a technological revolution is underway.
- Furthermore, the GD is conducted under the principle of “I am not my opinion,” which avoids a key negative instrument behind the system of debating with partial ignorance.
- This is also onorthodoxed, but potentially very useful approach.

Changing from the system of debating to the system of GD will help us move forward towards the emergent paradigm



Introduction: On the Conference

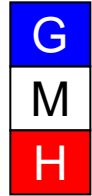
- Getting adequate resources of the right technologies for generation, transmission and distribution over the next three decades is a supply side approach.
- Such approach misses the need for the emergent market architecture and design paradigm, where the development of the resources of the demand side take a key role to reach the End-State of the power industry.
- Venture capitalist know that good money should not be thrown after bad. Now is a great timing to shift course.
- The new paradigm introduces elements that should be researched and taught, on MS and PhD level education and well as the training of skilled blue collar workers

The development of the physical and human resources of the demand side is paramount in the emerging paradigm



MAIN ISSUES

- Development Path and Possible End-States
 - Small Chance Events...
 - Possible End-States...
 - Coordinating Benefits
- End the Debate and Start a Generative Dialogue Towards Electricity Without Price Controls
- Dominican Republic Potential



Small Chance Events Leading to An Inferior Path

- The death of Fred Schweppe in 1988 and a misunderstanding by William Hogan in 1992 of Schweppe's work on the energy marketplace were “small chance events early in the history of” deregulation that “tilt[ed] the competitive balance,” to an inferior solution path, as W. Brian Arthur explained in general in his Scientific American, February 1990, article “Positive Feedbacks in the Economy.”
- The events, were naturally pulled by strong vested interest community, by neo-liberalization, by the debating system approach, and by the regulatory design, which self reinforced each other.

Lets look at the paths available to the End-State.

Possible End-States of the Power Industry

- **Sally Hunt and Graham Shuttleworth** (“Unlocking the Grid,” IEEE Spectrum, July 1996) suggested 4 industry architecture solutions - End-States of the Power Industry Models. They identified, among other things, **three considerations to reach the End-State** which I select a posteriori as key system architecture requirements:
 - (Req. 1) **Most likely, [retail competition] is the world of the future.**
- Req 1 is now an incontrovertible fact to the future. Other models were initially thought to be transition states.

Retail competition End-State is key to ensure physical and human resources needed for the next 30 years.

Imperative of Ultraquality - I

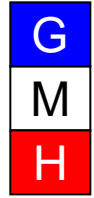
- Sally Hunt et al...
 - (Req. 2) Precise responsibility for poor service may be difficult to pinpoint when the local distribution company is not the retailer.
- Req. 2 helps support a stronger requirement that a transportation system be architected under an imperative of ultraquality, as nuclear power generation, modern manufacturing, and manned space flights. (Rechtin and Maeir “The Art of System Architecting.”)

With retail competition based on ultraquality it will be very easy to pinpoint poor service

Ultraquality Trumps Debate

- Ultraquality is an imperative that “consider the engineering requirements for controlling, operating and planning an electric power system,” which is a criteria of “Spot Pricing of Electricity” (Schweppe et al).
- Power systems are complex machines that should be operated on the normal state, not in the alert state.
 - Hence, ultraquality should not be performed as a professional response to the public's need and perceptions. It is not debatable to the system architect (the Art of system architecting).
- Ultraquality is also a response to exceedingly costly low frequency extended blackouts of power systems.

Ultraquality gives strong ground for ending the deregulation debate to allow an emergent market to arrive.



Selecting an Inferior Path to the End-State of the Power Industry

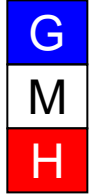
- Sally Hunt et al... (Req. 3) The models:
 - have quite different types of trading arrangements
 - require distinct sorts of contracting arrangements and have dissimilar regulatory requirements
 - may require different ownership arrangements for the companies operating in the sector
- As W. Brian Arthur explains, Req 3 results in possible configurations, which under small perturbations “phase lock” under mutually reinforcing elements.

An End-State can get “phase locked” when making trade, contract, regulatory, and ownership arrangements.

Active and Inactive Demand

- Although, the “Unlocking the Grid,” article had an introduction on “The new power brokering,” in which William Sweet, as editor, wrote that Schweppe’s “...vision is fast turning to reality...,” we can now see that it was unrelated to the 4 models as
 - (req 4) the most important element of increasing the efficiency of the utility industry – innovation with active demand, based on information technology – was missing.
- Innovation to change the coupling between the industry and its customers, from inactive to active with the spot price based energy marketplace framework developed by Schweppe et al.
- The benefits include improvements in operating efficiency, reduction in needed capital investments, and customer options on the type (reliability) of electricity to be bought.

Active demand is a prerequisite to innovation to increase system efficiency.



Possible End-States

- By adding active demand, the models result then in distinct 8 possible End-States.
- However, only the End-States with active demand are advisable.
- As the transition from one state to another may prove very costly (Req. 3), selecting the End-State at the outset is crucial: retail competition with active demand and ultraquality transportation is the suggested generic market model paradigm.

Only one state is the End-State: retail competition with active demand and ultraquality transportation.

Regulated Energy Marketplace

- Schweppe et al designed a regulated spot price energy marketplace as a starting step to a “possible” deregulation.
- As utilities are in the business of winning rate cases, Schweppe proposition, could not and was not selected, because it is a disruptive technology.
- Instead, many utilities sought to extend “native loads” under deregulation, to protect their business models, creating a big barrier to the development of the resources of the demand side.
- The barrier to Schweppe’s homeostatic utility controls, “phased locked” the US and elsewhere’s deregulation processes into an inferior development path.

Electricity without price control is a competitive marketplace.

Schweppe et al

Deregulation Warnings

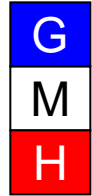
- "We believe the deregulation which considers only the supply side of the supply-demand equation is dangerous and could have very negative results."
- "A second major difference between this chapter and most of the rest of deregulation literature lies in our concern that the economics and physical security of the power systems not be destroyed or compromised."

Active customers and ultraquality are essential elements of EWPC that considers the demand side, economics, and physical security without destruction or compromises.

Transmission Open Access and Inferior Reliability

- After the death of Schweppe, [Bill Hogan](#) “extended” the theory and practice of Spot Pricing of Electricity without starting from the regulated energy marketplace and [compromised both the warnings on active customers and on ultraquality](#).
- “Big mistakes are made on the first day:” two small chance events that tilted the competitive balance as early as 1992.
- Hunt et al Model 3 was selected and the whole industry was developed on an inferior solution path, based on Transmission Open Access and inactive “native” loads.
- Richard [Tabors wrote](#) (“Lesson From the UK and Norway,” IEEE Spectrum, Aug 96), [“The US has heard, over and over, a mantra stating that only the existing players, if allowed to remain in control of the system functions, can guarantee no decline in reliability.”](#)

Transmission open access deadlocked an inferior path.



Transportation Reintegration

- Christensen's Innovators Solution teaches how to apply the theory on innovation requires separating the industry at modular interfaces.
- As distributed resources increase, distribution systems become more like (at least longitudinal) transmission systems. **As the separation of T&D is done at an interface that is no longer modular on real time, transmission open access needs to become a robust transportation open access.**
- As the transportation company requires to operate under ultraquality, **NERC mandatory standards might produce a large value destruction, as the interface that was defined is not modular either.** The system planner and operator should be responsible for systemic risk management.

Applying the Innovator's Solution will show that electric transportation should be kept whole to manage effectively and efficiently power system short and long run systemic risk

Coordinating Benefits

- Whether anybody knew it or not, interconnected power systems were being planned and operated under increasing returns since the 1920's, but the deregulated market design and architecture dismissed the large coordination saving, as economist and financial managers with a diminishing returns mental models took control of the industry.
- The result was a loss of institutional memory, in this case “coordinating benefits,” as Jack Casazza called them in many of his interventions.

A new paradigm of the power industry will result in many other benefits to be found, creating also new institutional memory.

Reserve Pooling

Increasing Returns

- Increasing returns of interconnected power systems are found in reserve pooling. Oliver S. Yu of EPRI wrote in IEEE PAS, Sept/Oct 1980, “To maintain high availability and reliability of a power system, capacity reserves in generating, transmission and distribution are required...for a given unit size, generating reserves decrease with system size... savings in capacity reserves provide another major efficiency for system sharing and interconnection.”

Saving in capacity reserves is a source of efficiency.

Coordinating Benefits on the Demand Side

- My thesis is that those “coordinating benefits” exploited in transmission interconnections are also available on the resources on the demand side, and that a new market design and architecture is required to exploit them. As a result, old vertical integration training will be somewhat different to new training, as iron coordination is being replaced by bits coordination.
- That market design and architecture is the electricity without price controls (EWPC) will provide savings of capacity reserves by extending Schweppe et al to a competitive energy marketplace much better than lumping investments in time and space.

Bits coordination reduces capacity and operating costs, getting much closer to capacity limits.

Decreasing vs Increasing Returns

- Jason Black (see his MIT PhD theses) has found diminishing returns to adopters of (only load shifting) demand response, when the current electricity on price control (EOPC) paradigm market architecture is kept.
 - Incumbents as retailers controlling wires
 - Lack of ultraquality shows pernicious effects
 - Marketing financing unclear
- By investing in the development of the resources of the demand side - bits coordination - for the Bottom of the Pyramid (BOP), increasing returns are available under globalization.
- Increasing returns on G, T & D capacity reserves coordination may also be available.

Competitive utility retailers business model innovations are at the center of the market.

Physical Risk of System Failure

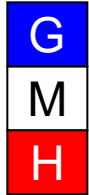
- Electricity markets uniqueness is associated with the non-linear nature of the physical risk of system failure.
- Such failure, linked to high prices in deregulated systems, used to be managed as a supply security risk under vertical integration by adding generation and transmission reserves.
- The apparently large costs of reserves required, became the target of inefficiency identified by economist and policy makers at the outset of deregulation.

Once high tech supply side risk management, that went unrecognized by economist, should be replaced by high tech demand side risk management under EWPC.

Congestion and Risk of System Failure

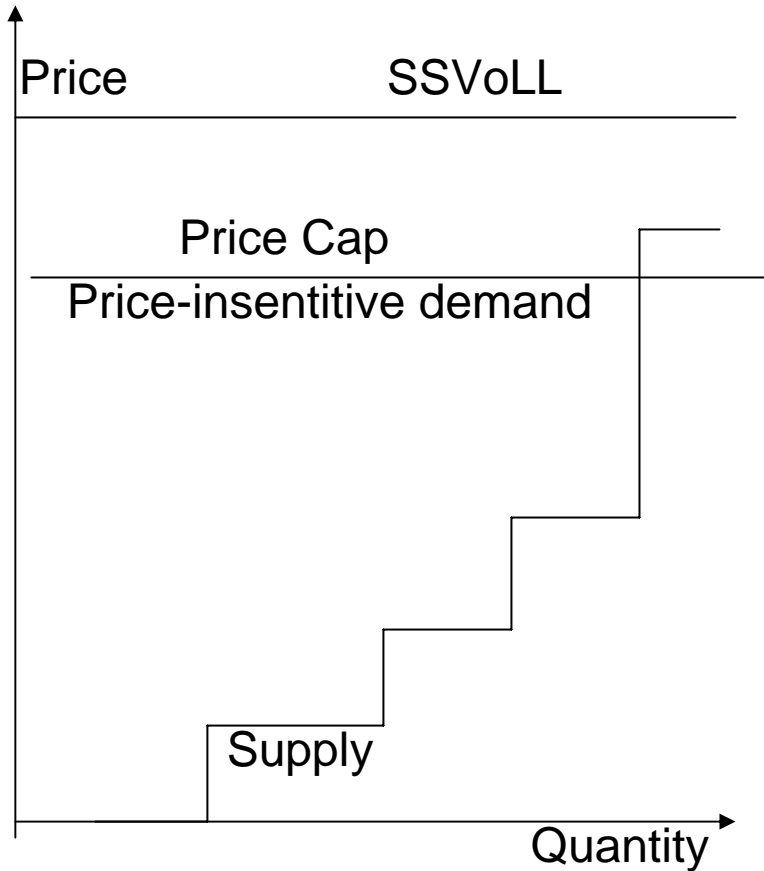
- By reducing reserves and creating congestion, here and there, long run risk of failure was thus increased by deregulation of wholesale markets and incomplete deregulation of retail markets.
- Associated with unnecessarily system operation under the alert state was increased value destruction, and unstable markets, with excessive prices spikes.
- Capacity markets, for coordination in time and space, will “phase-lock” inefficient Electricity On Price Controls (EOPC) practices.

Congestion and excessive price spikes are associated with value destruction and the risk of value destruction. Power systems should be operated on the normal state.



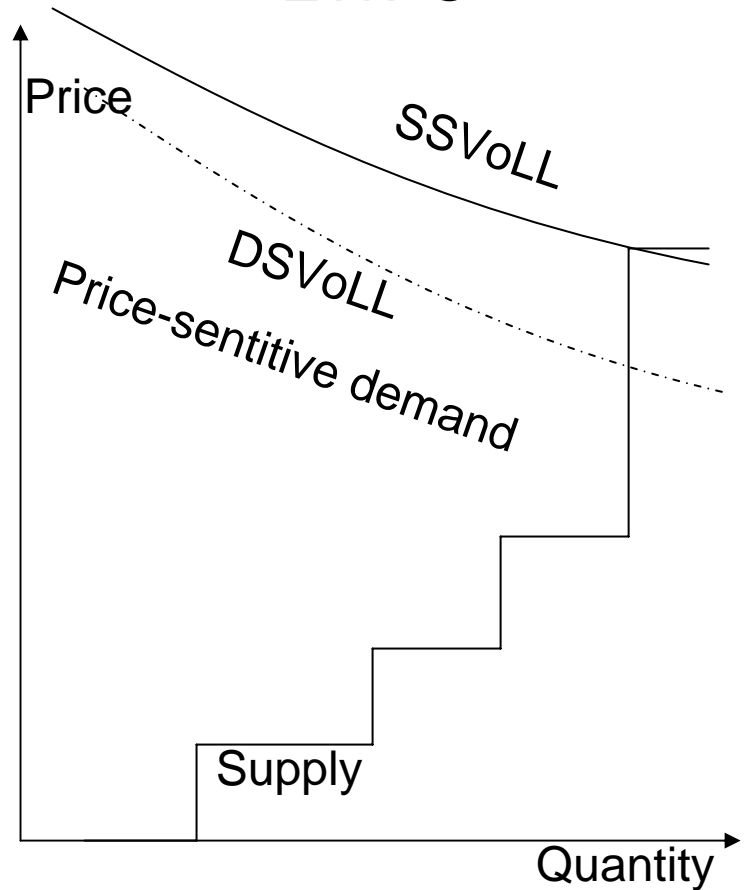
No Scarcity Rents Available
 Inefficient Capacity Markets

EOPC



Scarcity Rents Available
 No Capacity Markets required

EWPC

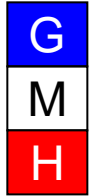


Extended from Jian Yang, "Resource Adequacy, IEEE P&E Mag. Mar/Apr. 2006.

Demand Side Reliability Differentiation

- As Information and communication technologies have progressed, end-customers perceived sensitivity to shortages has spread sufficiently as to make invalid the assumption that customers can be classified in neat classes to pay average rates.
- That sensitivity is the basis for differentiating customers, and an essence for a retail market to be developed.
- Progress has also brought us the new technologies, like Demand Response and Automated Metering Infrastructure (AMI).

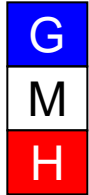
Capacity markets brute force coordination can be replaced economically by innovative business models developed by competitive retailers.



Demand Side Management of Risk of System Failure

- DR technology can repositioned systems reserves, in time and space, much better than lumpy investments in generation, transmission, and distribution.
- By developing a market on customers differentiated supply security (sensitivity to shortage) requirements, an efficient rationing system can be developed.
- Ultraquality requirements can be partly met with such rationing system.
- Investment on an AMI is apparently feasible just on the operational benefits to the distributor, but requires to reengineer its processes to reap most benefits.

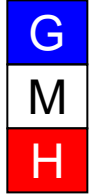
Supply side management of risk of failure is a high tech approach that creates a mix with the brute force approach. Developing countries can have a larger DS market share.



Integrated Approach to Reliability [and Adequacy] Assurance

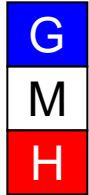
Time Frame	Activities	Competitive Retail Functions
2 - 5 Years	Long Term Planning	Investments Plans in DR and DSEE
3 - 6 months	Resource Adequacy	Available DR and DSEE
1 - 2 weeks	Operations Planning	DR Outage Coordination Market ?
12 - 24 hours	Day Ahead Scheduling	Load Commitment Market
5 - 180 min	Real Time Security	DR Execution Market

Complements Joe Chow et al “Electricity Market Design.” Proceedings IEEE, Nov 2005.



MAIN ISSUES

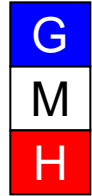
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Dr. Donella Meadows “GD” Advice

- ... some general rules are obvious. Plan far ahead, and plan for the welfare of the whole system, not just the utilities or the big consumers. Remember that demand reductions are as effective as supply increases and cheaper and cleaner. Don't set up the poor to bid against the rich. Don't try to control prices in only one part of the system. Don't hide real costs. Throw away comfortable myths about how the market will do everything for us and start thinking...Above all don't allow anything as critical as electricity (or health care or airline safety or food or pharmaceutical safety) to be restructured by power brokers in back rooms (see [Restructuring and Faith in the Market](#)).

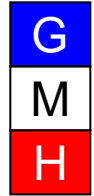
The advise of the late Dr. Meadows, a great system thinker, should be the basis to conduct the GD



Another Look at the California Deregulation Debacle

- In July 1996, Barkovich and Hawk reported in the IEEE Spectrum that “The debate in California has changed remarkably over the past year or two. Discussion now focuses not on whether retail competition or direct access is possible, but on how to make it happen. The three California investor-owned utilities affected by the commission's decision convened an industry working group, called the Western Power Exchange (Wepex) to address the issues related to implementing the new competitive retail market... only the investor-owned utilities... are voting members.”
- Power brokers were at work...

The decade old debate has been between vertical integration and deregulation without active loads



Replacing Financial Capital with Production Capital

- EWPC was not considered in the decade old debate as deregulation aimed to extend monopoly power of utilities. The game will be over when financial capital is replaced by production capital based on a stable market design and architecture for the long run.
- Those with a wait and see approach will be able to jump to the End-State with a clean slate.
- Those that didn't follow a clear vision might get unstuck through costly processes.
- Geoffrey Moore ("Living on the fault line,") suggests 2 phases to introduce competition: market vs market cooperation and company vs company competition.

There is a strong need to execute the GD to complete market vs market cooperation and introduce production capital ASAP.

The Correct Path was Available

- John Flory's "Electricity Transaction in an Open Access Market," IEEE Per, January 96, laid most of the elements of the evolution of deregulation that could have led to the correct path of deregulation as it was based on welfare economics and complete markets.
- On a hearing in the House of Representative, on Energy Industry on July 16th, 1998, Richard Tabors said:
 - There is not "an open and unbiased market" in the electric sector... because the "very technology that is allowing this revolution to occur is being applied to slow the progress from natural monopoly to competitive market."

An open and unbiased path can lead us to the End-State of the power industry as the required technologies are now available.

John and Jack were Correct

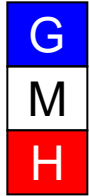
- Jack Cassaza's letter to IEEE PER of April 96, exploited the weaknesses of Flory's paper as real life implementation was not going according to Flory's statements. Jack said that 'deregulation was not going on anywhere.' He added "...the government continues to exercise some control over electricity prices..."
 - Related to price control, today we can state that a mental roadblock is the idea of trying to offer lower prices to customers, instead of lower costs or higher value from electricity.
 - A shift to prudential regulation is required to end regulation based on price controls.

Electricity Without Price Control (EWPC) concept arose to avoid talking of deregulation or reregulation.

EWPC: The End-State of the Power Industry

- Under Electricity Without Price Controls (EWPC)
 - A new value chain - wholesale, retail, end customer
 - Distributor reintegrate with transporter charging a toll,
 - Regulated retailers become competitive retailers.
 - Competitive retailers exploit economies of scope
 - Segmenting customers according to demand side reliability differentiation among many other parameters.
 - Take control of strategic enterprise solutions to develop innovative business models that reap interdependencies.
 - As each customer selects what he perceives is the maximum value addition, the economy as a whole perceives maximum welfare.

EWPC architecture is centered on competitive retailers.

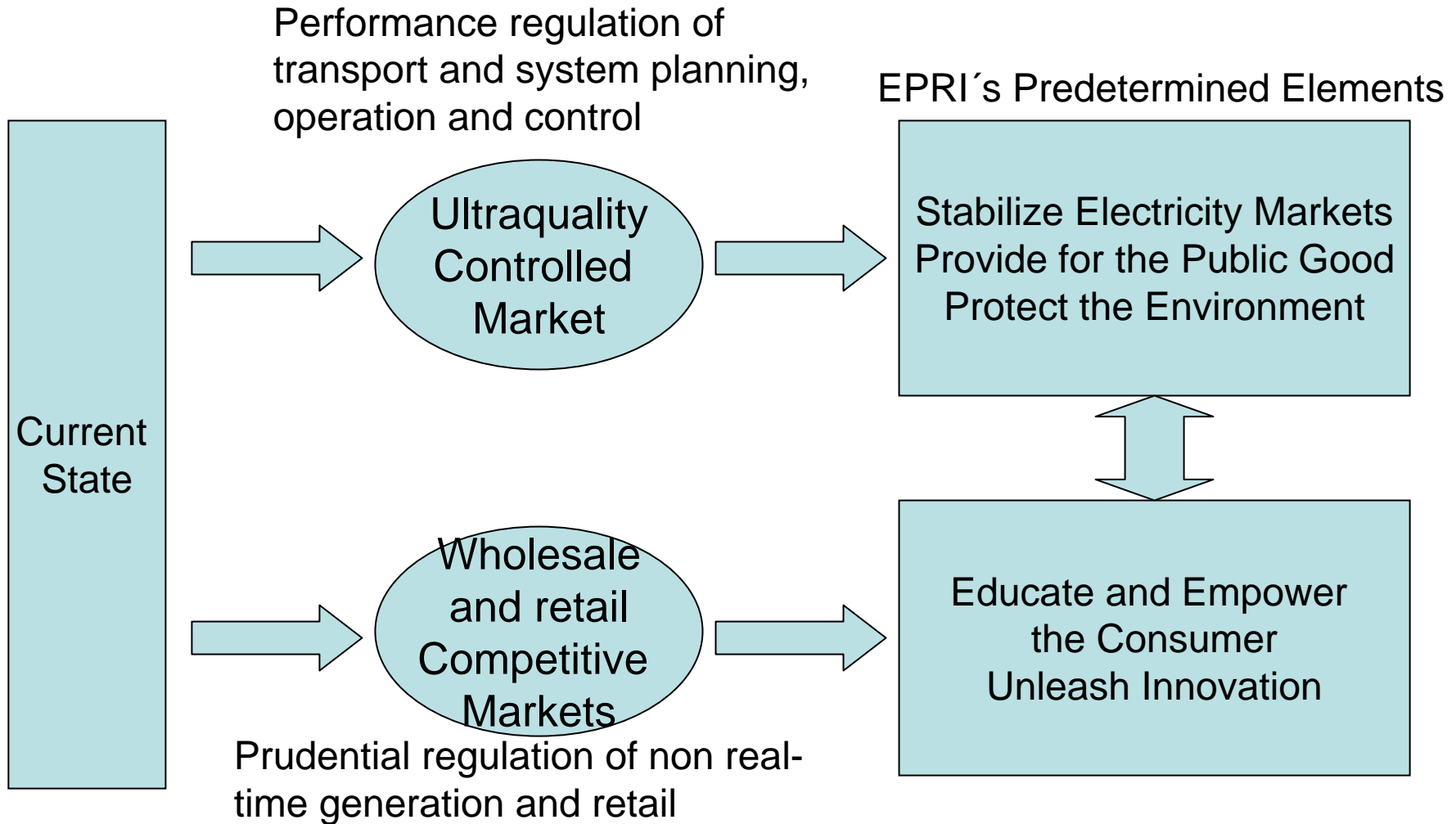


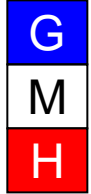
Transition to the End-State

- Given all the institutional arrangements and technical developments around the inferior path, it seems very difficult for those industry sectors to get away towards to a much superior path – the End State of the electricity industry – which I claim is the Electricity Without Price Controls (EWPC) market design and architecture.
 - Jack Casazza once wrote to me something like it is not possible to “unscramble the egg.”
- However, to ensure “that the industry has the physical and human resources needed for the next 30 years,”
 - Regulators need to change their authority to regulate prices to apply prudential regulation to retailers and generators.
 - It is the right time to develop a transition to EWPC with a generative dialogue that will allow the transitory solutions to emerge, avoiding to throw good money after bad.

The creative destruction transition to EWPC is already at work.

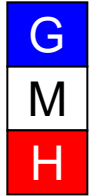
Pathways to the EWPC End-State of the 5th Technical Revolution





MAIN ISSUES

- Development Path and Possible End-States
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- End the Debate and Start a Generative Dialogue Towards Electricity Without Price Controls
- **Dominican Republic Potential**



Poverty Problems and Opportunities

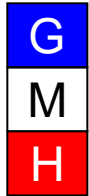
- Electric sector deregulation in the Dominican Republic has lead to a poverty trap. Customers were divided into profitable and non-profitable, which justified generalized subsidies.
- A program to reduce outages to the poor designed avoiding metering and distribution extensions investments replayed the tragedy of the commons archetype of system thinking.
- In practice long and frequent interruption, and associated costs, resulted in electricity that adds no value to the communities, while promoting waste when lights are on.
- Metering replacements in developed countries is more difficult to justify than in places with no metering at all.

Tragedy of the commons solution leverage is known to be in metering investments to reduce energy waste.

Poverty Reduction on the Basis of Fairness

- Extended now as the basis for the development at BOP, Mohan Munasinghe, wrote (IEEE Power Apparatus and Systems) in 1979 “A new Approach to Power System Planning,” that,
 - ... leads to an optimized power system plan in which the net social benefits are maximized... This approach indicates that the optimum reliability level will tend to be higher for areas in which outage costs are greater, and therefore, on the basis of fairness alone, electricity tariffs should also be higher in such neighborhoods.
- This is total agreement with Req. 4 – active demand and is the conceptual basis for demand side reliability differentiation.

Under EWPC BOP customers with lower outage costs should pay less by helping system stability and welfare



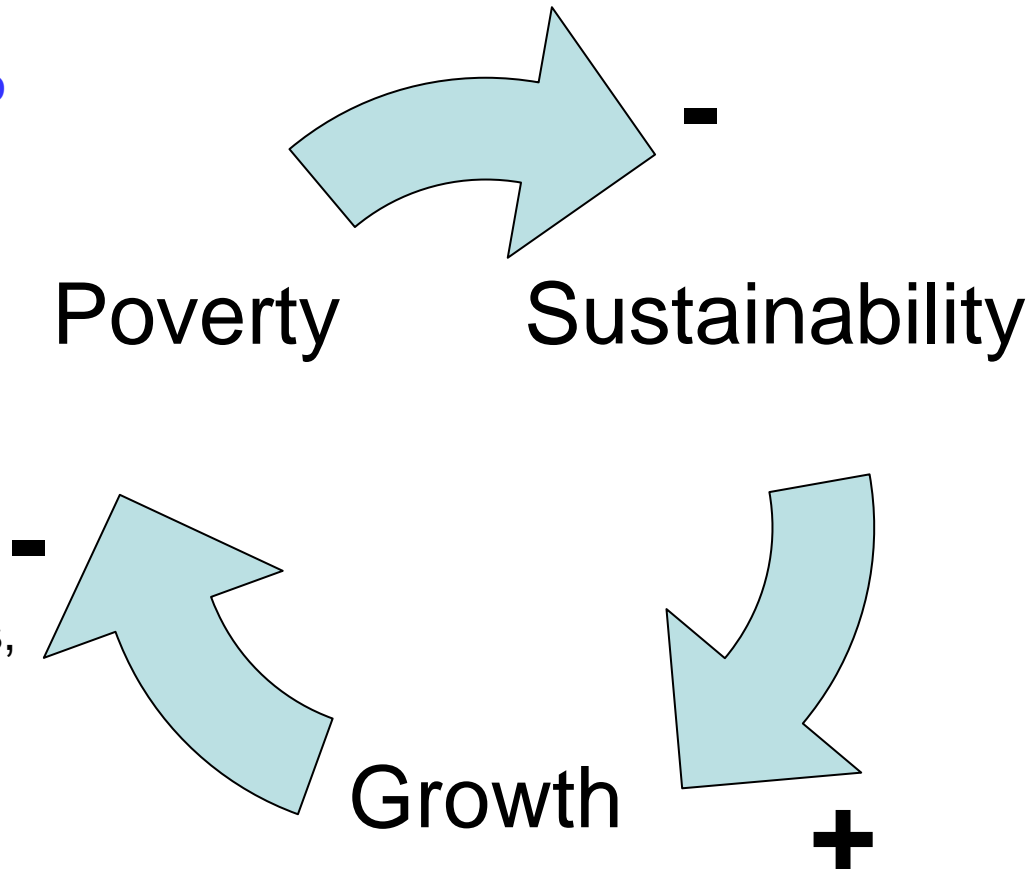
Poverty
Increasing

Vicious and Virtuous Circles at the BOP

Neo-liberal
exclusive
policies lead to
a vicious circle

Electric
interruptions
affect social
activities
needed by the
poor to -
school, roads,
health facilities,
resulting in
electricity that
adds no value
and increases
violence...

March 13, 2007



Poverty
Reducing

Pro-growth
inclusive
policies lead to
a virtuous
circle

EWPC
maintains
reliable
services to key
social activities
missed under
the vicious
circle, mutually
reinforcing
itself with micro
credit virtuous
circles

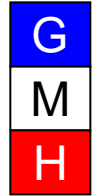
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A Clear and Blunt Vision

- On 1996, I was retained under a contract financed with funds from the American taxpayer to develop a solution to the electricity crisis of the Dominican Republic.
- I suggested to exploit the IT revolution extending Schweppe's marketplace with a white paper written in Spanish, which translates to "The need for an integral electricity policy for the Dominican Republic."
- The vision has evolved into articles such as [a Dominican strategy](#) and [An Alternative Business Case for Demand Response](#).
- The emergent solution has not been publicly debated, as it is opposed by vested interests.
- Now I suggest that the debate is not required anyway.

I suggested a vision in which Dominicans were to become leaders in retail marketing in underdeveloped countries



Dominican Republic is well positioned to develop EWPC

- With collaboration of foreign knowledge and investments,
- Power industry on chronic collapse,
- Country has a FTA with US - Central America (DR-CAFTA),
- Electricity is largest barrier to investments,
- Modification of electricity law being consider,
- Customers' installed generation and storage capacity is nearly 3/4 the system capacity.
 - Helps GDP grow around 10% in the last 2 years.
 - Professor Schweppe 'envisioned a world of customer-based electrical generation and storage,' which has been happening in the Dominican Republic, for quite some time

Dominicans need to go from comparative advantage to competitive advantage by offering a predictable market.



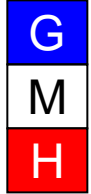
Predictability Will be the Key to Attract Investments

- Breaking the “native load” barrier will allow the integration of the available resources of the demand side to offer a high reliability service with adequate resources.
- The market architecture and design reform will attract businesses customers with price-sensitive demand with a high value of load lost.
- According to Dr. Pérez, the collapse is the turning point from financial capital to production capital. Expected costs of keeping the current system far exceed the costs of restructuring if global innovations are taken into account.
- As the vision to the End-State is clear and blunt, the modification to the electricity law in predictable ways will attract production capital investments under DR-CAFTA.

Predictability helps avoid throwing good money after bad

Conclusions

- The vertically integrated industry developed the cheap resources of the supply side because of the high transaction costs of the development of the resources of the demand side in the mass production Age.
- In the Information and Communication Age transaction costs become cheap and enable development of the resources of the demand side while supply side resources become expensive.
- No capacity markets are needed under EWPC, as competitive retailers develop the resources of the demand side making available scarcity rents to marginal generating units.
- As the paradigm shift will have a large impact on the research, manufacturing and power sector community, a lot of work is ahead to develop and require physical and human resources for the next 30 years.
- Keeping the old paradigm alive will be throwing good money after bad. A Generative Dialogue for the transition to the End-State of the utility industry is advisable.



Recommendations

- A generative dialogue to reach the End-State of the power industry is strongly advised to reduce value the large value destruction associated with vertical integration brute force approach to reserves coordination.
 - Without any loss of generality, said dialogue can be done on the Dominican power sector to conclude the market vs market cooperation, allowing for the second phase of company vs company competition.
- Prudential regulation of power sectors competitive activities should benefit from the large experience of the financial sector to curve market power and protect the customers from retailers that might go broke.



THANK YOU ALL

- ANY QUESTIONS
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