

Your Electricity Grid and You

What You Never Thought You Needed To Know But Should

Peter Cappers

Staff Scientist

John Patrick Daniel

Policy Researcher II

ETIPP Community Education Workshop

February 17, 2024



Where are we going?

- Section 1: Who am I & Why Am I Here?
- Section 2: The Electric Grid
- Section 3: Block Island and the Electric Grid
- Section 4: Implications for Block Island's 2040 Energy Roadmap



Where are we going?

- Section 1: Who am I & Why Am I Here?
- Section 2: The Electric Grid
- Section 3: Block Island and the Electric Grid
- Section 4: Implications for Block Island's 2040 Energy Roadmap



Who am I?



Credits: Universal Pictures

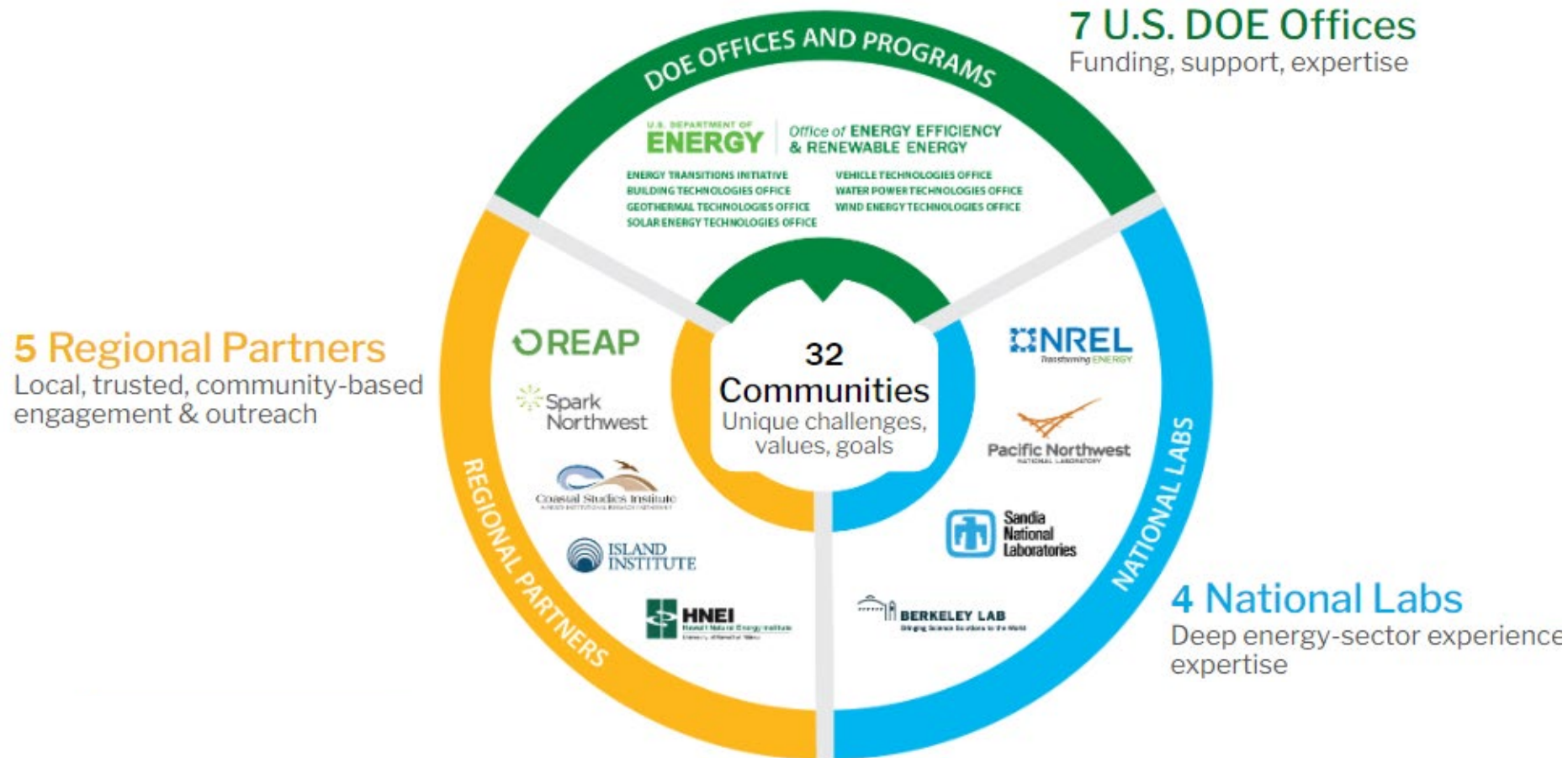


Credits: Britannica



What is ETIPP?

Energy Transitions Initiative Partnership Program



How did Block Island get here?

ETIPP and Block Island; how we met...

□ A Competitive Application Process with Community Commitments

13. Please list the names, titles, and organizations for team members (including yourself) who will serve as key points of contact for your proposed ETIPP project and can commit to engaging in the activities listed in question 12. At minimum, there should be a primary and secondary point of contact identified. *

We have not finalized how we are going to structure ETIPP project committee. However, Barbara and I from the BIUD board would be the main contacts. We have a lot of interest from other board and committees to participate.

Barbara MacMullen BIUD president (primary)

John Warfel BIUD secretary (secondary)

Judy Gray Sea Level Rise Committee

Cindy Davis Block Island Solar Initiative

Block Island Health Services (representative has not been finalized yet)

Block Island Town Council (representative has not been finalized yet)

The Commitment From Block Island:

□ Regular Meetings and Participation for 12-18 Months

12. Does the applicant agree to participate in the following activities? *

- Participate in virtual meetings (30-90 minutes each) with ETIPP staff every 2-4 weeks during project scoping (Summer and Fall 2023) and throughout the remainder of the project (12-18 months after scope is finalized).
- Provide information requested by ETIPP staff in a timely manner.
- Submit feedback about your experience in ETIPP every 6 months during project execution and 6-12 months after project concludes.
- Be available for media inquiries and work with a regional organization by providing photos, diagrams, video footage, quotes, or interviews, as appropriate and relevant to the ETIPP project.
- Be available to other local communities to share your experience and lessons learned via webcast or conference call.

Yes

No



Block Island ETIPP Application Highlights

Challenges faced by Block Island

- Energy cost associated with diesel backup in the case of a cable outage
- Energy reliability in the case of a cable outage
- Sea level rise

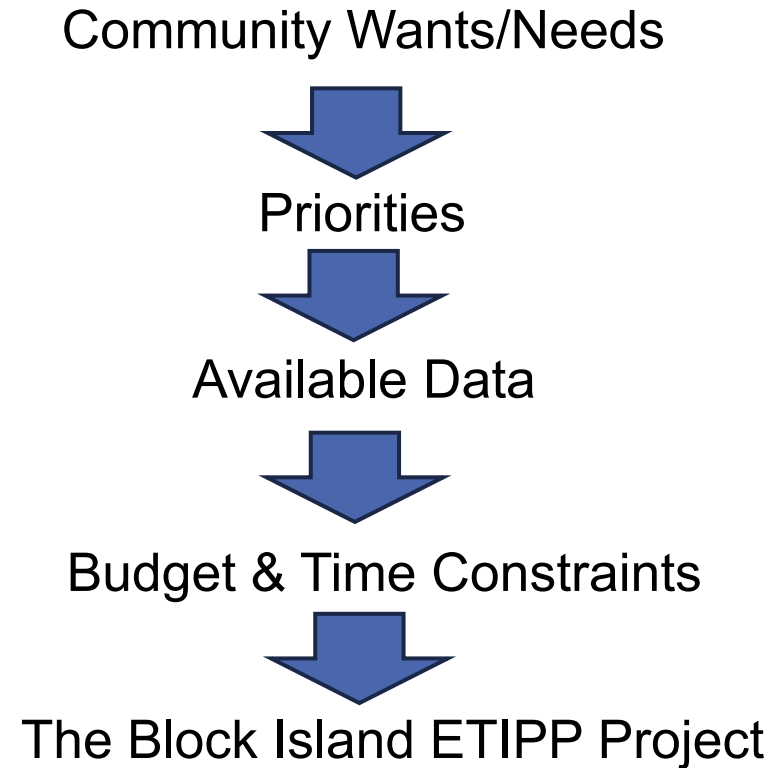
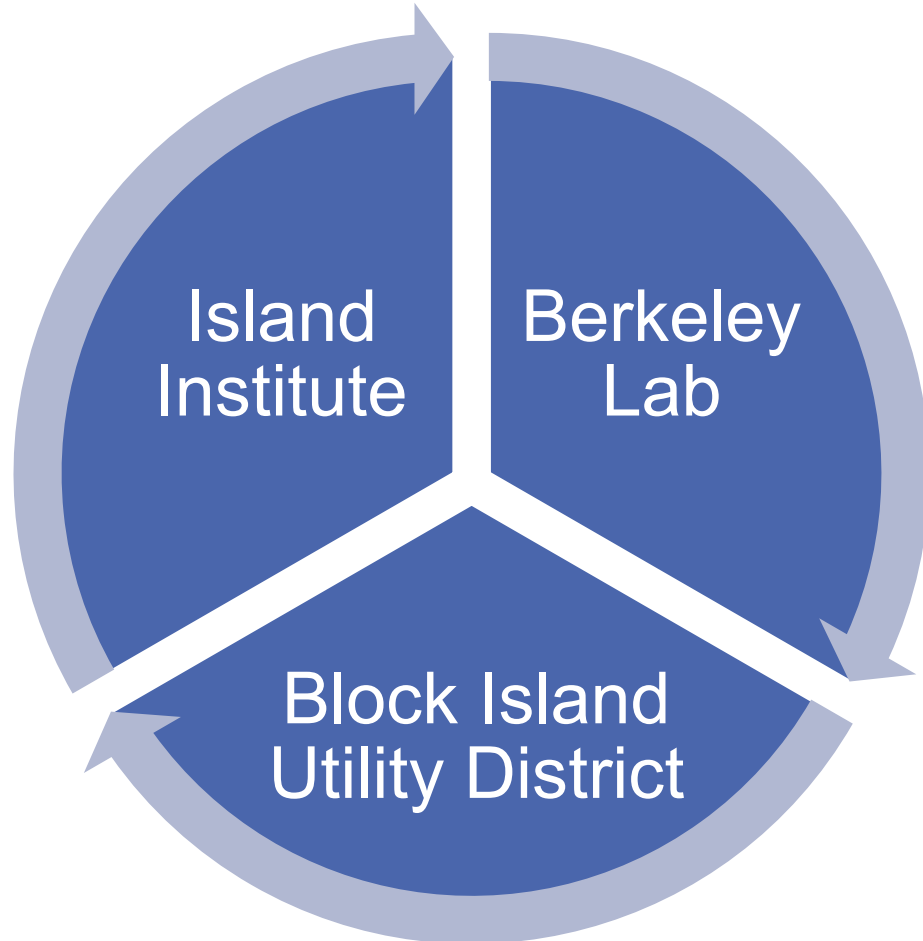
Priorities for ETIPP

- Further investigate options for alternative energy sources and storage systems
- Encourage stakeholder and community engagement on urgent issues related to climate change

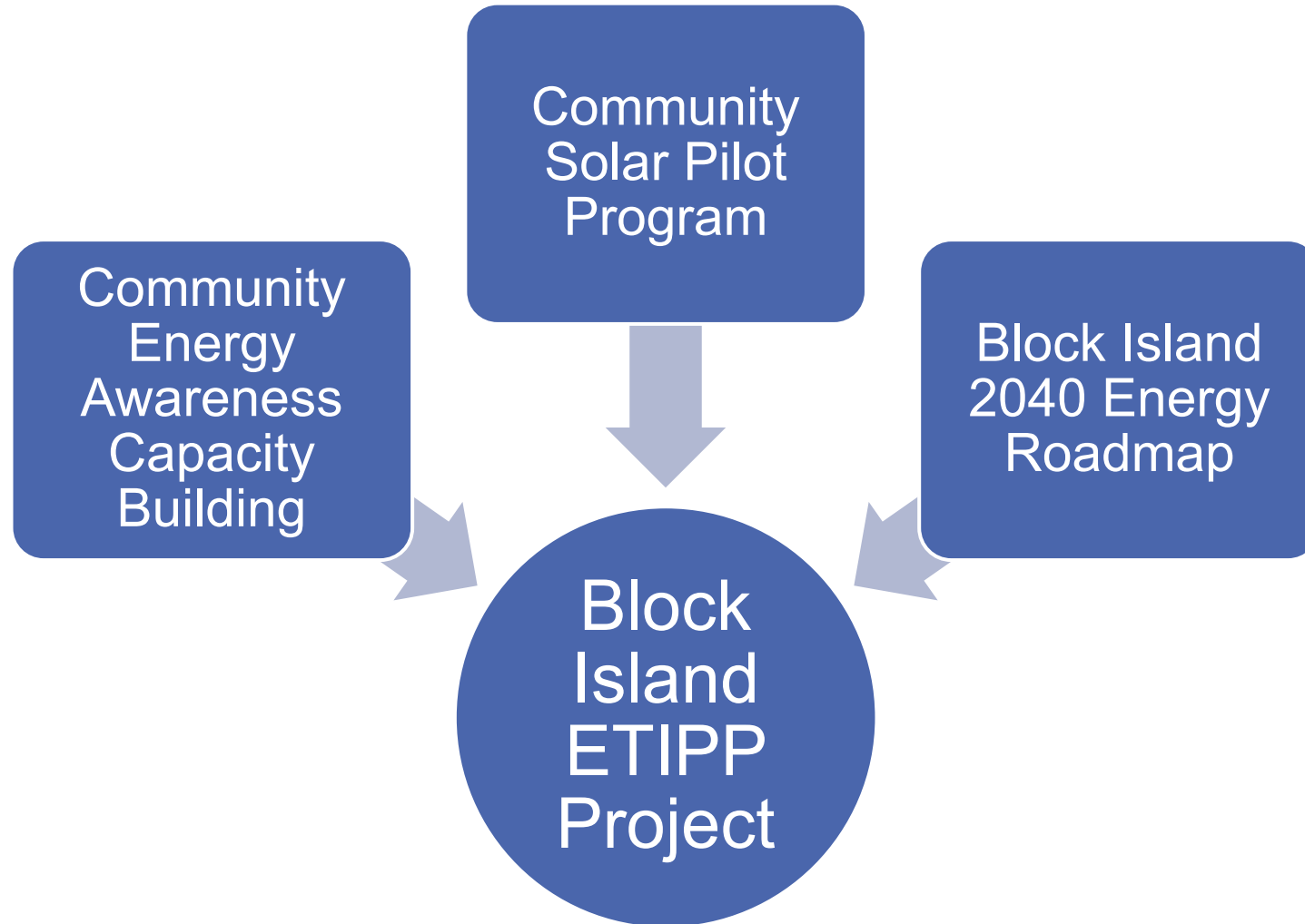


ETIPP Teamwork to Date: Scoping

Convening bi-weekly to understand Block Island's priorities and develop a scope of work...



Block Island ETIPP Project Scope

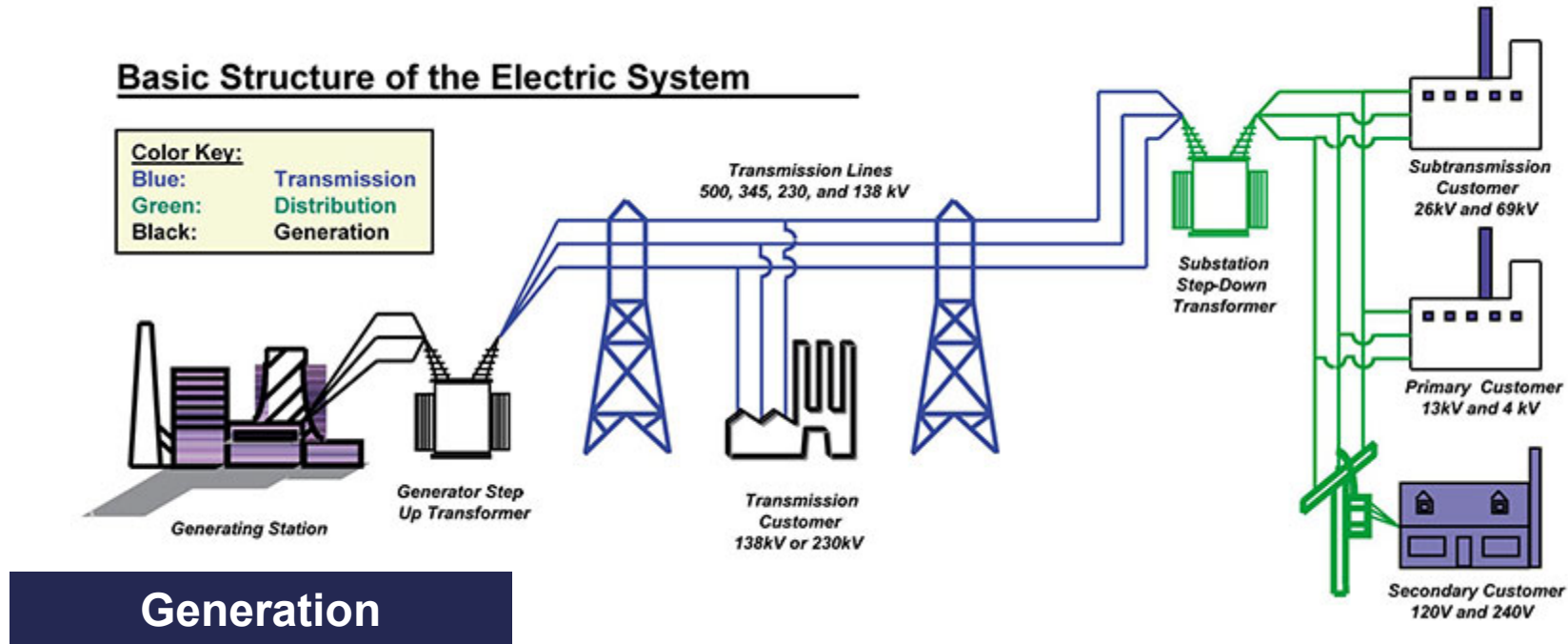


Where are we going?

- Section 1: Who Am I & Why Am I Here?
- **Section 2: The Electric Grid**
- Section 3: Block Island and the Electric Grid
- Section 4: Implications for Block Island's 2040 Energy Roadmap



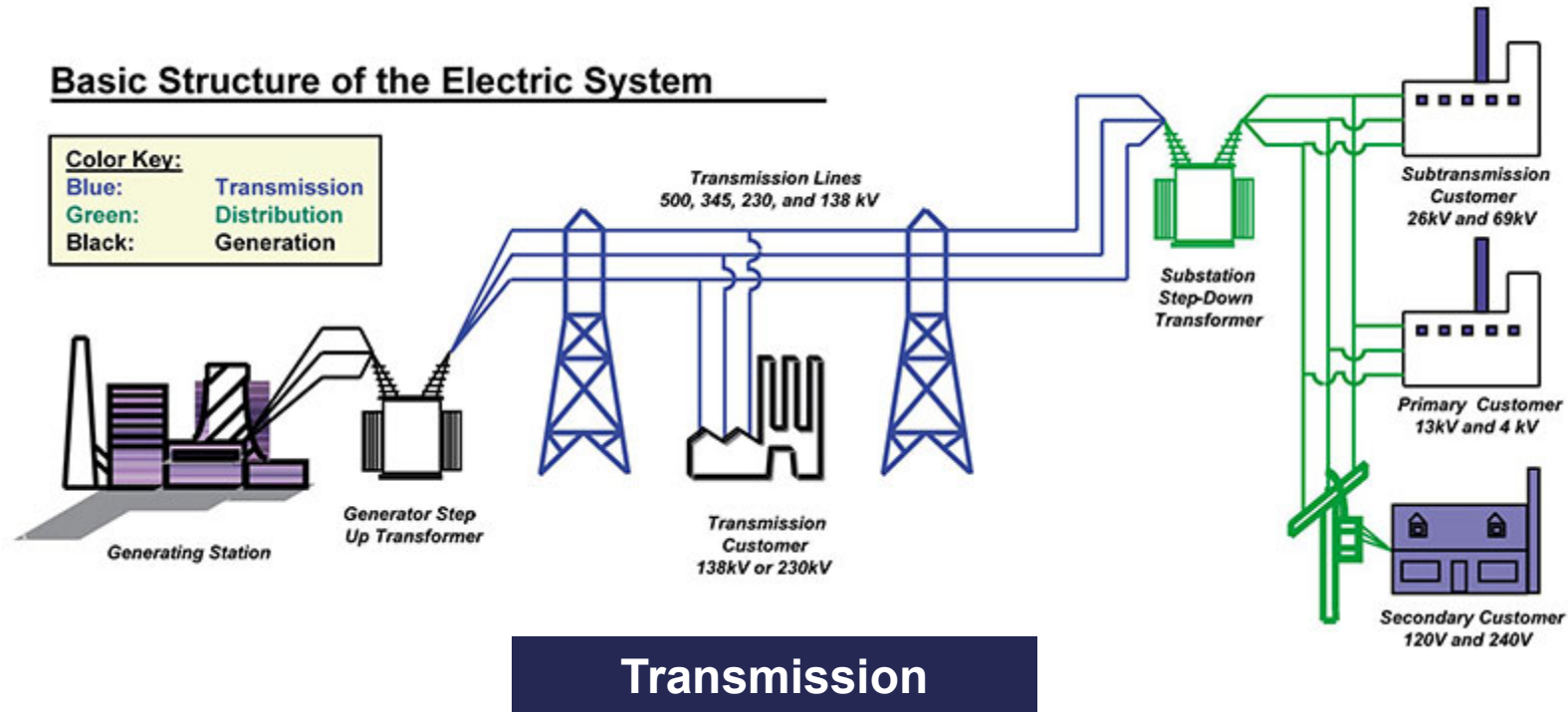
What is the electricity grid?



Credits: Union of Concerned Scientists



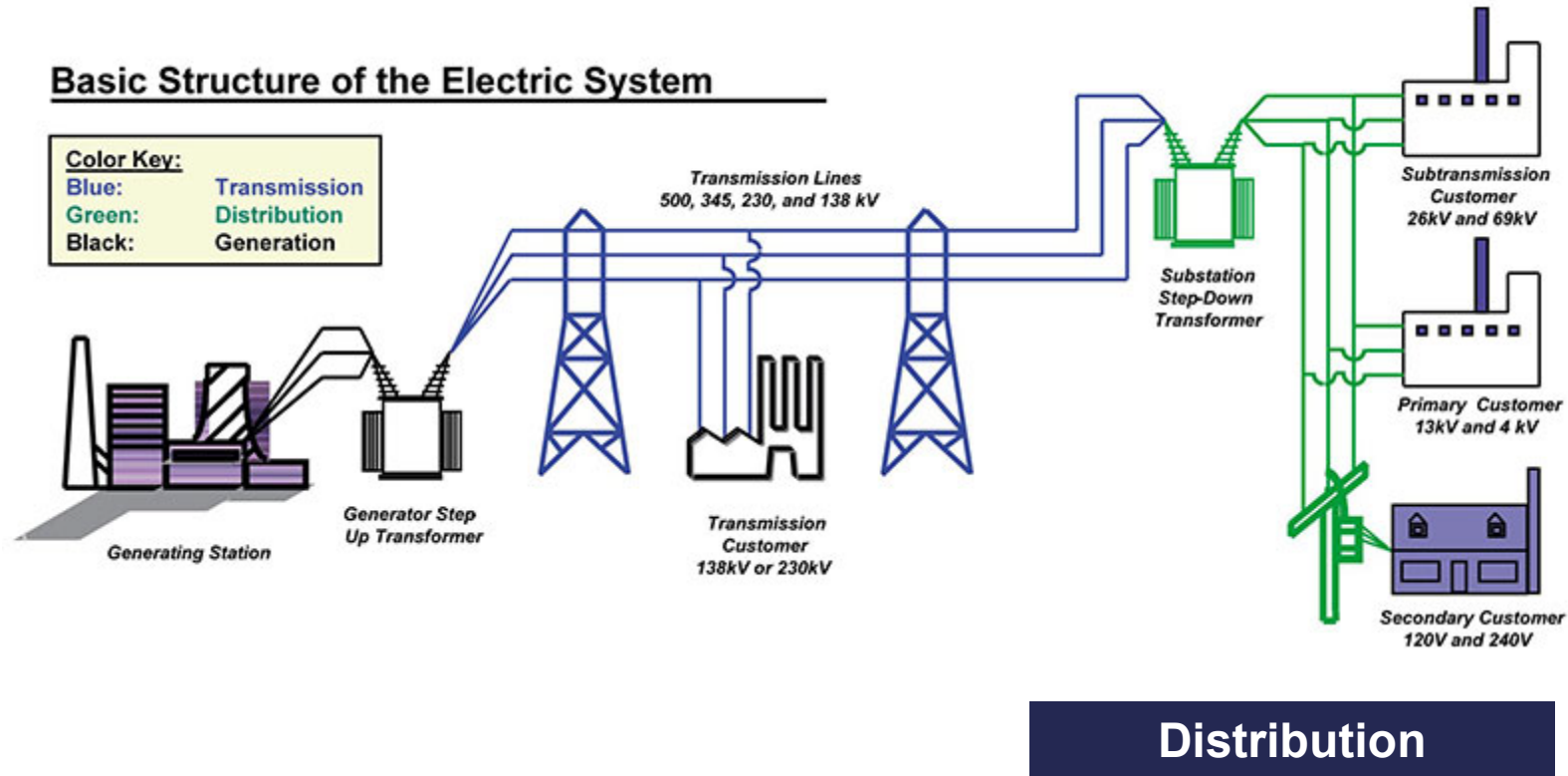
What is the electricity grid?



Credits: Union of Concerned Scientists



What is the electricity grid?



Credits: Union of Concerned Scientists



Why should you care about the electricity grid?

Everything is becoming dependent on it!

Entertainment



Credits : iStock

Telecommunications



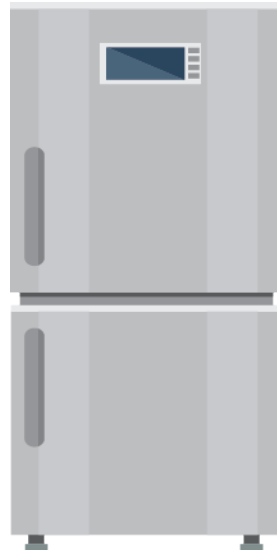
Credits iStock

Buildings



Credits iStock

Appliances



Credits iStock

Transportation

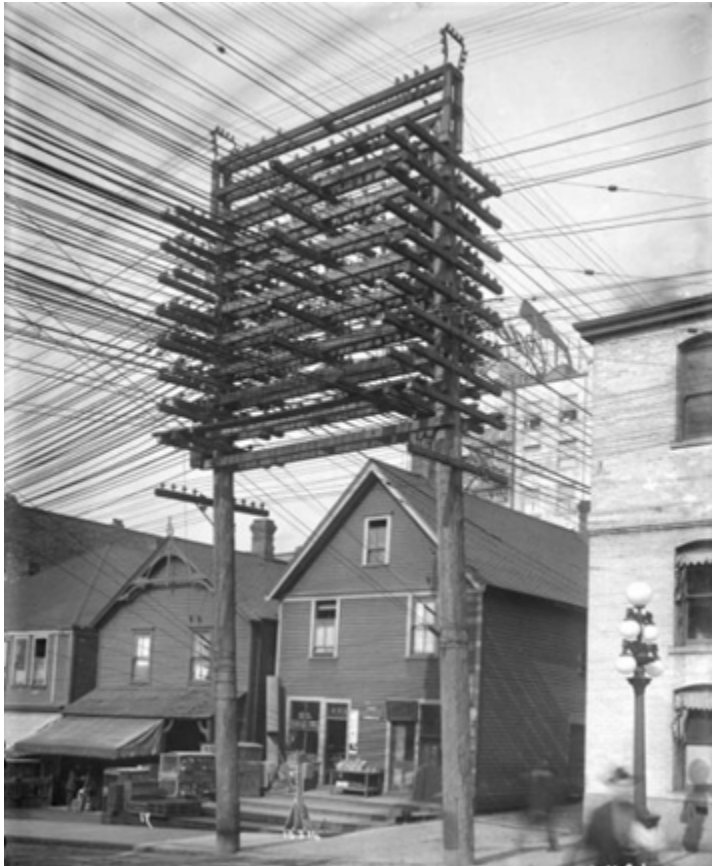


Credits iStock

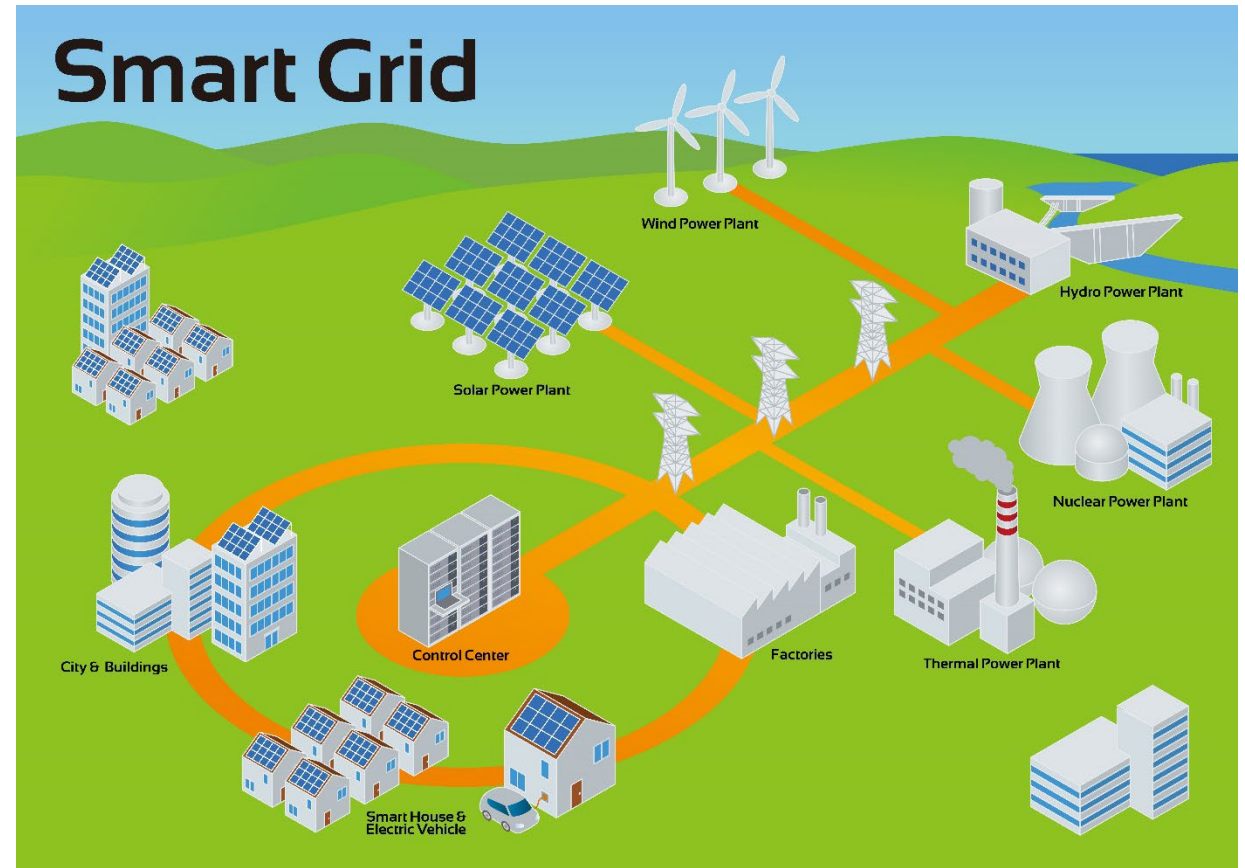


Why should you care about the electricity grid?

This ain't your great-great granddad's grid!



Credits: Pete Larsen



Credits: iStock

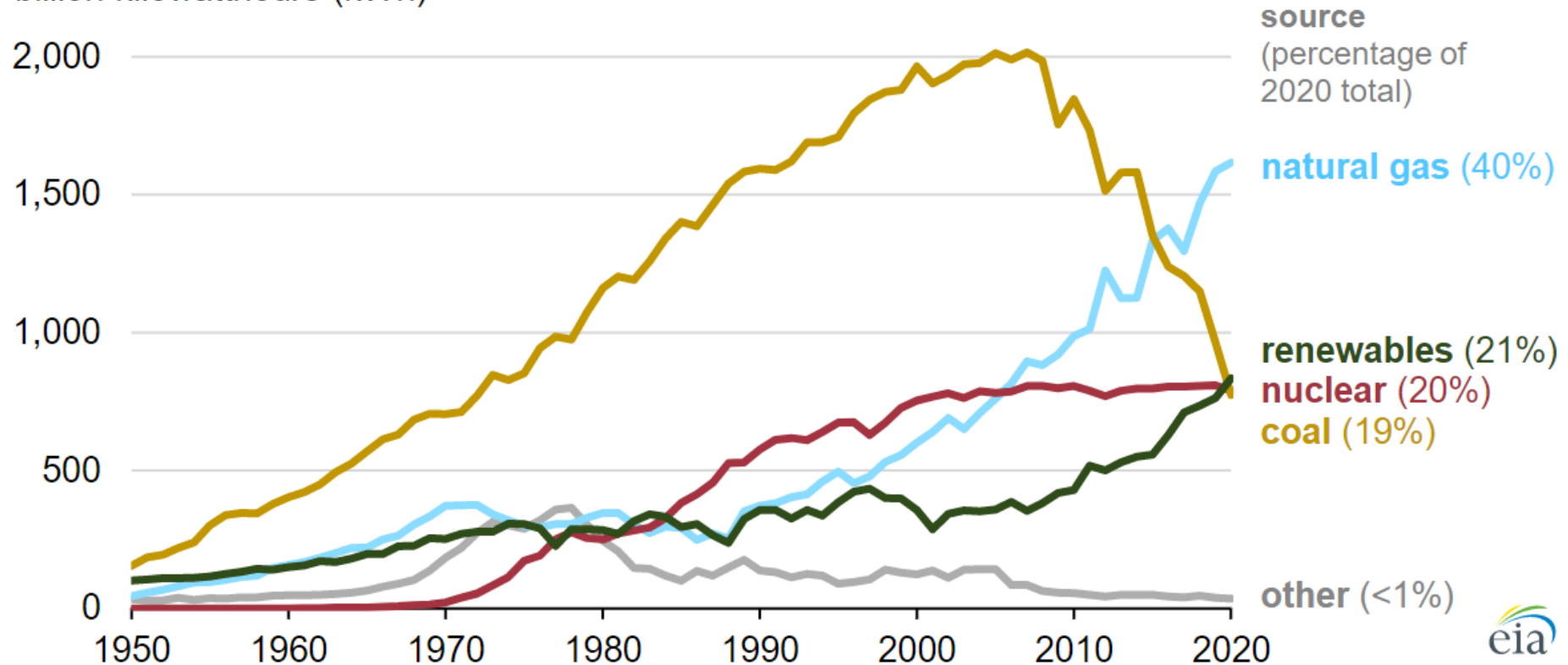


Why should you care about the electricity grid?

The generation mix is evolving...

Annual U.S. electricity generation from all sectors (1950–2020)

billion kilowatthours (kWh)



Source: U.S. Energy Information Administration (EIA), *Monthly Energy Review*

Note: This graph shows electricity net generation in all sectors (electric power, industrial, commercial, and residential) and includes both utility-scale and small-scale (customer-sited, less than 1 megawatt) solar.



Why should you care about the electricity grid?

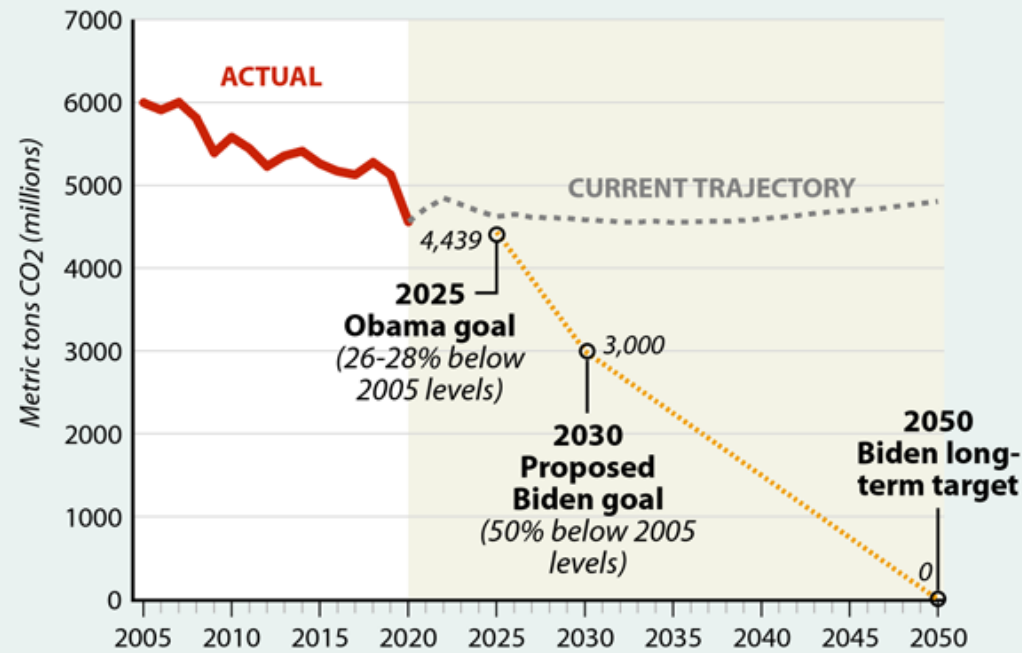
And will need to continue evolving...

Bending the Carbon Curve

Advocates of strong climate action are urging President Biden to adopt an ambitious goal of cutting greenhouse gas emissions 50 percent by 2030, to put the U.S. on track to decarbonize by 2050. Without policy action, climate pollution is on course to rebound and stay level.

U.S. ENERGY-RELATED NET CO₂ EMISSIONS

In millions of metric tons, 2005-2020



SOURCES: U.S. Energy Information Administration; ICN research

PAUL HORN / Inside Climate News

Why should you care about the electricity grid? Without a map, do you know where you are going?



Credits: Mapize



What is electricity?

e·lec·tric·i·ty

/əˌlekˈtrɪsədē/

noun

1. a form of energy resulting from the existence of charged particles (such as electrons or protons), either statically as an accumulation of charge or dynamically as a current.



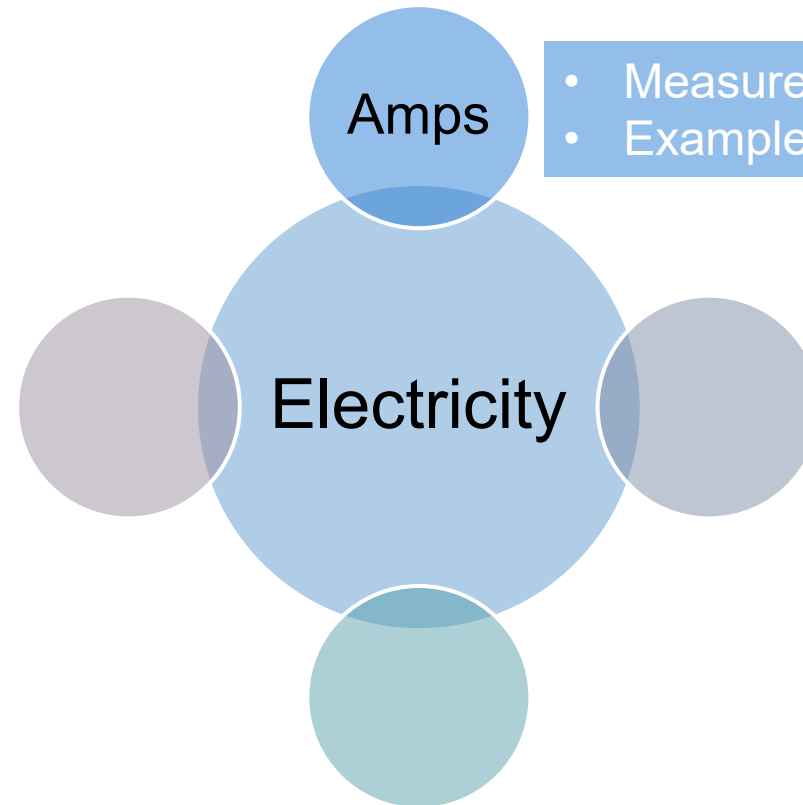
What is electricity?

e·lec·tric·i·ty

/əˈlekˈtrɪsədē/

noun

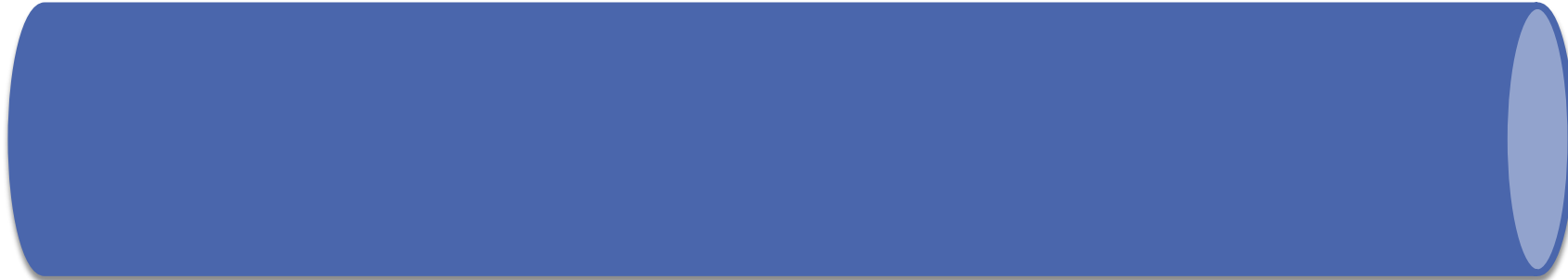
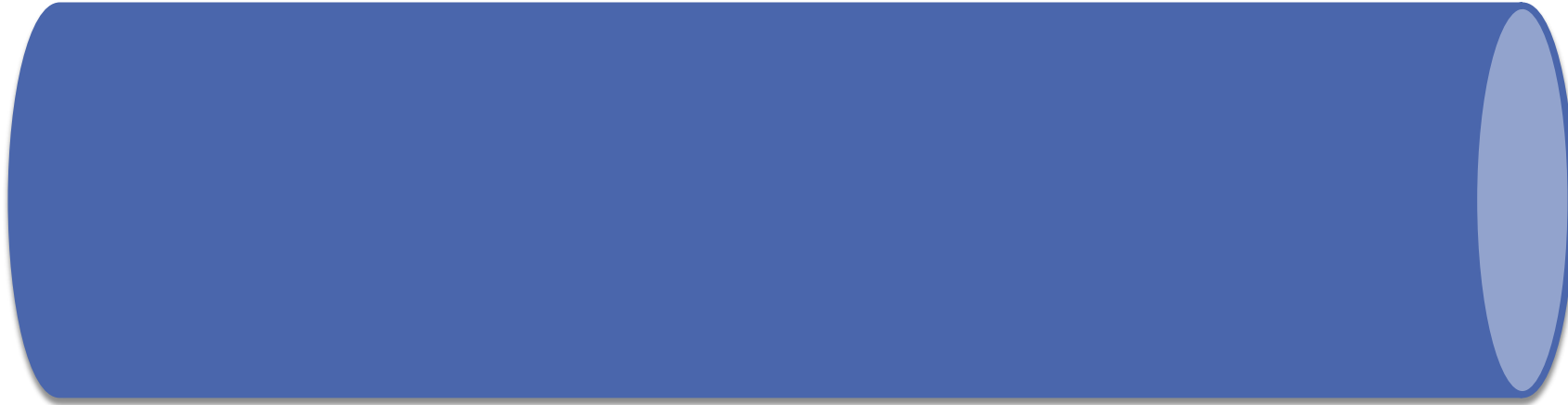
1. a form of energy resulting from the existence of charged particles (such as electrons or protons), either statically as an accumulation of charge or dynamically as a current.



- Measures **throughput** in a circuit
- Example: 15, 20, 30 amp



Which pipe has more throughput (i.e., amps)?



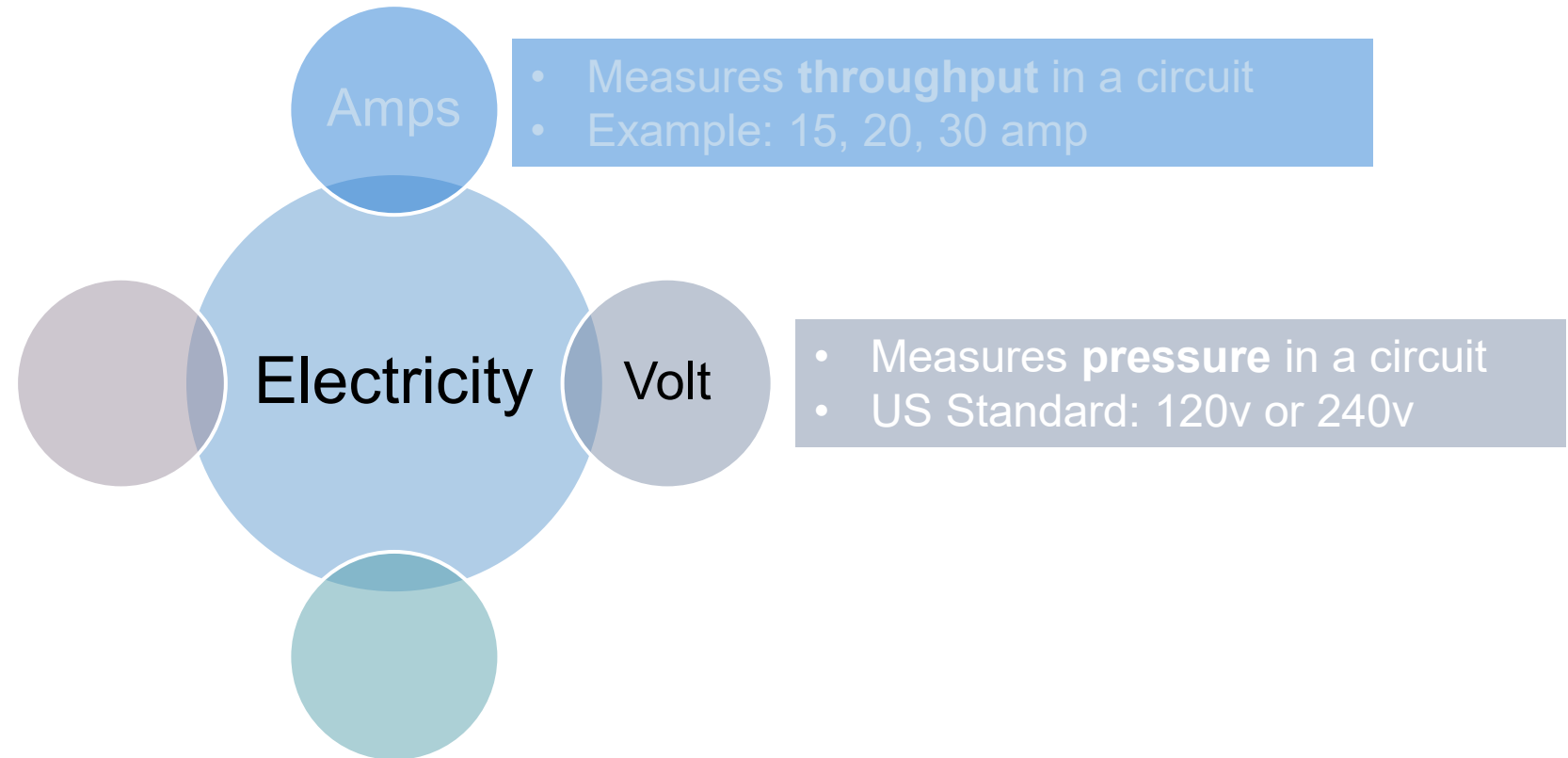
What is electricity?

e·lec·tric·i·ty

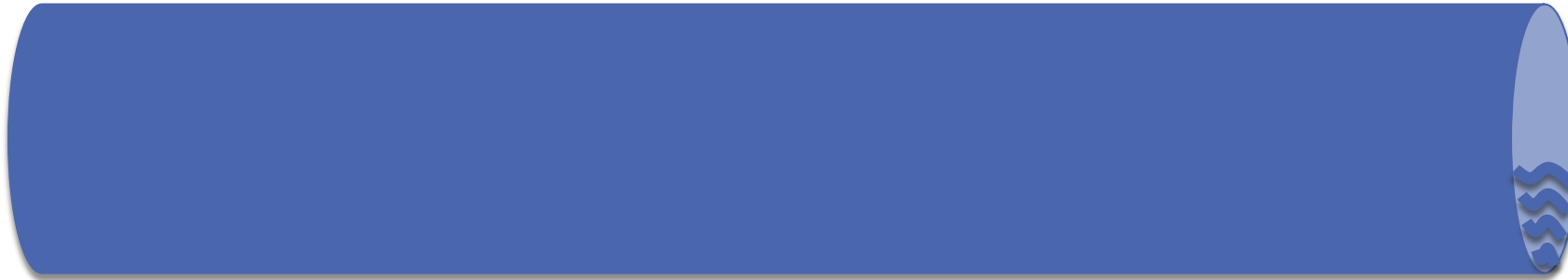
/əˈlekˈtrɪsədē/

noun

1. a form of energy resulting from the existence of charged particles (such as electrons or protons), either statically as an accumulation of charge or dynamically as a current.



Which pipe has more pressure (i.e., volts)?



What is electricity?

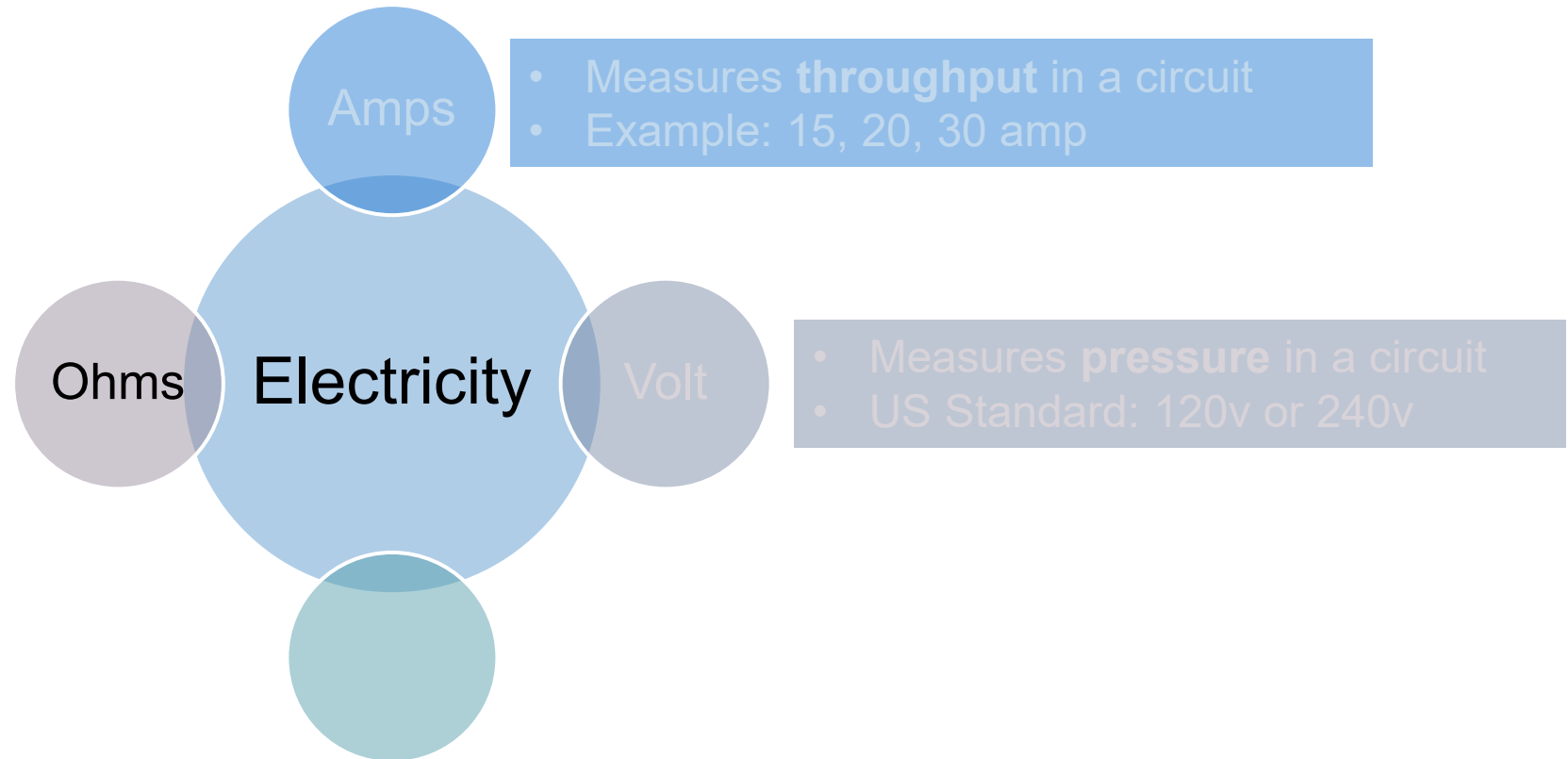
e·lec·tric·i·ty

/əˌlekˈtrɪsədē/

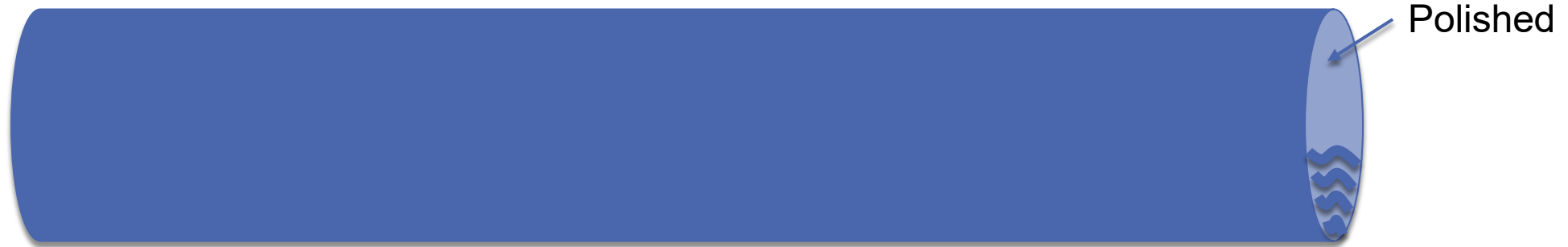
noun

1. a form of energy resulting from the existence of charged particles (such as electrons or protons), either statically as an accumulation of charge or dynamically as a current.

- Measures **friction** in a circuit
- Examples: 15, 20, 30 ohms



Which pipe has more friction (i.e., ohms)?



What is electricity?

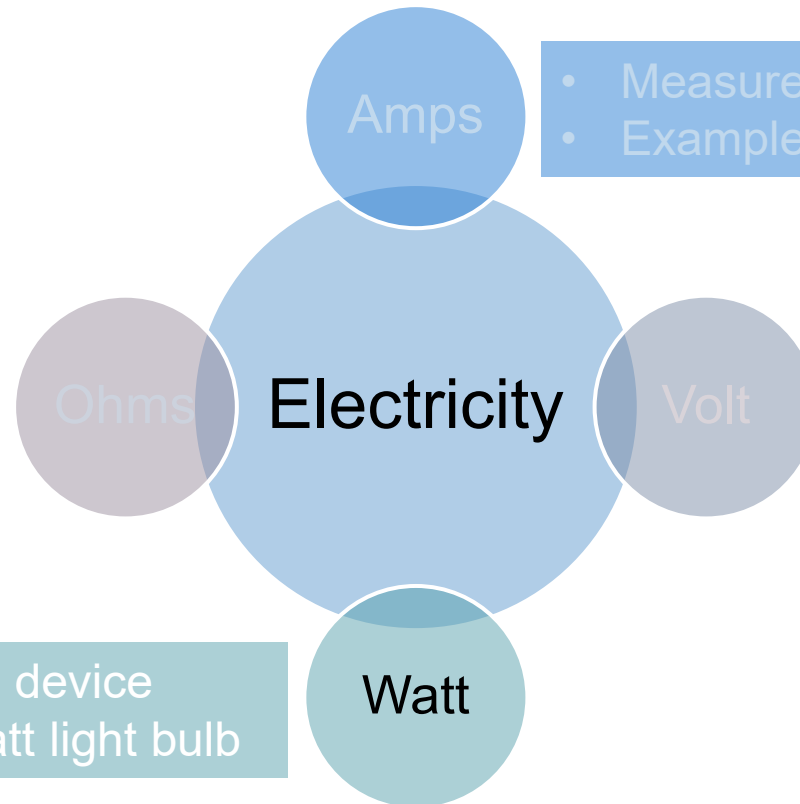
e·lec·tric·i·ty

/əˌlekˈtrɪsədē/

noun

1. a form of energy resulting from the existence of charged particles (such as electrons or protons), either statically as an accumulation of charge or dynamically as a current.

- Measures **friction** in a circuit
- Examples: 15, 20, 30 ohms



Amps

- Measures **throughput** in a circuit
- Example: 15, 20, 30 amp

Ohms

Electricity

Volt

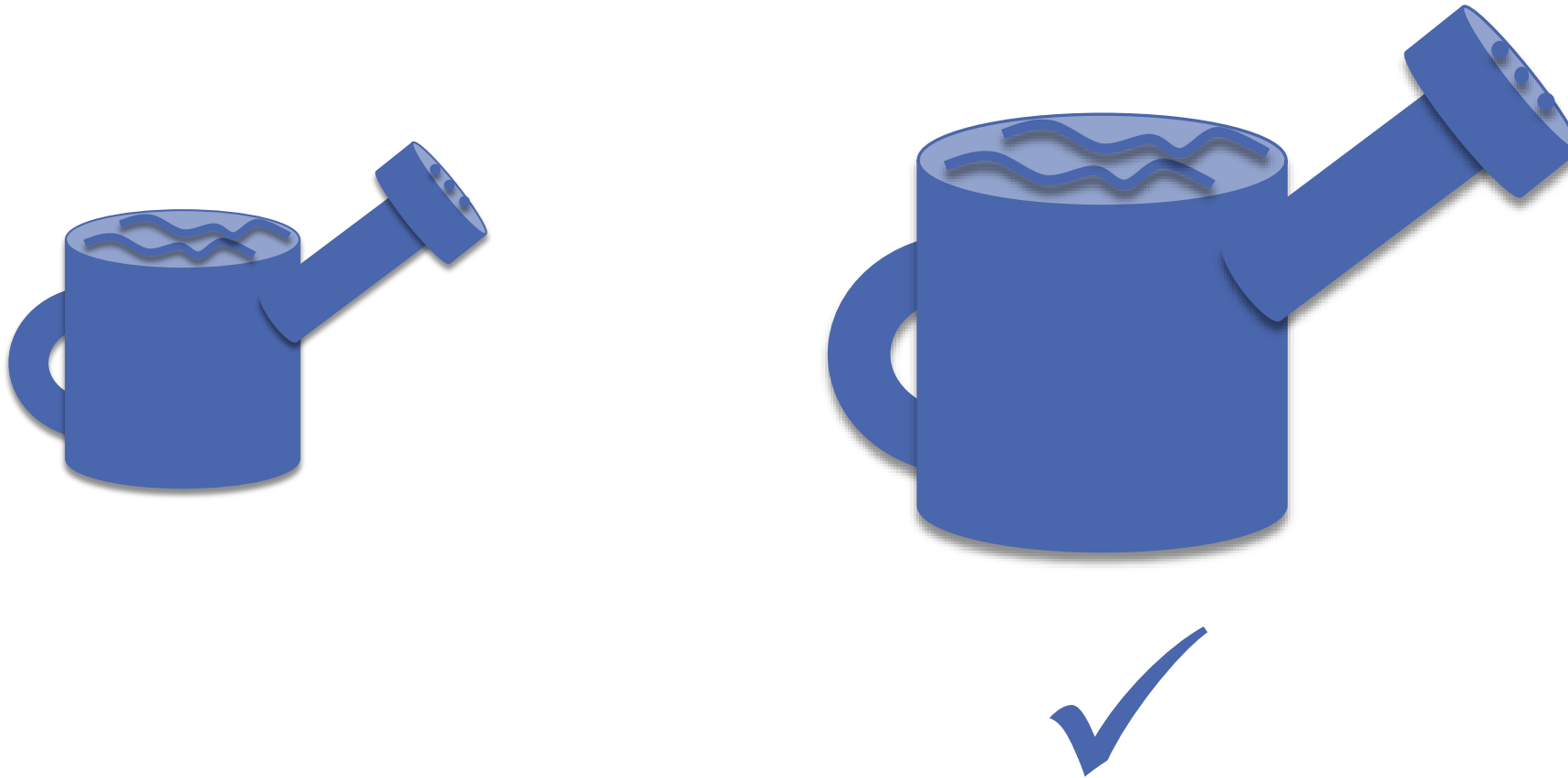
- Measures **pressure** in a circuit
- US Standard: 120v or 240v

Watt

- Measures **demand** of a device
- Example: 40 vs. 100 watt light bulb

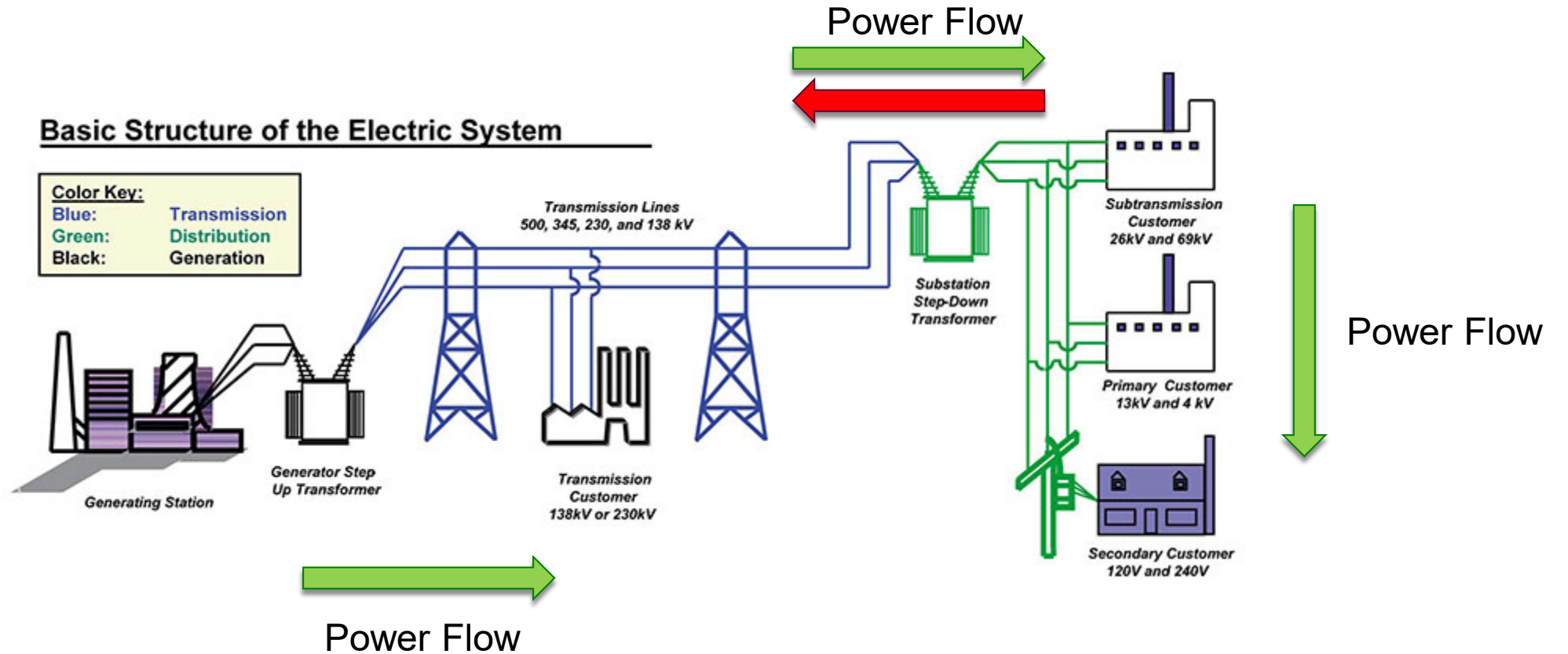


Which demands more water (i.e., watts)?



Electricity Grid 101

Traditional Design

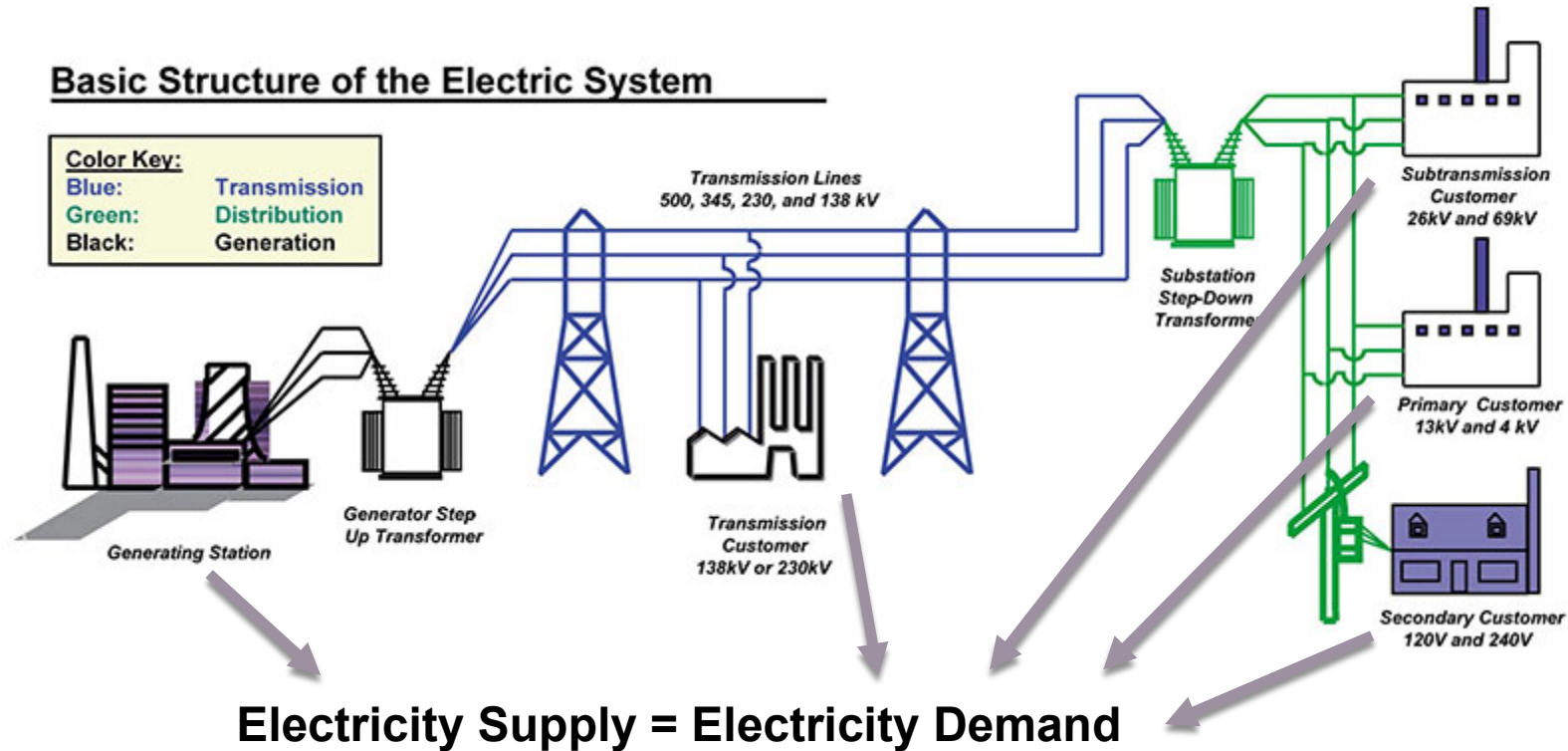


Credits: Union of Concerned Scientists



Electricity Grid 101

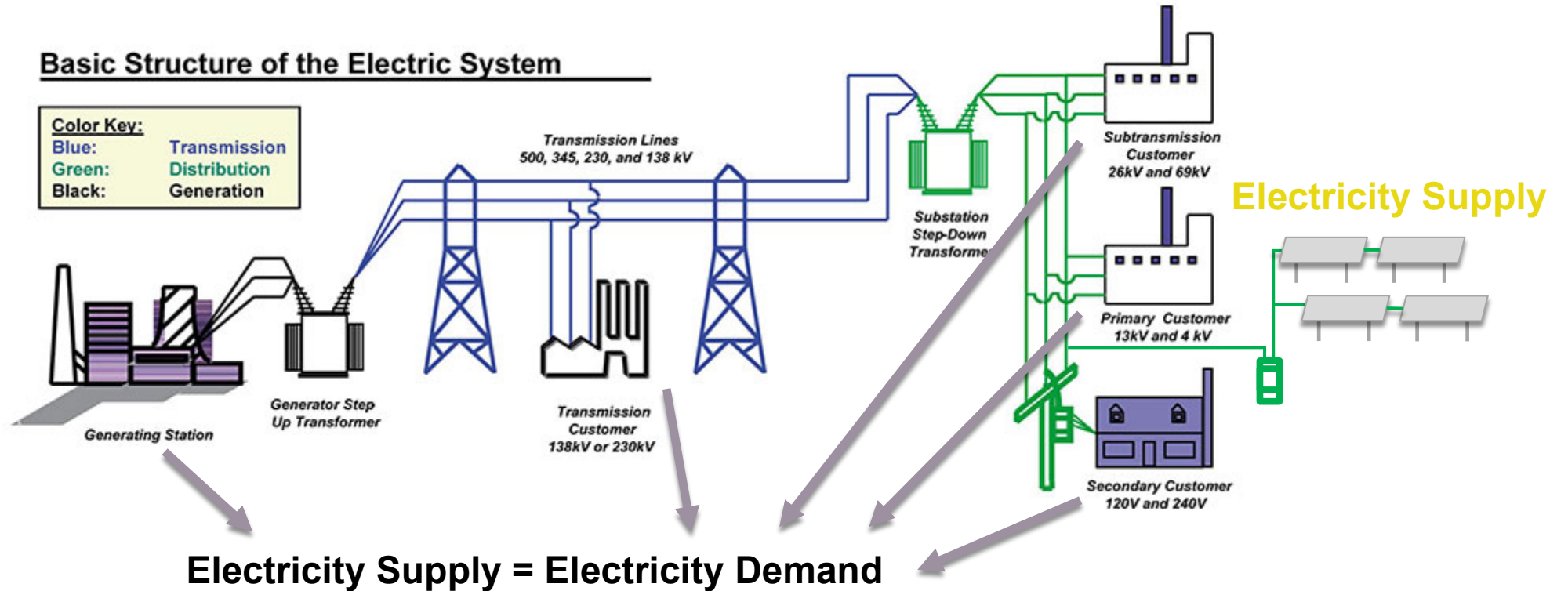
Planning and Operating Requirements



Credits: Union of Concerned Scientists

Electricity Grid 101

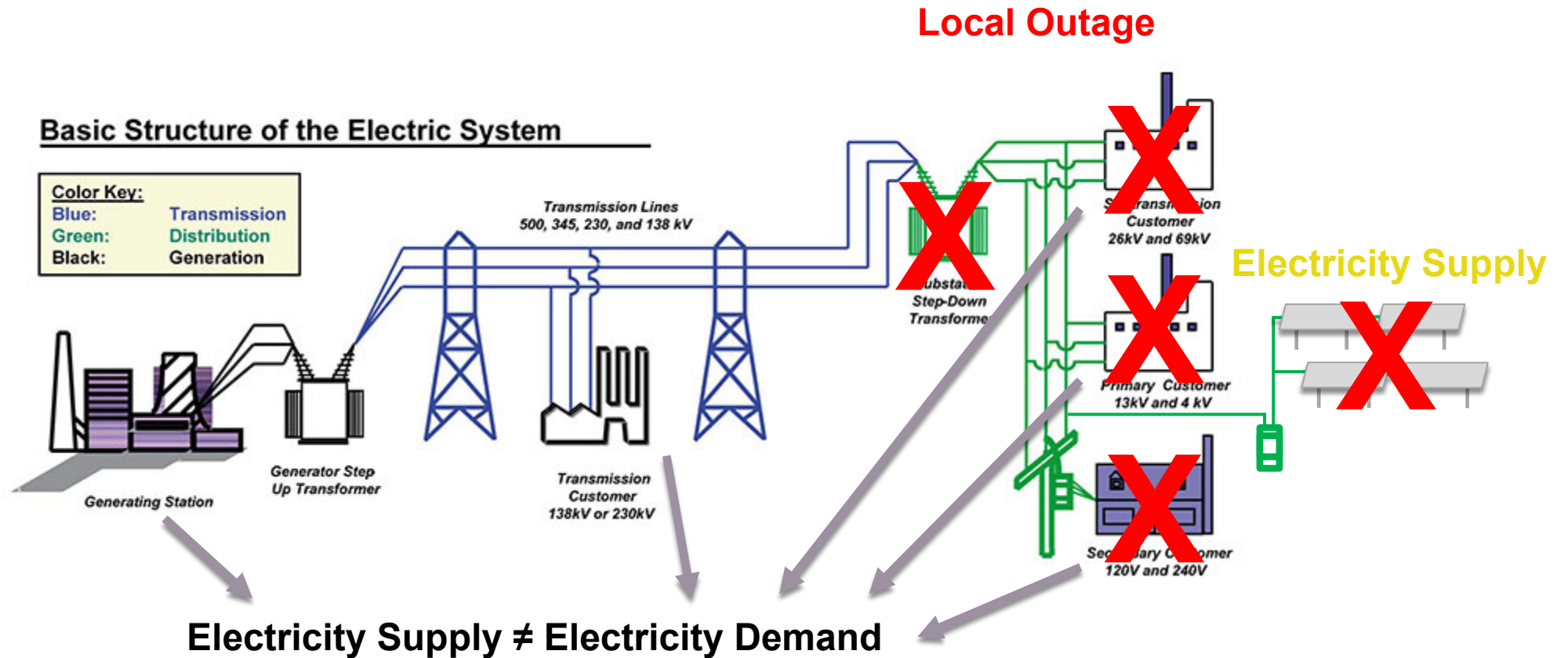
Integrating New Elements



Credits: Union of Concerned Scientists

Electricity Grid 101

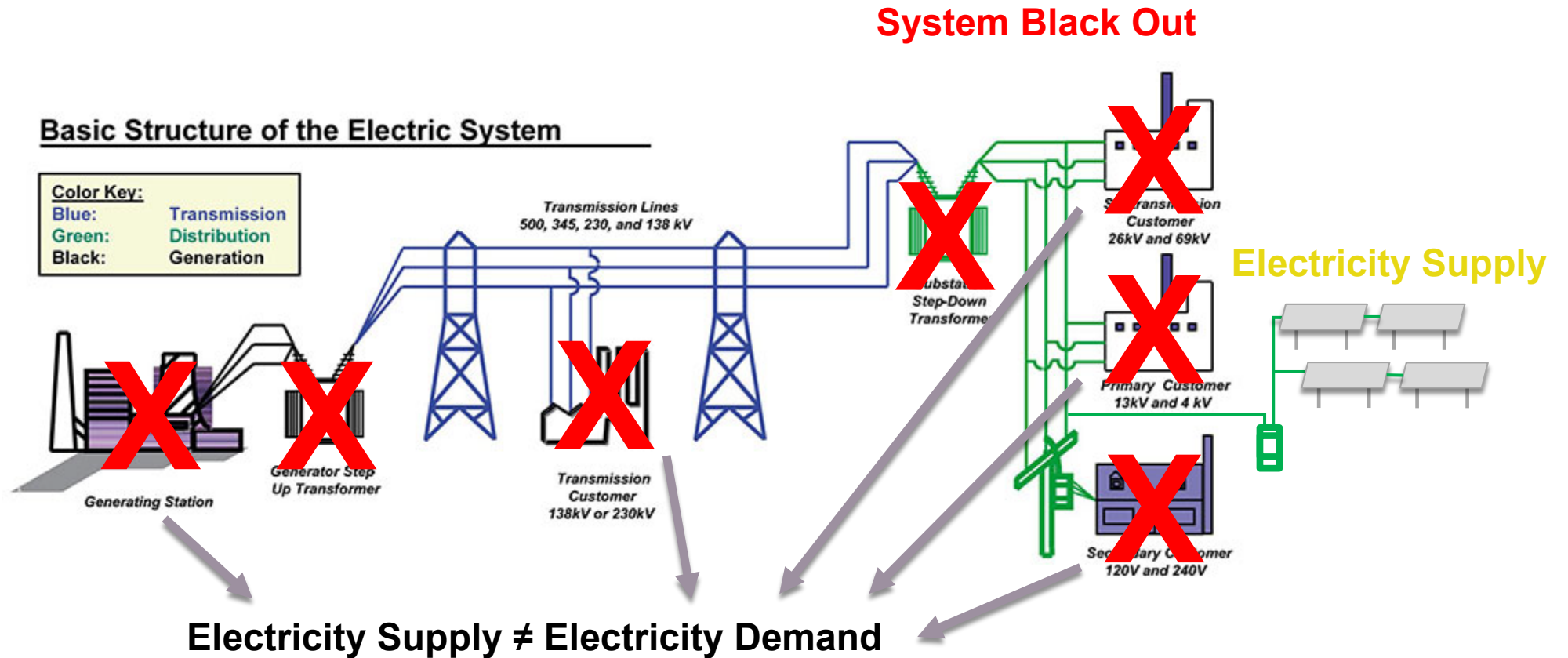
Integration Challenges with New Elements



Credits: Union of Concerned Scientists

Electricity Grid 101

Integration Challenges with New Elements



Credits: Union of Concerned Scientists

Thermal Generation Technologies

Operational Characteristics



Credits: Peter Cappers (LBNL)

- **Dispatchable:** Dependably able to be turned off, turned on, and generate electricity at a pre-determined level... **but** requires time before it can begin generating electricity (down time)
- **Ramping:** Dependably able to change the amount of electricity generated... **but** this is usually limited both over time (ramp rate) and range (min gen vs. max gen)



Variable Renewable Generation Technologies

Operational Characteristics



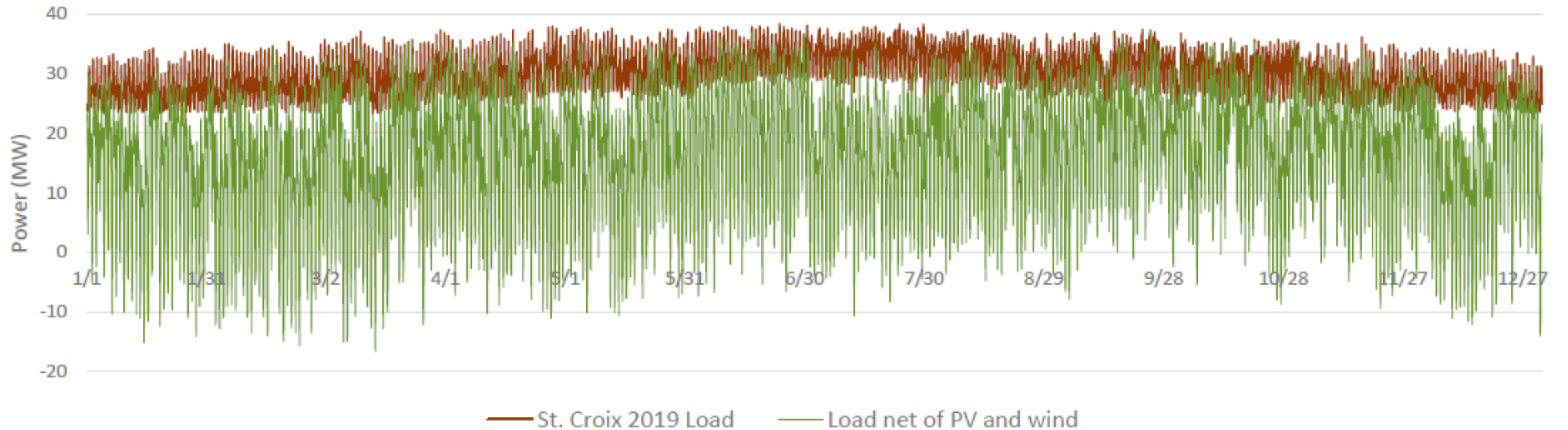
- **Dispatchable:** Dependably able to be turned off and turned on... **but** level of generated electricity is highly variable and uncertain in seconds to hour times scales
- **Ramping:** Unable to change the amount of electricity generated

Credits: Peter Cappers (LBNL)



Variable Renewable Generation Technologies

Integration Challenges



Credits: Dan Olis (NREL)

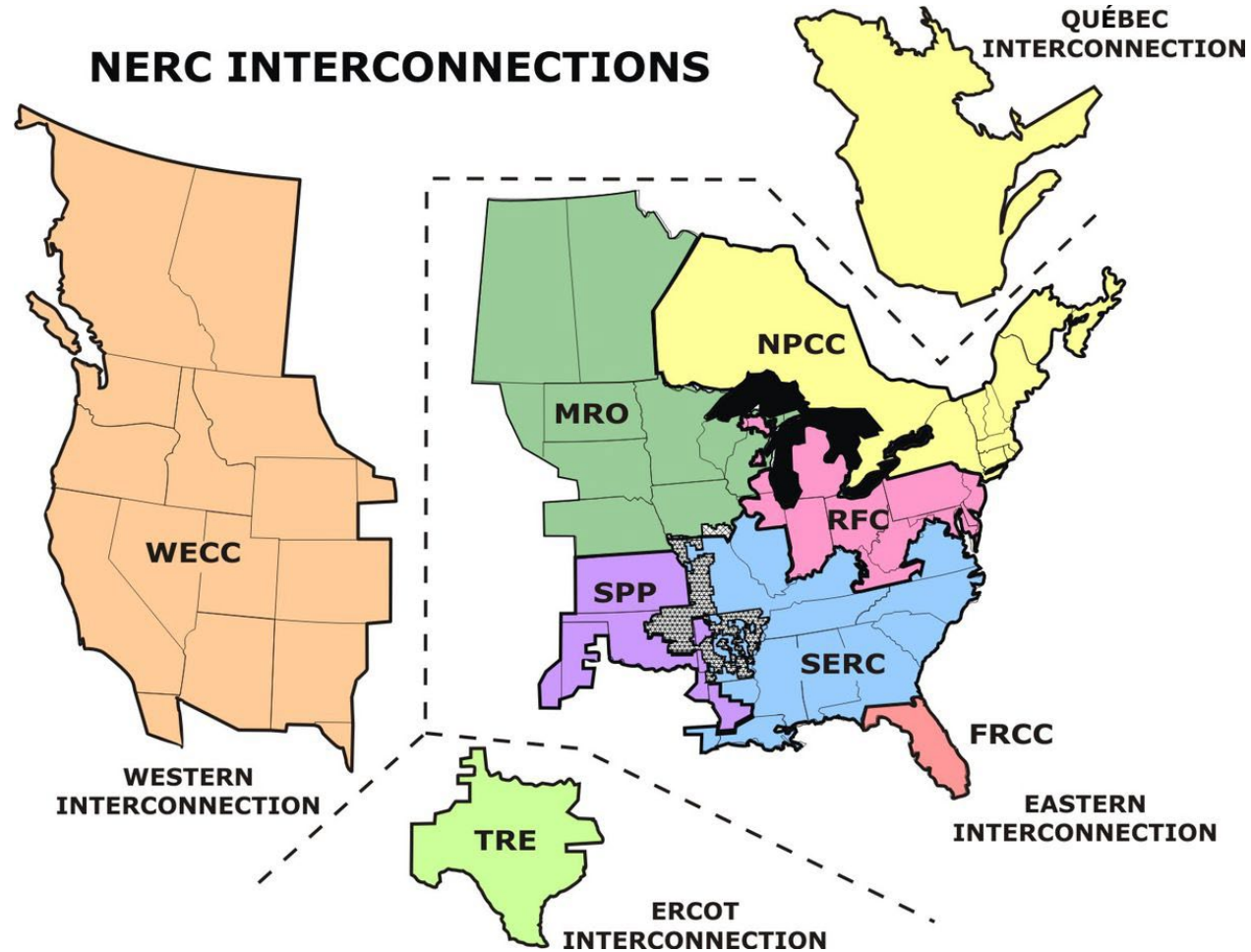


Where are we going?

- Section 1: Who Am I & Why Am I Here?
- Section 2: The Electric Grid
- **Section 3: Block Island and the Electric Grid**
- Section 4: Implications for Block Island's 2040 Energy Roadmap



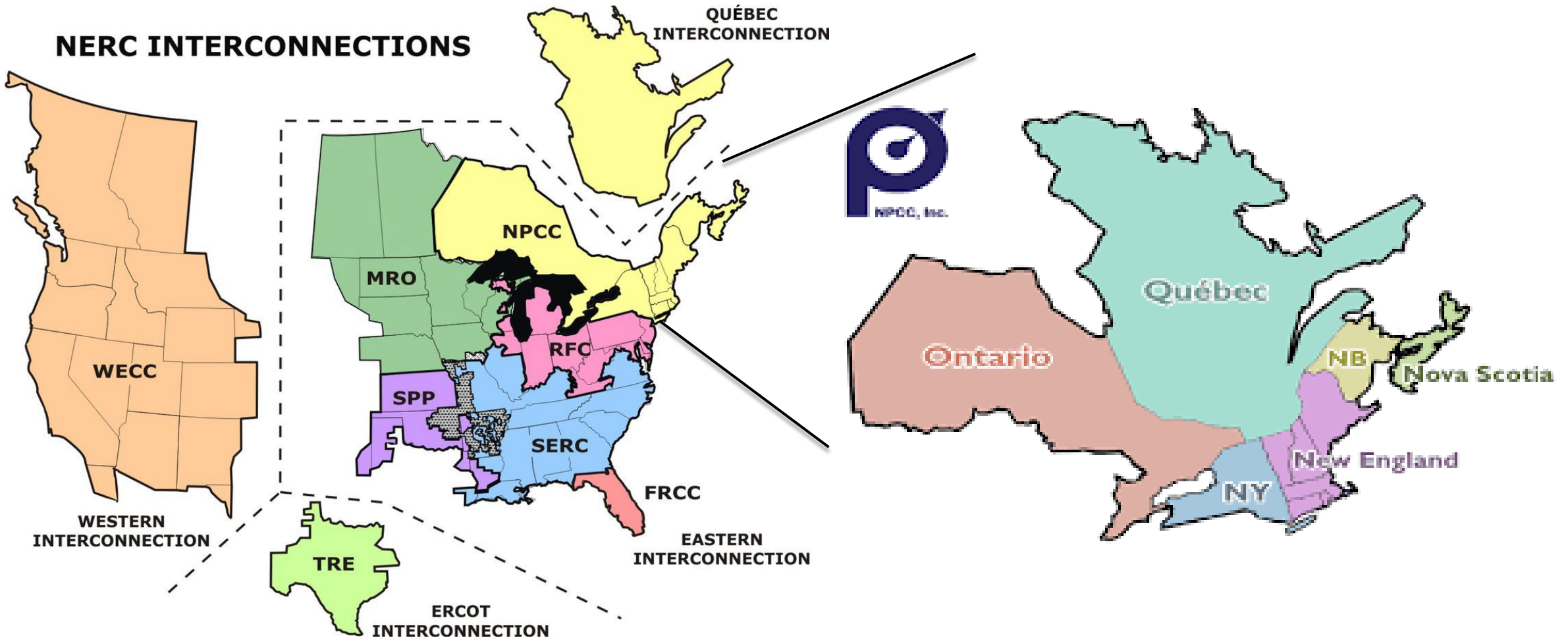
Block Island Is Part of a Much Bigger Electric Grid



Credits: North American Reliability Council



Block Island Is Part of a Much Bigger Electric Grid



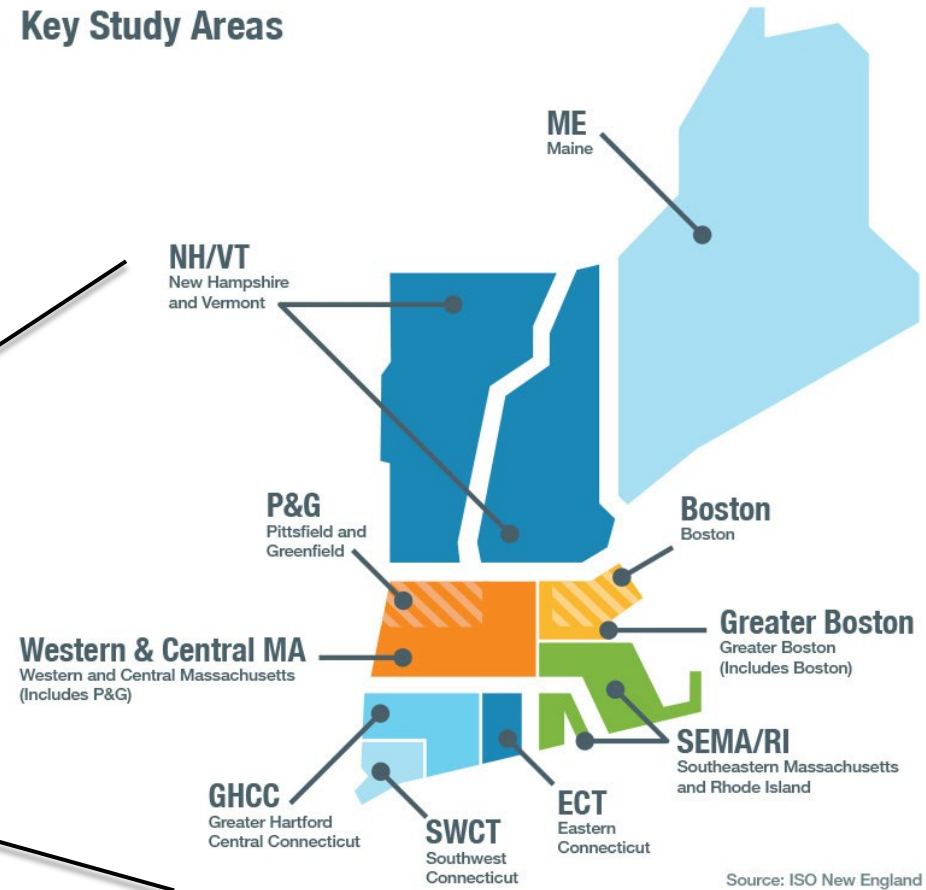
Credits: North American Reliability Council

Credits: Northeast Power Coordinating Council

Block Island Is Part of a Much Bigger Electric Grid



Key Study Areas



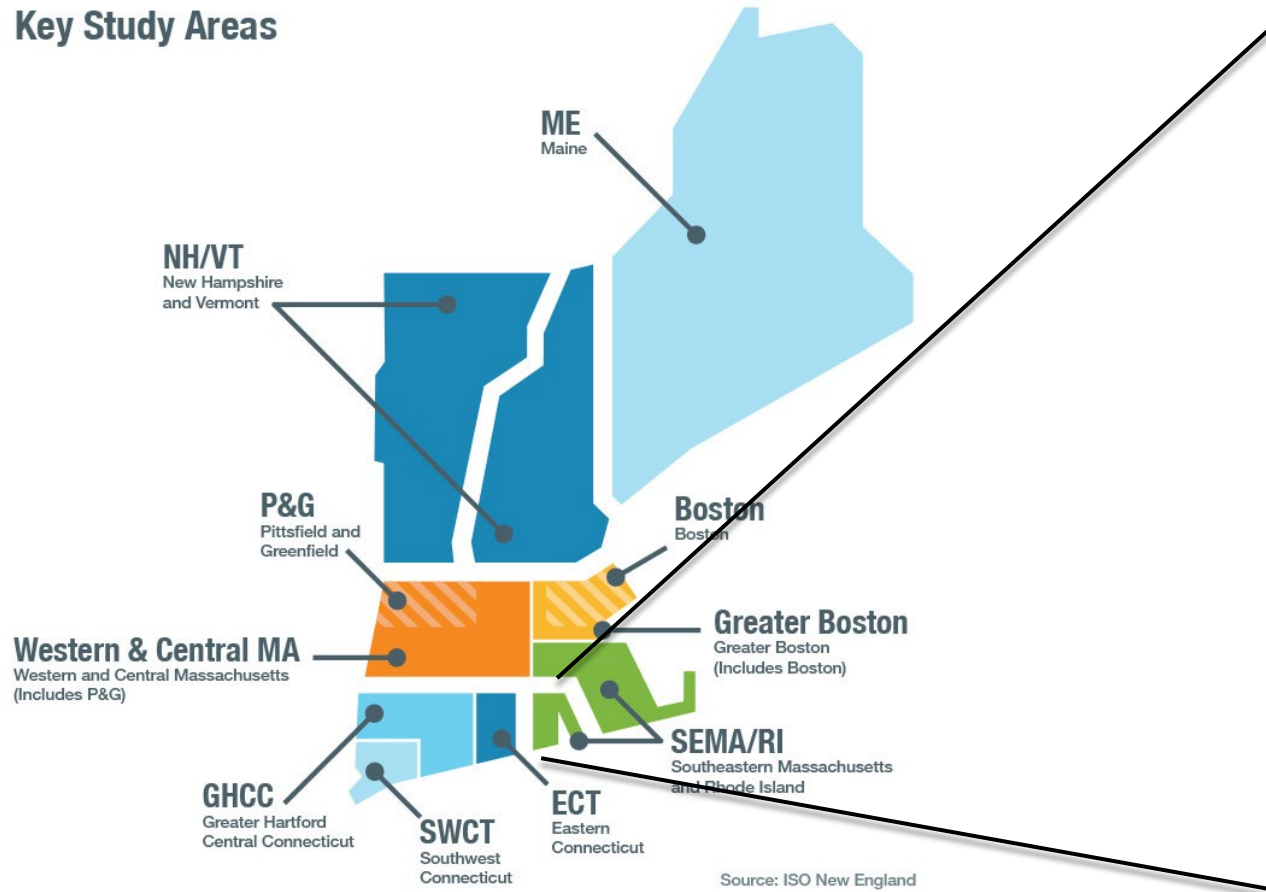
Credits: Northeast Power Coordinating Council

Credits: ISO New England

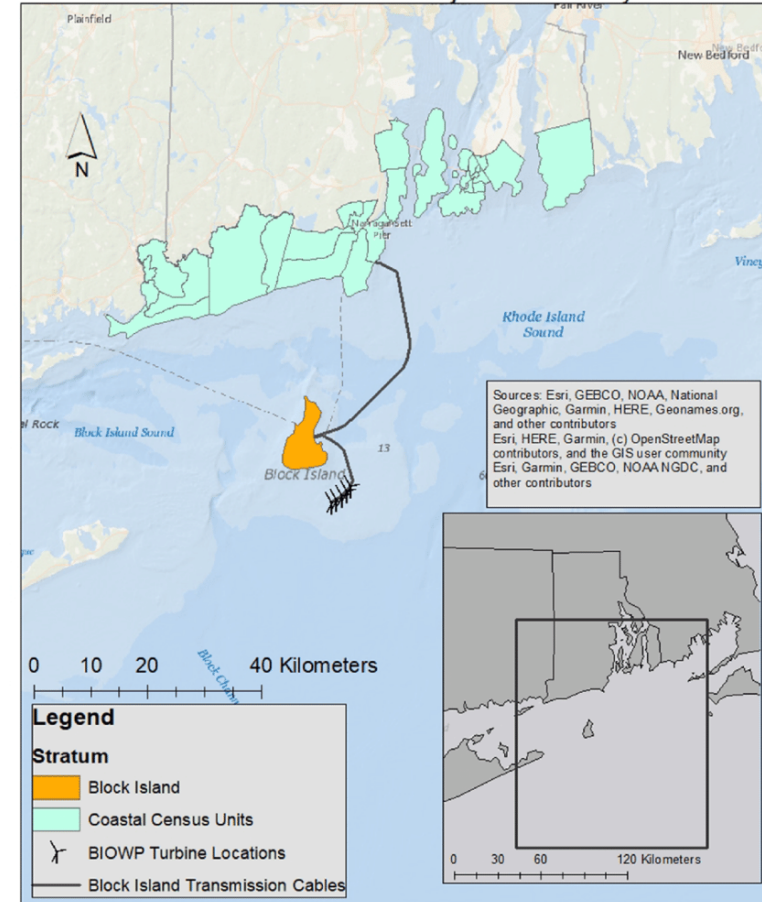


Block Island Is Part of a Much Bigger Electric Grid

Key Study Areas



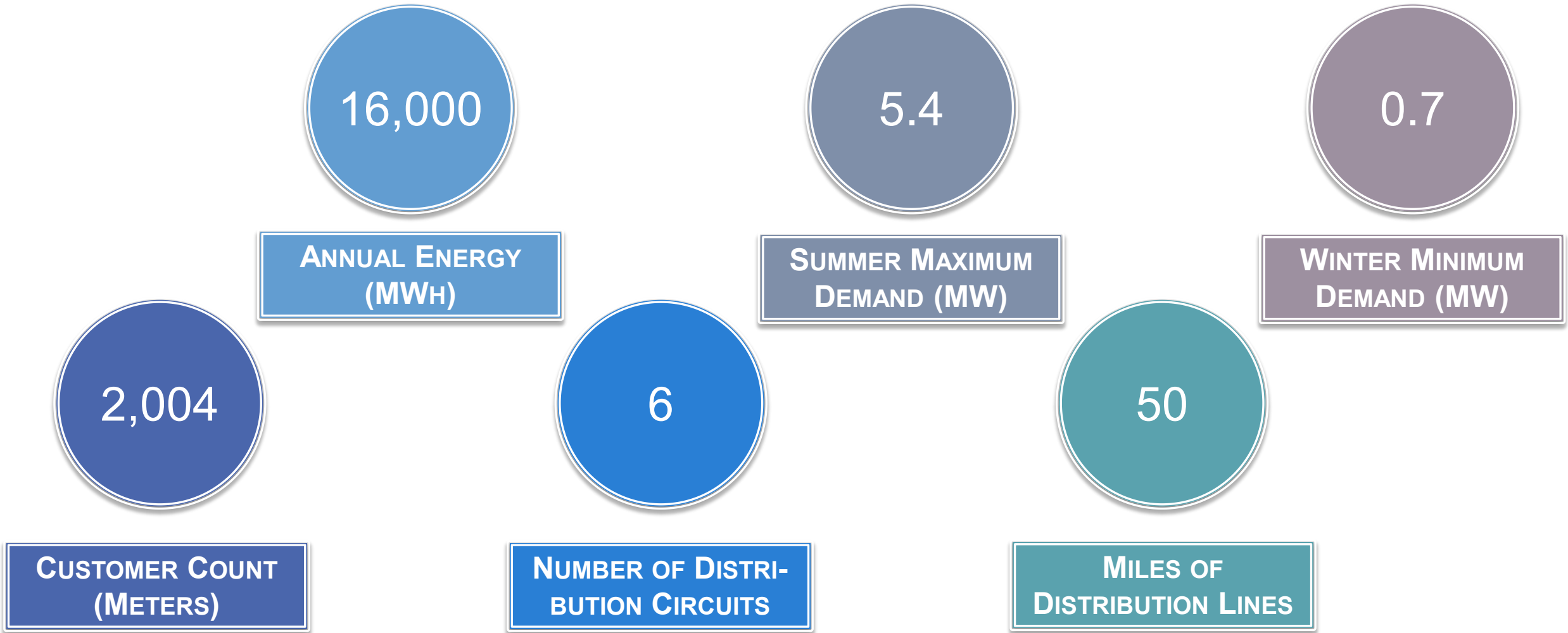
Block Island Offshore Wind Project and Survey Strata



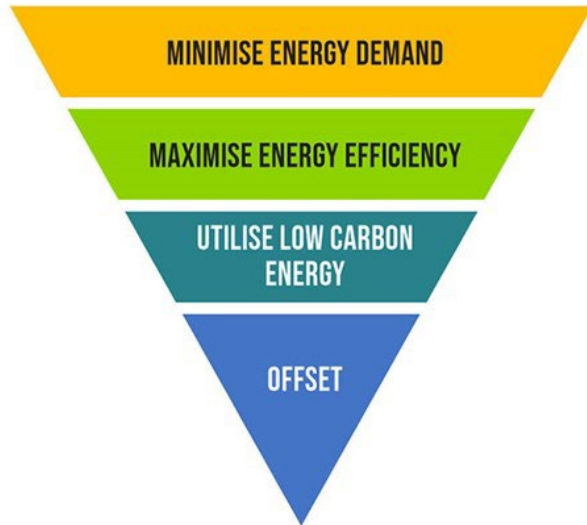
Credits: ISO New England

Credits: Russell et al. (2020)

Your Electricity Provider: Block Island Utility District



BIUD Sustainability Initiatives



Energy Efficiency Program

- Demand Side Management Plan
- Energy Audits
- Business Lighting Rebates
- Weatherization Rebates
- HVAC and Water Heating Rebates

Distributed Energy Export Compensation

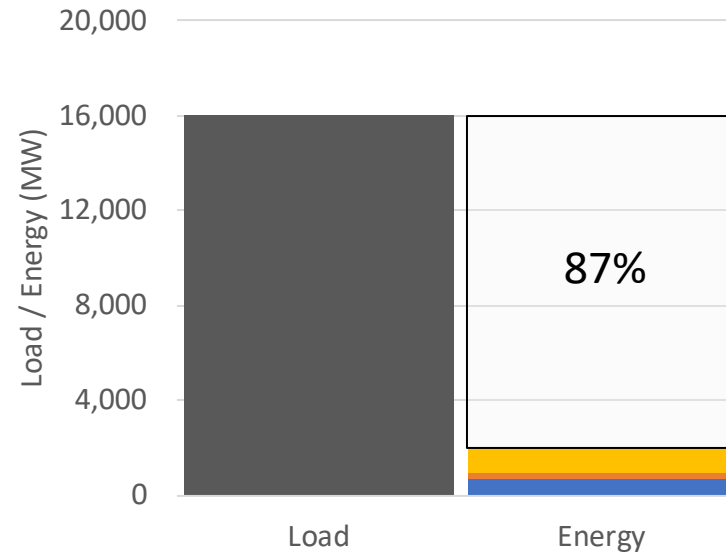
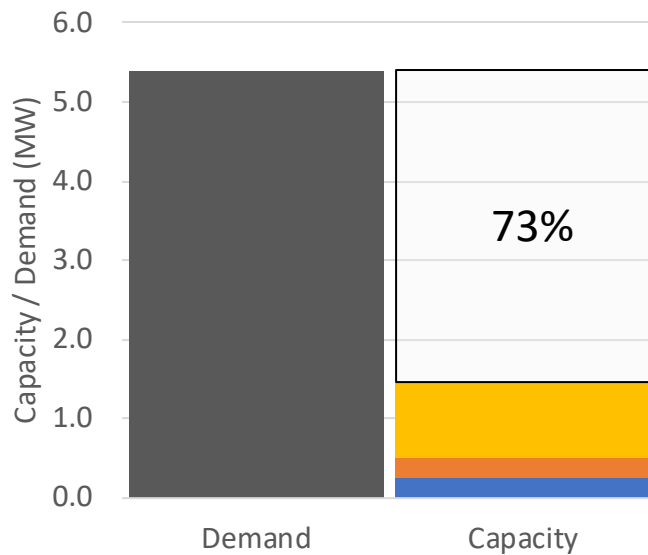
- Avoided cost + Transmission / Capacity Benefits
- \$0.1855 /kWh
- \$1,000 DER Meter Rebate

Renewable Energy Credit Purchases

- 24% of annual energy supply from existing contracts provide RECs
- BIUD goes out into the REC market to cover the remaining 76% given interest in being carbon neutral



Current On-Island Generating Capacity and Energy



- Utility-Scale Solar (0.00 @ 13.0% Cap Factor)
- Utility-Scale Wind (0.00 MW @ 30.9% Cap Factor)
- Biofuel (0.00 MW @ 55.0% Cap Factor)
- Community-Scale Solar (0.94 MW @ 13.0% Cap Factor)
- Community-Scale Wind (0.00 MW @ 30.9% Cap Factor)
- Distributed-Scale Solar (0.26 MW @ 13.0% Cap Factor)
- Distributed-Scale Wind (0.25 MW @ 30.9% Cap Factor)



Block Island Wind Farm

- 5 GE Haliade 150-6MW turbines
- 30 MW Nameplate Capacity
- Owned by Orsted US Offshore Wind
- Exclusive 20 year PPA with National Grid (now Rhode Island Energy)
- 24.4 ¢/kW + 3.5% annual increase

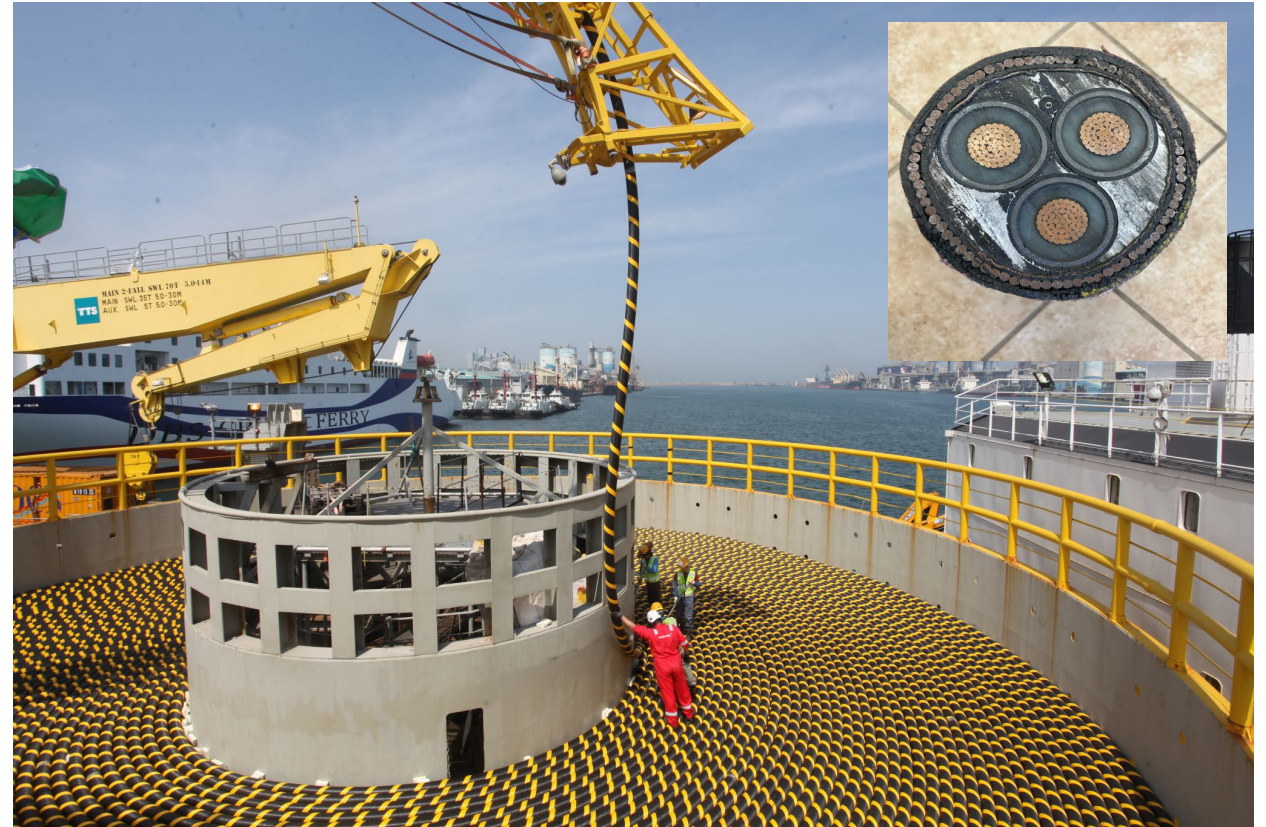


Credit: ENDIPREV



The Undersea Cable

- ❑ Owned by National Grid (now Rhode Island Energy) since project initiation
- ❑ Maximum carrying capacity of 30MW at 34.5kV (relatively low voltage)
- ❑ 20 year O&M contract for the cable
- ❑ **No backfeeding** allowed in current agreement
- ❑ Status and capability of the cable is uncertain after the O&M contract expires (is the 2021 reburial a good thing or a bad thing?)



Credit: Kokosing



Where are we going?

- Section 1: Who Am I & Why Am I Here?
- Section 2: The Electric Grid
- Section 3: Block Island and the Electric Grid
- **Section 4: Implications for Block Island's 2040 Energy Roadmap**



Energy demand on Block Island is going to change



Credits : House and



Credits : iStock

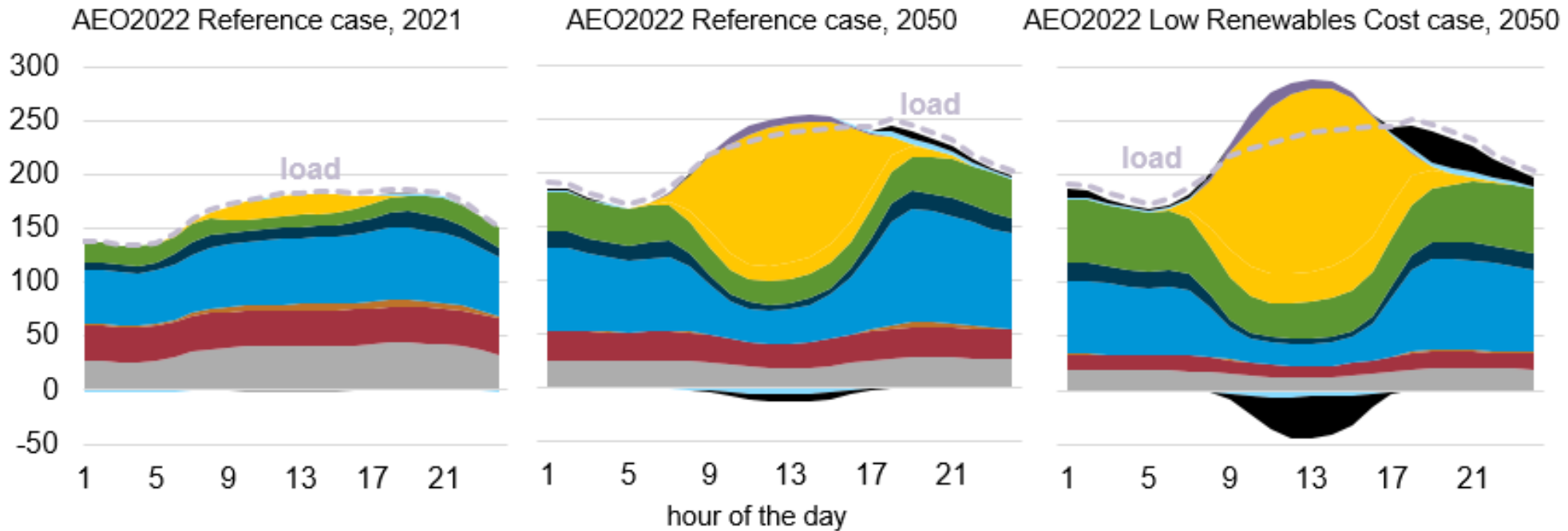


Credits : iStock



Timing of energy demand is going to change

Hourly U.S. electricity generation and load by fuel for selected cases and representative years
billion kilowatthours



curtailment battery storage pumped storage solar wind hydroelectric natural gas combined-cycle natural gas and oil peakers nuclear coal

Source: U.S. Energy Information Administration, *Annual Energy Outlook 2022* (AEO2022)

Note: Negative generation represents charging of energy storage technologies such as pumped hydro and battery storage. Hourly dispatch estimates are illustrative and are developed to determine curtailment and storage operations; final dispatch estimates are developed separately and may differ from total utilization as this figure shows. Solar includes both utility-scale and end-use photovoltaic electricity generation.



ETIPP – Roadmap to 2040

1. Develop annual load forecast



Energy supply on Block Island will need to change



Credits : iStock

Credits : Green Energy Consumers Alliance



ETIPP – Roadmap to 2040

1. Develop annual load forecast
2. Develop community-scale renewable energy resource assessment



Ensure Block Island grid is stable and secure



Credits : The Motley Fool



ETIPP – Roadmap to 2040

1. Develop annual load forecast
2. Develop community-scale renewable energy resource assessment
3. Assess grid integration needs



The future electric grid on Block Island is uncertain

Electric
demand

?

Renewable
energy supply

?

Integration
needs

?



ETIPP – Roadmap to 2040

1. Develop annual load forecast
2. Develop community-scale renewable energy resource assessment
3. Assess grid integration needs
4. Perform scenario analysis to assess tradeoffs associated with different potential pathways





Questions?

Peter Cappers
Staff Scientist

PAcappers@lbl.gov
315-637-0513



This is Wallie 😊