

Electric Utility Regulation 101

Grace Relf

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Agenda

- Power Sector Fundamentals
 - ▣ Generation, Transmission, Distribution, and End-Use Customers
 - ▣ Prosumer Evolution and Two-Way Power Flows
- Purpose of Regulation
- Market Structures, Electric Utilities, and Regional Grid Operators
- Regulatory Processes
 - ▣ Regulatory Procedures
 - ▣ Types of Proceedings
- Stakeholder Engagement



Poll: How familiar are you with utility regulation?

- I am starting from ground zero.
- I have some idea of what utility regulation involves, but not much.
- I can confidently have a conversation about utility regulation.
- I could teach the class on utility regulation.

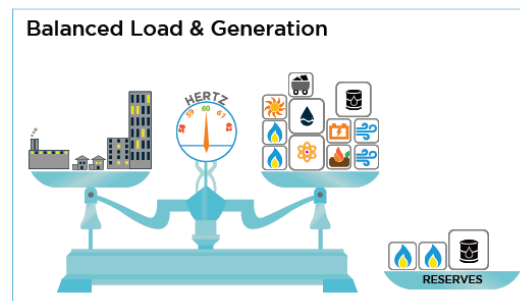


Power Sector Fundamentals



Power Sector Fundamentals: Grid Operations and Services

- The grid must balance supply and demand in real time to maintain the grid's frequency and stability.
 - ▣ Ancillary services help balance the system, including frequency regulation, operating reserves, voltage support, black start (units that can re-start without grid support), and others.
- Resources have different characteristics and provide different grid services.
 - ▣ Resources have different generation or load-modifying profiles (e.g., solar energy is available during the day, wind generation is variable, gas is often used to meet peak demand, energy efficiency and demand flexibility reduce demand at peak and other times).
 - ▣ Some types of resources are able to respond quickly to grid needs (within less than a second), while others need minutes to hours to change output or to start up.
 - ▣ Grid operators are adapting to a changing balancing act as the resource mix shifts.



Sources: [PJM](#), [U.S. Department of Energy \(DOE\)](#), [U.S. Energy Information Administration \(EIA\)](#)

Power Sector Fundamentals: Generation

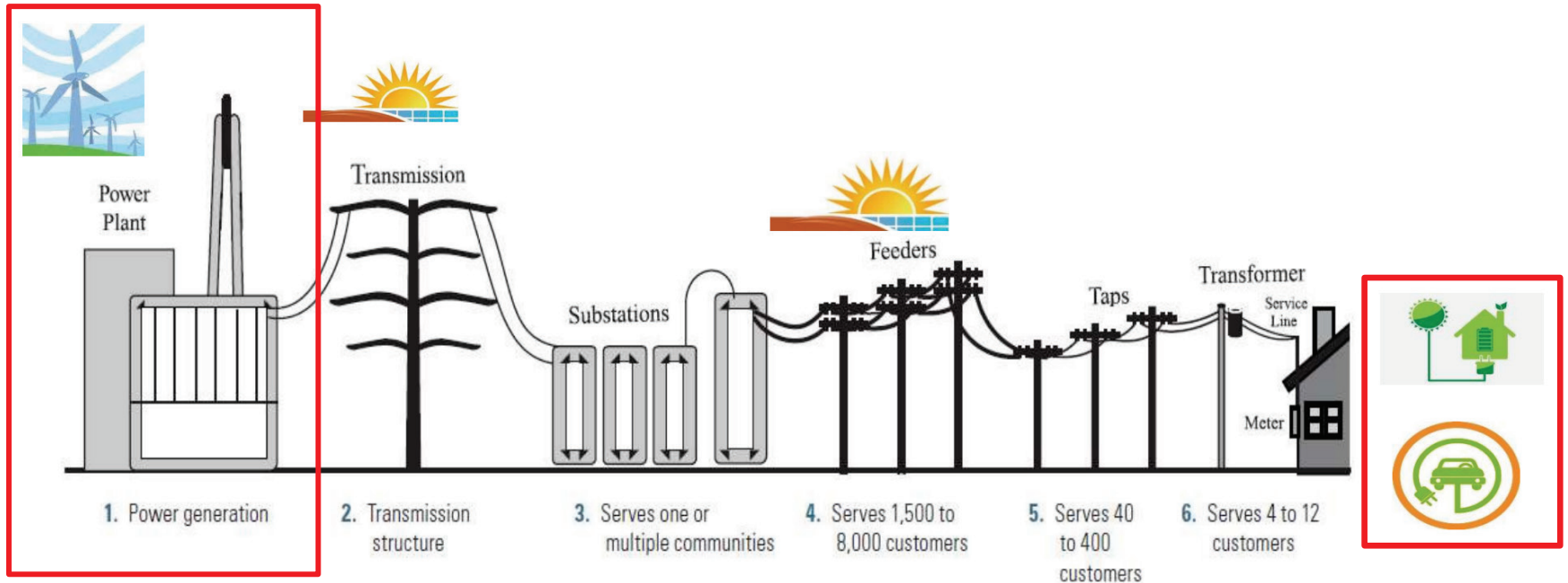
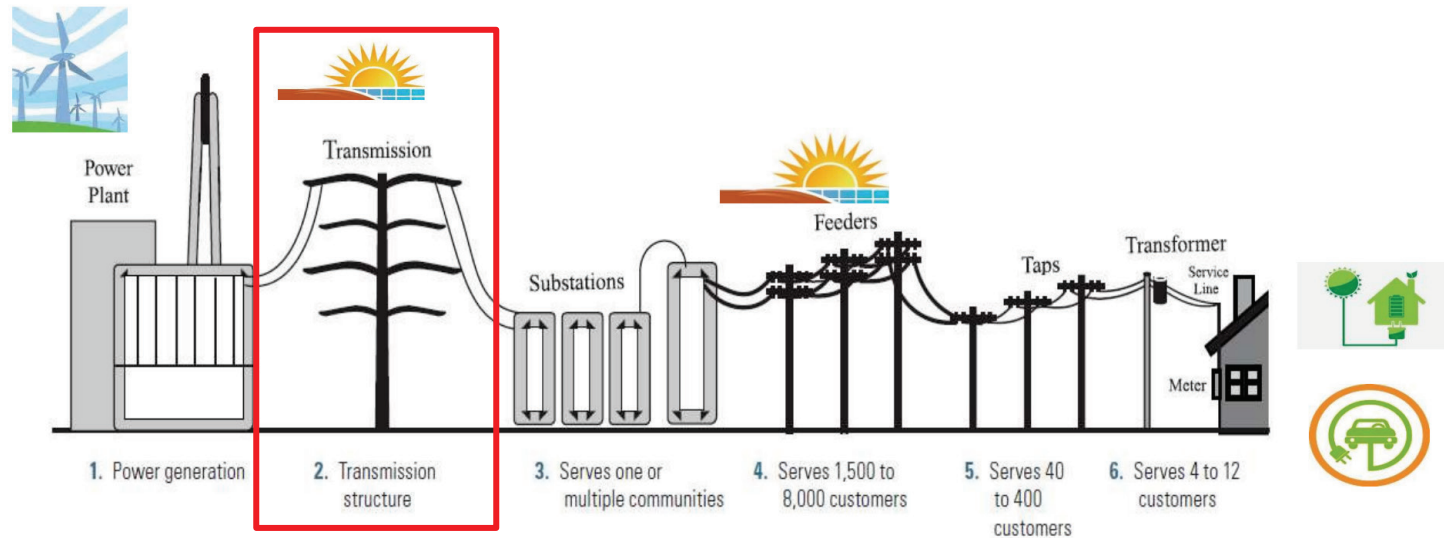


Image Source: [Xcel Minnesota](#)

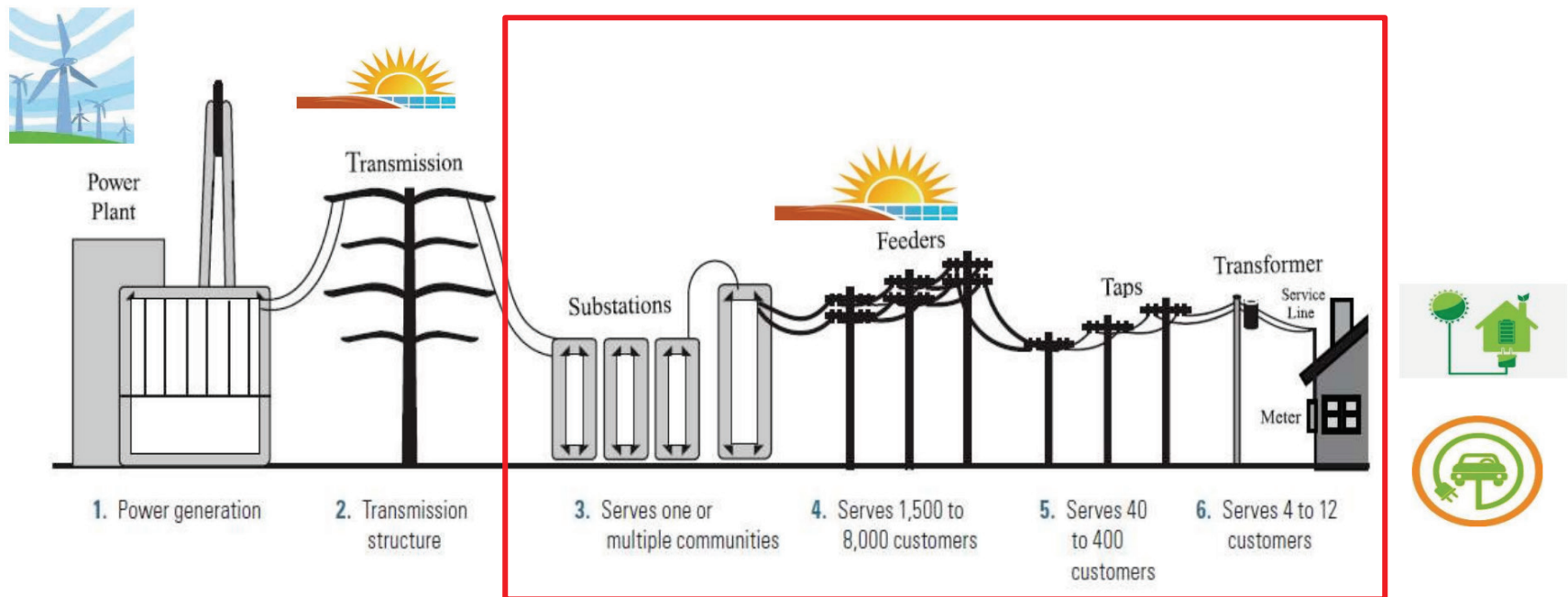
Power Sector Fundamentals: Transmission



- The high-voltage transmission system is important to the clean energy transition.
 - ▣ Transmission transports clean energy from where it is abundant and can be sited to where it is consumed.
 - ▣ Transmission is needed to meet growing electricity demand.
- The Federal Energy Regulatory Commission (FERC), regional transmission organizations (RTOs) and independent system operators (ISOs), and states are working to improve transmission development processes and implement interconnection reform to help generation come online more quickly.

Sources and resources: [Xcel Minnesota](#), U.S. DOE [Transmission Planning Hub](#), [Transmission Interconnection Roadmap](#), [Transmission Interconnection and Queue Report](#)

Power Sector Fundamentals: Distribution

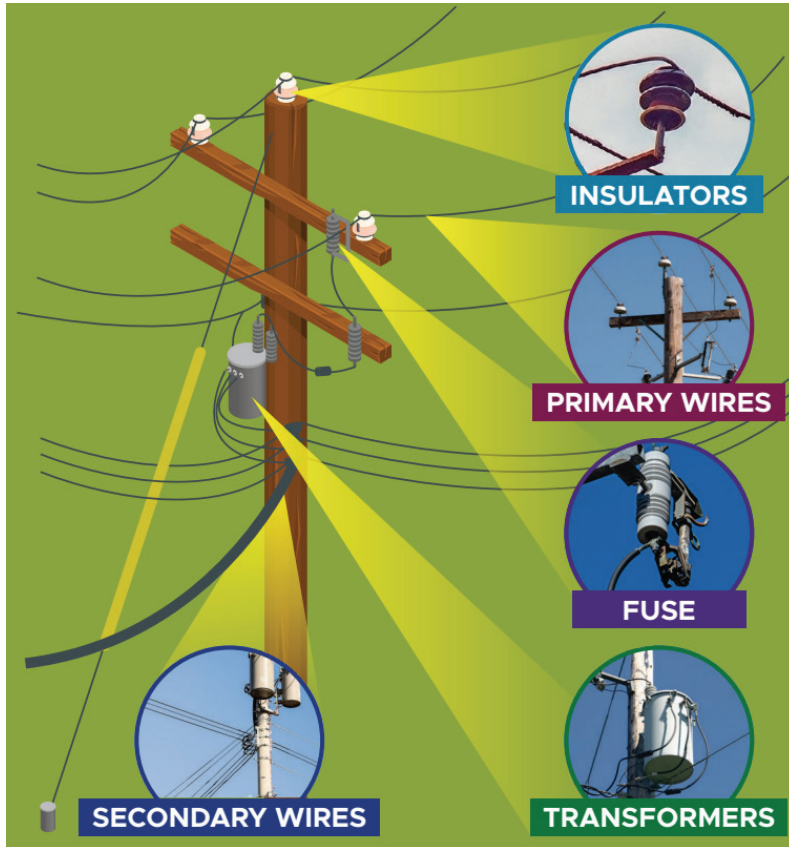


- The distribution system is composed of medium voltage (up to 69 kV) lines, substations, feeders, and related equipment.
 - Equipment transports electricity to and from homes and businesses and links customers to high-voltage transmission system.
 - The distribution system includes physical infrastructure (transformers, wires, switches and other equipment) and cyber components (information, telecommunication and operational technologies needed to support reliable operation).

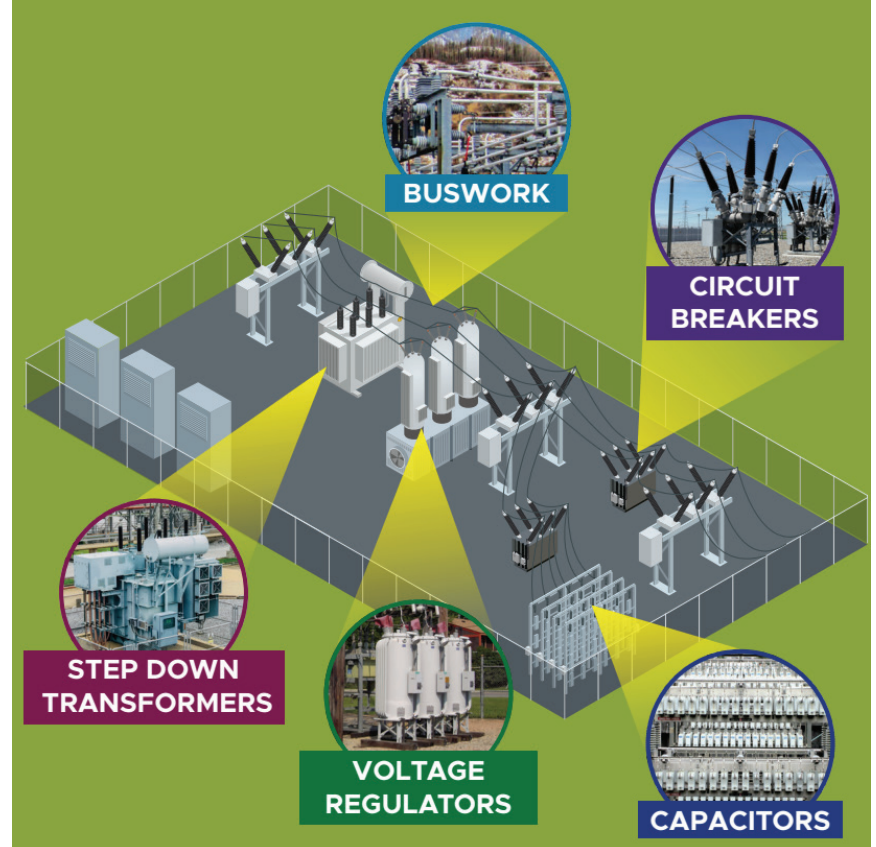
Sources: [Xcel Minnesota](#), [Modern Distribution Grid - Volume III](#)

Power Sector Fundamentals: Distribution

Utility Pole Components



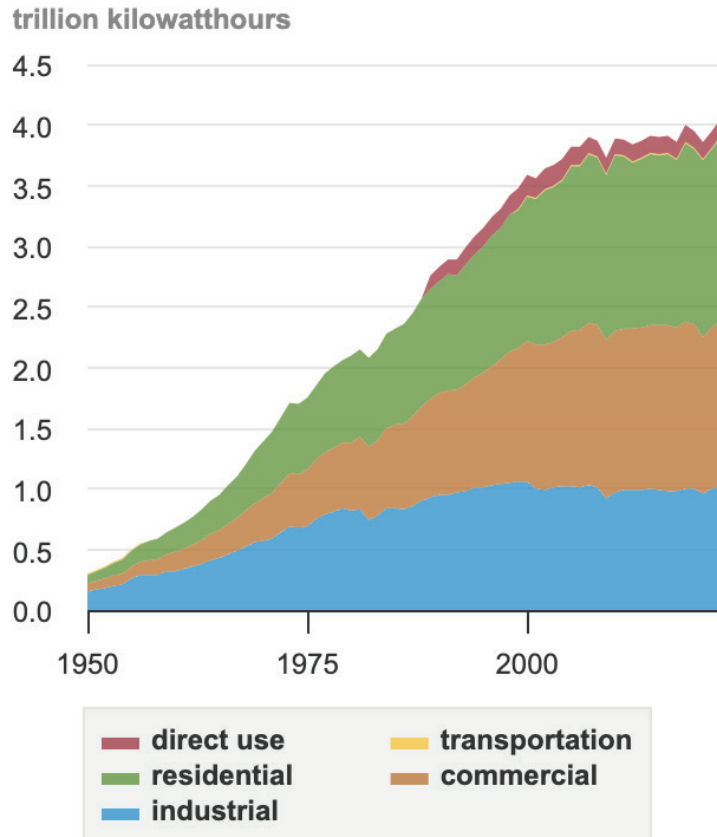
Substation Components



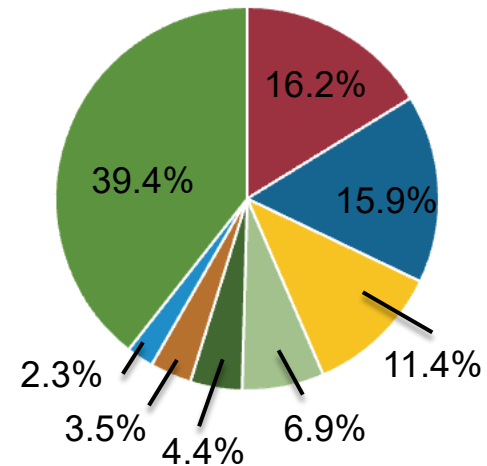
Source: [Pacific Northwest National Laboratory \(PNNL\)](#)



Power Sector Fundamentals: End-Use Customer



1950 - 2022 Electricity Sales by Sector

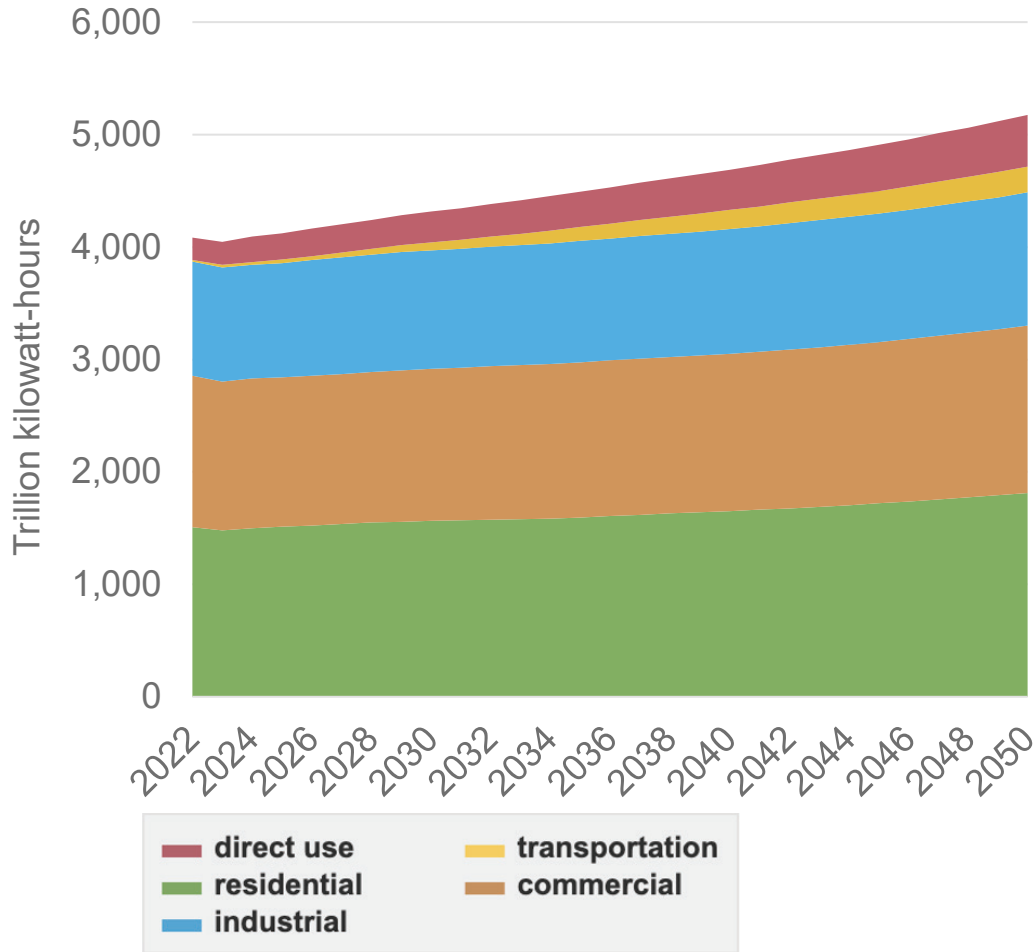


2022 Residential Electricity End Uses

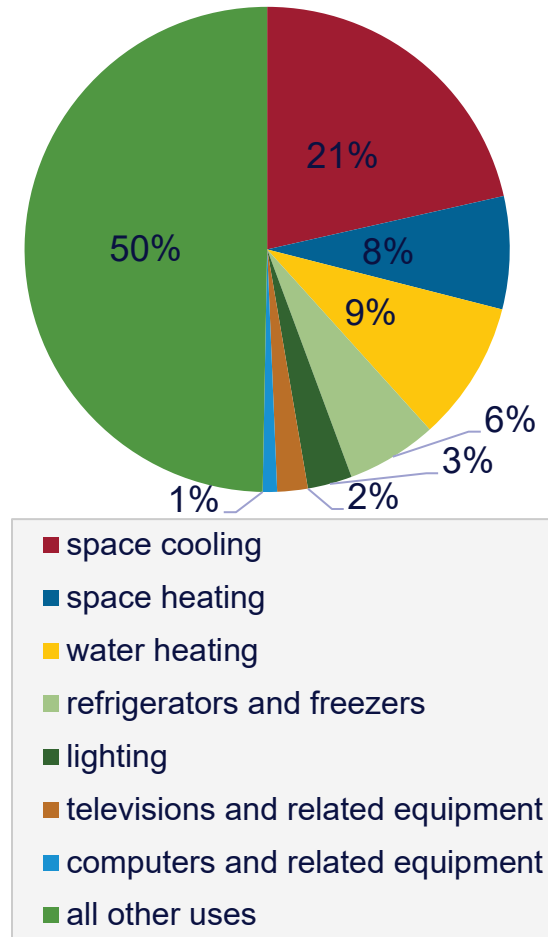
Source: [EIA](#)



Power Sector Fundamentals: Projected Electricity Use



2022 - 2050 Electricity Sales by Sector

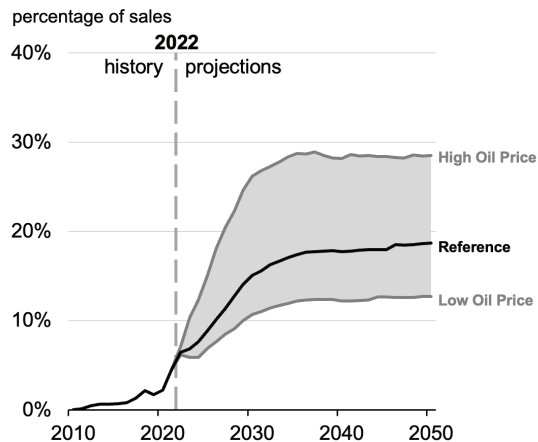


2050 Residential Electricity End Uses

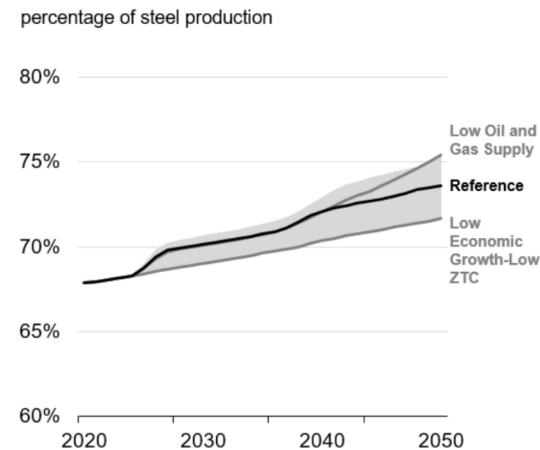


Power Sector Fundamentals: Forecasted Electric Sector Trends

- Total projected electricity sales grow by almost 30% in 2050.
 - ▣ Electrification of heating, vehicles, and the steel industry drive load growth.
 - ▣ New uses including artificial intelligence, data centers, and domestic manufacturing also drive load growth.
- The projected electricity mix shifts to renewable energy.
 - ▣ Renewable energy costs decline and government incentives support development.
 - ▣ Solar capacity grows by between ~320% – 1000% and wind capacity grows by between ~130% - 230% by 2050, supported by battery deployment.



Light Duty Electric Vehicle (EV) Market Share



Electrified Steel Production

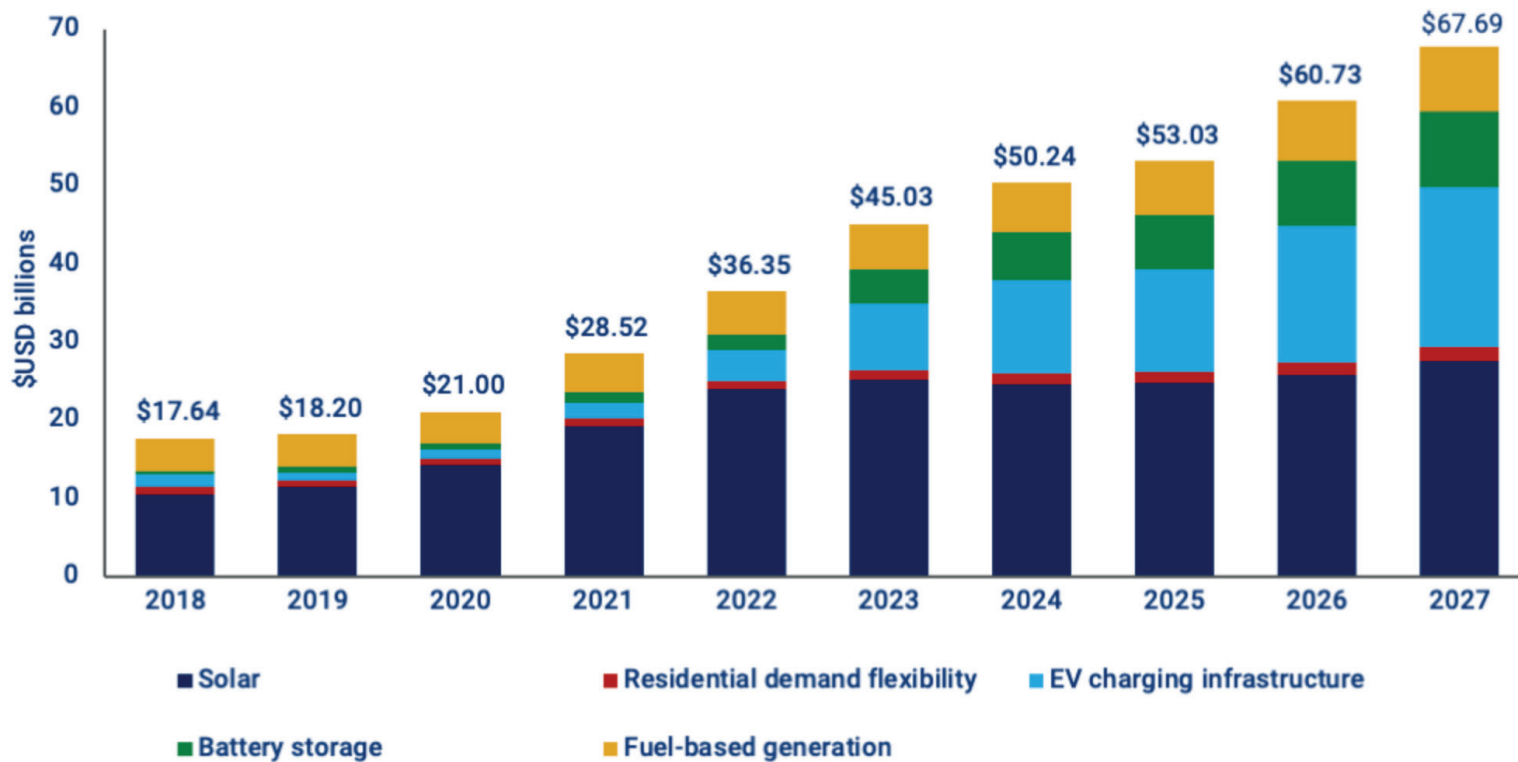
Poll

- What topics are you addressing as a Clean Energy Innovator Fellow to help address forecasted electric sector trends?

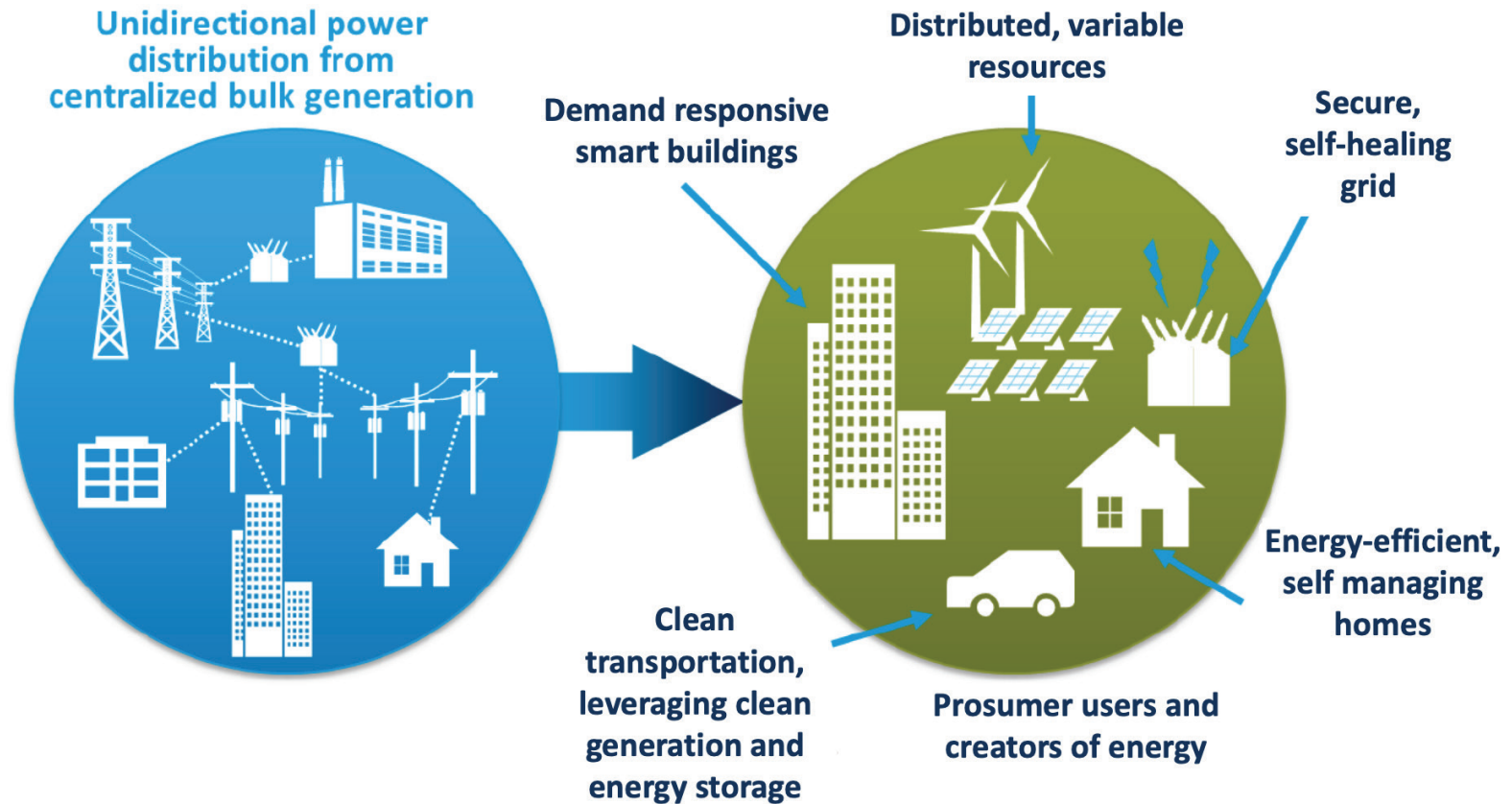


Power Sector Fundamentals: Distributed Energy Resource (DER) Growth

Historic and Projected DER Market Growth



Power Sector Fundamentals: Grid Modernization



Source: [Berkeley Lab](#)

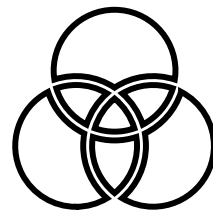


Purpose of Regulation



Purpose of Regulation (1)

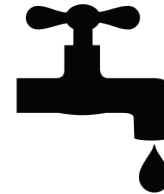
- Regulation aims to “align private behavior with the public interest” ([Hempling, 2021](#)).
- The public interest is multi-faceted and includes:
 - ▣ Public policy objectives
 - ▣ Economic principles
 - ▣ Protecting consumers
 - ▣ Considering the financial viability of utilities
- Interests can be in conflict or mutually reinforcing.



Sources: Hempling 2021, [Regulatory Assistance Project \(RAP\)](#)

Purpose of Regulation (2)

- Utilities are monopolies that provide essential services, including:
 - ▣ Access to life-sustaining resources
 - ▣ Communication infrastructure
 - ▣ Safe and comfortable buildings
- Utility infrastructure physically crosses private property and public spaces and has public impacts, including:
 - ▣ Visual and auditory impacts
 - ▣ Pollution and health impacts
 - ▣ Accidents that occur in connection with infrastructure
- Regulation defines expectations and standards and provides incentives to meet those standards.
 - ▣ Incentives can take many forms, from mandates and penalties, to encouragement and rewards.



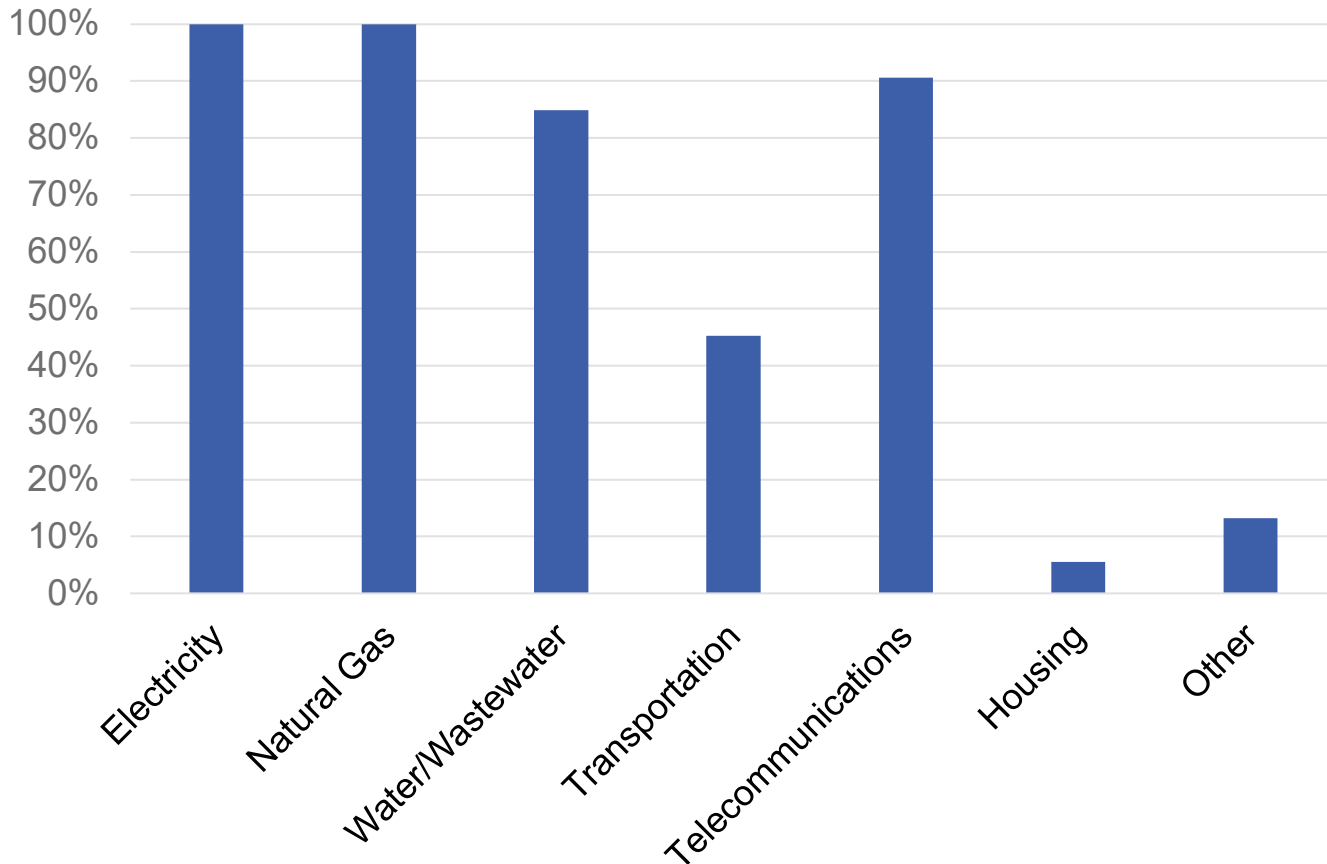
Commonly Regulated Utilities

Sources: Hempling 2021, [RAP](#)



Industries Regulated by Utility Commissions

Percent of Public Utility Commissions (PUCs) Regulating Key Industries



Data are from 2021 and include Commissions in all 50 states, Washington DC, and Puerto Rico. Source: [National Association of Regulatory Utility Commissioners \(NARUC\)](#)



Purpose of Regulation (3)

- Regulatory expectations include:
 - An obligation to serve under a “regulatory compact”
 - Utilities agree to be regulated in exchange for serving customers at rates that will fully cover costs to provide service.
 - Provision of safe, adequate, and reliable services at just and reasonable rates
- Distribution is a natural monopoly.
 - A single provider is more efficient than multiple providers.
 - Vertically integrated utilities also have a monopoly on providing electricity.



Sources: [RAP](#), [NARUC Desk Manual](#)



Purpose of Regulation: Federal Jurisdiction

- Federal and state statutes define regulatory jurisdiction.
- FERC [authority](#) includes:
 - Rates and services for transmission of electric energy by public utilities
 - Electric sales for resale in interstate commerce
 - Sales for Resale are defined as “A type of wholesale sales covering energy supplied to other electric utilities, cooperatives, municipalities, and Federal and state electric agencies for resale to ultimate consumers.” ([FERC Glossary](#))
 - Oversight of electric reliability via the North American Electric Reliability Corporation ([NERC](#))
 - NERC is a non-profit, certified by FERC to set and enforce reliability standards for the bulk power system, study the ongoing reliability landscape and possible threats, and support the industry through monitoring and education.



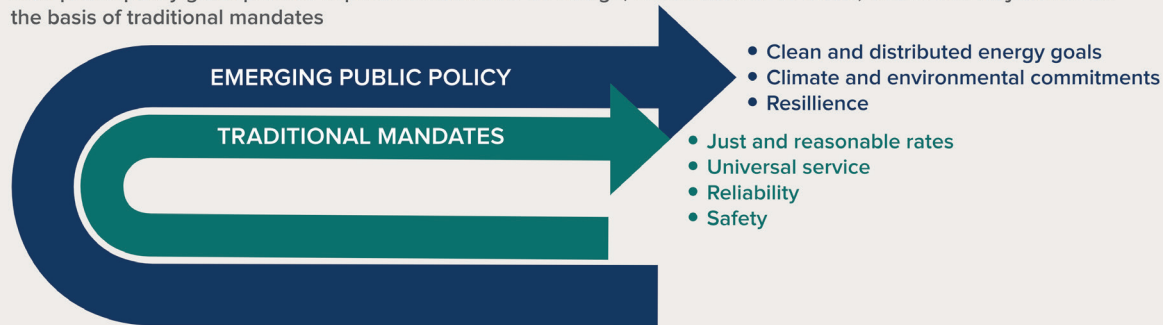
Sources: [Resources for the Future, 2021](#), [Greenfield, 2018](#), [FERC Glossary](#), [FERC](#), [NERC](#)



Purpose of Regulation: State Jurisdiction

- State statutes define the specific authorities of the utility regulator.
- Among a long list, state authority typically includes:
 - Identifying the revenue requirement and approving just and reasonable retail rates
 - Overseeing resource planning and acquisition (such as requiring plan filings, authorizing plant construction, and approving power purchase agreements — in vertically integrated states)
 - Approving certain financial transactions such as mergers and acquisitions
 - Authorizing utility entry in competitive markets where appropriate and monitoring anti-competitive behavior (e.g., unauthorized affiliate transactions)
 - Setting and monitoring distribution-level service standards, including ensuring utilities provide reliable power
 - Considering the impact of utility actions on the environment, equity, resilience, affordability, and other state policy goals

New public policy goals provide important motivators for design; in the absence of those, reform can be justified on the basis of traditional mandates



Source: Adapted from [RAP](#)

Image Source: [RMI 2019](#)



Market Structures



Market Structures: Overview

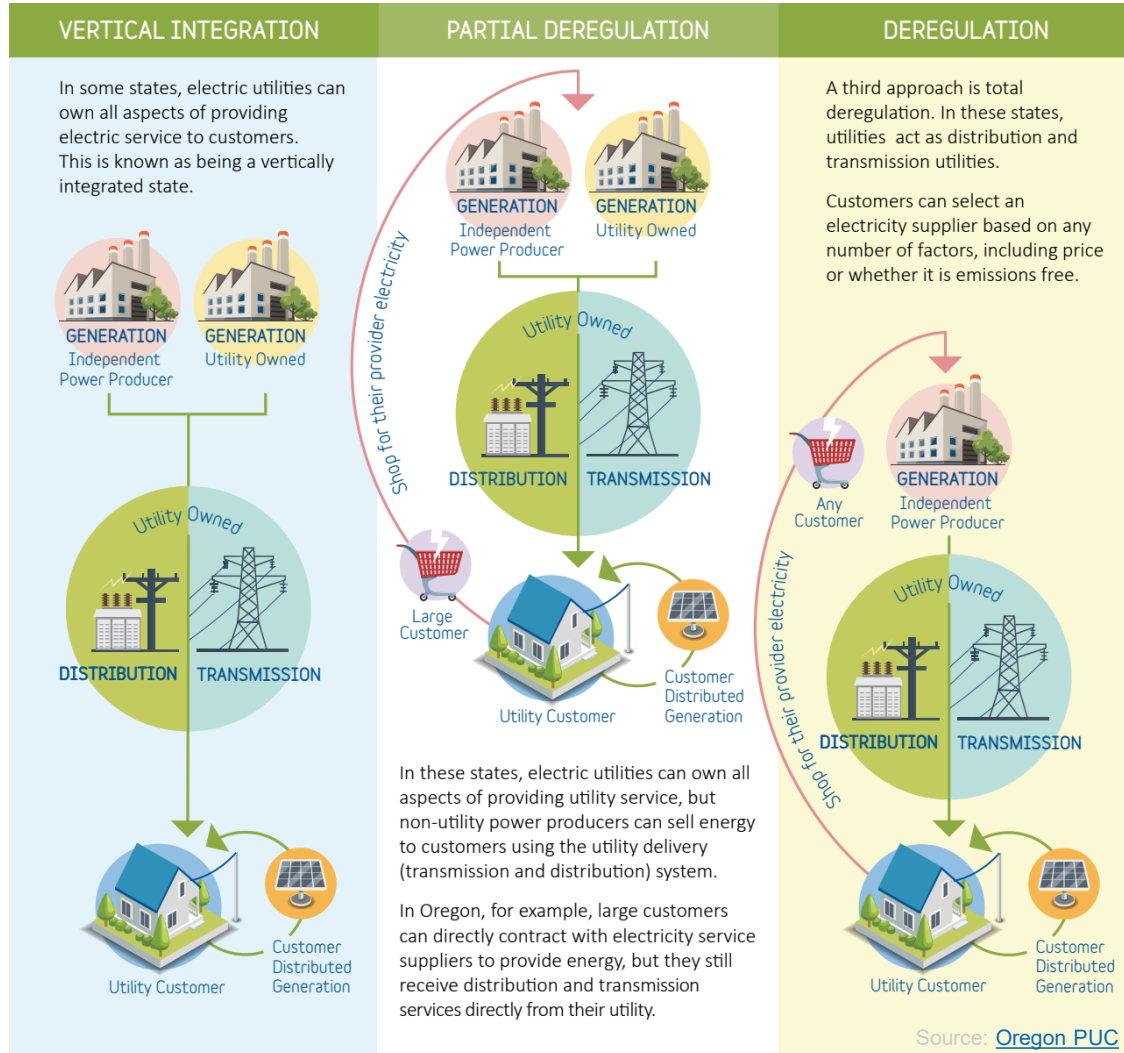
Type of Electricity Sale	Buyers in the Market	Sellers in the Market	Types of Markets	Parts of the Grid Used
<u>Wholesale</u>	<ul style="list-style-type: none"> Power resellers 	<ul style="list-style-type: none"> Power plant and DER owners and aggregators 	<ul style="list-style-type: none"> Bilateral trading and contracting Real time Day ahead Capacity Ancillary services 	<ul style="list-style-type: none"> Generation Transmission
<u>Retail</u>	<ul style="list-style-type: none"> End use customers 	<ul style="list-style-type: none"> Power resellers Power plant owners 	<ul style="list-style-type: none"> Direct sales to customers Bilateral trading or contracting 	<ul style="list-style-type: none"> Generation Transmission Distribution Grid edge

Sources: [PJM](#), [EIA](#)



Market Structures: Vertically Integrated vs. Restructured

Who can own what?



Market Structures: Electric Utility Ownership Models

Investor-Owned Utility (IOU)

- “A privately-owned electric utility whose stock is publicly traded. It is rate regulated and authorized to achieve an allowed rate of returns.” ([EIA](#))

Municipal Utility (Muni)

- City-owned and governed by the local city council or another elected commission

Public Utility District (PUD)

- “Utility-only government agencies, governed by a board elected by voters within the service territory.” ([RAP](#))

Cooperative Utility (Coop)

- “Private nonprofit entities governed by a board elected by the customers of the utility.” ([RAP](#))

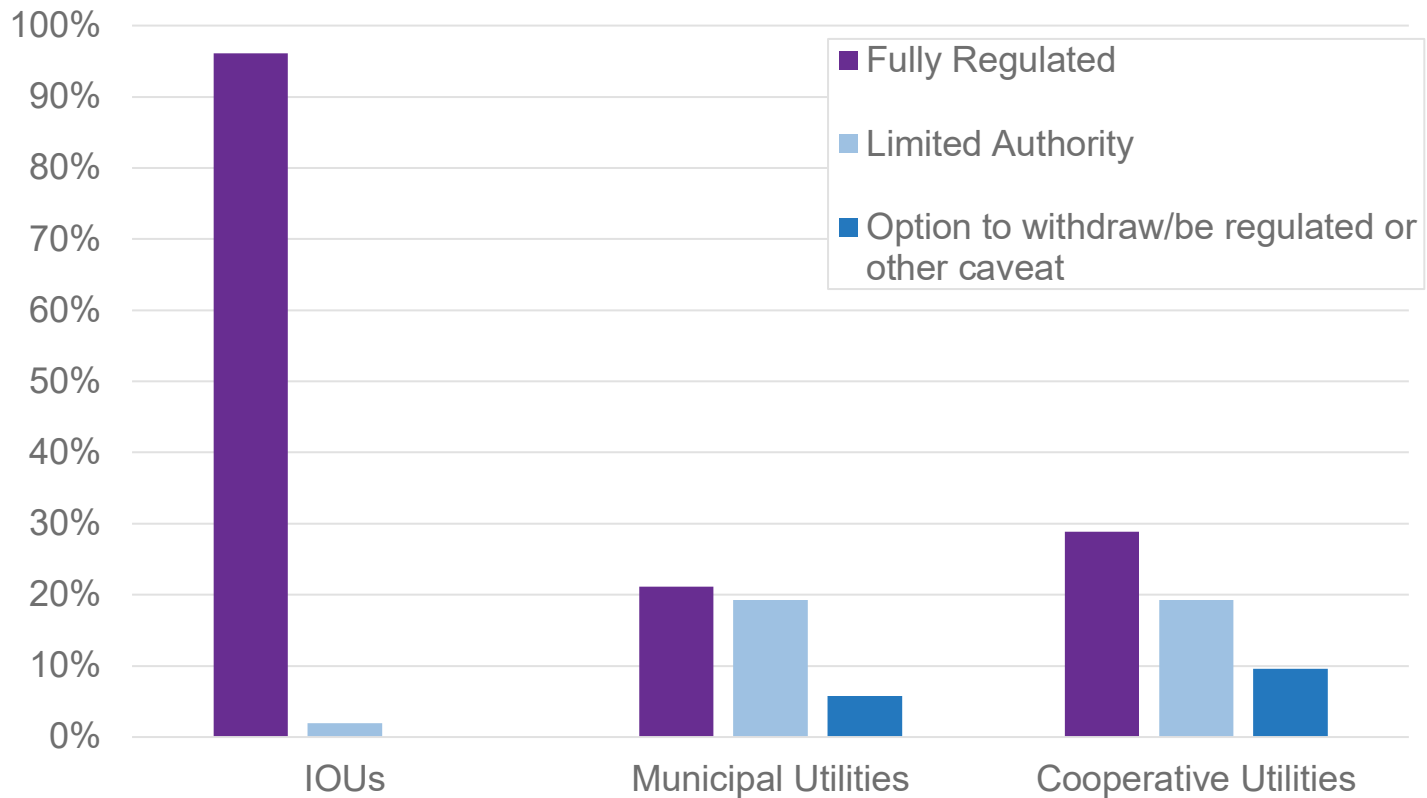
Others

- Owned by the federal or state government, Native American tribes, irrigation districts, mutual power associations, and other entities



Market Structures: PUC Oversight of Electric Utilities

Percent of Utility Commissions Regulating Types of Electric Utilities



Data are from 2021 and include Commissions in all 50 states, Washington DC, and Puerto Rico. Source: [NARUC](#)



Market Structures: Other Market Participants

Federal Power Marketing Administration

- A federal administration that sells federal hydroelectric power and may own and operate electric systems. The Tennessee Valley Authority is a federally-owned wholesale power corporation, but is not a power marketing administration.

Primarily energy resellers

Community Choice Aggregator

- An organization (a government entity or contracted third party) that purchases power from an alternative supplier on behalf of a local government

Primarily energy resellers

Generation and Transmission Cooperative

- An organization that builds and owns generation and transmission infrastructure on behalf of a group of distribution utilities

Power generators and energy resellers

Independent Power Producer

- A private organization that owns electric generation and sells it to other entities

Power generators

DER Aggregator

- An organization that combines customer-sited resources to sell to utilities, market operators, and other entities, such as through a Virtual Power Plant that coordinates small, distributed resources to act as a single power plant

Grid service providers



Market Structures: Buying and Selling Electricity

- Types of wholesale transactions:
 - Bilateral contracts – Vertically integrated utilities trade energy and capacity directly with each other and purchase from independent power producers.
 - Organized wholesale markets – In areas with RTOs and ISOs, utilities purchase energy and demand-side resources from sellers (utilities, independent power producers, and other asset owners). Markets include:
 - Energy – Day to day procurement of energy
 - Capacity – Advance procurement of resources for resource adequacy
 - Ancillary services – Procurement of grid stability services like frequency
- Types of retail transactions:
 - Vertically integrated utilities sell directly to end-use customers.
 - Retail choice – In states with restructured electricity markets, customers of IOUs can buy power directly from an alternative electricity supplier; utilities serve as a provider of last resort and transmit and distribute electricity.



Market Structures: Authority in the Bulk Power System

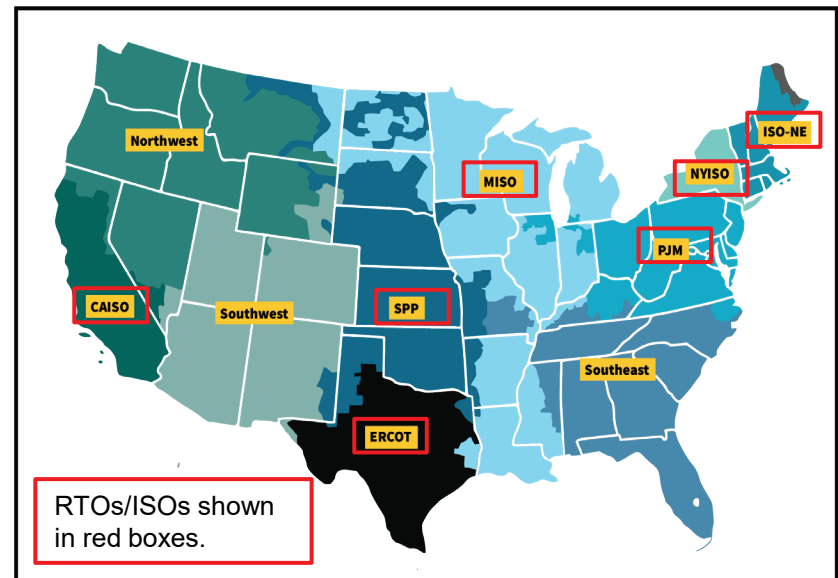
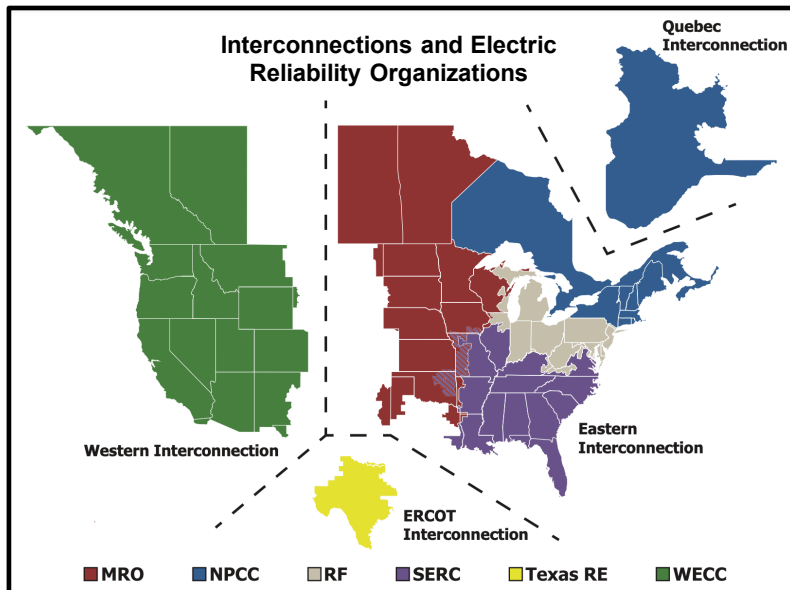
- The country's grid consists of three distinct areas that operate independently, called interconnections.
 - The interconnections are the Eastern Interconnection, Western Interconnection, and Electric Reliability Council of Texas (ERCOT) Interconnection.
- Balancing authorities match supply and demand and maintain stability within their balancing authority area in real time. Balancing authorities include utilities, power marketing administrations, and RTOs and ISOs.
- RTOs and ISOs ensure open transmission access, operate regional grids and wholesale markets, and oversee bulk system reliability.
 - RTO and ISO responsibilities include:
 - System planning
 - Managing energy and other grid service markets
 - System balancing and dispatch
 - Compared to ISOs, RTOs cover larger geographic areas and have slightly more responsibility under FERC to control and monitor the transmission system.
 - FERC oversees RTOs and ISOs when they meet certain criteria.
 - The PUC of Texas oversees the ERCOT because it does not include interstate commerce.

Sources: [RAP](#), [FERC](#), [U.S. DOE 2015 Electricity Industry Primer](#),



Market Structures: Electric Reliability Organizations and RTO/ISOs

- With NERC, six regional entities ensure bulk system reliability.
- Some regions with vertically integrated utilities do not have an RTO or ISO.
 - ▣ Utilities in the Southeast, Southwest, and Northwest U.S. mostly use bilateral power trades.
 - ▣ The Northwestern and Southwestern regions participate in a voluntary regional real-time market called the [Western Energy Imbalance Market](#), run by the California ISO.



Acronyms include: Midwest Reliability Organization, Northeast Power Coordinating Council, ReliabilityFirst, SERC Reliability Corporation, Texas Reliability Entity, and Western Electricity Coordinating Council

Image and Other Sources: [NERC](#), [FERC](#), [FERC 2023 Energy Primer](#)

Regulatory Processes



Regulatory Processes: Types of Proceedings

Rulemaking

- Rules define how the Commission carries out duties and sets procedures and direct utility activities.

General Rate Case (GRC)

- The Commission determines changes to a utility's retail rates.

Tariff Filing

- The Commission formally approves terms, conditions, and prices for utility services.

Policy or Investigative

- The Commission defines policy on a certain topic or explores an emerging regulatory issue, typically using an informal process resulting in such outputs as policy statements, programs and utility guidance.

Planning

- The Commission oversees utility planning, as applicable, for generation, transmission, distribution, grid modernization, energy efficiency, other distributed resources, electrification, resilience, and more.

Applications

- Utilities can apply for approval to procure resources in some states, commit funds to new projects, or start new programs.



Regulatory Processes: Proceedings and Record Building

- Nature of proceedings:
 - ▣ Some proceedings are always formal (such as rate cases).
 - ▣ State statutes and rules define types of proceedings (such as administrative, adjudicated, investigative, or policy proceedings).
 - ▣ The Commission determines the type of proceeding to use depending on proceeding objectives and applicable laws and rules.
 - ▣ In a formal proceeding, the Commission makes decisions based on what is in the proceeding's record.
- Proceedings often include:
 - ▣ Approving requests for intervention
 - ▣ Defining proceeding scope
 - ▣ Listening sessions / workshops
 - ▣ Discovery (through data/information requests)
 - ▣ Adjudicatory hearings
 - ▣ Issuing decisions and orders
- Rules dictate who can communicate with Commissioners in various types of proceedings, including what constitutes *ex parte* communications.



Regulatory Processes: Participants

- In formal proceedings, only what is in the formal record informs PUC decisions.
- State rules dictate who can participate in proceedings and how they can participate.
- Consumer advocates are responsible for representing the interests of residential customers.
- Other state agencies, utility customer organizations, environmental and justice groups, and other stakeholders also may intervene in proceedings.
 - State Energy Offices strategically choose when to participate in PUC working groups and whether to participate in PUC proceedings.

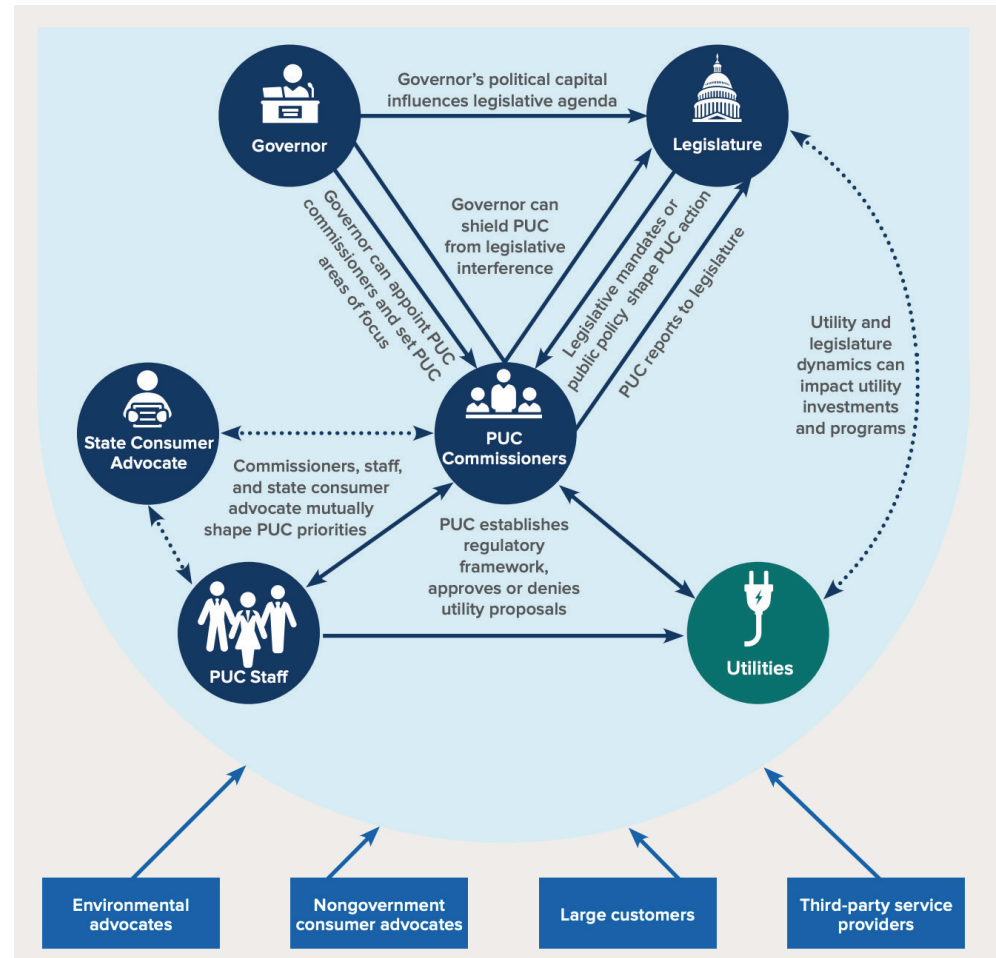
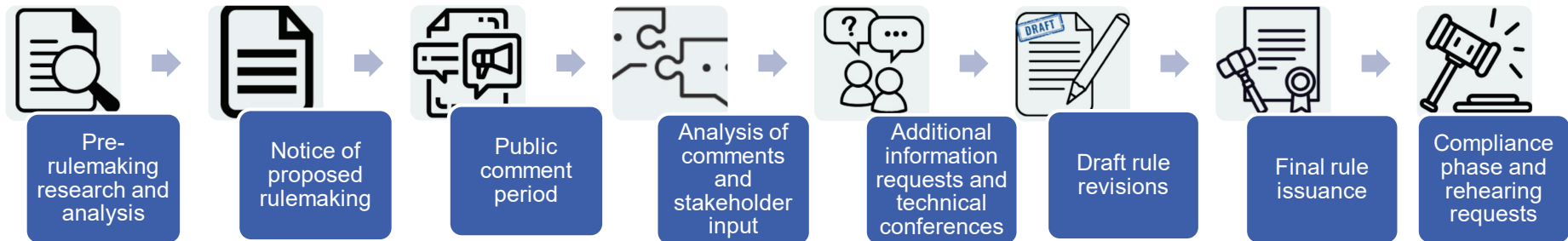


Image source: [RMI 2019](#)



Regulatory Processes: Rulemaking

- Rulemaking or administrative proceedings address a policy issue or change in regulations or laws.
 - ▣ Commissions release draft rules for comment, seeking input and information to inform final rules.
 - ▣ Commissions may hold workshops, hearings, or otherwise solicit input from a wider range of stakeholders compared to formal proceedings.
- Rules establish regulatory procedures, provide guidance to utilities on how their actions will be viewed in the future, and govern utility actions.
 - ▣ Rules may need to be reviewed or approved by another state agency or be subject to judicial review.



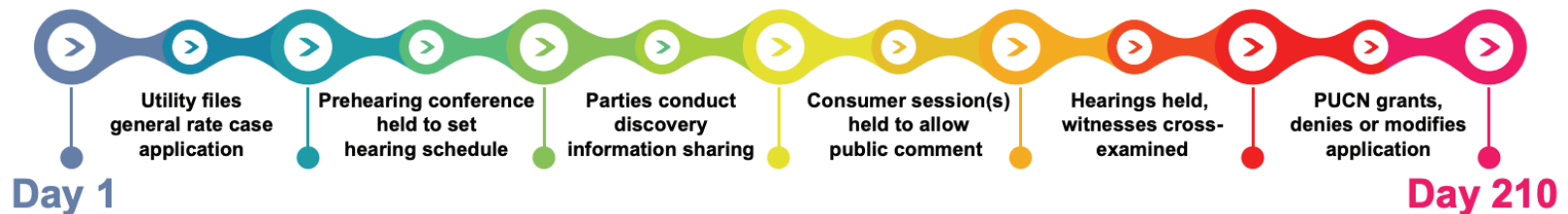
FERC's [Rulemaking Process](#)

Sources: [RAP](#), [NARUC Desk Manual](#)

Regulatory Processes: GRC

- Rate cases are formal, contested or litigated proceedings that establish the rates utilities can charge customers.
 - Expenses that can be recovered in rates and expected revenues are based on a “test year,” either a recent year or a future year.
 - The rate of return is often the most contentious area of a GRC.
 - As part of the GRC process, a designated official presides over a formal hearing, typically the Chair of the Commission or a hearings officer.
 - Some states have statutory deadlines associated with rate case proceedings, and all rate cases follow formal administrative processes as outlined in statute or rules.

Nevada PUC’s GRC Process



Sources: [RAP](#), [NARUC Desk Manual](#), [Nevada PUC](#)

Regulatory Processes: Policy Investigations

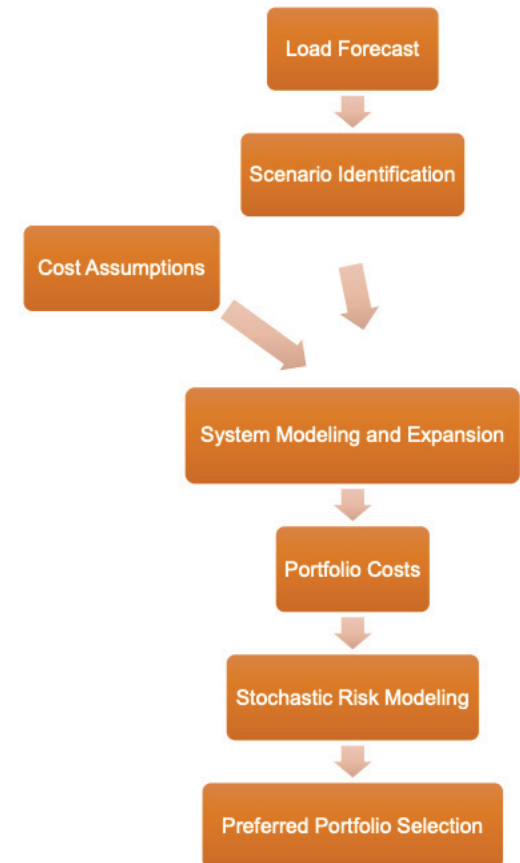
- Policy investigations explore emerging issues such as:
 - ▣ Rate design
 - ▣ DER program design
 - ▣ Low-income program development
 - ▣ Equity initiatives
 - ▣ Smart grid or grid modernization initiatives
 - ▣ Utility business model changes
- These proceedings may involve a wide group of utilities (e.g., all regulated electric utilities) or stakeholders because resulting guidance will often be generally applicable rather than only applicable to a single utility.
- These dockets may result in a policy statement or guidance for future proceedings.
- Commissions may also use stakeholder collaboratives or public comment proceedings to collect information and recommendations on a certain topic.



Regulatory Processes: Integrated Resource Plans (IRP)

- IRPs are a tool used to forecast future needs and examine possible ways to meet those needs.
- IRPs seek to identify the mix of resources that is the least-cost and/or lowest risk solution to maintain reliability given constraints (e.g., policy mandates) over a range of possible future scenarios.
 - ▣ IRPs consider a suite of supply- and demand-side options and account for their costs, technical capabilities, environmental performance, and other factors depending on state goals (such as equity or resilience impacts).
- IRP is used in about 35 states.
 - ▣ Utilities may use the IRP to guide investment decisions.
 - ▣ Regulators may use the IRP as one tool for determining whether a utility's investments are prudent and necessary.

High-Level IRP Steps

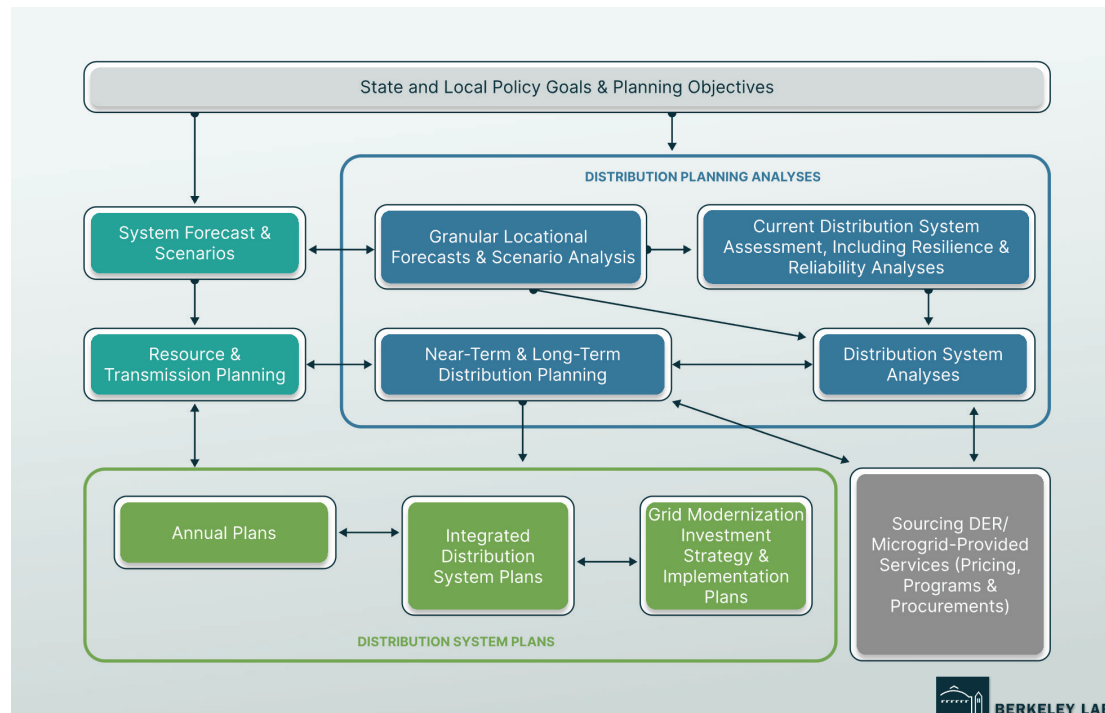


Sources: [Berkeley Lab](#), [PNNL](#)



Regulatory Processes: Integrated Distribution System Planning (IDSP)

- IDSP provides a systematic approach to satisfy customer service expectations and state and utility objectives for grid planning and design. ([Berkeley Lab](#))
- IDSP assesses reliability, resilience, safety, operational efficiency, DER integration and utilization, and grid modernization, with strong links to bulk power system planning.



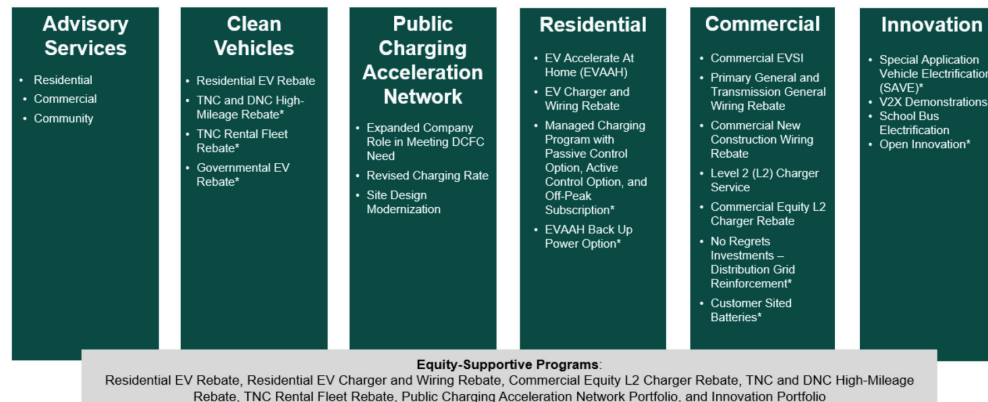
Source: [Berkeley Lab](#)



Regulatory Processes: Other Planning Processes

- Transmission planning: FERC, RTOs, ISOs, and utilities conduct analyses to determine where transmission is needed, when it is needed, and how to allocate costs.
- Electrification planning: Some states require utilities to plan for load growth from electrification of buildings and transportation.
- Planning to meet other state goals: Some states require utilities to plan for DER growth, grid modernization, resilience, and policy goals.
- Best practice is to coordinate and integrate related planning processes to realize efficiencies, such as through an integrated grid plan.

Snapshot of Xcel Minnesota’s 2024 – 2027 Transportation Electrification Plan



* New Program

Image Source: [Xcel Minnesota](#). Other sources: [RFF](#), [Berkeley Lab](#)



Stakeholder Engagement



Stakeholder Engagement: Why is it important?

- PUCs are facing increasing levels of responsibility in a quickly changing regulatory landscape.
 - ▣ Issues are more complex and interrelated.
- Enhanced stakeholder engagement can improve outcomes by allowing more transparency, collaboration, and learning across parties.
 - ▣ Participation by stakeholders directly impacted by decisions improves processes and outcomes.
- PUCs may consider recruiting new participants, educating stakeholders, building consensus, and phasing proceedings to improve processes.

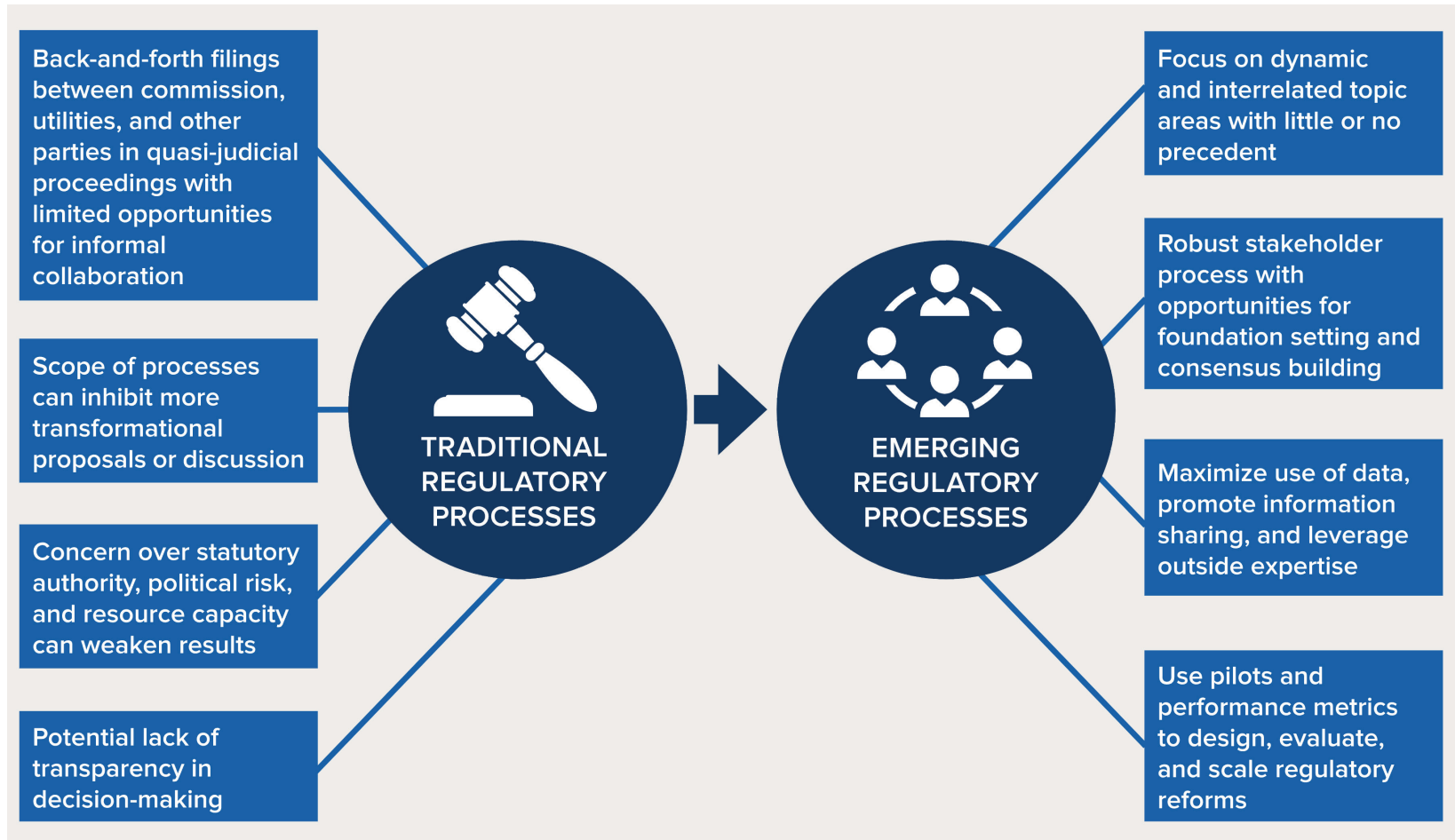
Modern Stakeholder Engagement Framework



Sources: [Berkeley Lab](#) [NARUC](#)



Stakeholder Engagement: Evolving Processes



Source: [RMI 2019](#)

Stakeholder Engagement: Best Practices

- Best practices include:
 - ▣ Gather feedback at the outset and throughout the process.
 - ▣ Provide clear guidance on roles, responsibilities, and timing.
 - ▣ Use working groups and outside experts to gather input and facilitate learning.
 - ▣ Make resources and materials transparent, understandable, and accessible.
 - ▣ Require accountability to show how input was addressed.
 - ▣ Evolve and improve practices and requirements over time.



Image source: [Facilitating Power](#), Other Source: [Berkeley Lab](#)



Questions?



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