Electric Utilities, Deregulation and Restructuring of U.S. Electricity Markets

http://pnnl-utilityrestructuring.pnl.gov/publications/Primer/primer.pdf

In The Early Days

Initially utilities were not regulated.

Early utilities would often compete for the same customers including building duplicate distribution systems. Naturally, competition was greatest in urban areas. It was cheaper to compete in densely populated areas & wealthy customers more likely to use power.

An Historical Perspective

Historically, the cost of generating power declined as utilities built ever-larger power plants, which increased efficiency and reduced production costs.

Increased electric demand required more & larger plants, which reduced costs further as well as increasing the utility rate base. This era was a win-win for everyone. Consumers had abundant, low-cost power; regulators oversaw declining rates, increased electrification, & economic growth; & utilities & stockholders gained financially.

Utility Functions

The common vision of a utility embodies three functions:

(1) Generation (electricity), or production (gas)

(2) transmission

& (3) distribution

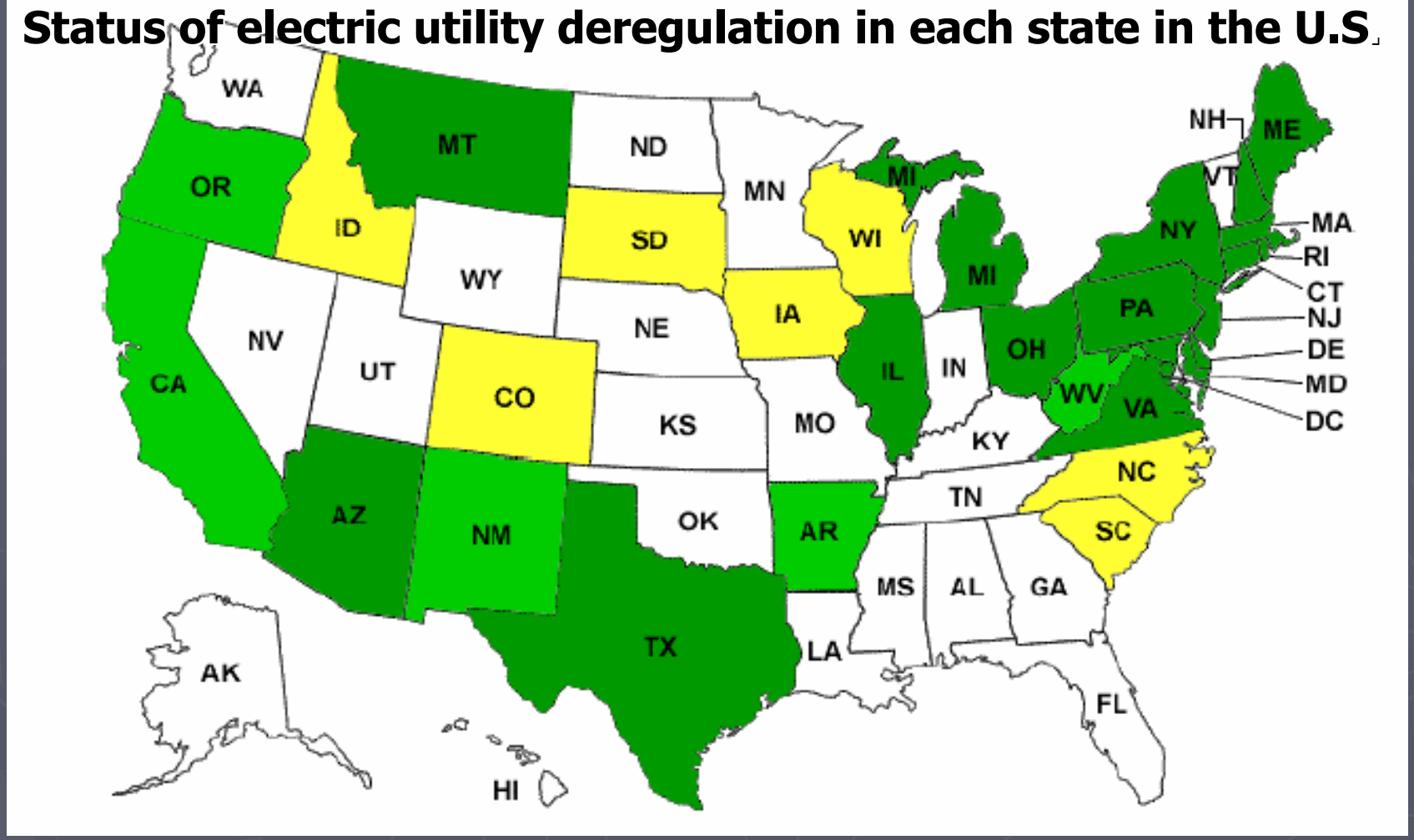
Facts are that only a small fraction of the 3,200 or so electric utilities, in the U.S., perform all three functions & virtually no utility exists in isolation. Major investor owned utilities (IOUs) do own generation, transmission, & distribution.

Very few of the publicly owned utilities (POUs) own their own generation or transmission.

USA Structure Outline:

- Federal
- State
- Utility
- Power Pool

Status of electric utility deregulation in each state in the U.S.



White - Continuing to monitor restructuring investor-owned utilities, IOUs, not pursuing further action now.
Yellow - Completed studies of IOUs (power providers), not pursuing further action at this time.
Green:
Light – enacted legislation to implement investor-owned utility restructuring ~ transition not begun or suspended.
Medium – Transition to restructuring begun, implementing competitive electric utility market IOUs (includes DC)
Dark Green – Functioning competitive electric utility markets for investor-owned providers, allowing all customers choice without stranded cost or other surcharges.

PUHCA -- 1935

Since state regulation was not sufficient to control the action of interstate holding companies headquartered out-of-state, Congress passed the Public Utility Holding Company Act of 1935 (PUHCA).

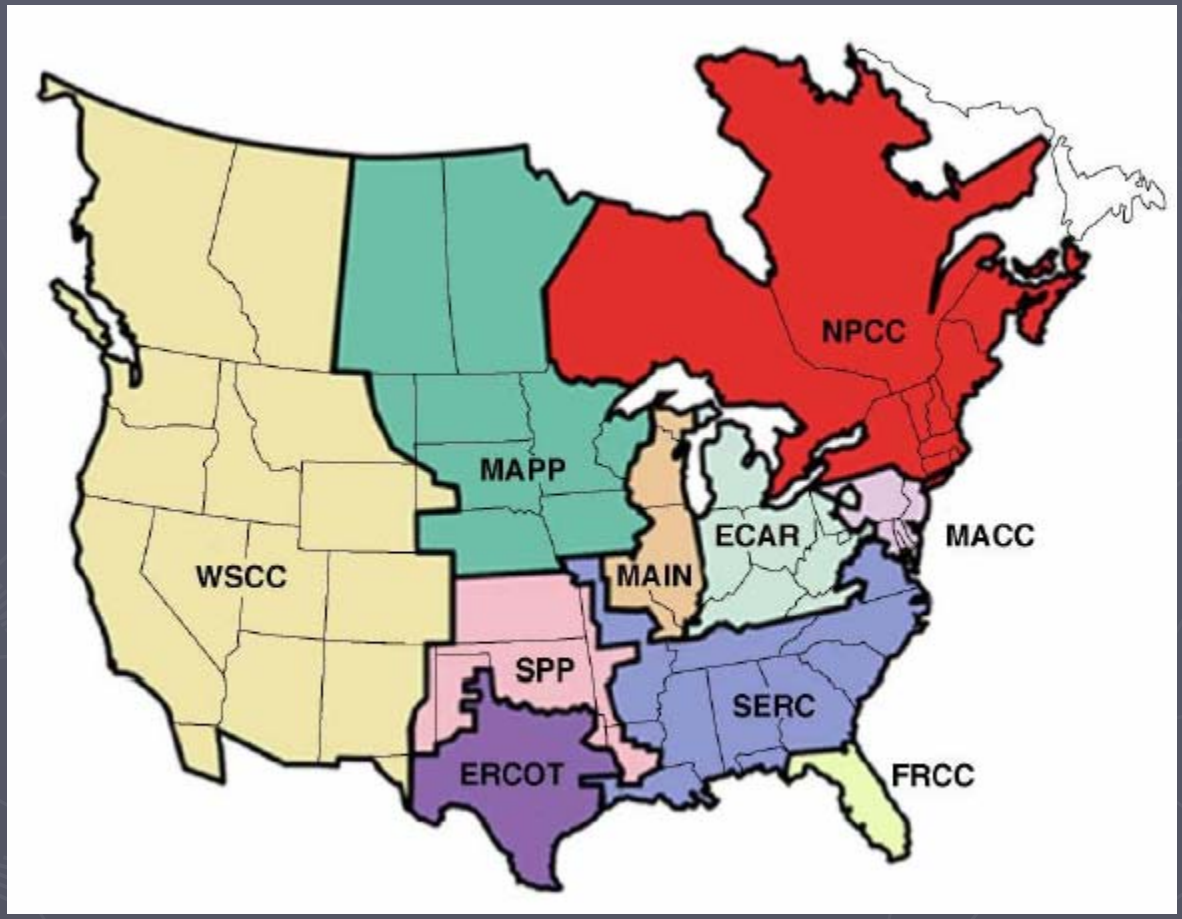
The New York Blackout of 1965 and the Creation of NERC

The New York blackout of 1965 was a wake-up call to the power industry. The industry responded to the blackout by creating a voluntary, utility-managed reliability organization, the North American Electric Reliability Council (NERC).

NERC

NERC divided the nation into ten reliability regions. The largest council is the Western Systems Coordinating Council (WSCC). The smallest is the Mid- Atlantic Coordinating Council (MAAC). Each reliability council promulgates system planning & operating criteria that are intended to ensure that each utility with generation or transmission assets builds & operates them in a way that allows system controllers to preserve bulk power reliability.

NERC



The 10 reliability regions of the North American Electric Reliability Council

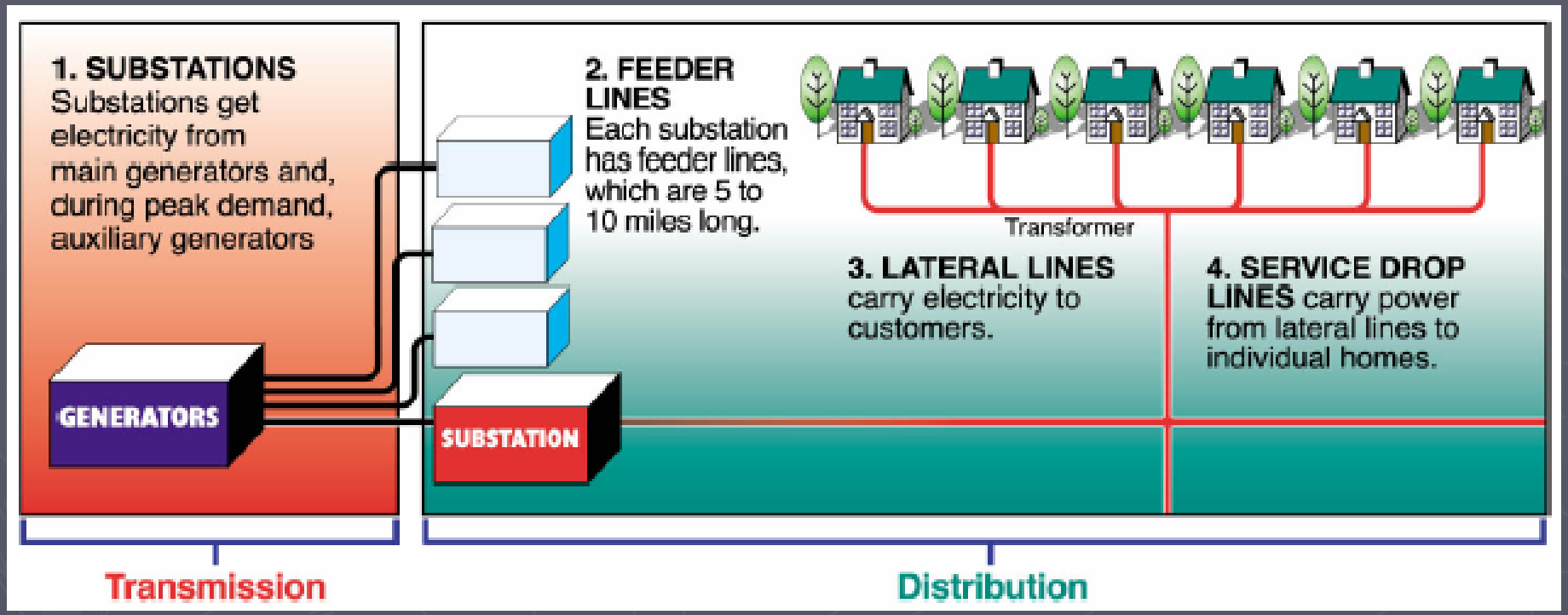
1970's Oil Embargo

The Oil Embargo of the 1970s changed things in a hurry. Rapid increases in the cost of fuel to operate power plants translated into equally large jumps in retail power prices. Continued increases in oil prices & unstable fuel supplies led electric utilities to construct new power plants that relied on domestic coal and uranium. These plants cost much more to build than simple oil or natural gas-fired generators. Consequently, the fixed costs of utility operations increased, further increasing retail electricity prices. The natural consequence was consumer complaints & increased regulatory oversight.

PURPA -1978

Federal Public Utility Regulatory Policies Act of 1978, Section 210, (PURPA). This legislation created a new legal category of power plants known as qualifying facilities, QFs, & new market entrants called independent power producers, IPPs. Contracts for power from QFs typically covered the life of the plant, because the only outlet for power from a QF was the local utility. Subsequently, utilities asked Congress and state PUCs to reform the power purchase requirements of PURPA. Although Congressional action is still pending, PURPA did create a new category of power producers.

Transmission and Distribution



The transmission grid moves wholesale power from generators to distributors. The distribution system moves retail power from distributors to customers. Transmission will continue to be regulated at the federal level by FERC. Distribution will continue to be regulated at the state level by state commissions.

IRP

By the early 1980s, the situation appeared to be out of control, with most utilities requesting routine, often significant, rate increases and several utilities on the verge of bankruptcy. As a result, regulators began to take a much more active role in utility planning. One response was for regulators to require utilities to evaluate conservation and other alternatives rather than automatically building new plants. This process, called *integrated resource planning (IRP),* was successful in keeping retail rates in check, although rates were still thought to be too high.

Why Regulation?

Regulation of utilities is based on the inherent risk that a single monopoly supplier will overcharge consumers due to the lack of competition and high demand.

In the United States, state PUCs regulate retail electricity prices while FERC regulates wholesale prices.

Cost Based Regulation

The historic standard for wholesale power exchanges has been that the price of electricity be cost-based, not market-based & that savings associated with the exchange be shared. In other words, the extra income the seller reaps and the reduced costs the buyer receives are shared between the two utilities & passed on to consumers in lower rates. The cost-based regulatory approach was adopted by FERC to stimulate so-called economy exchanges & to protect buyers (small utilities) from the inherent advantage the sellers (large neighboring utilities) had in the transaction.

Electric Industry Restructuring in the 1990's

By the early 1990s it was becoming apparent that electric industry regulatory approaches were not working. IRP was successful in holding rate increases in check & stimulating consumer choice, but the process was highly adversarial, time consuming, & expensive. Rates were still high & significant differences among adjacent electric utilities & between gas & electric utilities caused problems.

Introduction to Restructuring

Until recently the local utility set a price, called a rate or tariff. Next, it metered the energy used & sent the customer a bill based on the rate. Finally, the customer pays the bill.

Facility managers can participate in the regulatory process through which rates are set, but individual consumers have little influence over final prices. Now, however, this structure is undergoing a profound change. State legislators & utility regulators are now letting consumers choose among a variety of new energy suppliers on the basis of competitive prices & products.

This trend is called **deregulation, or restructuring**.

A Utility Defined

What is a utility? Typically, a utility provides a commodity or service that is considered vital to the general public such as power, water, or natural gas. Utility service is a vital need.

It is deemed by state & federal lawmakers to be in the public interest to regulate its provision. To prevent price gouging & encourage widespread access, the government has granted individual utilities certain monopoly rights, accompanied by the right to regulate price as well as service terms & conditions.

IOUs & PUCs

Utilities are defined differently by each state & in federal legislation. Generally, there are two types of utilities, private and public.

Private investor owned utilities, IOUs, issue stocks, sell bonds, & are regulated at the state level by regulatory commissions. Regulatory commissions have a variety of names although the names Public Utilities Commission (PUC) & Public Service Commission (PSC) are the most common. These commissions, or PUCs, set the retail rates charged by IOUs for their services. Commissions also ensure that IOUs respond to customer service requests & are properly maintaining utility infrastructure.

POU's

Publicly owned utilities, POUs, are member-owned cooperatives or government or municipally owned utilities.

Publicly owned utilities are generally exempt from regulation by state regulatory commissions because they are assumed to have the customers' (who are also the owners or voters) best interests in mind when setting rates & service standards. A few states do subject publicly owned utilities to regulatory oversight.

There are approximately **3,200 utilities** operating in the United States, roughly **200 of them are IOUs**. The IOUs provide power to almost **70 percent of all consumers.**

PMAs

The federal power marketing agencies, PMAs, include the semi-autonomous Tennessee Valley Authority, TVA, & the four DOE power marketing administrations:

- Western Area Power Administration,
- Bonneville Power Administration
- Southeastern Administration
- Southwestern Power Administrations.

Federal PMAs generally restrict their sales to wholesale customers, typically publicly owned utilities. They have the authority to sell to federal & state agencies & a few very large industrial customers. Some states also have power marketing agencies.

Examples: New York Power Authority, the Lower Colorado River Authority, TX, the Platte River Power Authority, CO, & the Salt River Project, AZ.

Regulated Utility Features

- Own most of generation needed to meet the needs of customers in a dedicated service territory.
- The local utility may import power to meet demand some months and export surplus power to adjacent utilities during others.
- Neighboring utilities may use the local utility's transmission lines to wheel power to other utilities. Obligation to serve customers all the power they require.
- Inter-utility sales of surplus power may result in an active and competitive wholesale power market.

Transmission & Distribution

The distinction between transmission & distribution for a utility is not so obvious.

The industry has tried to draw a so-called bright line between the two. Such a line is needed to clarify FERC and State jurisdiction over power line regulations & rates. In general, transmission lines are high-voltage lines, those with kilovolt-ampere (kVa) ratings of 750, 500, 230, & 115. Distribution lines have lower voltage ratings, such as 69, 34, & 13 kVa. Many in the industry refer to ratings of 115 kVa & above as transmission.

Major Generator Designs

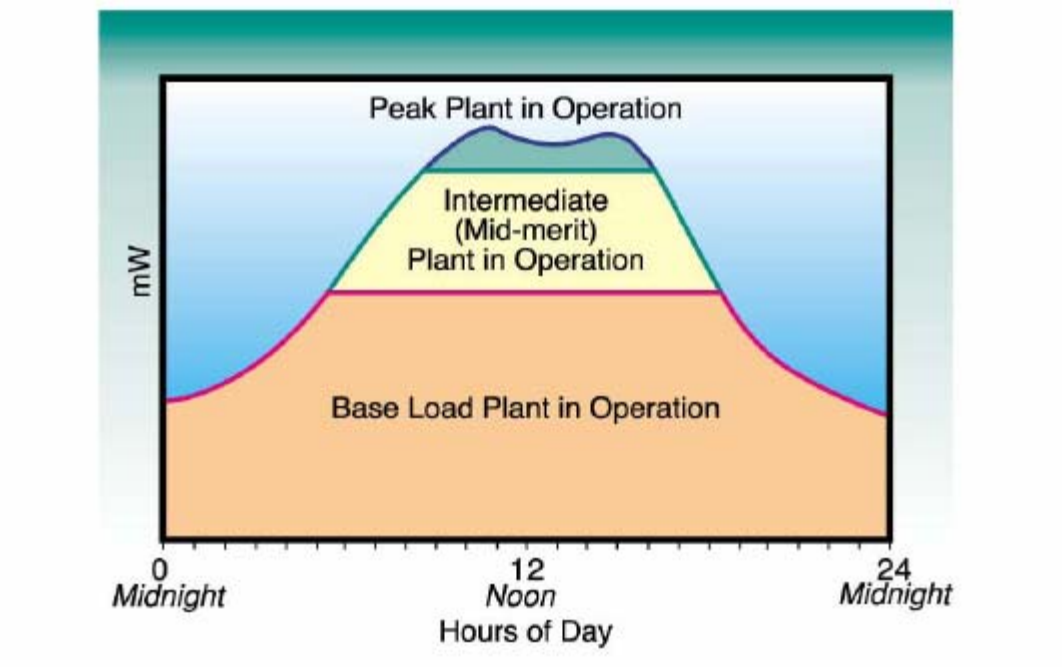
There are four major power plant designs based on the primary source of energy. These are water turbines, reciprocating engines, steam turbines, and gas turbines.

1. Hydropower plants
2. Gen-sets
3. Steam Turbine
4. Combustion Turbine & Combined-Cycle CT

Plant Efficiency

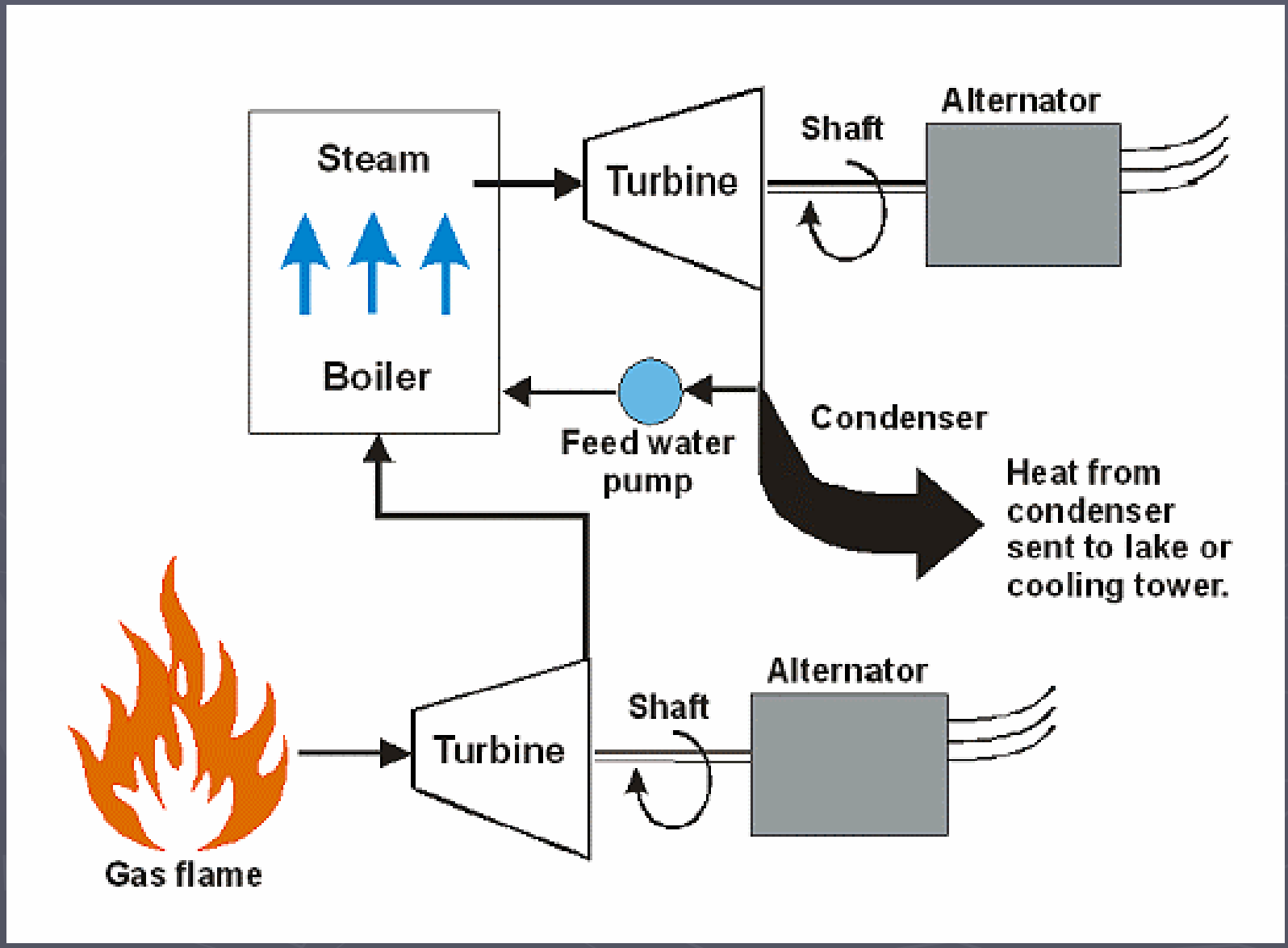
- Older plants are less fuel efficient than newer ones. The efficiency of a plant is reflected in a metric called the heat rate, which is expressed in terms of BTUs per kilowatt hour (kWh) of power (e.g., 9,500 BTUs/kWh).
- One kWh of power produces 3,412 BTUs of energy, so a plant with a heat rate of 3,412 would be perfectly efficient.
- Improved heat rates are the focus of intense research sponsored by U.S. Department of Energy, DOE, & industry.

Plant Selection & Dispatch



Some power plants operate around the clock. These plants are called base load plants. Utilities typically choose coal-fired, hydro, or nuclear plants for this continuous base-load operation because their fuel costs are low, and their relatively high capital costs are spread over a large number of hours and years. To meet demand during peak daylight hours, utilities are likely to run oil and gas-fired plants, referred to as peaking plants, which are more expensive to operate, can be started and stopped quickly, and their capital costs are relatively low. In between are intermediate or mid-merit plants, which are typically combined-cycle combustion turbine plants.

Combined-Cycle Combustion Turbine Plant



Plant Construction & Operating Costs

Generating plants vary in construction cost & complexity. The fuel for generators also varies in price.

Generally, fuels with low heat content, like coal or wood waste, are inexpensive & those with high heat content, like gas, oil, & uranium, are expensive. As a result, the selection of generating plant designs requires trade-offs between construction costs & operating costs, primarily fuel. An approximate rule of thumb is that coal, which fuels 55% of U.S. electricity, is about a third as expensive as gas, per Btu.

Construction Costs of Various Generating Plants in the U.S.A.

Plant Type:	Typical Plant Size:	Typical New Plant Cost/kW	Efficiency Range
Reciprocating engine	2.5 kW up to 10 MW+	$350	30-40%
Combustion Turbines	90 – 500 MW	$300-400	30-35%
Combined-Cycle Combustion Turbines	250-1,500 MW	$600-650	50-65%
Coal plant	1,000 MW	$1,200	30%
Nuclear plant*	300-1,500 MW	$2,000	na

*These figures are based on estimates as no new nuclear plants have been ordered in the United States since 1978.

Utility Planning and Generating Reserve Margins

Customer demand growth is uneven and somewhat unpredictable but utilities are required to provide for all customer demands. The amount of reserves is set through industry standards, & are reviewed & approved by regulators.

Typical reserve margins are in the 15% to 20% range, usually based upon the need to have power available if two of the utilities' largest plants are out of service at the same time during peak demand.

Reliability

Reliability is actually composed of two elements:

- Generation & transmission capacity adequacy
- Reliability of transmission & distribution

In other words, is there enough power & transmission capacity & can it be used to get power to all customers when they need it?

Reserves

Two different types of reserves are required for system reliability.

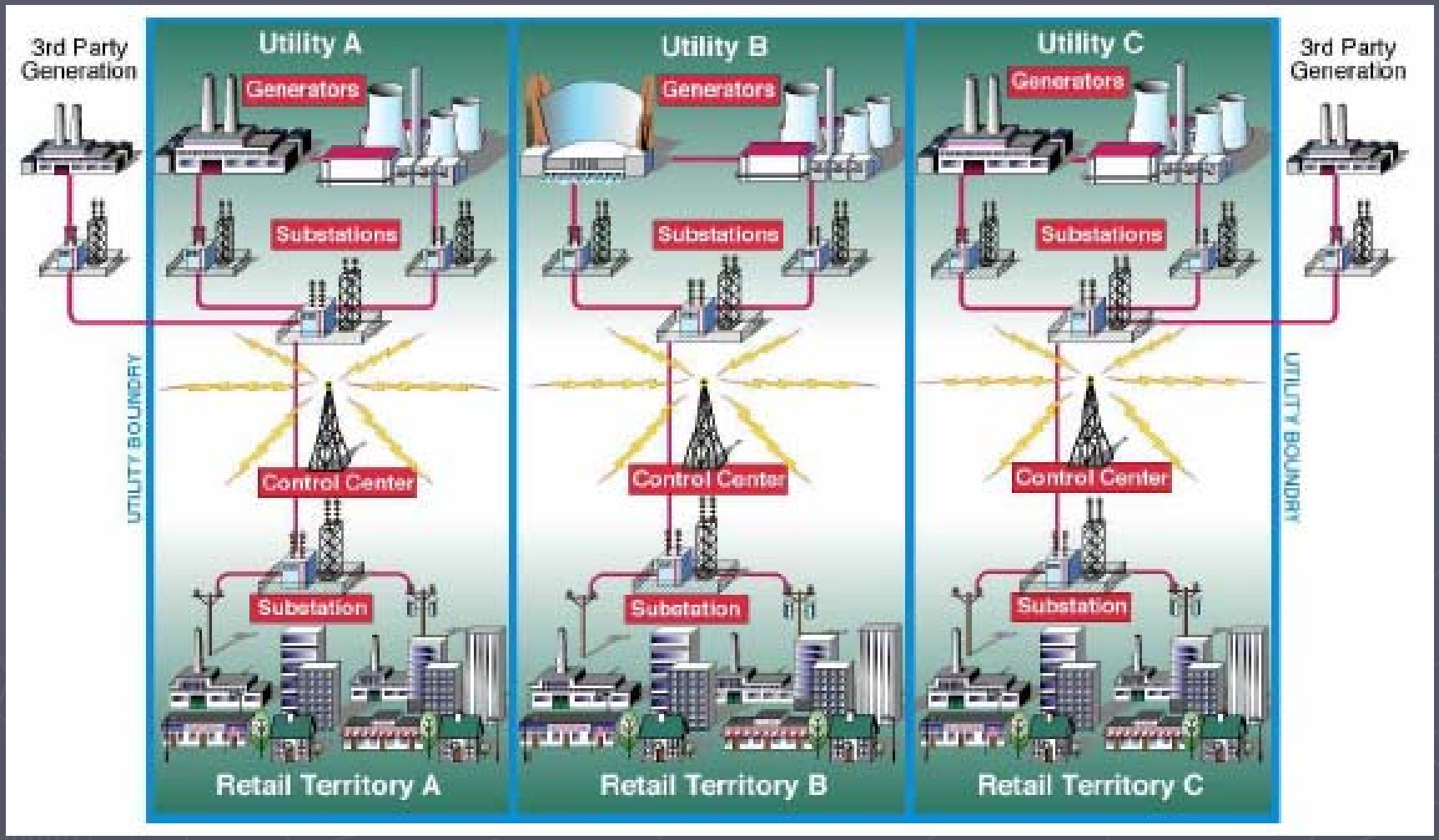
- Non-spinning reserve, or installed capacity reserve (ICAP). This is usually supplied by power plants that are available for operation, but sitting idle.
- Spinning reserve or operating capacity reserve (OCAP). Spinning reserves are provided by power plants that are actually operating.

Control Centers

Wheeling power requires the use of transmission lines that are owned by multiple utilities. This use needs to be managed so that power can be tracked as it flows from utility to utility. Utilities manage the operation of generation, transmission, & transmission maintenance from facilities called control centers. Power that is wheeled through a system is coordinated between adjacent control centers.

Although there are over 3,000 retail utilities, there are only **140 control centers in North America**.

Structure of the Traditional Utility



Examples of U.S. Power Pools

Operation of pooled generation requires **cooperative operation** of transmission in the pool. Tight power pools have some form of centralized transmission dispatch. Usually, there is a control center for the pool as a whole that issues dispatch instructions to the control centers of the larger utilities in the pool.

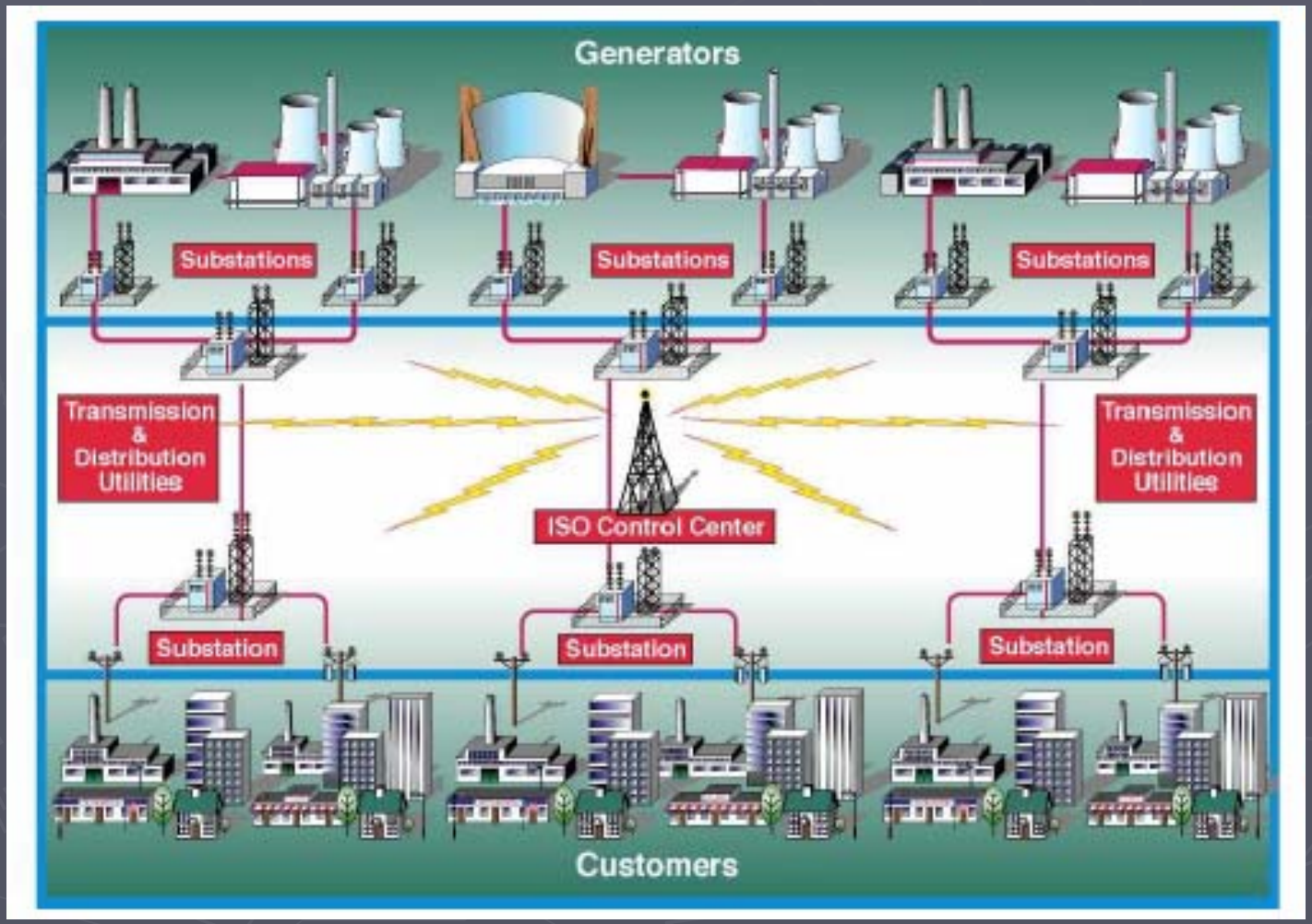
Examples of tight pools include the **New England Power Pool (NE Pool),** the **New York Power Pool (NY Pool),** & the **Pennsylvania, New Jersey, & Maryland Pool (PJM).** PJM is the oldest U.S. power pool having been founded in the 1920s.

Unbundling & ISOs

In the traditional system, although the utility may purchase power from neighboring utilities, it is primarily responsible for its own generation, transmission, & distribution of power to all of the retail customers in its service territory.

In the deregulated supply system, generation & distribution are unbundled & customers are no longer captive but are free to purchase from any suppliers on the grid. Purchasing of power is done via market mechanisms like the power exchange and transmission scheduling is conducted by the **Independent System Operator (ISO).**

Structure of the Deregulated Electric Supply System



Functions after Industry Restructuring

Conventional utility operations, prior to restructuring, consisted of generation, transmission, distribution, & service to captive customers. Deregulation can be rather narrowly defined as the **substitution of market forces for regulated generation rates**.

In order to create an appropriate environment for consumers to participate in the generation marketplace, new rules & standards of conduct are needed to ensure truly competitive markets result. This process has launched a series of changes in utility management & institutions - revolutionary.

Power Pools, Exchanges, & Wholesale Markets

In a deregulated environment, the power pools that had existed are replaced by power exchanges (sometimes still called pools) for the wholesale marketing of power only. Tight power pools integrated the operation of wholesale markets & transmission operations.

New power markets require new rules & new methods for conducting transactions. Power trading has to be isolated from transmission operations to prevent collusion between the two or insider trading based on non-public information about plant or transmission line outages.

Power Pool Pricing

A utility has generating resources that cost 3 cents/kWh & its neighbor has resources that produce power for 1 cent/kWh. It would be advantageous for the first utility to buy power from its neighbor rather than operate its own plants. Implementing this scheme creates two challenges.

(1) How to price the power in the exchange?

(2) How to create and manage an exchange, or market, that ensures cost minimization while maintaining overall system reliability.

Pool Procedures

In order to facilitate economy exchanges & collaborative generation development, utilities formed power pools. Pools have standard procedures for conducting power exchanges among members including arranging for wheeling. As a result, each transaction does not have to be submitted for FERC review.

Power Pools and Regional Power Markets

In addition to providing reliability reserves, adjacent utilities can also provide alternative sources of generation to meet routine loads & partners to jointly build new generation. Through these arrangements, utilities can collaborate to operate their collective portfolio of generation so that operating costs are minimized.

Transparent Pricing

Price deregulation requires open markets & transparent pricing. Transparent prices are prices that can be readily determined by market participants in an open environment.

Exchange markets typically take the form of bid-offer auctions where sellers can bid against each other and market clearing prices are known by all parties, including consumers, buyers, and sellers.

Pool Types

Two types of power pools - **tight and loose**:

A loose power pool is a voluntary association of utilities that negotiates generation sales primarily on a bi-lateral (two-party) basis. **Bi-lateral transactions are private**, thus other participants are unaware of the terms of the exchange, including price & transmission access.

Tight power pools require true pooling of generating & transmission assets. The **cost of each resource in the pool is known** & each is operated on the basis of those costs, with the lowest cost resources being used most.

Pool Concerns ~ Market Power

In order to make all sellers comfortable that an incumbent utility does not have market power, or undue market influence, deregulation rules require local utilities to mitigate potential market power.

Pool Concerns ~ Market Manipulation

Prices in electricity markets can be manipulated through a variety of mechanisms, including restricting power generation, restricting transmission access, & manipulating power exchanges. Restricting power supplies has the effect of increasing prices in the short run, because prices are a function of supply & demand – difficult to detect manipulation.

Independent System Operators

Competitive generation & transmission markets merge in the ISO, despite the fact that the markets themselves operate independently. A central point of control is necessary to ensure system reliability. ISOs became the heart of the new competitive electricity industry & are required by FERC to be broadly representative of all market participants, not just transmission owners.

South Asia Energy Links

- What is there to learn from the experiences of the U.S. & others?
- What structures might be considered?
- What should be South Asia's priorities?
- What umbrella agencies can assist to promote regional co-operation & rules?