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ELECTRICITY RESTRUCTURING IN THE UNITED STATES

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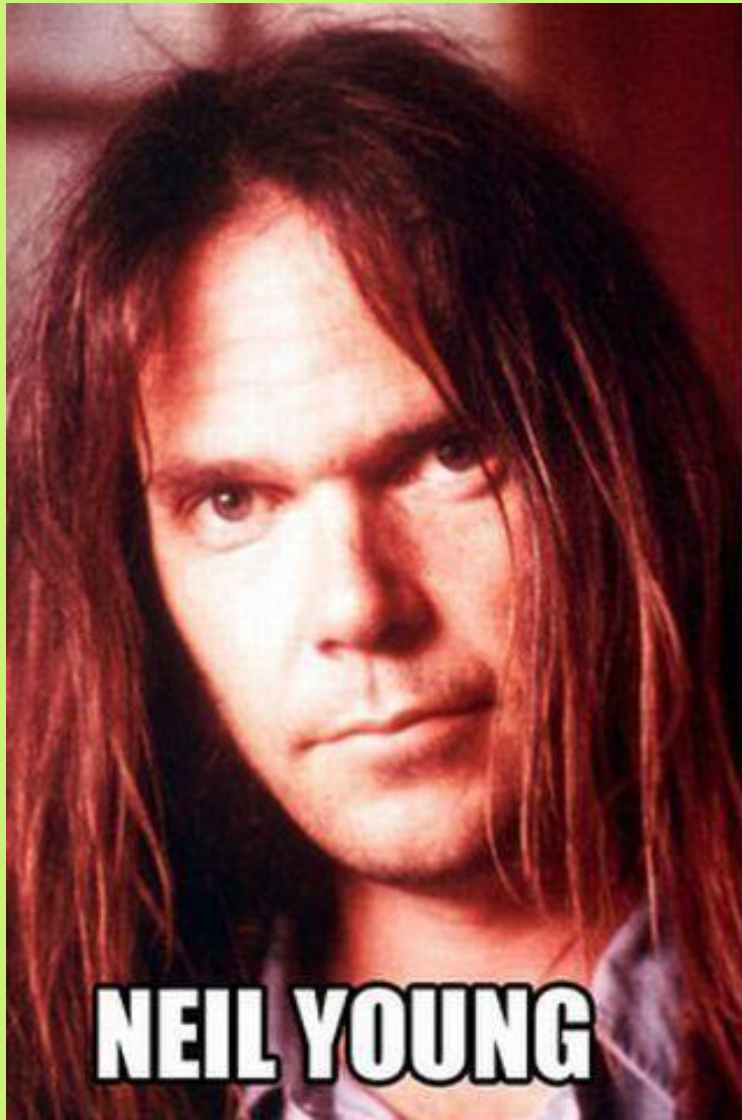
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Background Notes

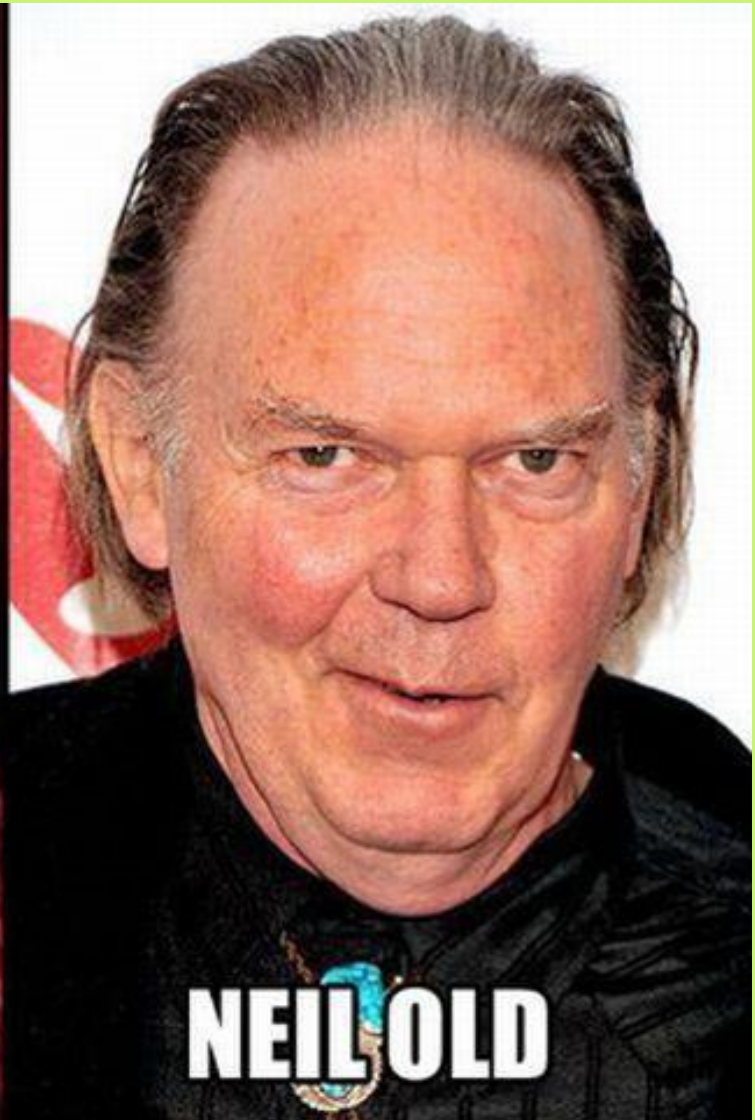
- BS Natural Science, MS Public Policy
- 3 years Energy Consulting, Synergic Resources (SRC), DSM pioneer
- Ph.D. in Economics
 - Neoclassical training, but no real world skills, dissertation on Oil
 - 6 years Litigation Economics: self-taught financial theory, IO, antitrust law and economics, and business
- Law school, more “book learning”
- Management Consulting
 - Electricity deregulation in PJM, foreign legion
- Lawyer/Consultant
 - Represented ISO-NE at FERC
 - Potomac Economics, market monitor
 - Represented clients in ERCOT, pushing DSM again

Background Notes

- Generalist Approach
 - Can't be taught in academia, too focused, profession programs teach you to be facile
 - Requires mastering multiple skills and extensive experience; learning by doing (and listening)
 - Young are smarter (at least in math), old people hopefully develop wisdom and perspective
- Tried it with my dissertation (first book on Oil)
 - Ambitious muddle, bite off more than I could chew
 - If at first you don't succeed . . .



NEIL YOUNG



NEIL OLD

Background Notes

- Book crosses genres
 - **Politics**, or why things are the way they are
 - **Law**, or the “rules of the game”, EPA Act 1972, 1990, 2005, CAAs
 - **Regulation**, how law is applied
 - Electricity regulation, FERC, NERC and PUCs
 - Environmental Regulation, EPA, Clean Air Regulations
 - **Policy**, what we’d like to accomplish
 - “Economic engineering” – abstract modeling
 - Real world economics, thinking about actual markets and actors
 - Feasibility, the gap between “what is and what never should be”
 - **Science & Engineering** (have to know the basics)
 - Some electrical engineering, can’t avoid it
 - Thermodynamics, chemistry, materials science
 - **Business**, or how things are done (attempted)

**“People of the same trade seldom meet together,
even for merriment and diversion, but the
conversation ends in a conspiracy against the public,
or in some contrivance to raise prices.”**



Background Notes

- Influences

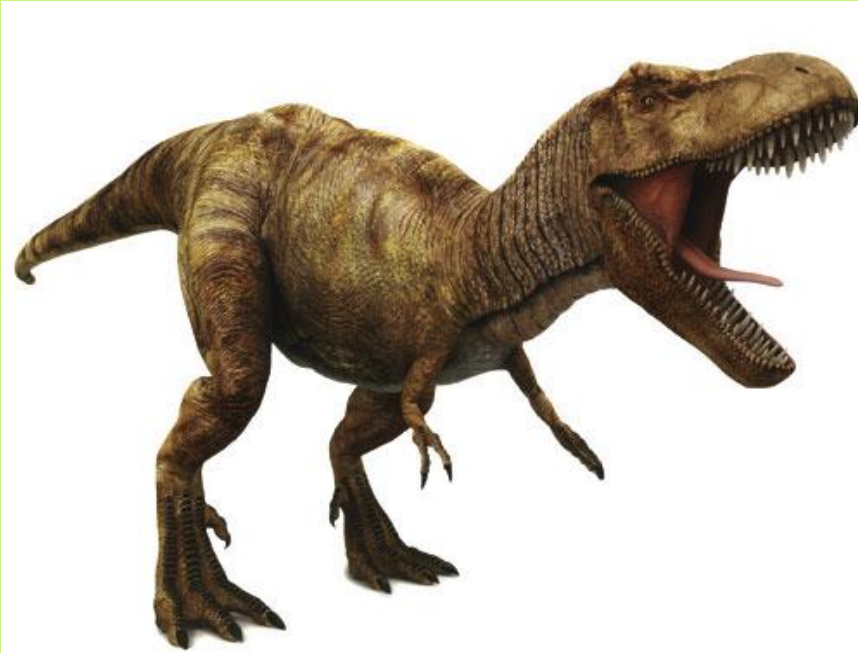
- Fernand Braudel, *Civilization and Capitalism, 15th -18th Century*, 3 volumes, a true “tour de force”
- Edward Leamer, “Let’s Take the Con out of Econometrics,” *AER* 1983
- Lipsey & Lancaster – “The General Theory of Second Best,” *Review of Economic Studies* 1957
- Paul David and the “Path Dependence” literature, economics, law (Posner), politics
- Charles Lindblom, “The Science of Muddling Through,” *Public Administration Review* 1959

In the Beginning

- Before Eve bite into the apple of deregulation
 - Investor Owned Utilities (IOUs), dinosaurs ruled the earth
 - Federal government had TVA, BPA, Western Power
 - Municipals and Cooperatives scurried through the undergrowth (with their tax exemptions)
- Federal Regulation
 - Gap filler after Attleboro
 - PUCHA to end perceived holding company abuses



Were the traditional utilities predatory dinosaurs or slow moving herbivores?



Energy Crisis

- 1970 – the year of reckoning
 - Nominal electricity prices start to rise
 - Natural gas shortages begin
 - Environmental Policy Act (EPA Act) 1970 amendments
- 1973 – Oil Embargo, price jump
 - Energy prices jump with oil prices
 - Monetary policy fuels inflationary pressures

Back in the bad old days . . .



Energy Crisis - Aftermath

- Nuclear Power Cost meltdown (before TMI)
- Plant cancellations and delays
- Energy Policy & Conservation Act – 1975 (CAFÉ)
- Energy Conservation Policy Act – 1976
 - Funded state efficiency plans and programs
 - Established standards for appliances (never finalized)
 - California standards lead to Appliance Conservation Act of 1987 (manufacturers wanted uniform standards)
- Demand Side Management and Integrated Resource Planning emerge at the state level in the 1980s
 - Electricity demand growth falls from pre-crisis levels

Energy Policy Act of 1978

- Power Plant & Industrial Fuel Use Act
- Natural Gas Policy Act (NGPA)
- Public Utilities Regulatory Policy Act of 1978 (PURPA)
 - Encouraged states to promote energy conservation and load management techniques
 - Created Qualifying Facilities (QFs)
 - Renewables 80 MW or less
 - Cogeneration
 - Prices to be based on avoided costs
 - Purchased Power Agreements (PPAs) with utilities

Unintended Consequences

- QF contracts in high priced states
 - Fixed price PPAs quickly subscribed
 - Developers could leverage PPAs into high debt/equity ratios
 - Barn door closed after horse fled, competitive bidding reduced QF rates
- By 1992, QF cogeneration sales 3.6% of sales
- PURPA created lobby of independent generators and developers, AES, Calpine

Natural Gas Glut

- NGPA gradual decontrol of NG prices
 - Expectation was increasing prices, based on high oil prices (barrel = 6MMBtu or 6 Mcf, \$30 oil = \$5/Mcf gas, \$10 oil = \$1.70 Mcf gas)
 - High priced gas was developed, rolled into average gas sales price, gas prices rose
 - Decontrol stimulated production, oil prices began to decline, and gas prices dropped in the early 1980s
 - By 1985, gas was essentially decontrolled and a growing spot market continued downward pressure on prices
 - Oil prices crashed in 1986, residual oil pushed gas prices down
 - FERC “spread the take-or-pay pain” between producers and pipelines
 - Congress enacts the Natural Gas Wellhead Decontrol Act in 1989
- Repeal of the Fuel Use Act in 1987 allowed Utilities to use NG

Combined Cycle (CC) Technology

- “Overnight revolution” decades in the making
 - Combustion turbines adopted from jet engines
 - 1949, CT exhaust used to heat intake water
 - Heat recovery CCs installed in 1959
 - GE Frame 7F Turbine (147 MW) CC plant installed in 1990, 45% net efficiency (coal plant ~38%)
 - QF provided market for CTs/CCs, 44,000 MW by 1992



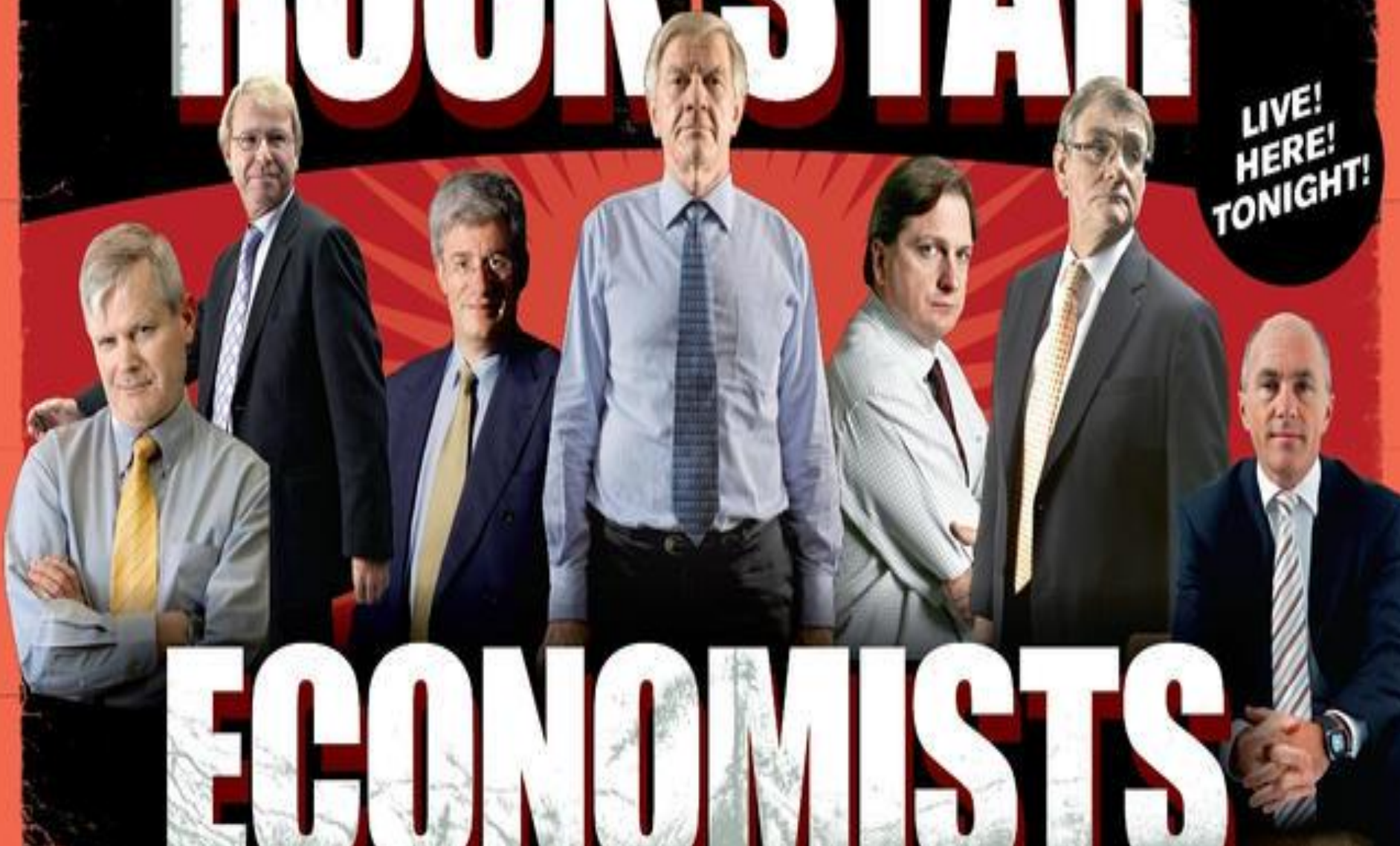
Blame the Economists

- Economics indirectly influences policy
 - Influenced deregulation under Ford and Carter
 - Promised consumer benefits from increased efficiency
 - Early success in airlines, trucking, natural gas seemed to confirm economists' judgment
- Economists turned to electricity in early 1980s
 - Joskow and Schmalensee, *Markets for Power*, 1983
 - Schweppe, Caramanis, Tabors & Bohn, *Spot Pricing of Electricity*, 1988

ROCK STAR

LIVE!
HERE!
TONIGHT!

ECONOMISTS



Or Maybe the Consultants?

- Putnam, Hayes & Barlett (PHB, merged with Hagler Bailly in 1999, swallowed by PA Consulting in 2000)
 - William Hogan, Scott Harvey, Susan Pope, all moved to Law & Economics Group (LECG) in 1999.
 - LECG imploded in 2011
- Tabors, Caramanis & Associates (Bohn was an advisor)
- NERA
- Brattle Group
- General consensus around nodal pricing and locational marginal pricing, following the academic literature.



Energy Policy Act of 1992

- Political pressure for deregulation
 - Industry wanting to bypass their utilities
 - Independent power producers (IPPs)
 - Consumer groups
- IOUs fighting a rear guard action
- Empowered FERC to order transmission access to independent power producers

Power Pools to Power Markets

- IOUs were generally self-contained, few external transmission ties or transactions
- North American Electric Reliability Corp (NERC)
 - Formed after Northeast blackout of 1965
 - 10 regional reliability councils
 - Reliability planning encouraged interconnections
- FPC had encouraged power pools

Tight Power Pools

- Contractual
 - Michigan Electrical Coordination System
 - New England Power Pool (NEPOOL)
 - New York Power Pool (NYPP)
 - Pennsylvania-NJ-Maryland (PJM)
- Holding Company
 - Allegheny Power System
 - American Electric Power System (AEP)
 - Middle South Utilities (Entergy)
 - Southern Company
 - Texas Utilities Company (TXU)

Order 888

- Began incrementally with transmission rate making decisions requiring nondiscrimination
- Notice of Proposed Rulemaking in Spring 1995
- Order No. 888 in 1996
 - Order 888 required filing of nondiscriminatory transmission tariffs
 - Required functional unbundling of wholesale transmission services
 - Required provision of ancillary services to customers
 - Required open access for power pools run by Independent System Operators (ISO)
 - Holding companies had to establish a single transmission tariff
- Order 889, issued simultaneously, established electronic bulletin boards (OASIS) posting prices and transmission availability
- New York v FERC (2002) – Supreme Court affirms FERC authority

Creative Destruction

- The Great Merger Wave
 - Divestitures, 50,000 MWs sold off between 1997-2000
 - Mergers, 41 with value > \$1 billion between 1997-2002
 - Trend continues, Duke Energy, Exelon, First Energy, Ameren, Mid-American, National Grid, Wisconsin Energy, XCEL Energy swallow the “little fish”

Rising From the Wreckage

- IPPs
 - Calpine, LS Power, International Power, Dynegy, AES
- Utility Genesis/Independent Power
 - Exelon, NRG, GEnOn, First Energy, Luminant, PSEG, PPL, Dominion, NextEra, Duke Energy, Edison
- Power Marketing, Enron et al

Retail Competition

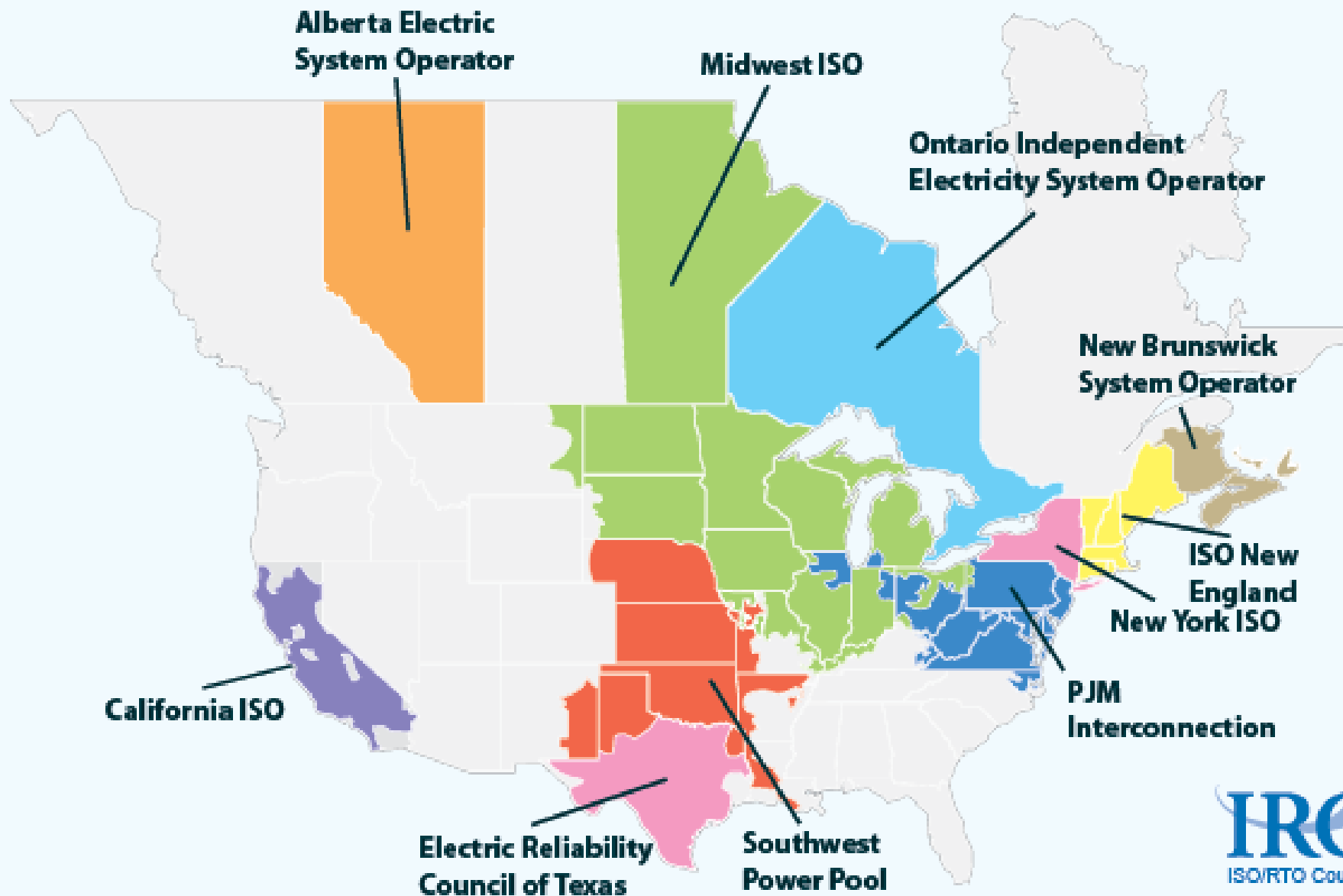
- High cost states
 - Primarily due to QF contracts, Nuclear costs, Northeast, Atlantic and Midwest states, along with California
 - Deals usually included stranded costs, rate caps and retail markets, securitization used to reduce costs
 - Some sort of provider of last resort
 - Buyer's regret, once caps ended, prices often escalated, depended on wholesale price
 - If you pay stranded costs, little gain to be found in the short run
- Texas – its own little world
 - Most competitive market, but most REPs bought out, NRG, Direct Energy (Centrica), TXU Energy dominate
 - Despite rhetoric, incumbents did well on consumer inertia

Creation of Wholesale Markets

- Tight power pools
 - NEPOOL (ISO-NE), NYPP (NYISO), PJM
- NERC region
 - ERCOT
- De novo
 - California
- Further down the line
 - MISO
 - SPP

Evolution of Markets

- ISO-NE, NYISO, PJM
 - All three gradually moved to multi-settlement (day ahead & real time), congestion management systems (LMP with some sort of financial transmission hedge).
 - Price caps (\$1,000/MW), capacity markets
- ERCOT
 - Deregulation an “insiders’ game,” rates were low
 - Pat Wood ordered transmission built to relieve congestion, postage stamp pricing, zones
 - Retail and wholesale in same region starting in 2002
 - Didn’t go multi-settlement LMP until December 2010.
 - Energy Only Market



Order 2000 Markets

- Attempted to cajole all transmission utilities to join/form Regional Transmission Organizations (RTOs)
- Passive resistance in West and Southeast
- Midwest ISO (MISO), hodgepodge ISO formed in Midwest
 - Multi-state, mostly IOUs
 - Hard to reach consensus on market rules
- Southwestern Power Pool (SPP) formed out of NERC regional council, goes LMP in 2014

California

- Camel (horse designed by a committee)
 - Driven by politics, technical decisions on market design ended up as political compromises
- CalPX, CAISO created out of thin air
 - Used different models
 - CalPX day-ahead, CAISO ran balancing market
- Didn't relieve north-south congestion before opening market
- What can go wrong . . . Drought, storms, El Paso gas line (accident and collusion), air pollution, etc.

Market Power

- MISO price spikes of 1998 a warning
- Market Based Rates based on IOU transactions
 - Market power analysis was rudimentary, 20% rule
 - FERC had understaffed monitoring and enforcement groups
 - Utilities and IPPs failed to share required data, including data they gave to NERC
 - Filed rate doctrine meant limited refund authority, 60 days after a complaint, subject to refund for 15 months
 - Strategic bidding was legal under FERC rules and antitrust law (no collusion, Cournot)

California Loophole

- CAISO's Market Monitoring and Information Protocol put offenders on notice
 - Bans “gaming practices”
 - Applied to many sorts of market manipulation, including noncompetitive bidding
 - Used as basis of California and Western markets refund proceedings
- FERC then incorporated similar language in its Market Based Rate Authorization order.
- FERC adopted these rules in Order 670, Prohibition of Energy Market Manipulation (2006)

Energy Policy Act of 2005

- Repealed PUHCA
- Prohibited market manipulation or deception on contravention of Commission rules
 - References SEC Rule 10b-5
 - Penalties for violations of the FPA or NGA from \$5,000 to \$1 million
- Incentive based rates for transmission
- Authority still limited, can't order building of transmission, states can still block projects

EPAAct 2005 and Reliability

- Reliability standards to be established, enforced by FERC
- NERC designated as Electric Reliability Organization, no longer voluntary, and under FERC's authority
- FERC authority extends even into ERCOT
- Motivated by 2003 Midwest/Northeast blackout
 - 50 million without power
 - Triggered by equipment malfunctions, failure to trim trees, operator error

Lessons?

- Policy formulation is extremely complex
 - “Essentially, all models are wrong, but some are useful”
Box & Draper, *Empirical Model-Building and Response Surfaces*
 - The devil is in the details, start with the details, then simplify, don't simplify away the details
 - History teaches us humility, something economists need reinforced on a daily basis
- Muddling through is a rational response to complexity
 - The best is the enemy of the good (Voltaire)
 - Real options theory says flexibility has value
 - Learning by doing requires doing to learn

Coming Attractions

- Shale We Dance on the Oil Peak
 - Natural gas deregulation, the World Oil Market, Peak Oil, Shale Gas, LNG tankers, CAFÉ standards, Energy Security, ISIS, Iran, Saudi Arabia, Putin's chest hairs, and anything else that fits.
- In the Next World You're On Your Own
 - Climate change (aka Global Warming), Renewable energy, smart grid, electric cars, energy efficiency, sustainable growth and the limits to growth.
 - “In the long run, we're all dead”
 - “All things being equal, I'd rather be in Philadelphia”

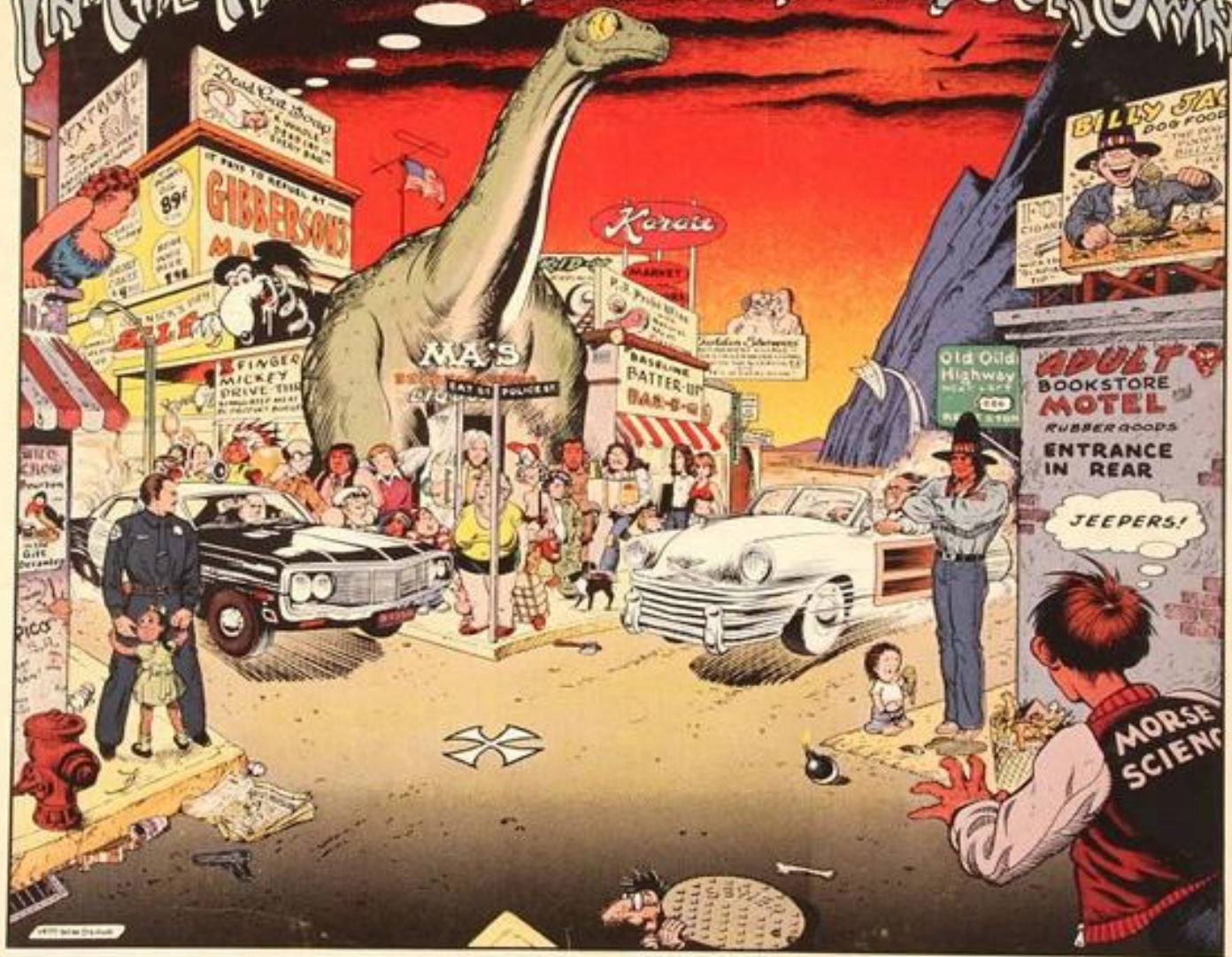


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Every Pack

FIRESIGN THEATRE PREDICTS

IN THE NEXT WORLD, YOU'RE ON YOUR OWN



Chapter One: "POLICE STREET" — IT'S THE WORST STREET IN TOWN, IT'S SO BAD!