

A decorative graphic on the left side of the slide, consisting of a network of thin, light blue lines and small circles, resembling a circuit board or a stylized tree structure, extending from the top to the bottom of the frame.

ONGOING EVOLUTION OF THE US GRID





INNOVATION

1882 - Pearl Street (DC)

1896 - Niagara Falls and Buffalo (AC)

1907 - Commonwealth Edison – First Utility

1914 – Expansion for 43 states (with regulation)

1932 – Grid consolidated into 8 holding companies

1935 – Structure of utilities formalized with PUHCA

1937 – Rural co-ops created

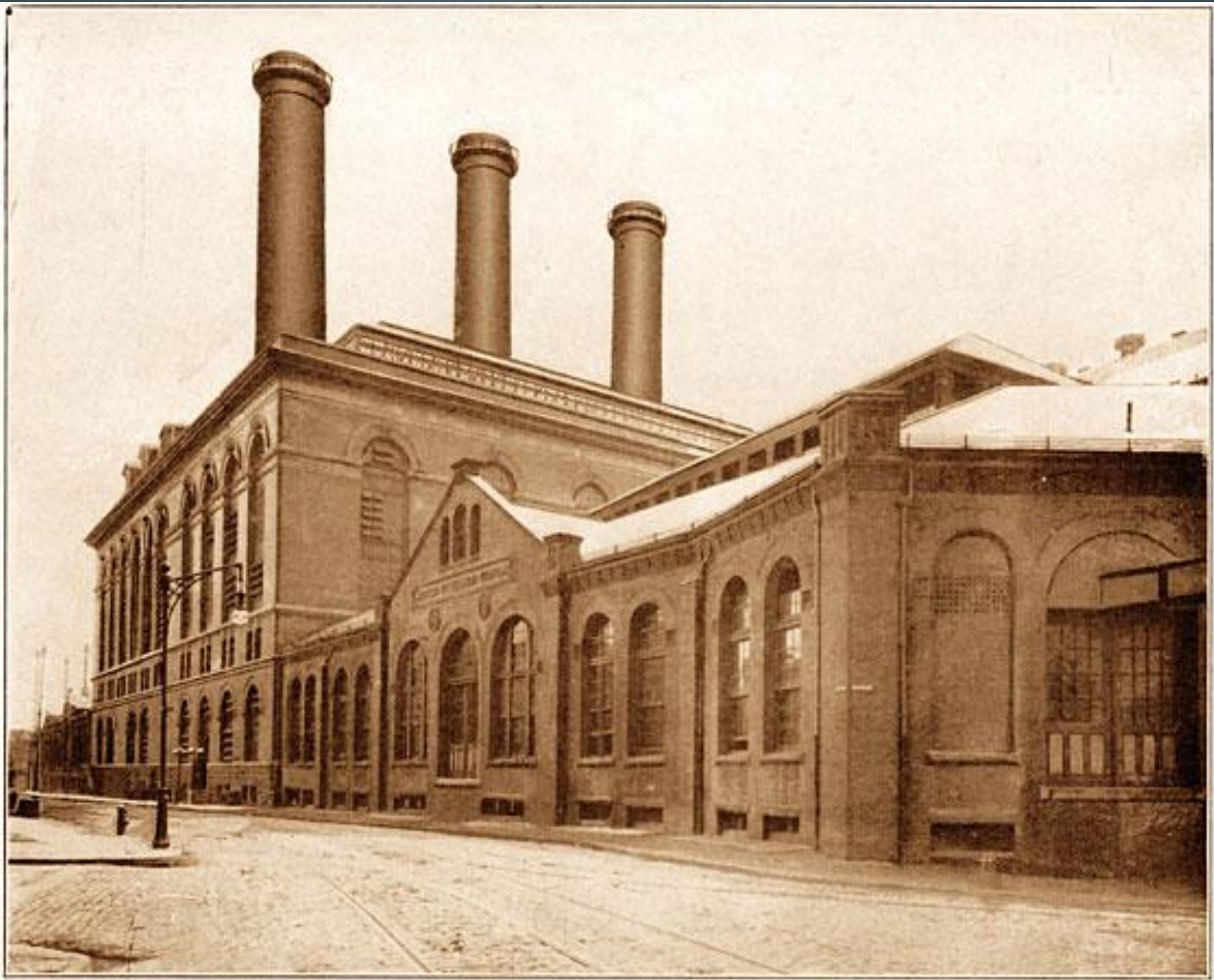


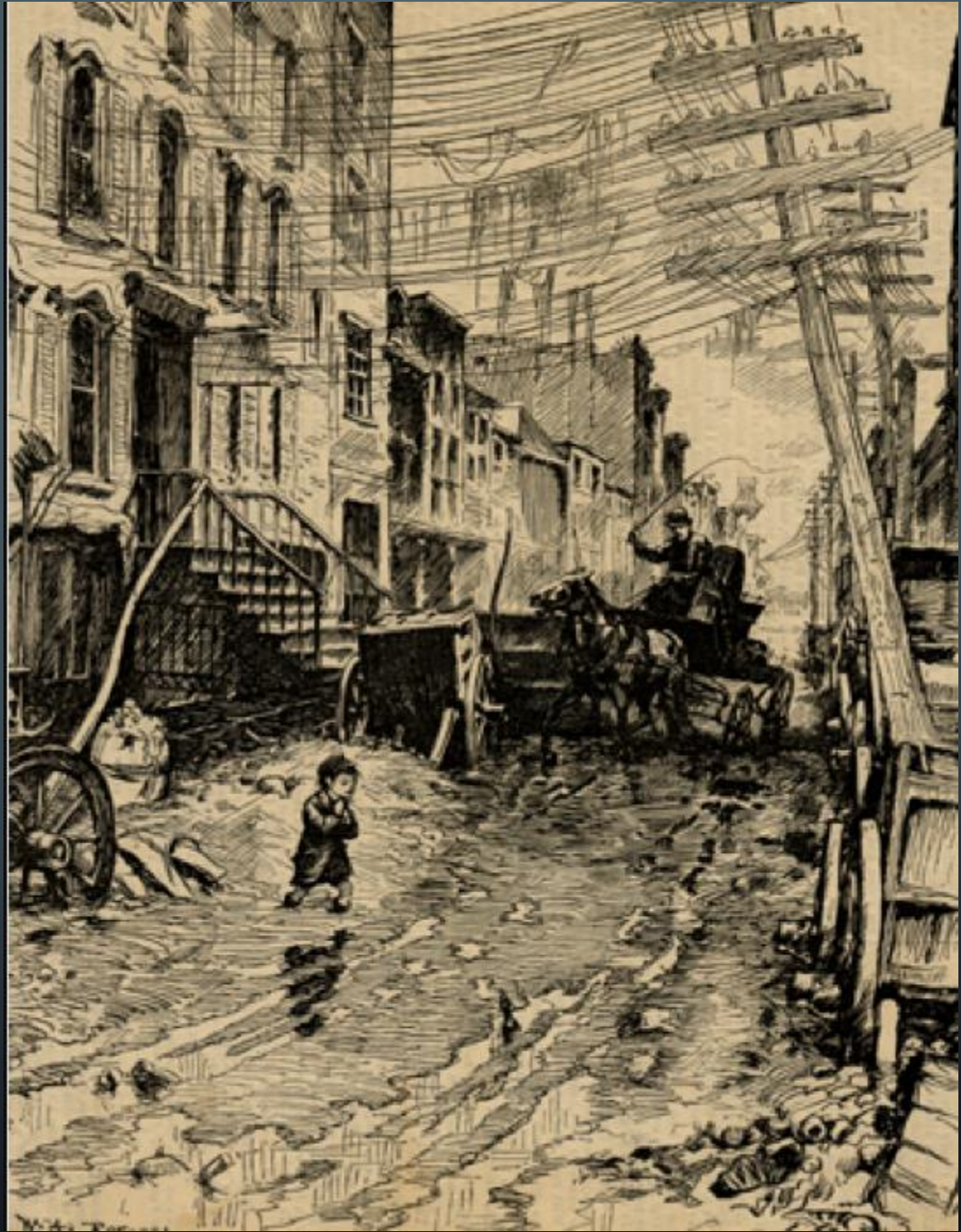
EXPANSION

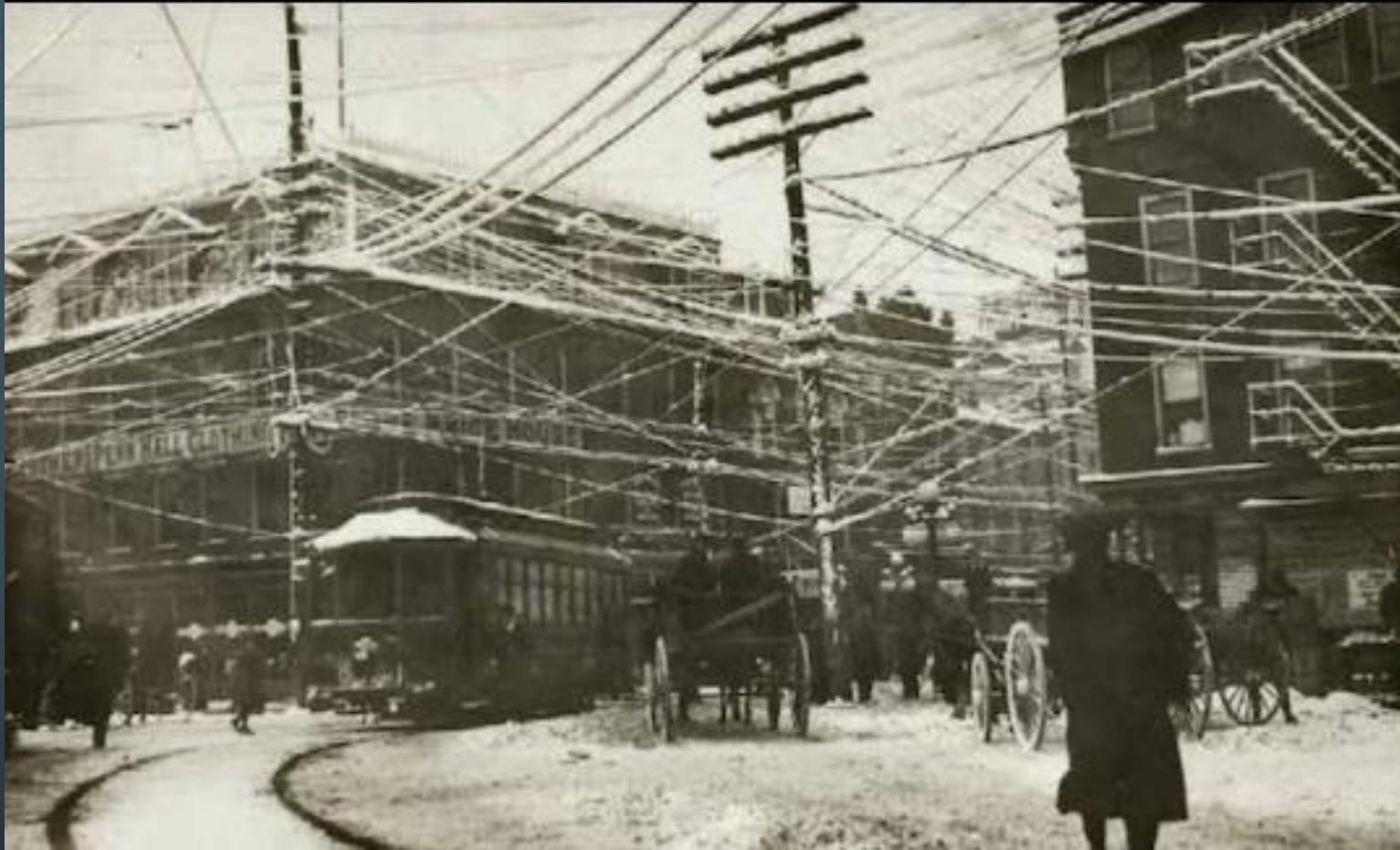
- 1914** - By the end of the year, 43 states have regulatory commissions with oversight of electric utilities.
- 1932** - By the end of the year, eight large holding companies control about three-quarters of the investor-owned utility business. Many of these holding companies cross state lines.
- 1960 - 1969** - Economies of scale make it cheaper to make electricity. The number of miles of high-voltage transmission lines tripled in the decade to 60,000 circuit miles

LEGISLATION

- **1935** - Public Utility Holding Company Act (PUHCA)
- **1978** - The Public Utility Regulatory Policy Act (PURPA)
- **1985** – Advent of the silicon grid
- **1992** - The Energy Policy Act (EPACT)
- **1995 to present** - FERC passes several orders to better enforce EPACT







New York 1887



Buenos Aires 2016



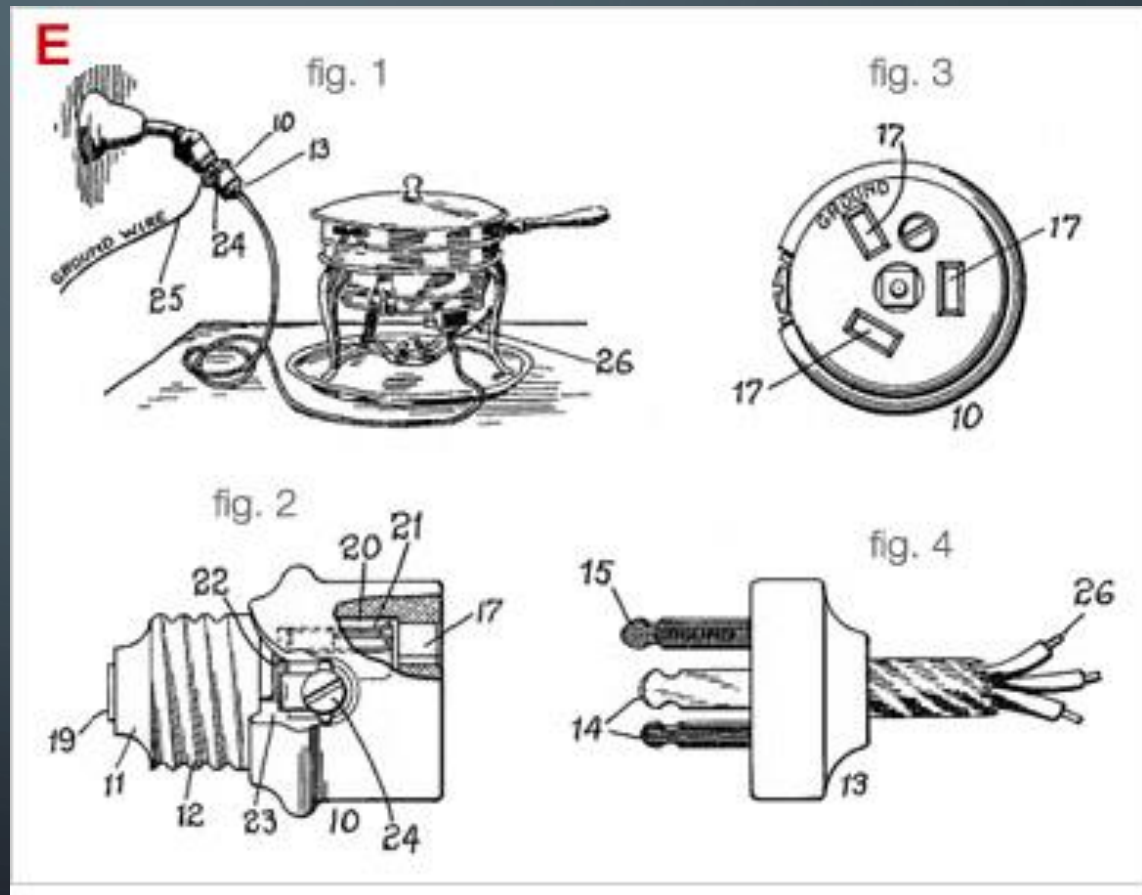
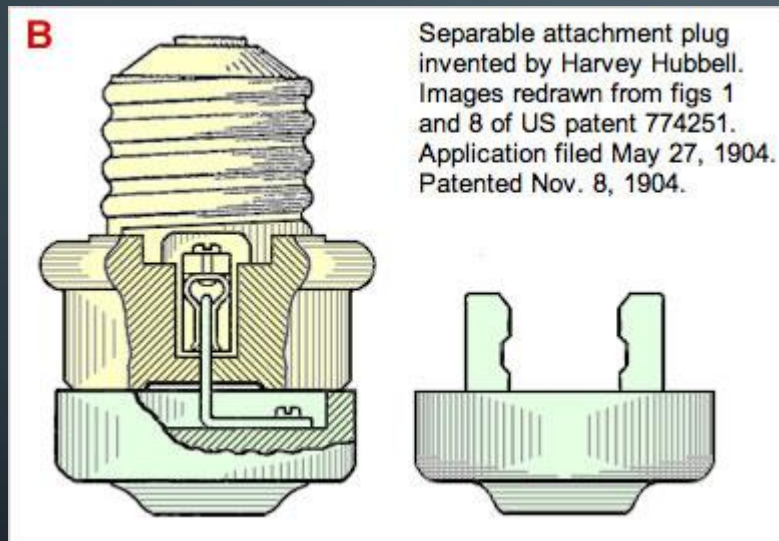
Bangkok 2017



1892 General Electric Plug



PATENT DRAWING OF HUBBLE PLUG



1832 - Hippolyte Pixii (France) built the first dynamo using a commutator, his model created pulses of electricity separated by no current. He also by accident created the first alternator. He did not know what to do with the changing current, he concentrated on trying to eliminate the alternating current to get DC power, this led him to create the commutator.

1830s-1860s - The battery is still the most powerful way to supply electricity for the various experimentation going on in that period. Electricity was still not commercially viable. A battery powered electric train from Washington DC to Baltimore failed, proving a gross embarrassment to the new field of electricity. After millions of dollars wasted steam still proved to be a better power source. Electricity still needed to prove to be reliable and commercially viable.

1860 - Antonio Pacinotti- Created a dynamo that provided continuous DC power

1867 - Werner Von Siemens and Charles Wheatstone create a more powerful, more useful dynamo which used a self powered electromagnet in the stator instead of the weak permanent magnet.

1871 - Zenobe Gramme sparked the commercial revolution of electricity. He filled the magnetic field with an iron core which made a better path for magnetic flux. This increased the power of the dynamo to the point where it was usable for many commercial applications.


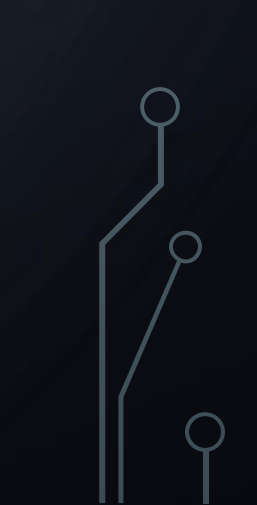
1870s - There was an explosion of new designs in dynamos, designs ranged a wild assortment, only a few stood out as being superior in efficiency.

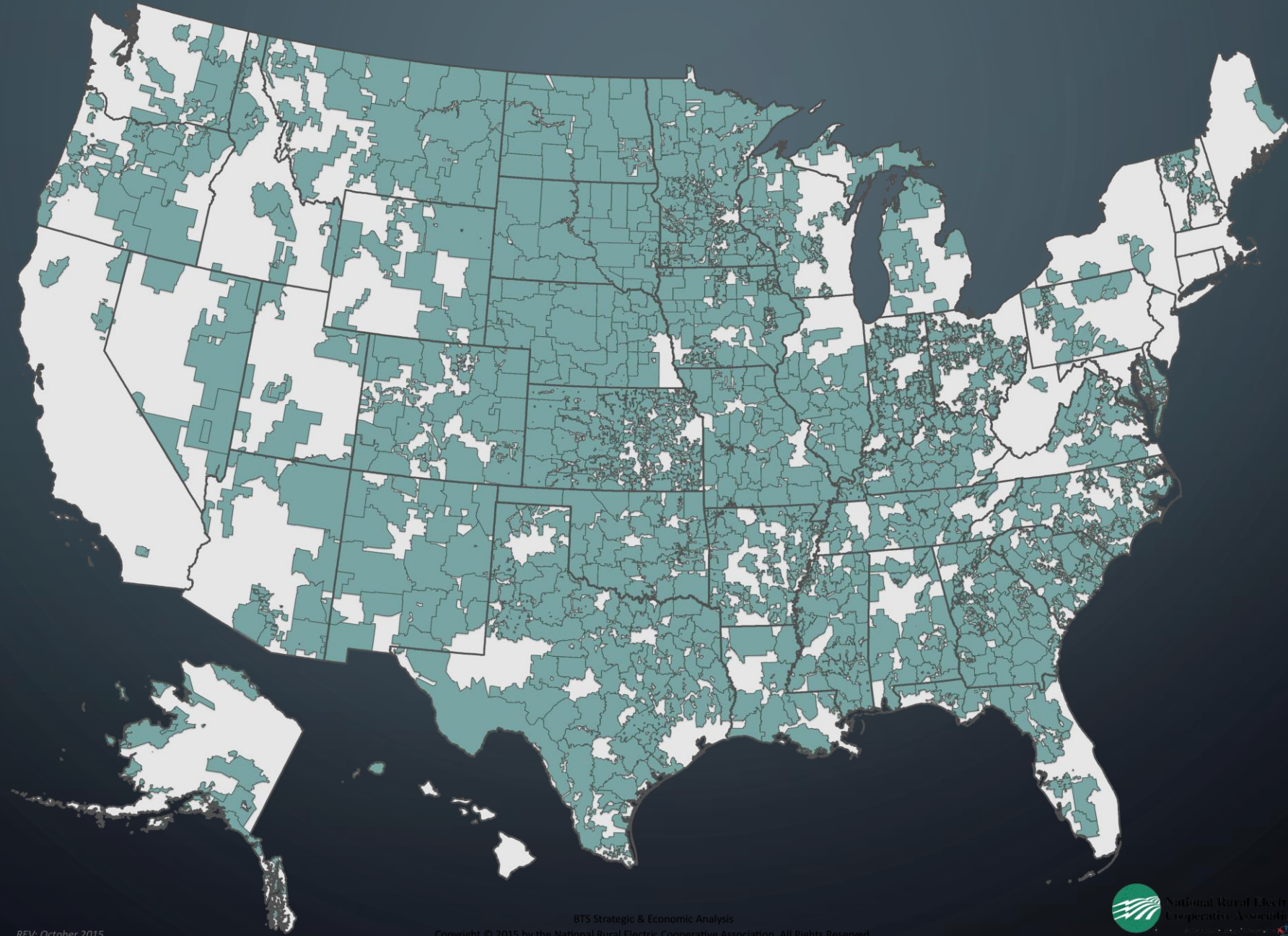
1876 - Charles F. Brush (Ohio) developed the most efficient and reliable dynamo design ever to that point. His inventions was sold through the Telegraph Supply Company.

1877 - The Franklin Institute (Philadelphia) conducts test on dynamos from around the world. Publicity from this event spurs development by others like [Elihu Thomson](#), Lord Kelvin, and [Thomas Edison](#).



“20 YEAR TECHNOLOGIES”

- Fusion
 - Magnetohydrodynamics
 - Storage?
- 
- 

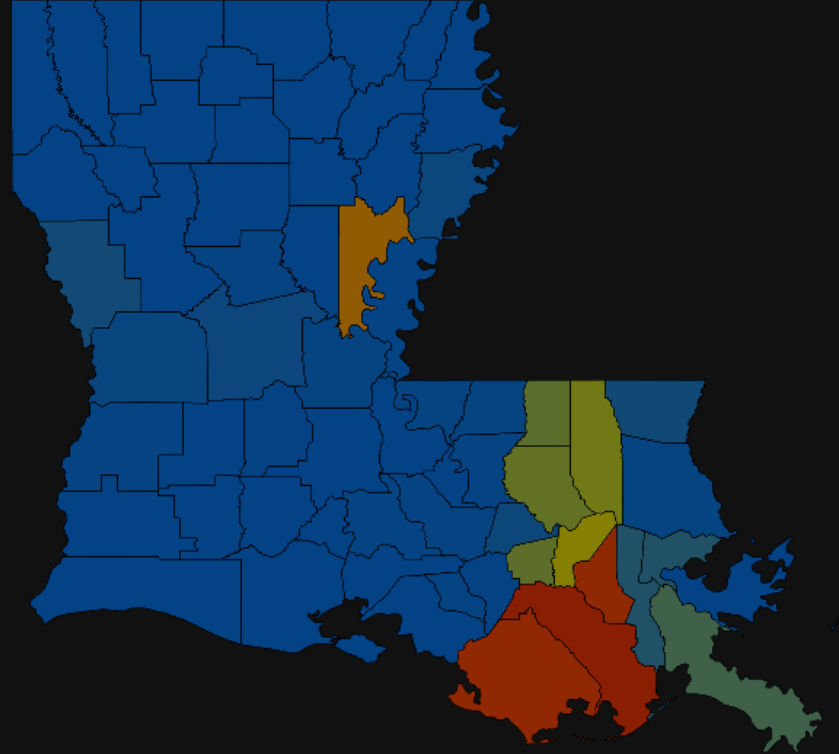


Louisiana

Customers Tracked: 2,202,766

State Outages: 72,153

Last Updated: 9/15/2021, 08:56:08 AM



Outage Scale: 0% 10% 30% 60% 100%

Electric Providers for Louisiana

Provider	Customers Tracked	Customers Out	Last Updated
Beauregard Electric Cooperative	41,527	47	9/15/2021, 08:56:06 AM
Claiborne Electric Cooperative	27,140	0	9/15/2021, 08:56:08 AM
Cleco Power	289,405	789	9/15/2021, 08:56:03 AM
Dixie Electric Membership Corporation	123,023	4,943	9/15/2021, 08:52:57 AM
Entergy	1,282,361	65,882	9/15/2021, 08:51:01 AM
Lafayette Utilities System	65,000	0	9/15/2021, 08:56:08 AM
Southwest Louisiana EMC	92,454	39	9/15/2021, 08:56:07 AM
Southwestern Electric Power Co	229,888	322	9/15/2021, 08:50:29 AM
Washington St. Tammany Electric Cooperative	51,968	131	9/15/2021, 08:56:07 AM



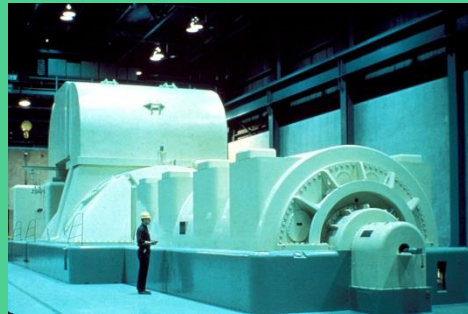




LIVING IN THE INTERESTING TIME

1883→ 1990

Control Through Angular
Momentum



Reliability through
overbuilding

Transition

Lack of overall model
Changing Technology
Complicated Transition

2025?→ ...

Analytically Driven
Control



Knowledge of state
Precise control
High performance analytics

SO HOW WILL THE GRID EVOLVE

- Diluting the dichotomy
- Greater emphasis on resiliency
- Emphasis on Power Quality
- Distributed Generation
- Ownership
- Operational Authority
- Method of Control
- Control Technology

“20 YEAR TECHNOLOGIES”

- Fusion
- Magnetohydrodynamics
- ~~Storage~~
- ~~HVDC~~
- ~~Solid state power electronics~~

THE VULCAN MIND MELD

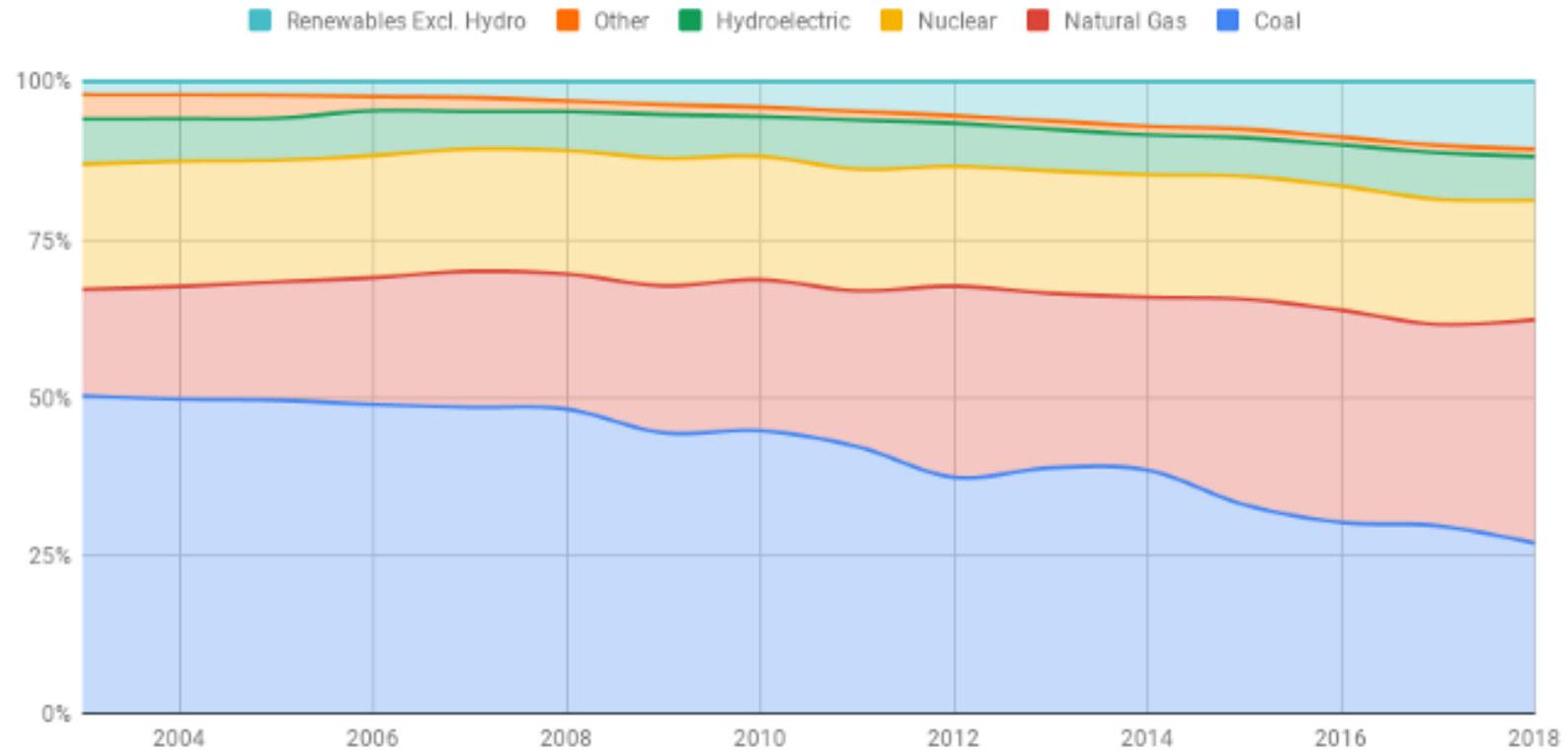


“DOUG’s of a different stripe”



Evolution Of The US Electric Grid

2003-2018



Source: Energy Information Administration

