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Fueling the Future: Prices, Productivity, Policies and Prophecies

On-Site vs. Off-Site Electric Power Supply in Refineries in the USA: The Use of Cogeneration in Texas and Louisiana

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INTRODUCTION

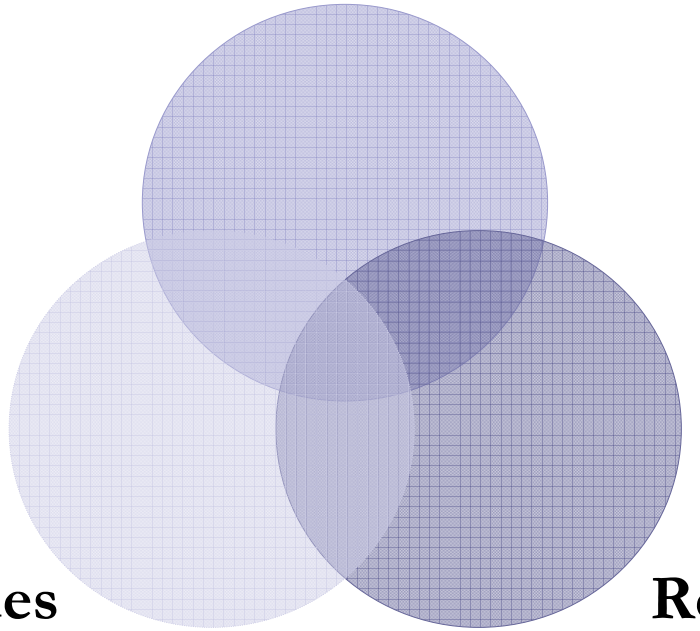
- Cogeneration provides advantages such as:
  - Allowing a more reliable, efficient and cost-effective use of steam and electricity on site;
  - Minimizing refinery's reliance on outside sources of electricity;
  - Minimizing impacts to the environment due to the increase of energy efficiency in the process.

On-Site vs. Off-Site Power Supply

Technical Issues

Technology

Innovation



Institutional Issues

Market Design

Prices

Regulatory Issues

Laws

Regulations

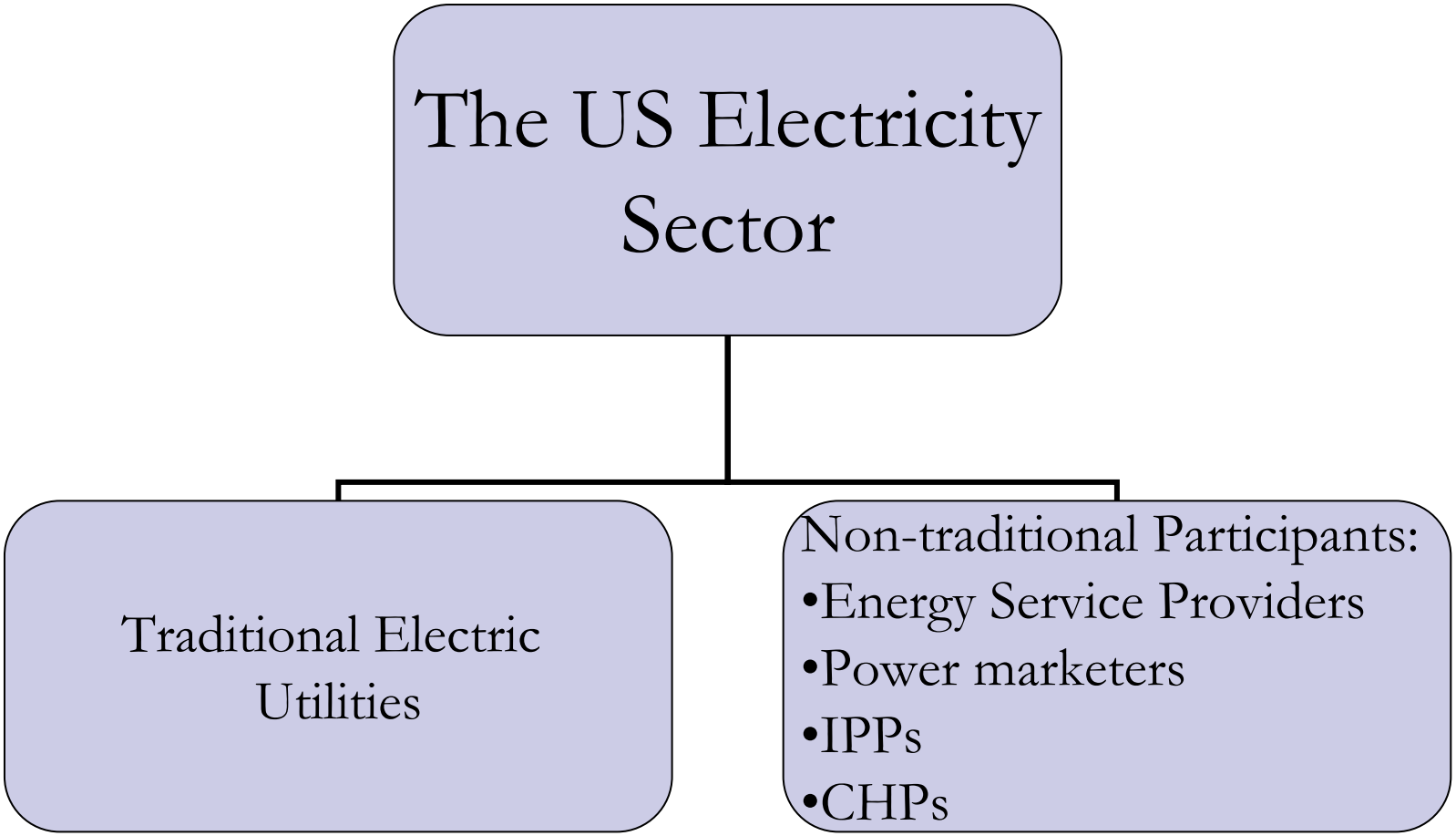
Research Design

- Assumptions:
  - Competitive electricity markets create incentives for cogeneration beyond the traditional, cost-of-service approach.
  - Under the traditional approach, utilities are inclined to create barriers of entry to cogenerators as well as rate structures that decrease their cost-effectiveness.
- Cases:

The Power Sector in the US

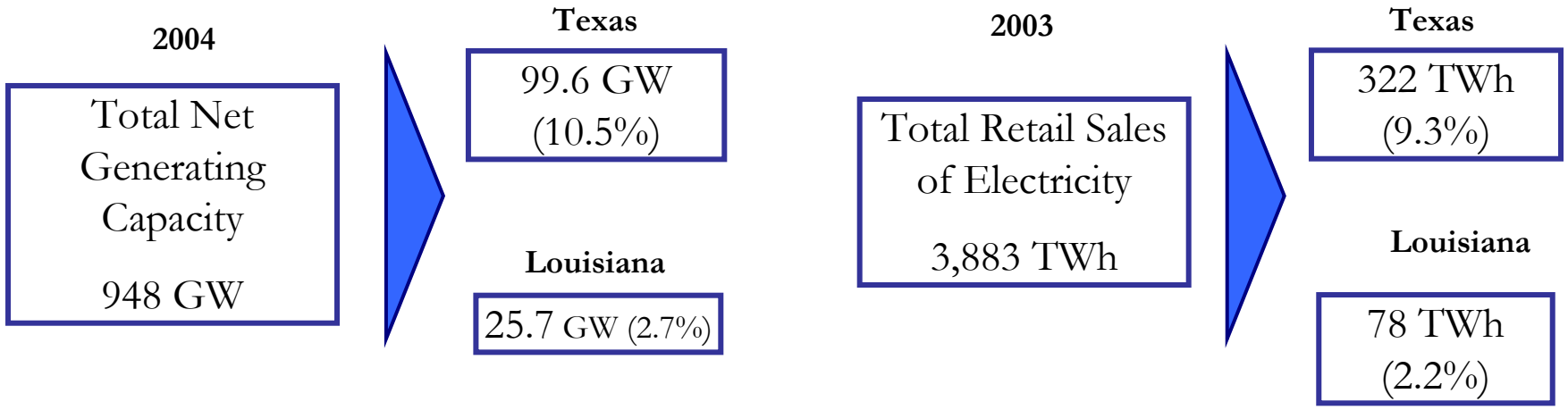
The Institutional Design

The US Power Sector



The US Power Sector

- The United States is by far the world's largest electricity market nowadays, accounting for approximately 25 percent of the electricity generation throughout the world.



Texas' vs. Louisina Power Sector: Facts

	Texas	Louisiana
Net summer capacity (GW)	**94.5**	**25.6**
Electric utilities	38.9	14.2
IPP's & CHP's	55.6	11.4
Net generation (TWh)	385.6	95
Electric utilities	149.6	54.9
IPP's & CHP's	236	40.1
Utility retail sales (TWh)	320.8	79.3
Number of retail customers (thousand)	10,267	2,111
Share of top-ten generating plants (%)	23.6	49
Share of top-five utilities retail sales (%)	55.6	85.6

MAP KEY:

ECAR - East Central Area Reliability Coordination Agreement

ERCOT - Electric Reliability Council of Texas

FRCC - Florida Reliability Coordinating Council

MAAC - Mid-Atlantic Area Council

MAIN - Mid-America Interconnected Network

MAPP - Mid-Continent Area Power Pool (U.S., Canada)

NPCC - Northeast Power Coordinating Council (Quebec, Ontario, Maritimes, ISO New England, New York)

SERC - Southeastern Electric Reliability Council (Tennessee Valley Authority or TVA, Southern, Virginia-Carolinas or VACAR, Entergy)

SPP - Southwest Power Pool (Northern and Southern)

WSCC - Western Systems Coordinating Council (California, Northwest Power Pool or NWPP, Rocky Mountains Power Authority, Arizona-New Mexico-Southern Nevada or AZNMSNV)

Source: North American Electric Reliability Council (NERC)

The Power Sector in the US

The Regulatory Design

Electric Power Sector: Federal Legislation

PUHCA (1935): Gave SEC detailed oversight of the utility capital structures in order to avoid abuses; prevented non-utility companies from entering T&D

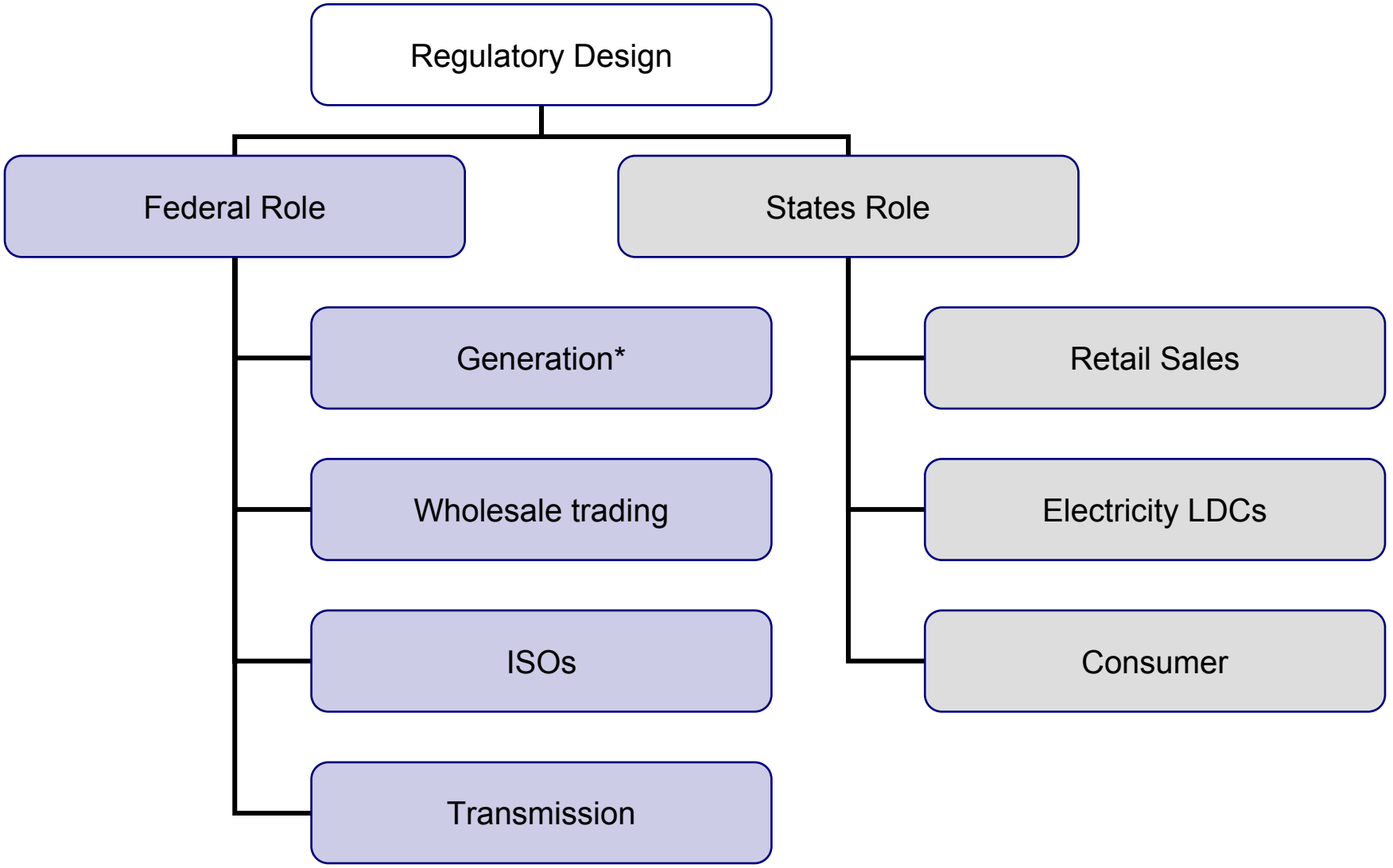
FDA (1920): created Federal Power Commission as supervisory body of interstate electricity business; federal government has jurisdiction over wholesale power sales, interstate transmission and hydroelectric licensing

PURPA (1978): Created incentives for cogeneration and alternative energy resources; utilities must buy power from IPPs at avoided cost

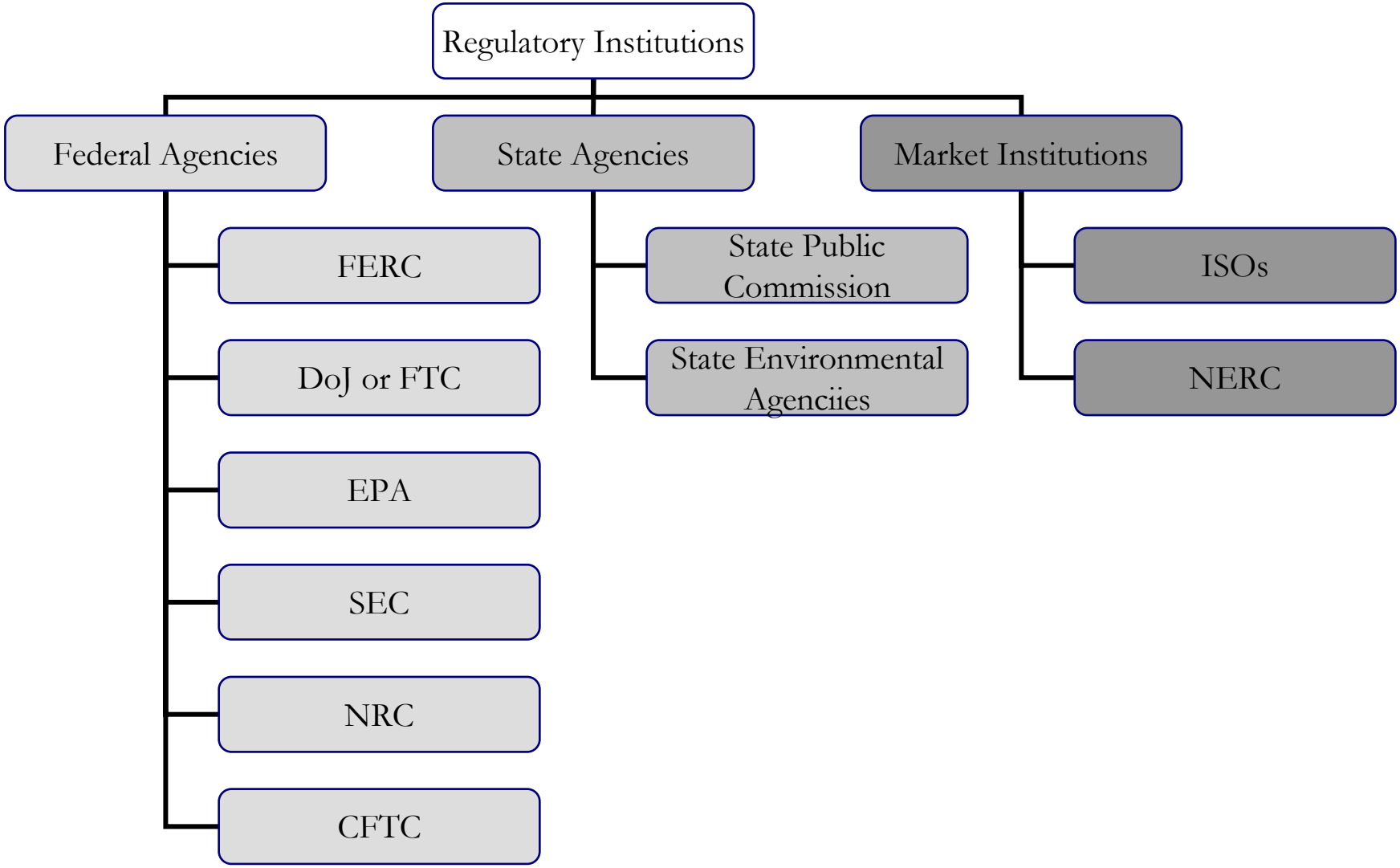
EPAct (1992): Increased competition in generation by creating new entities such as the exempt wholesale generators

Orders 888, 889 and 2000 (1996-1998, 2000) issued by FERC: the goal was to make interstate transmission facilities available to a variety of market participants: to promote open access to the interstate transmission grid. Order 2000 aimed to create RTOs.

Regulatory Design: Overlapping Jurisdictions



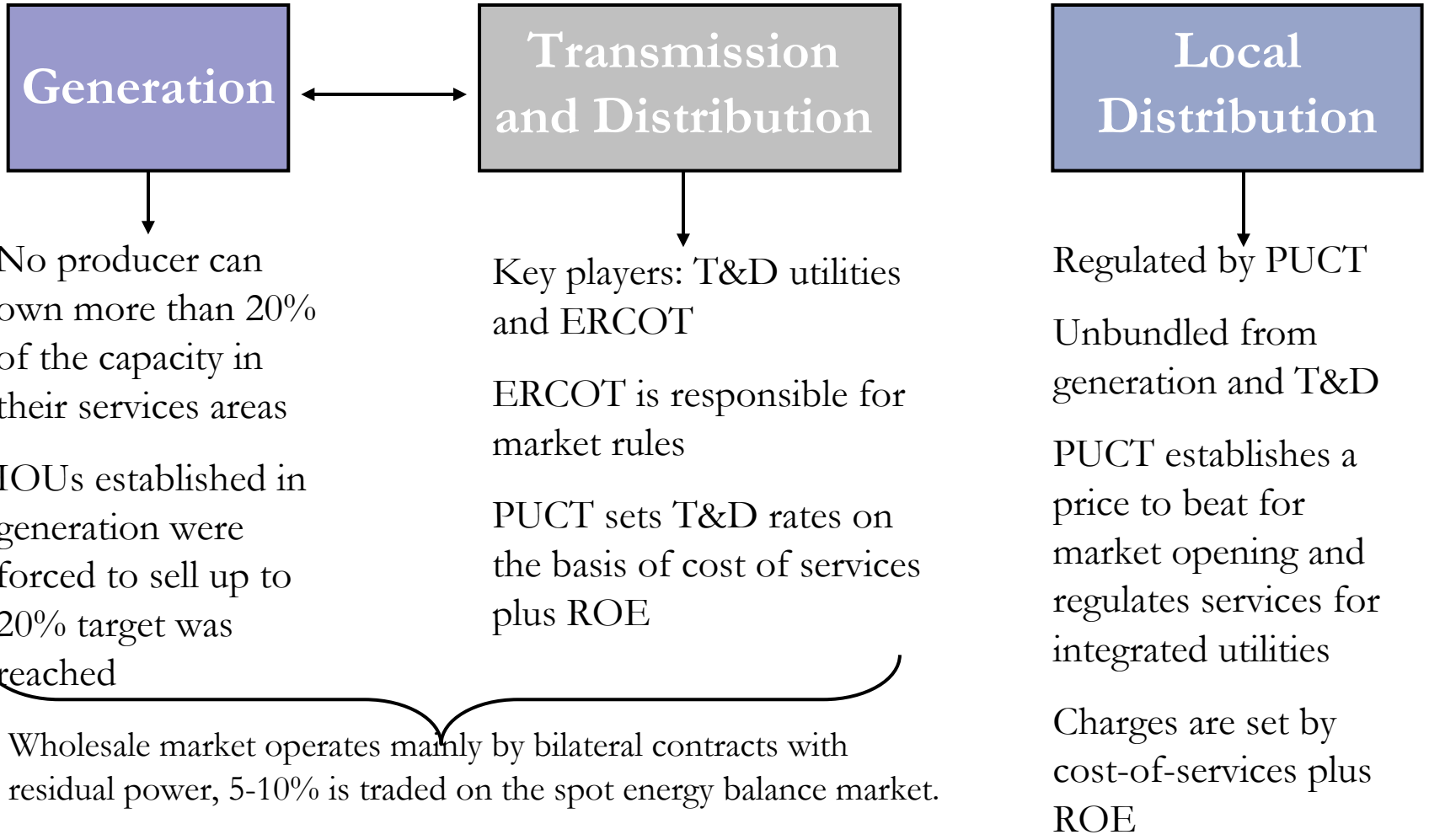
Regulatory Institutions



Texas' Regulatory Design

- State Legislation regarding competition:
  - PURA (1995): Deregulated of the wholesale generation market; increased competition
  - Senate Bill 7 (1999): Unbundled generation, transmission, distribution and retail operations
- Institutions:
  - ERCOT
    - NERC Region and ISO
  - PUCT: Texas regulatory commission to monitor non-competitive behavior.

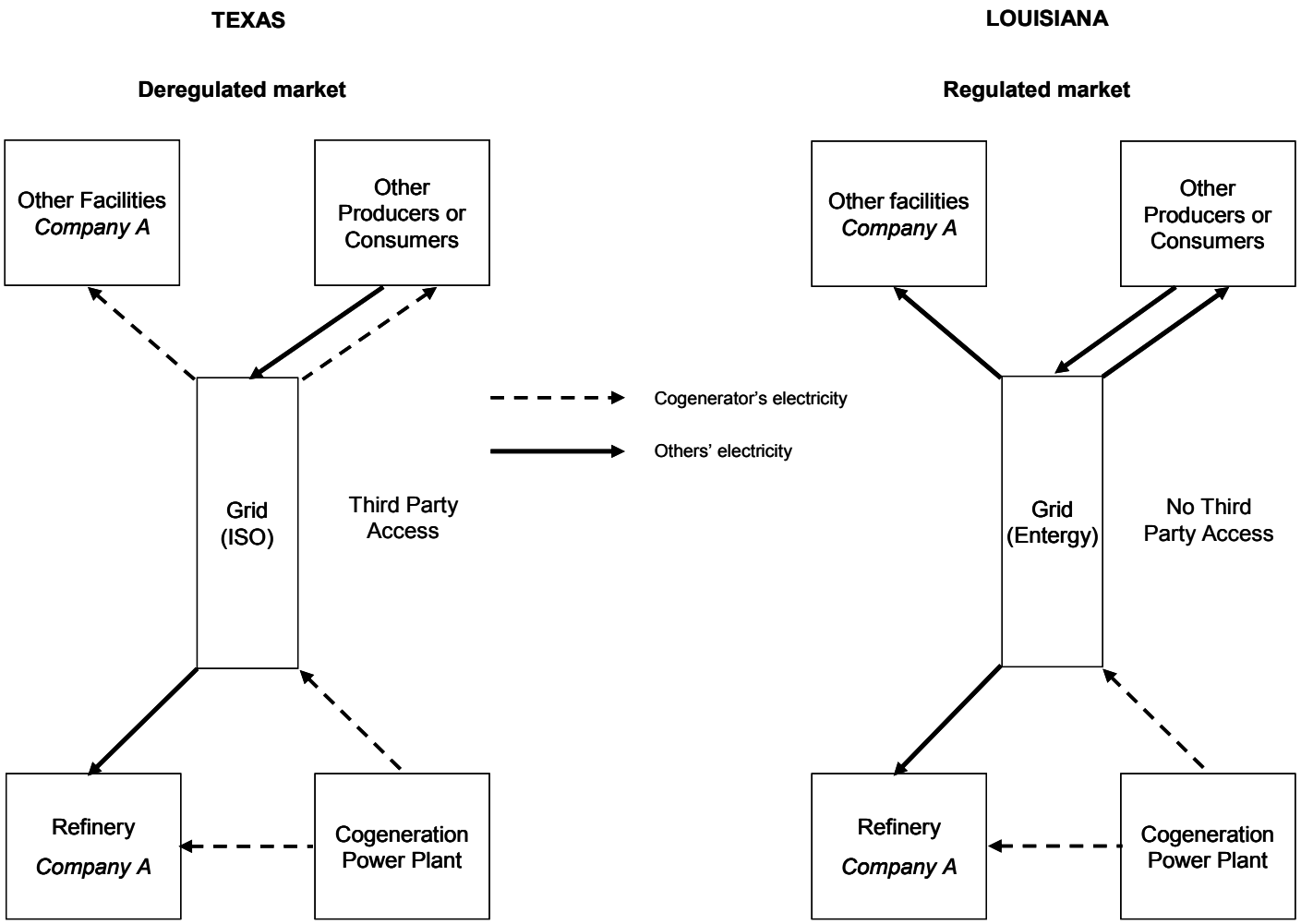
Texas' Regulatory Design



Louisiana's Regulatory Design

- State Legislation regarding competition:
  - No actively pursuing restructuring
  - Two orders in regards of competition
    - Cogeneration and plant construction
    - Monitoring restructuring efforts in other states
- Institutions:
  - FERC
  - LPSC: regulates utilities within state borders; oversees retail services; administers regulated tariffs for local distribution and entities

Study of Cogeneration in Refineries: Physical Transactions



Study of Cogeneration in Refineries: Physical Transactions

- **Objective 1**
  - To examine the extent of installed and excess capacity of cogeneration in Texas and Louisiana refineries.

- **Methodology**
  - Analysis of refineries' data extracted from the EIA website 13 refineries in Texas out of a total of 21, and 6 out of a total of 15 in Louisiana

Cogeneration in Refineries: Texas vs. Louisiana

	Total Refineries		Refineries Identified with Power Generation				
	Number	Processing Capacity1 (TBD)	Number	Processing Capacity (TBD)	Installed Capacity of Power Generation (MW)	Capacity of Cogeneration (MW)	Capacity of Cogeneration/Processing Capacity (MW/TBD)
Texas	21	4,627.60	13	3,275	2,404	2,001	0.6109
Louisiana	15	2,772.70	6	1,330	540	418	0.3142

1) Atmospheric Crude Oil Capacity. TBD: Thousand of Barrels per Calendar Day.

Results:

Capacity of cogeneration per unit of crude oil processed:

Texas: 0.61 MW/TBD

Louisiana: 0.31 MW/TBD

These figures suggest that cogeneration is more used in Texas

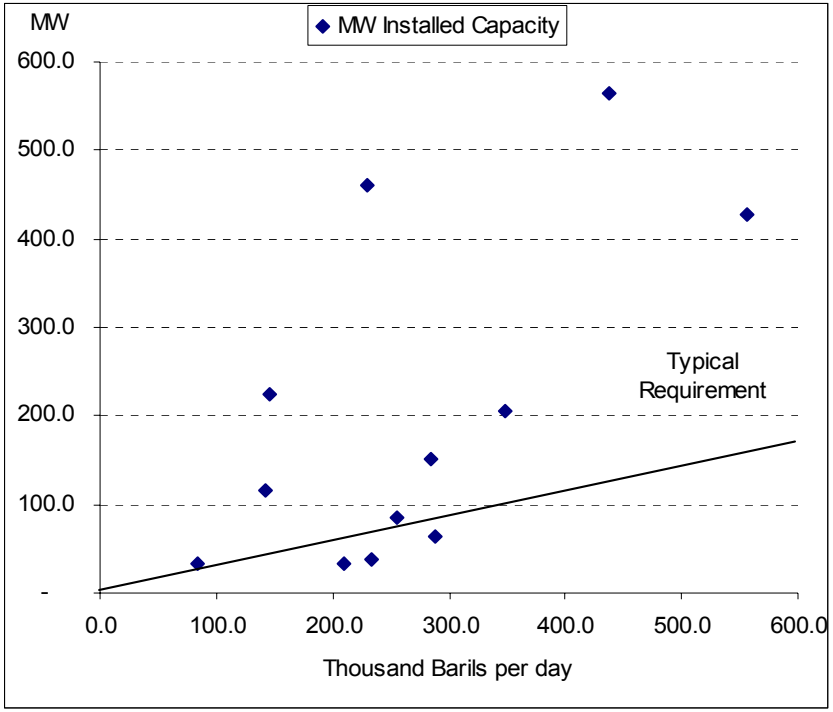
Study of Cogeneration in Refineries: Physical Transactions

- **Objective 2**
  - To compare the level of self-sufficiency that on-site generation plants, cogeneration or otherwise, offer to refineries in Texas and Louisiana.
- **Methodology**
  - Construction of a curve that shows power generation as a function of oil processing capacity for the 13 refineries in Texas[1] and the 6 in Louisiana.
  - Construction of a typical power requirement curve with data registered in 2003 by the six refineries operated by Petróleos Mexicanos (PEMEX) in Mexico. These data were adjusted to a linear function using a regression (r2 of 0.87).

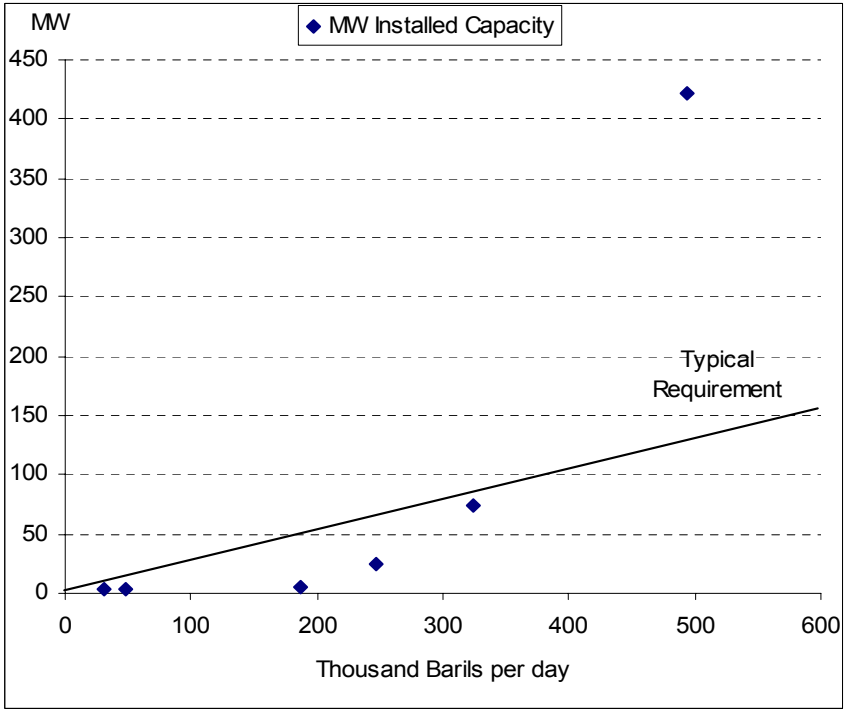
1. The selected refineries in Texas are connected to the ERCOT power grid.

Cogeneration in Refineries: Texas vs. Louisiana

Texas



Louisiana



The comparison of both graphics suggests that refineries in Texas have excess capacity in many cases. Refineries in Louisiana need to buy electricity from the grid to complement their on-site generation

Conclusions

- Deregulation and introduction of competition seems to be fundamental to promote cogeneration since it:
  - Decentralizes power
  - Reduces barriers of entry to new participants
- "Open access" is a key element to ensure competitive generation markets
  - Coordinated by ISO
  - ISO without upstream or downstream affiliation
- Open access was granted in PURPA, and EPAct 1992 moved to deregulation.

Conclusions

- More questions and answers:
  - Finding relevant information for most refineries in Texas and Louisiana
  - Trying to separate impacts of PURPA and EPAct 1992 on cogeneration.
    - Has excess capacity developed mainly in response of PURPA?
    - Can it be linked to evolving competitive market design in Texas?

THANK YOU!