2022 Biennial Energy Report

Senate Committee on Energy and the Environment
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OREGON DEPARTMENT OF ENERGY

OREGON DEPARTMENT OF ENERGY

Leading Oregon to a safe, equitable, clean, and sustainable energy future.

Our Mission

The Oregon Department of Energy helps Oregonians make informed decisions and maintain a resilient and affordable energy system. We advance solutions to shape an equitable clean energy transition, protect the environment and public health, and responsibly balance energy needs and impacts for current and future generations.

What We Do

On behalf of Oregonians across the state, the Oregon Department of Energy achieves its mission by providing:

- A Central Repository of Energy Data, Information, and Analysis
- A Venue for Problem-Solving Oregon's Energy Challenges
- Energy Education and Technical Assistance
- Regulation and Oversight
- Energy Programs and Activities

2022 BIENNIAL ENERGY REPORT

Goal of the Report

Pursuant to ORS 469.059, provide a comprehensive review of energy resources, policies, trends, and forecasts, and what they mean for Oregon.

Scoping the Report

Shaped by a data-driven process, equity considerations, and input from stakeholders and the public.

Designing the Report

Themes cross sections – energy 101s, resource and technology reviews, policy briefs.

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https://energyinfo.oregon.gov/ber

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Energy by the Numbers

Oregon's overall and sector-based energy use, energy production and generation, and energy expenditures.

Data and metrics track how Oregon produces, purchases, and uses various types of energy.

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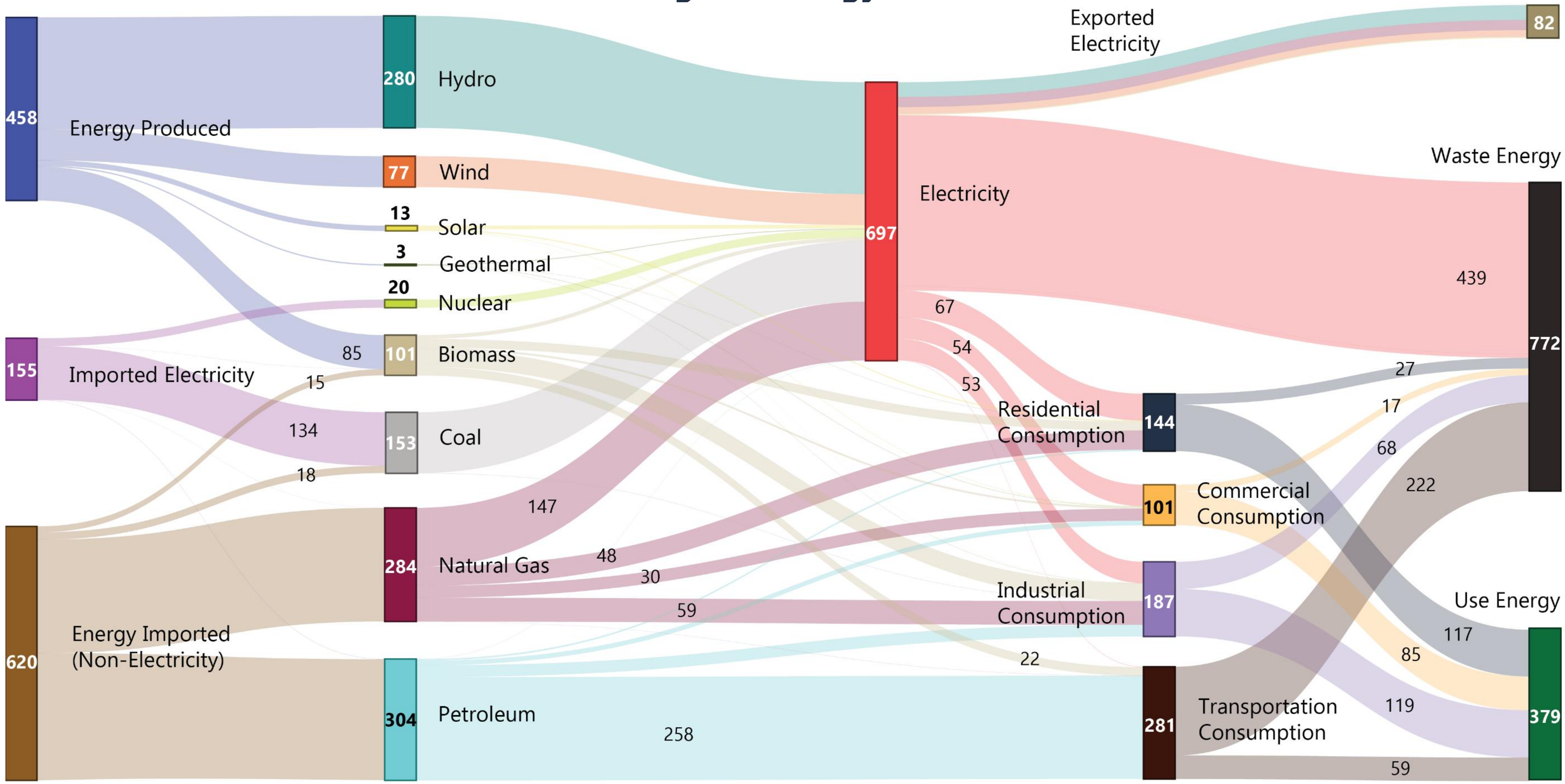
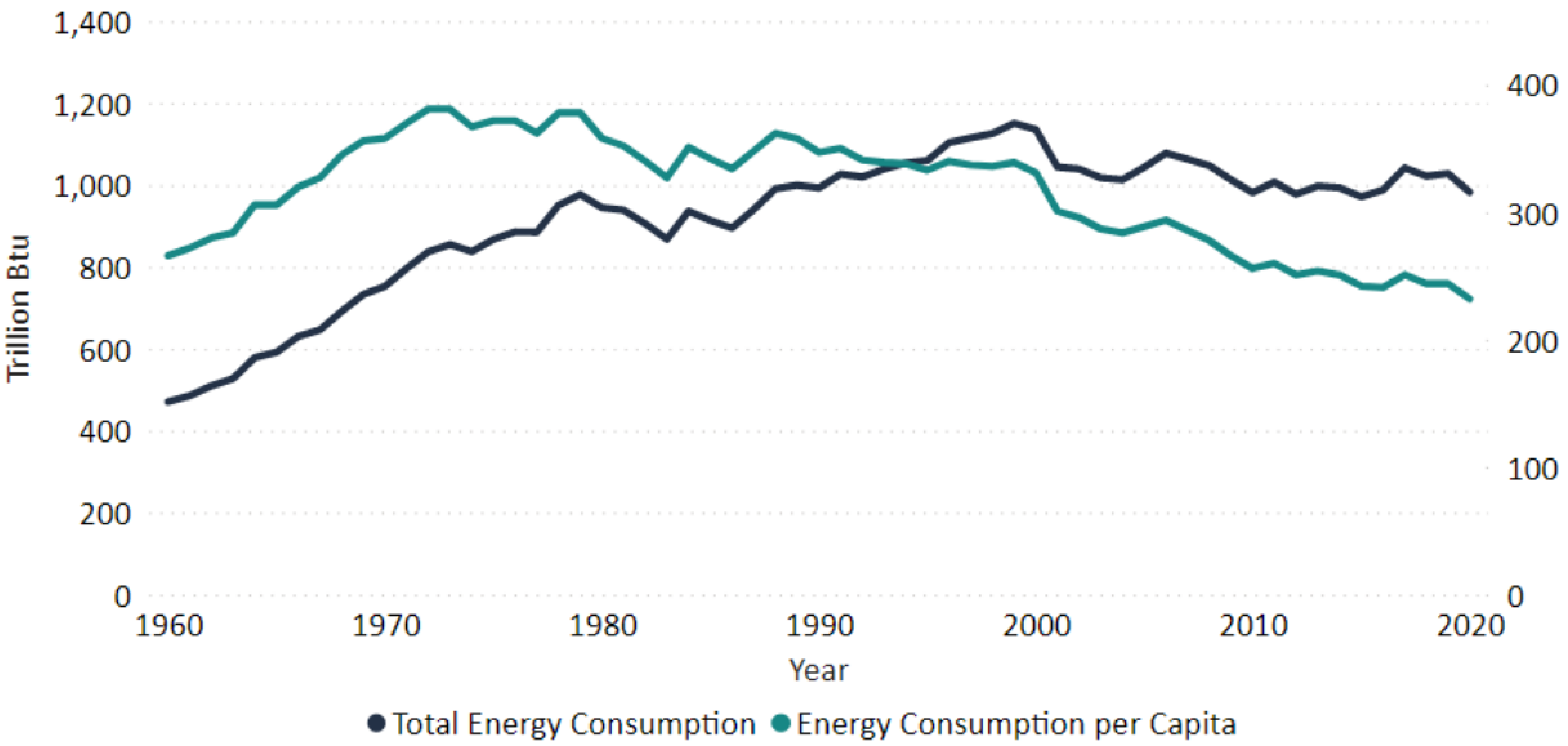
Oregon's Energy Flow

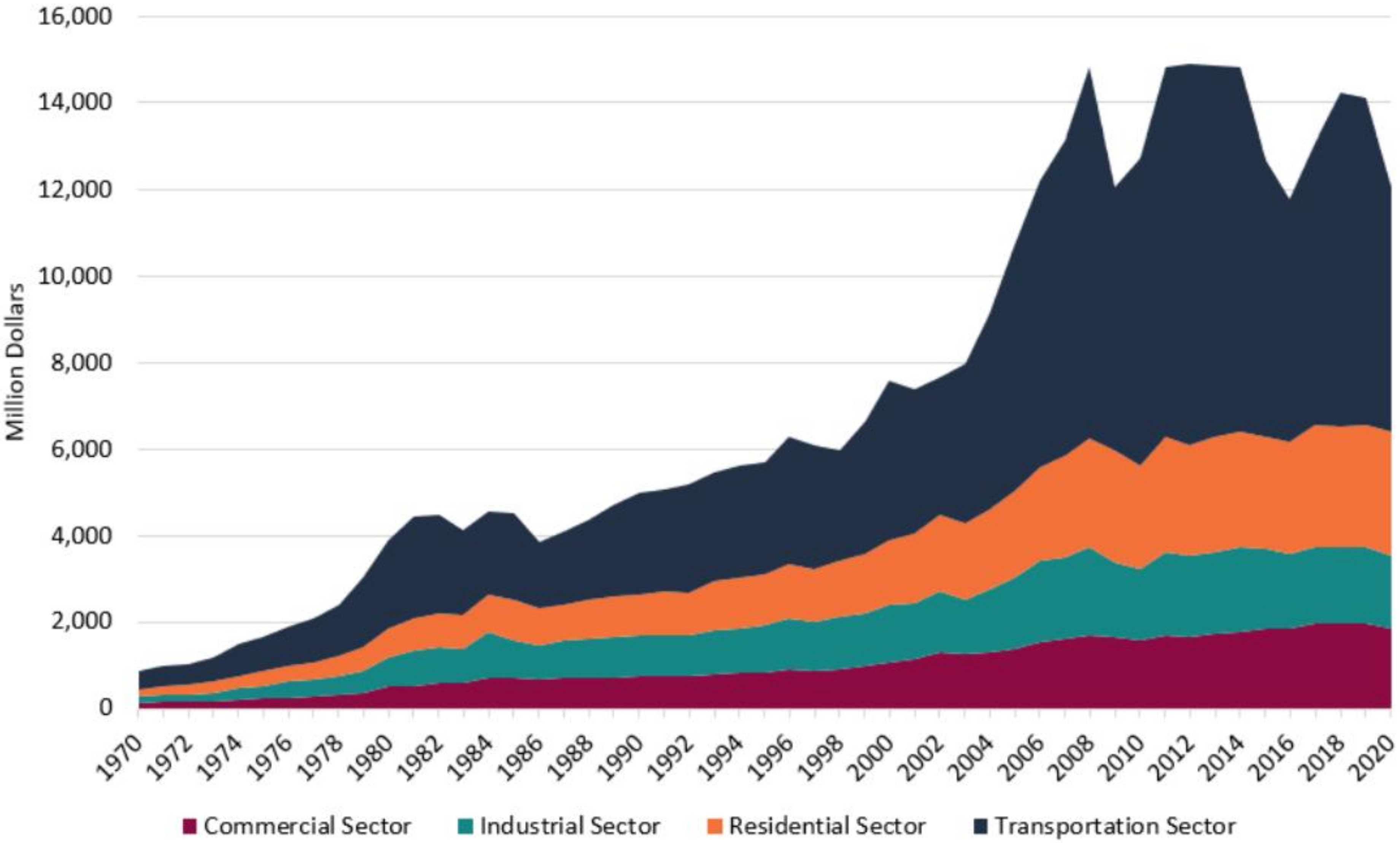


Numbers are in trillions of British thermal units (Btus)

Oregon's Total Energy Consumption and Per Capita Energy Consumption Over Time



Oregon's Total Energy Expenditures by Sector Over Time



U.S. EIA reports prices in current dollars per million Btu. Chart is not adjusted for inflation.

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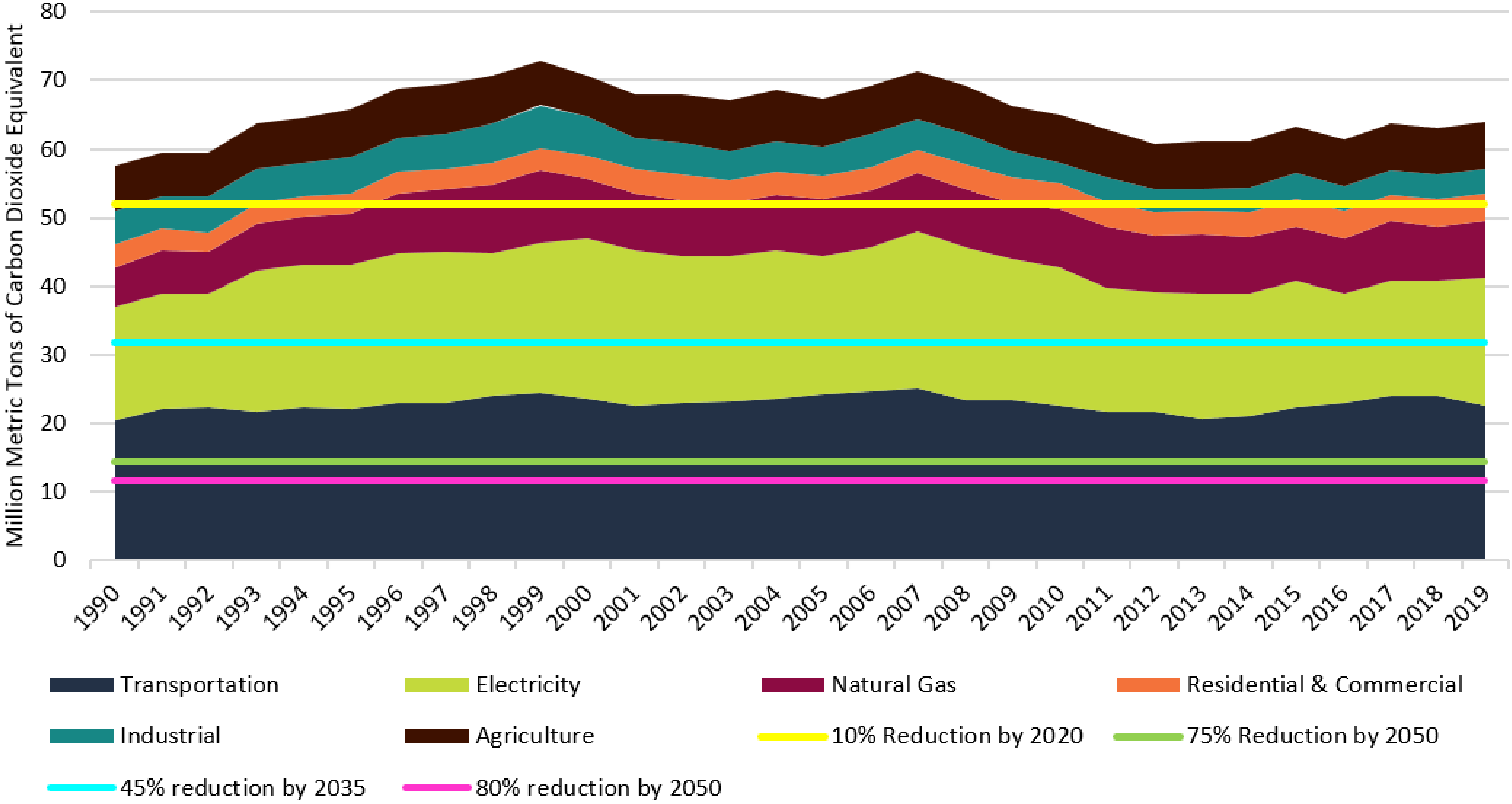
Oregon Greenhouse Gas Emissions Over Time



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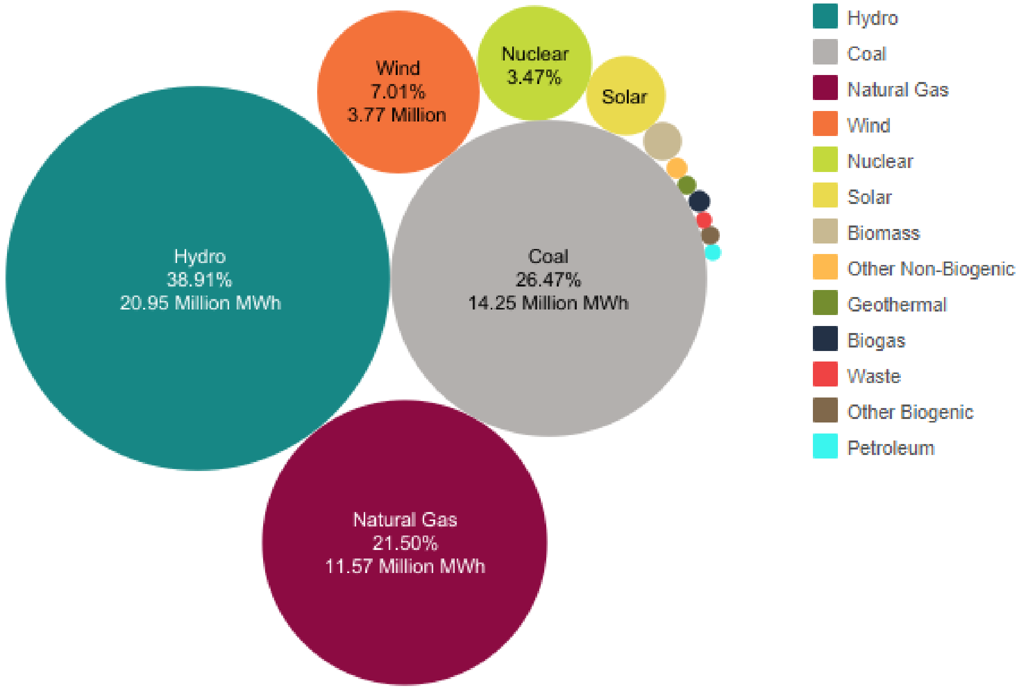
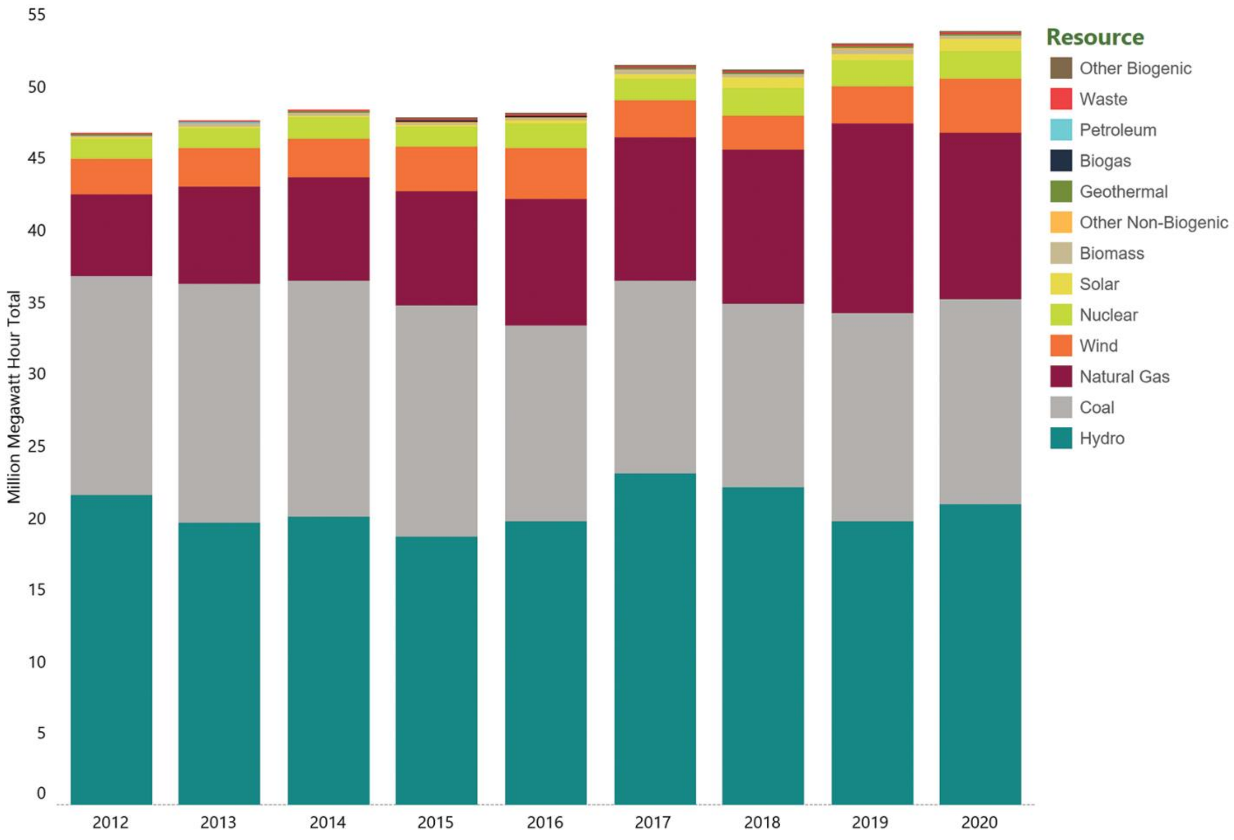
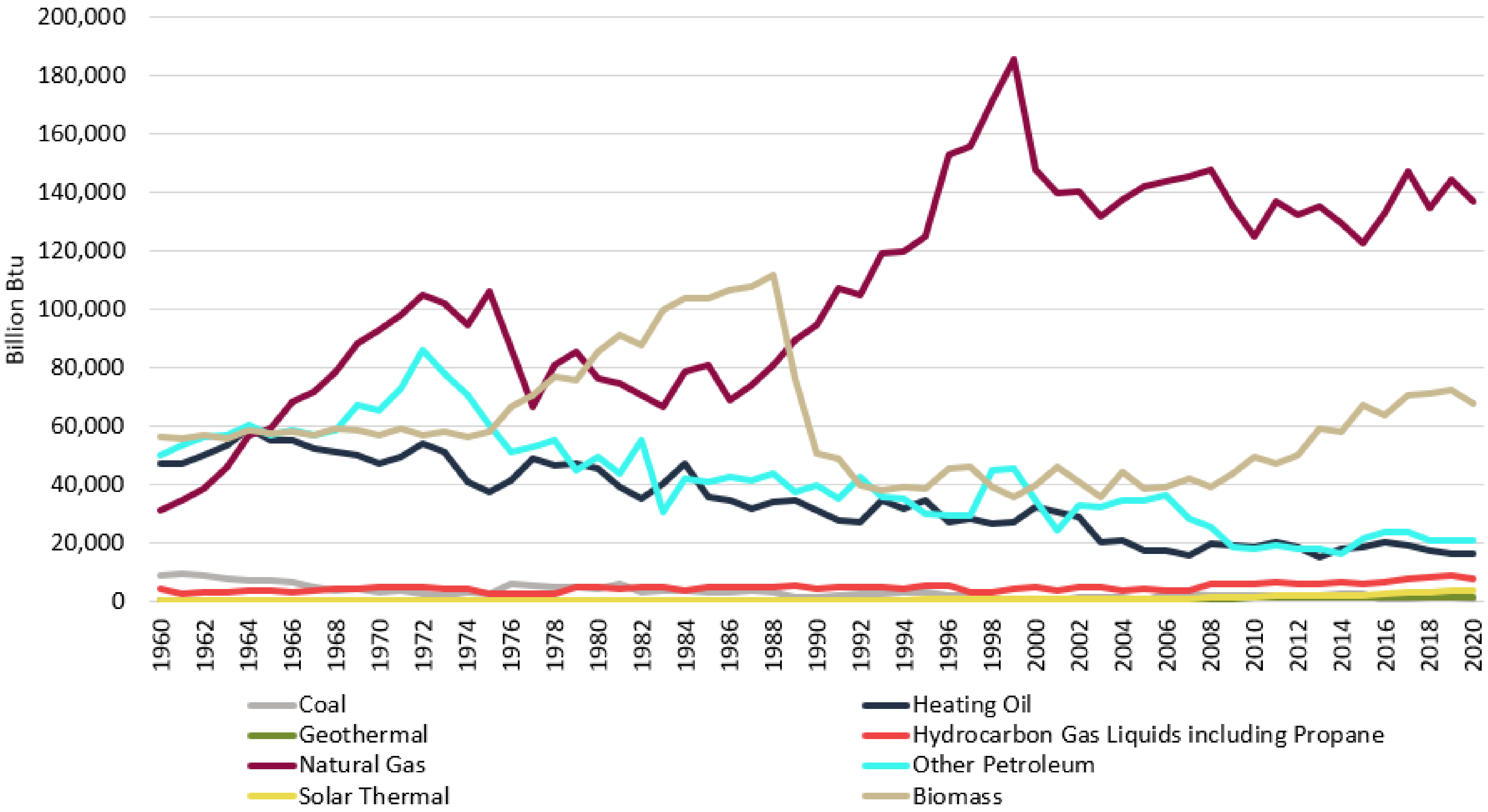
Resources Used to Generate Oregon's Electricity (2020)



Resources Used to Generate Oregon's Electricity Over Time



Oregon Direct Use Fuels Consumption Over Time



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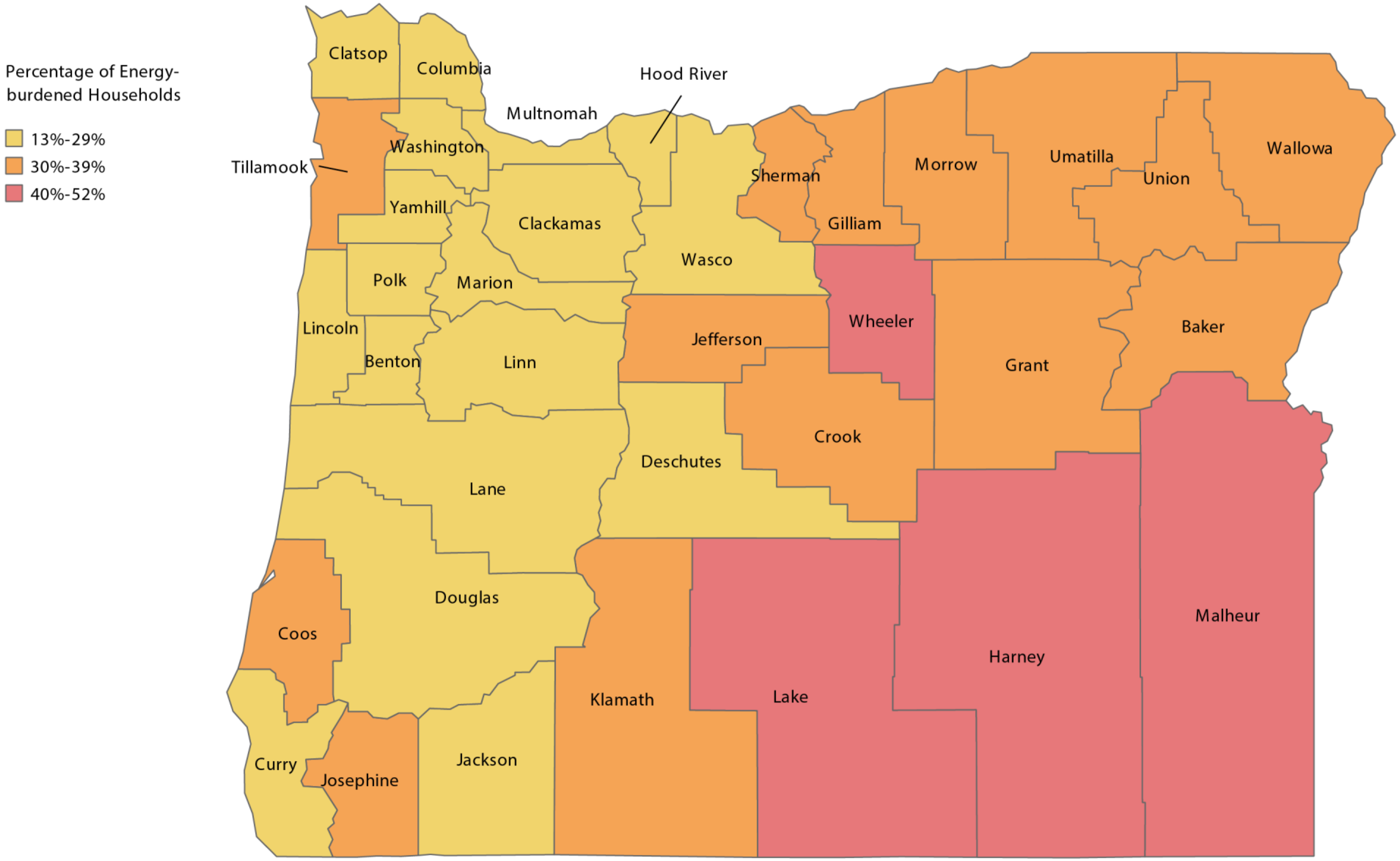
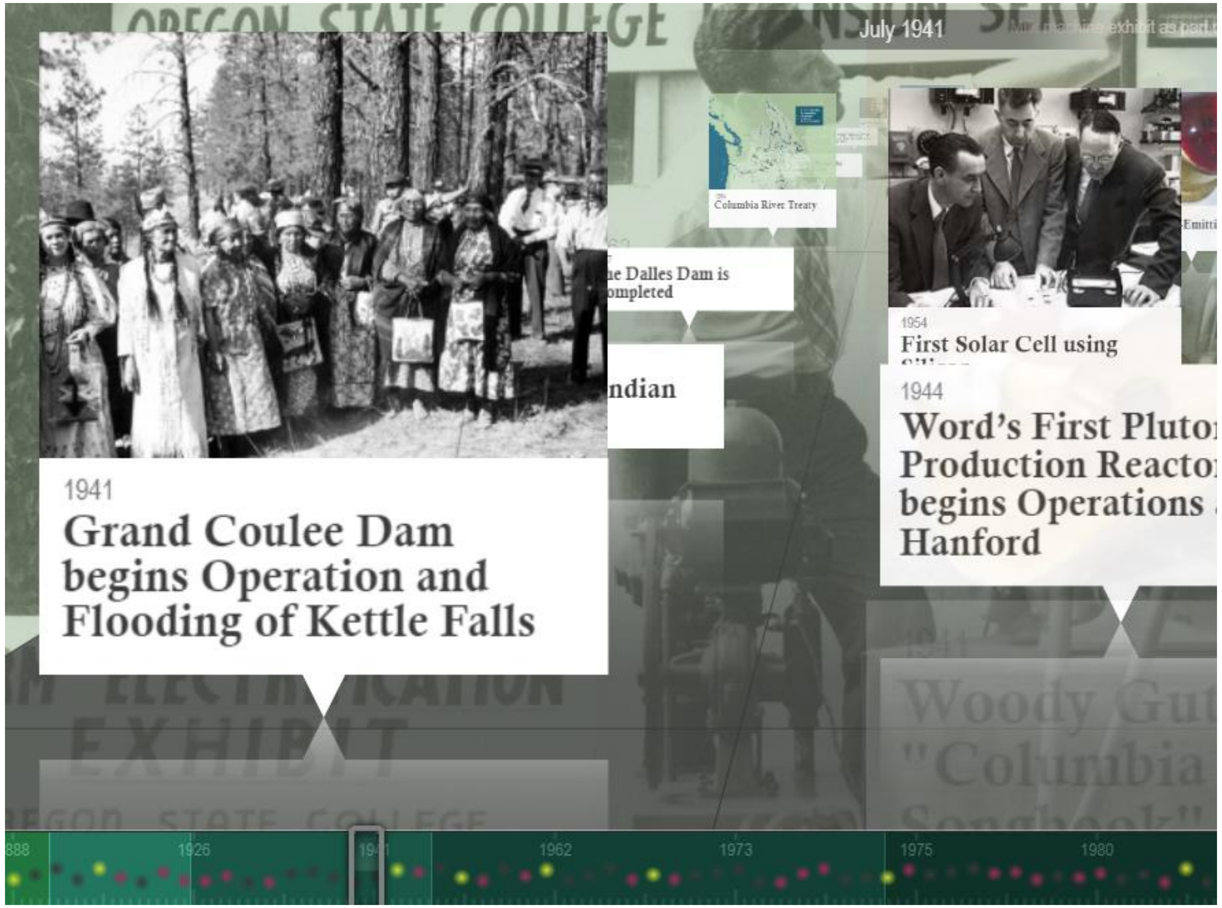
Percentage of Oregon Households Considered Energy Burdened and Earning 200 Percent or Below Federal Poverty Level by County (2020)



History Timeline

The online, interactive timeline of Oregon's energy history is meant to serve as a useful reference for readers as they review sections of the Energy Report, especially for energy data over time.



https://energyinfo.oregon.gov/timeline

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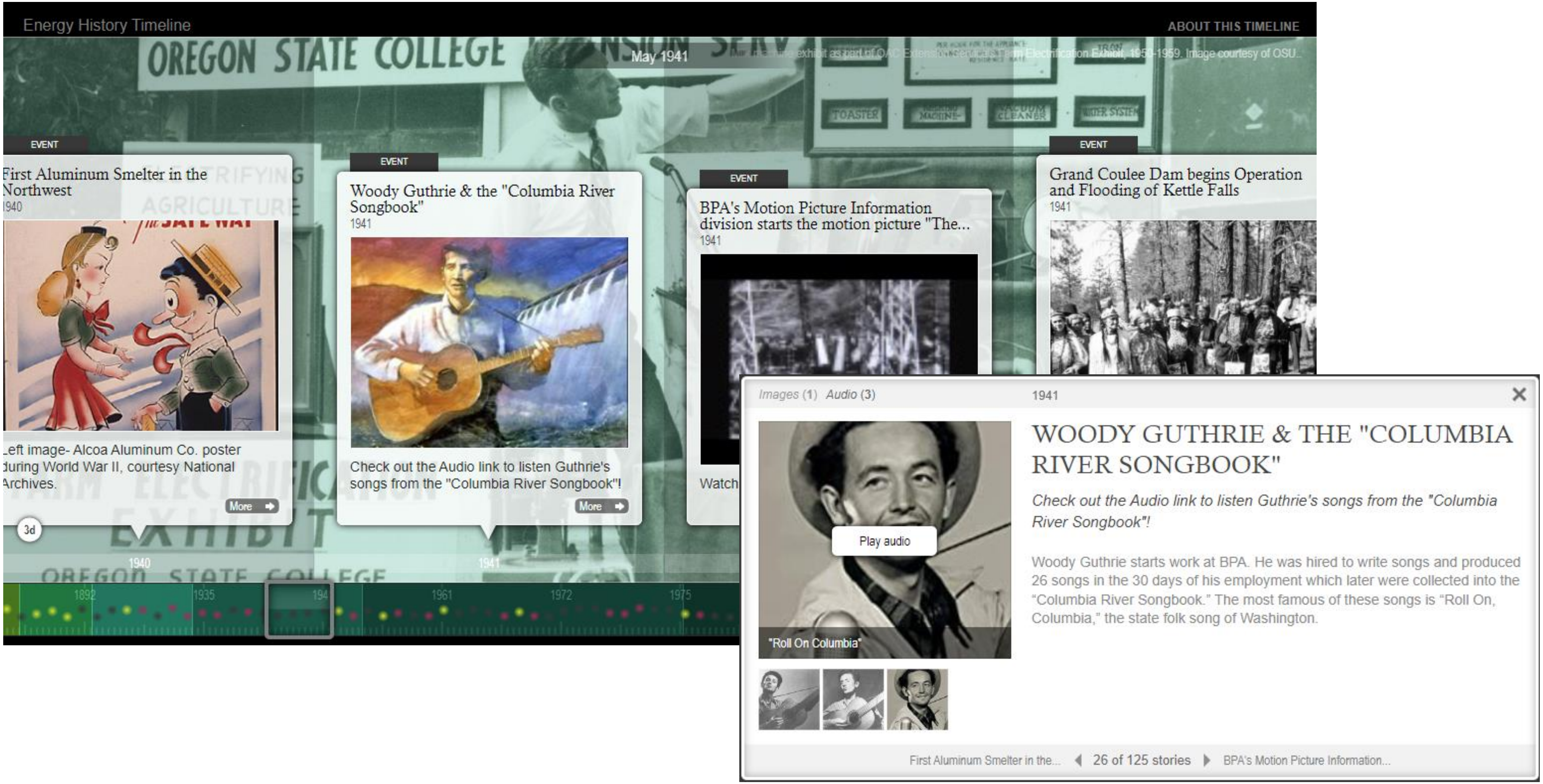

https://energyinfo.oregon.gov/timeline

Energy 101

This section is intended to help the reader understand the first part of the energy story: how energy is produced, used, and transformed.

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Consumer Energy Cost Drivers

Transportation fuel costs influenced by global crude oil prices

- *Global commodity prices subject to volatility and vulnerable to market disruption (e.g., war, pandemic)*

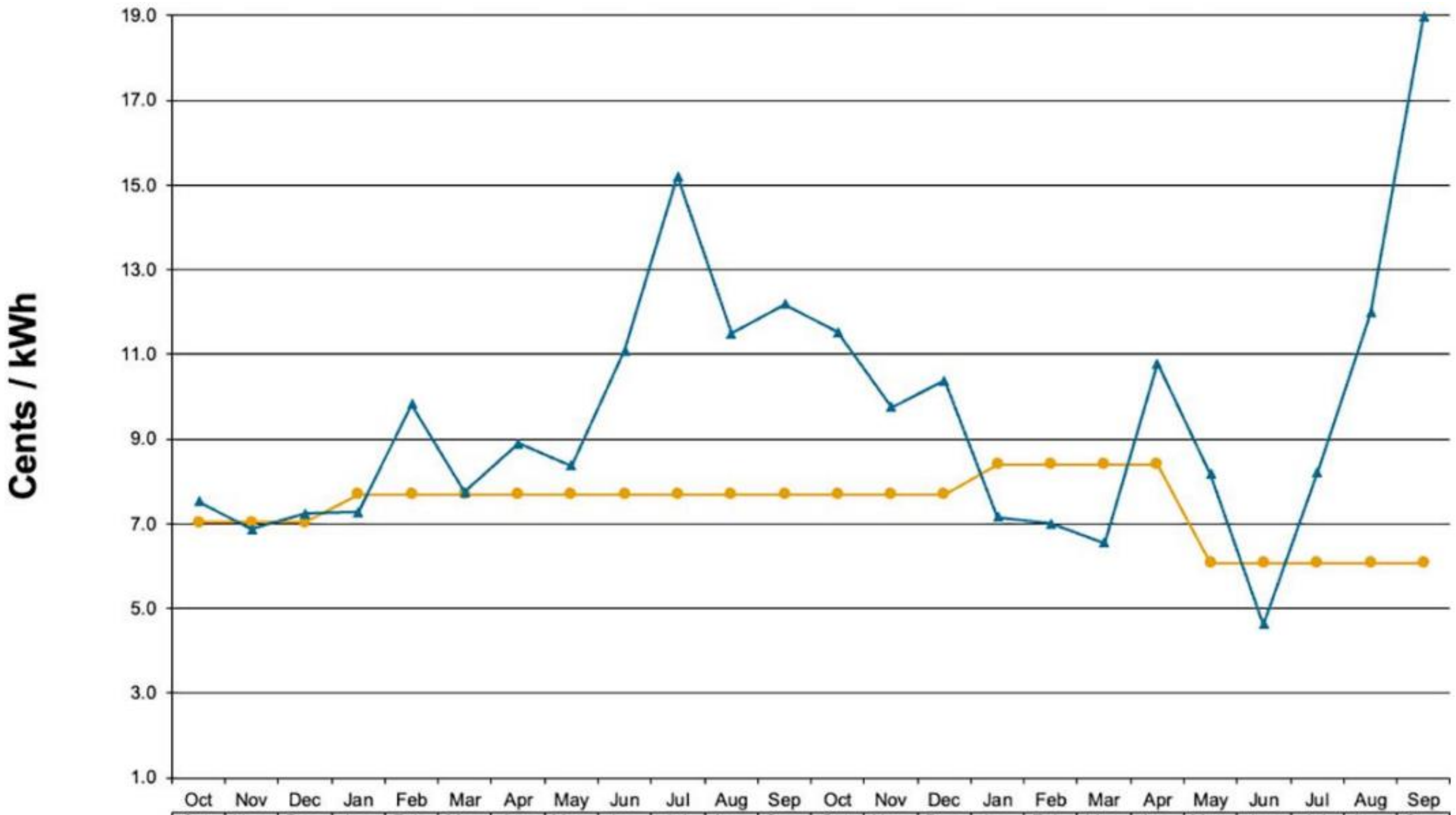
Wholesale electricity and natural gas costs driven by market supply and demand

- *Impacted by fuel price volatility and weather conditions*

Retail electricity and natural gas costs determined through utility cost-of-service ratemaking processes

- *Regulatory oversight provides consumer cost stability and mitigates impacts from wholesale price volatility*

Comparison of Wholesale and Retail Electricity Rates



	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22
Cost of Service	7.0	7.0	7.0	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	8.4	8.4	8.4	8.4	6.1	6.1	6.1	6.1	6.1
Daily Pricing	7.5	6.9	7.2	7.3	9.8	7.7	8.9	8.4	11.1	15.2	11.5	12.2	11.5	9.8	10.4	7.2	7.0	6.6	10.8	8.2	4.6	8.2	12.0	19.0

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Backup Power

Backup power systems provide emergency onsite energy generation in the event of a power outage.

- Increased frequency and severity of natural disasters is **increasing interest in backup power.**
- **Diesel generators** are the most common backup power systems for commercial and industrial loads.
- **Solar plus battery storage systems** are becoming more common in residential applications.
- Electric vehicles have the potential to serve as **mobile backup power systems**.

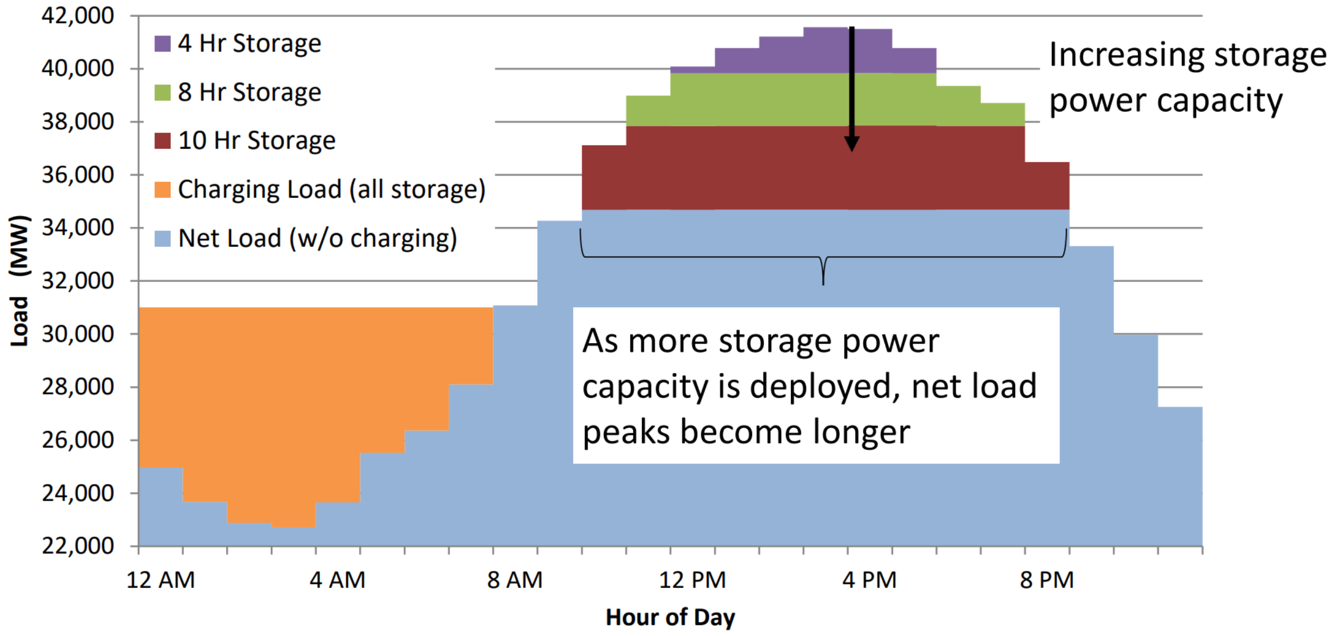
This residential battery storage system stores energy generated by rooftop solar panels.

Long-Duration Energy Storage

Storage Type	Primary Technology	Economical Duration of Max Output
Standard storage	Lithium-ion batteries	2-hour, 4-hour, 6-hour
Long-duration energy storage	Pumped-storage hydro, hydrogen, flow batteries, gravity storage, compressed air, derated lithium-ion batteries, etc.	10- to 100-hour
Seasonal storage	TBD – hydrogen a likely candidate	More than 100-hour

- Considering **potential needs** for long-duration energy storage
- What **technologies** could provide LDES?
  - Novel battery technologies
  - Stacked 'short-duration' batteries
  - Pumped hydro storage
  - Renewable hydrogen
- **Next steps**:
  - Innovation and cost reduction
  - USDOE Long Duration Storage Shot

Effect of Storage Deployment on Duration Needed



Electrification Options in the Agricultural Sector

- Oregon is one of the **most promising states for electric tractor** adoption
- Small tractors are increasingly available, but electric and hybrid versions of high-horsepower tractors, combines, and harvesters are **still under development**
- Oregon is home to an innovative electric "**tractor share**" program
- There are several other important on-farm fossil fuel uses that **could be electrified** now and in the near future – 96 percent of irrigation pumps in Oregon are already powered by electricity
- The **strongest candidates for early electrification** will be relatively small equipment that farmers and ranchers use daily, especially equipment used close to the center of the farm
- **Rural utilities** and their customers can incorporate many types of electric farm equipment with existing infrastructure, but large field and processing machinery will likely require electrical service upgrades

Oregon State Climate Programs & Actions

The Oregon Department of Energy and the Oregon Global Warming Commission summarized major ongoing climate change-related programs and projects led by various state entities (agencies, boards, and commissions) across four main categories.

Oregon Department of Energy and Energy Facility Siting Council*

Greenhouse Gas Emissions Reductions and Sequestration	Assessment of Climate Risks and Vulnerabilities	Preparing for Climate Change	Educating Oregonians About Climate Change
Solar + Storage Rebate Program • Rebate program for installation of solar panels and storage capacity • 684 projects completed in 2021 **Energy Efficient Schools Program** • Provide technical support and connect schools with resources for energy efficiency projects	**Energy Sector Climate Vulnerability Assessment** • Identifies and evaluates climate change related vulnerabilities and risks facing energy infrastructure and services • Explores opportunities for risk mitigation and resilience, and provides a guide for others to conduct climate vulnerability studies	**Community Renewable Energy Grant Program** • Grants for community renewable energy generation and storage projects • Improves energy resilience • 50% of funding dedicated to environmental justice communities	**Biennial Energy Report** Reports in 2018, 2020, and 2022 include analysis and resources on climate change including: • Statewide GHG emission data and statistics • Goals and climate commitments • Risks and impacts • Deep decarbonization pathways • Clean energy and renewable standards

**Abridged sample section*

Resource & Technology Reviews

The reviews in this section cover the spectrum of traditional to innovative – and demonstrate the breadth of technology that is integral to the production and management of our energy system.

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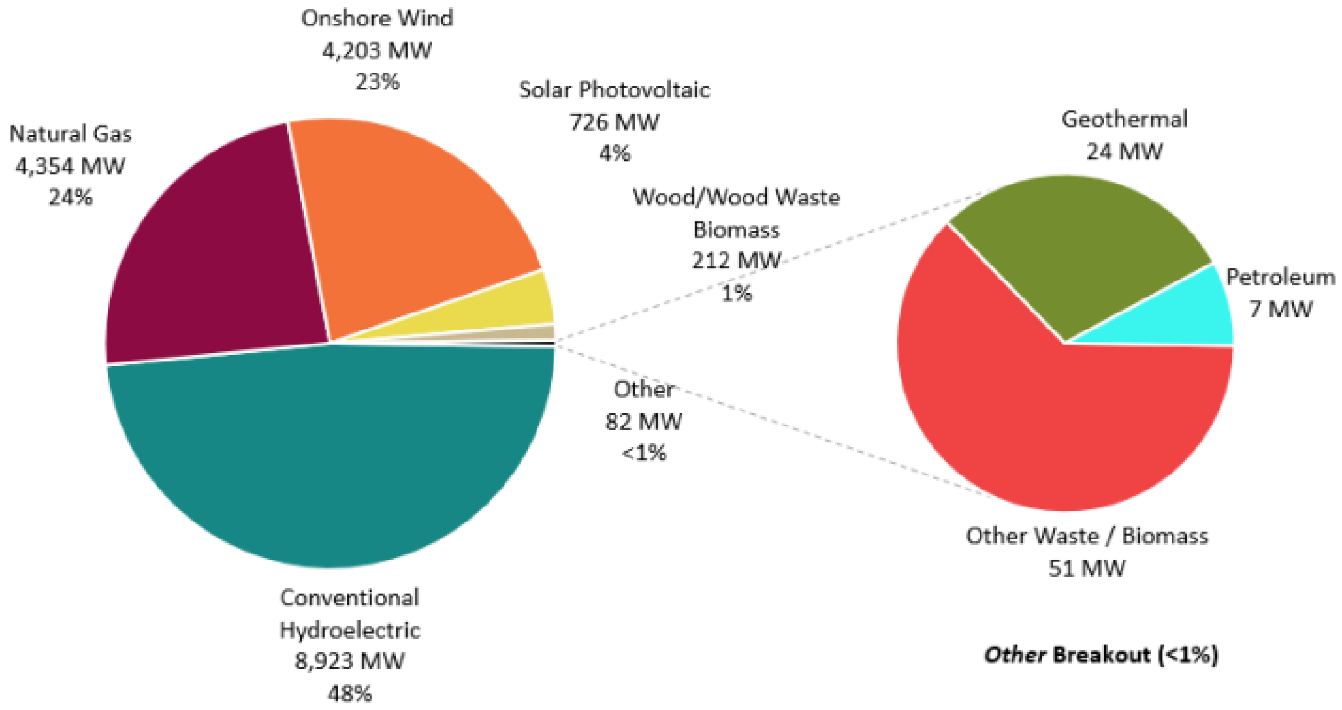
Electricity Generation

There are 459 utility-scale generators in Oregon that provide electricity for homes and businesses throughout the Pacific Northwest.

Oregon's clean energy goals will transform the makeup of energy generators in Oregon to include many more renewable energy facilities.

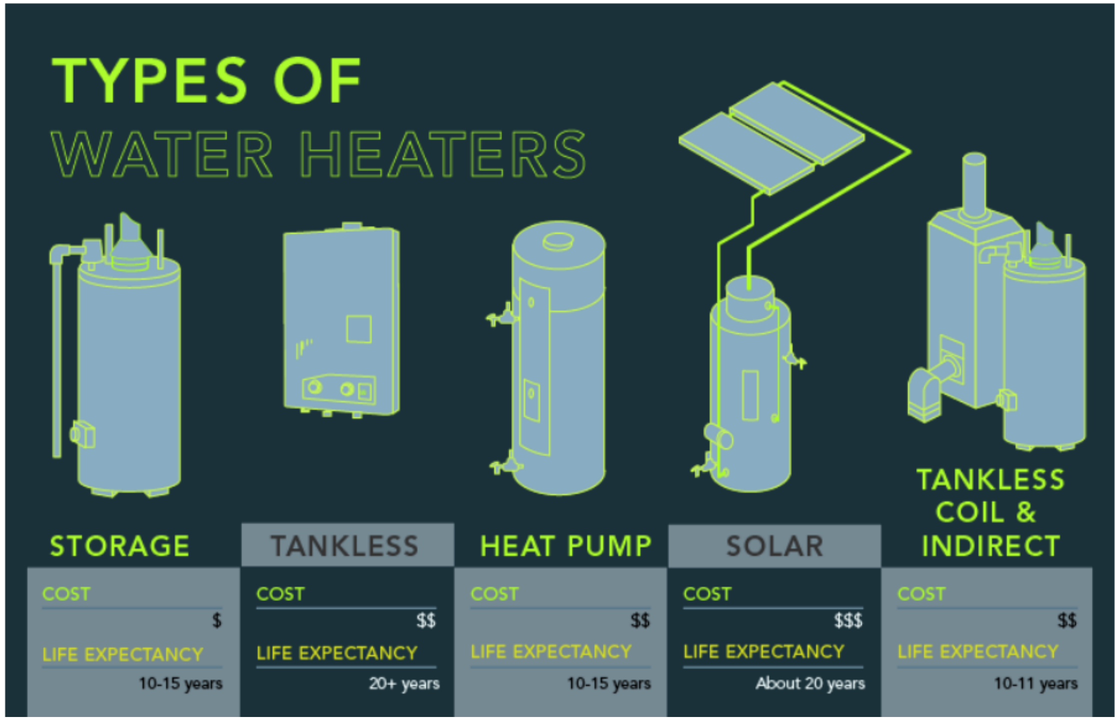
Total Technology Nameplate Capacity (MW) of Electricity Generation Facilities in Oregon

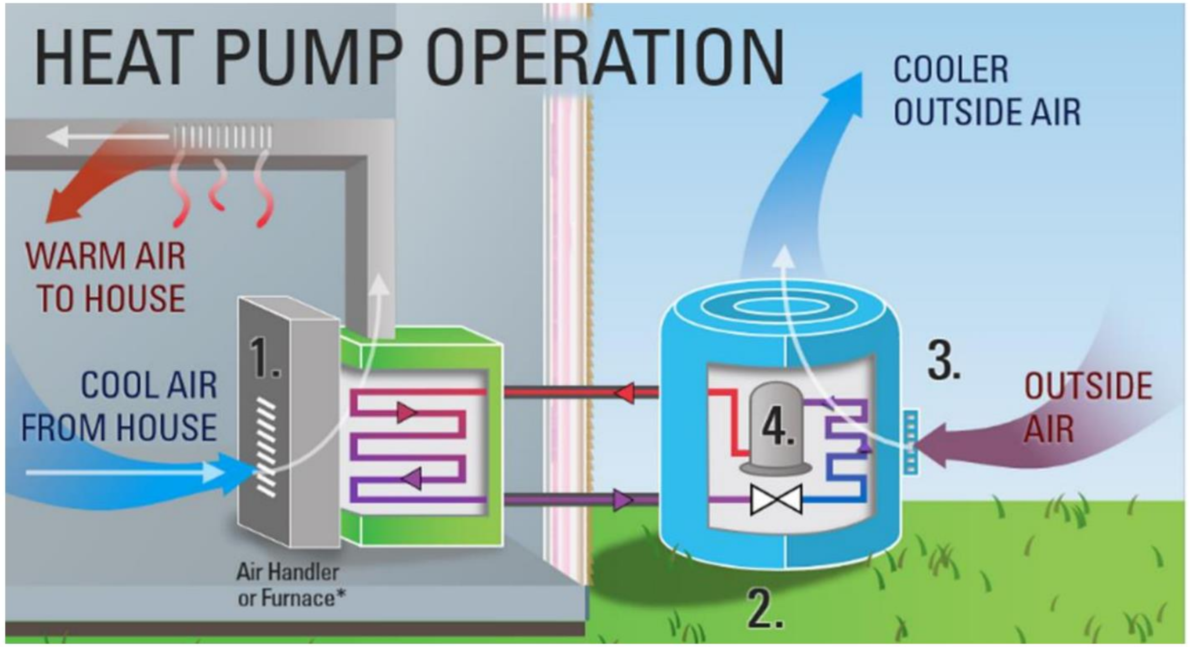


Wheatridge Energy Facilities, Morrow County
Photo: Portland General Electric

Energy Efficient Building Tech

Energy efficiency saves Pacific Northwest ratepayers over **$4 billion** and reduces GHG emissions by over 22 million MTCO2 each year.





Advances in energy efficiency have helped utilities manage regional demand and reliability for energy, **reduce energy burden** for many Oregonians, and contribute to progress toward state and local climate goals.

There remains significant energy efficiency potential to continue to provide these benefits.

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Electricity Storage

The most common types of electricity storage used in the U.S. are **batteries**, a type of electrochemical storage, and **pumped hydropower**, a types of mechanical storage. It requires energy to convert electricity into another form of energy for storage, and all forms of potential energy are subject to natural processes that slowly reduce the amount of energy stored.

Storage Form	Storage Type	Power (MW)*	Discharge Time	Energy Density (Watt-hour /Liter)	Maximum Lifetime	Efficiency
Mechanical	Pumped Hydropower	100 - 1000	4 - 12 hours	0.2 - 2	30 - 60 years	70 - 85%
	Flywheels	0.001 - 1	10 – 20 milliseconds	20 - 80	20K - 100K cycles	70 - 95%
	Compressed Air	10 - 1000	2 – 30 hours	2 - 6	20 - 40 years	40 - 75%
Electro-chemical	Lithium-Ion Batteries	0.1 - 100	1 min - 12 hours	200 - 400	1000 - 10,000 cycles	85 - 98%
	Flow Cell Batteries	1 - 100	2 – 10 hours	20 - 70	12,000 - 14,000 cycles	60 - 85%
Chemical	Hydrogen	0.01 - 1	mins - weeks	600 (at 200 bar)	5 - 30 years	25 - 45%
Thermal	Molten Salt	1 - 150	hours	70 - 210	30 years	80 - 90%

** Power rating is based on typical storage devices today. Devices like batteries and physical mediums like hydrogen are easily scalable, meaning a particular site may have a much higher power rating.*

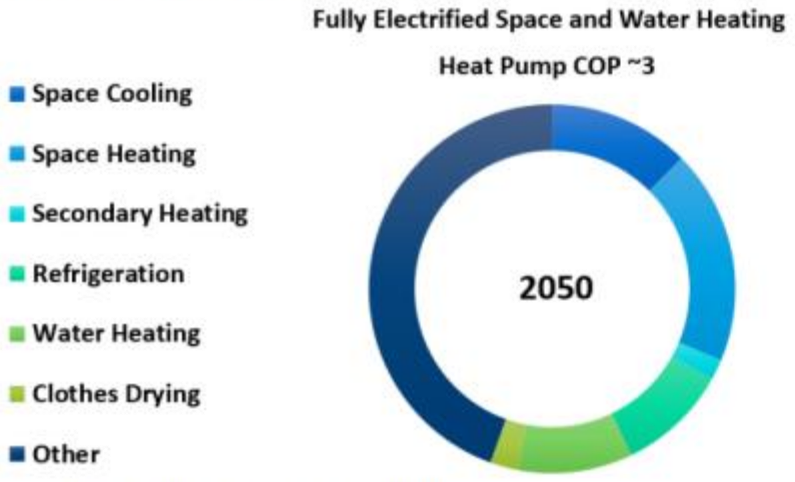
There are no existing pumped hydropower systems in Oregon, but there are two proposed sites at different stages of permitting and development.

Global demand for batteries is expected to grow rapidly in the next decade, and lithium-ion batteries will likely dominate the storage market through 2025.

Electricity Storage

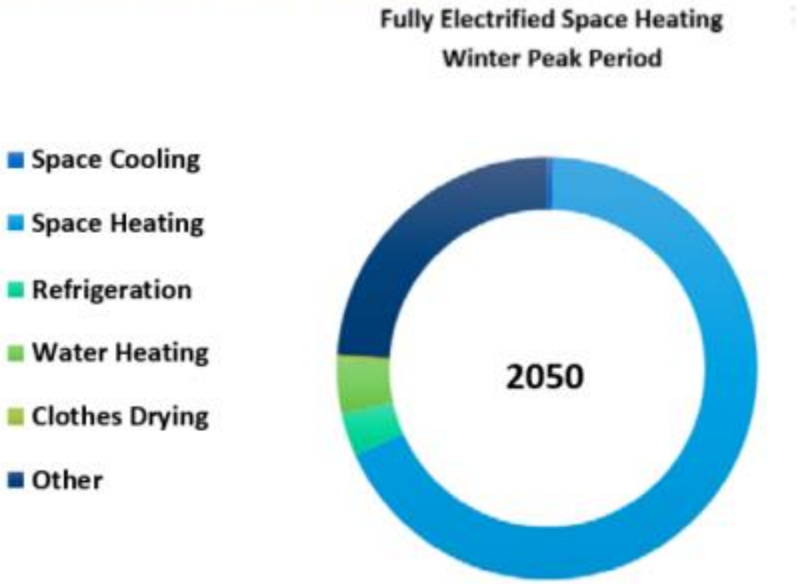
Building thermal energy loads are expected to grow by 2050, increasing to more than 50 percent of building electricity consumption and exceeding 75 percent during peak electricity demand times. Thermal energy storage systems in buildings have the potential to help better manage building energy use, including reducing the building's peak energy load and providing grid reliability benefits.

Figure 5: Annual Electrical Energy Consumption in Residential and Commercial Buildings for Space and Water Heating[78]



Graphic modified from its original.

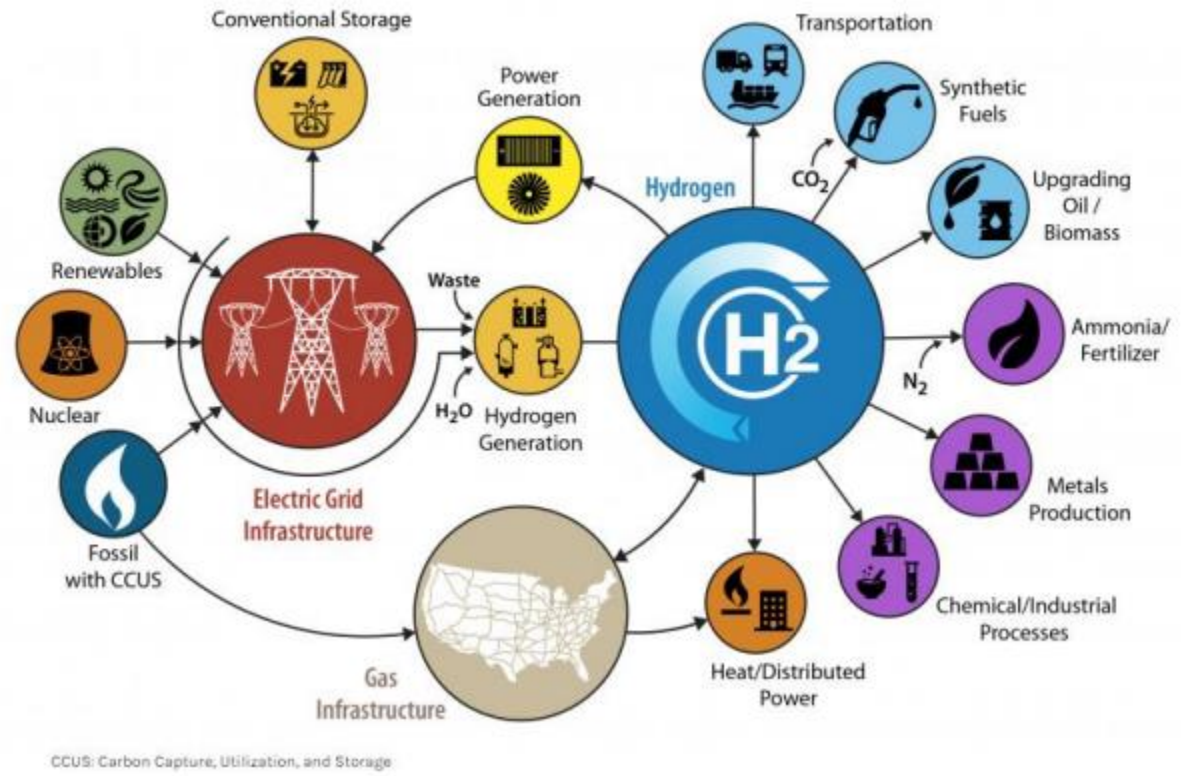
Figure 6: Peak Period Electrical Energy Consumption in Residential and Commercial Buildings for Space and Water Heating[78]



Hydrogen

The most common pathway to produce hydrogen today uses steam to separate the hydrogen from methane in natural gas. Lower-carbon and zero-carbon hydrogen – often referred to as **clean hydrogen** – can be produced through several pathways, including electrolysis of water with renewable electricity or natural gas/renewable natural gas coupled with carbon capture and sequestration technology.

Hydrogen is used predominantly in industrial applications, such as petroleum refining, steel and other metal production, food processing, and chemical production. **Clean hydrogen could reduce greenhouse gas emissions** in sectors where the option to electrify is either too costly or not technologically feasible, such as medium- and heavy-duty transportation, aviation, long-duration storage, or as a substitute for natural gas, among others.



Policy Briefs

This section provides deeper-dive insights on emerging energy trends, opportunities, and barriers in the energy sector.

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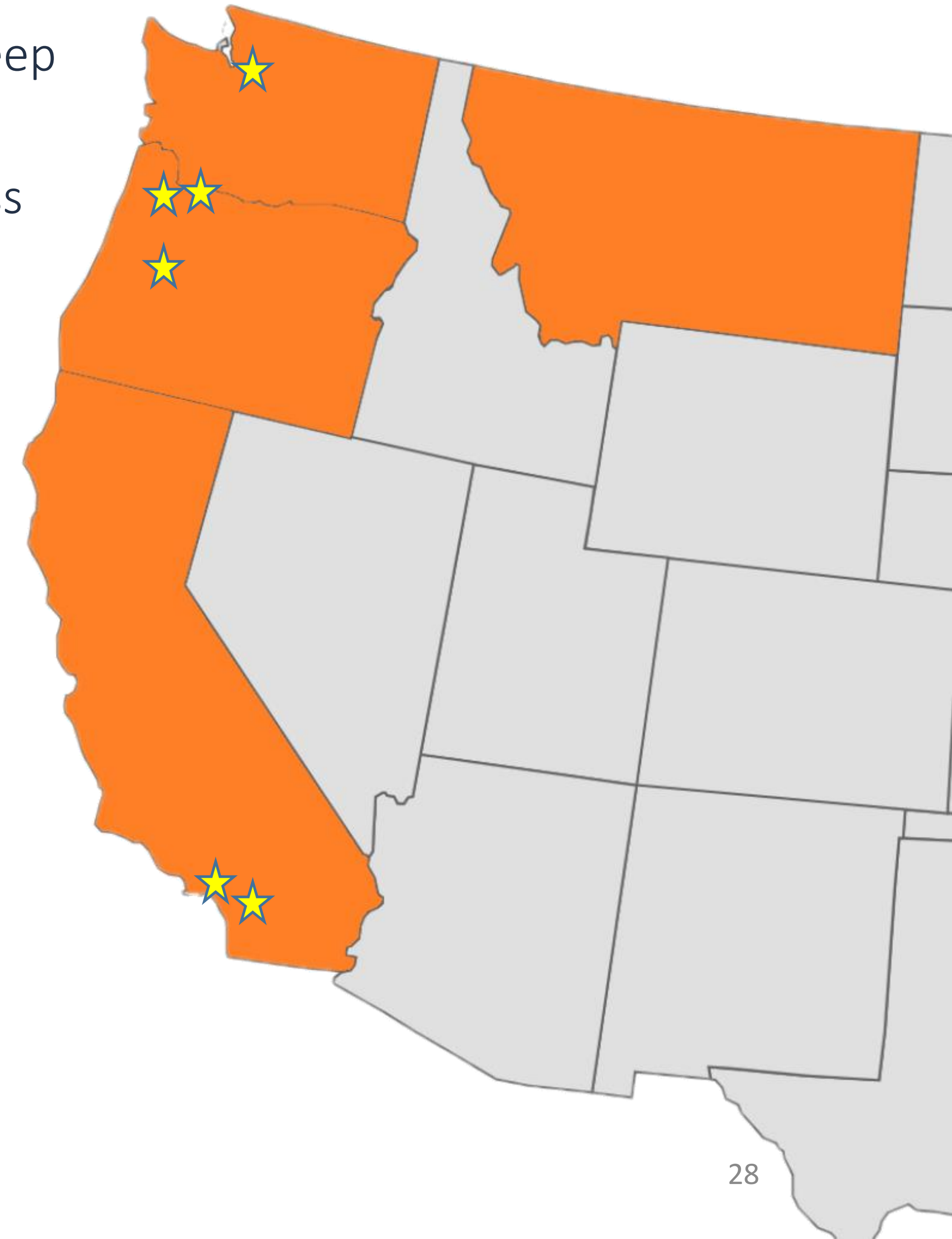
Charting a Course for Oregon's Energy Future

Part I: Introduction

- What will it take to achieve economywide deep decarbonization and 100% clean energy?
- We reviewed 20 technical studies from across the country (mostly the west)



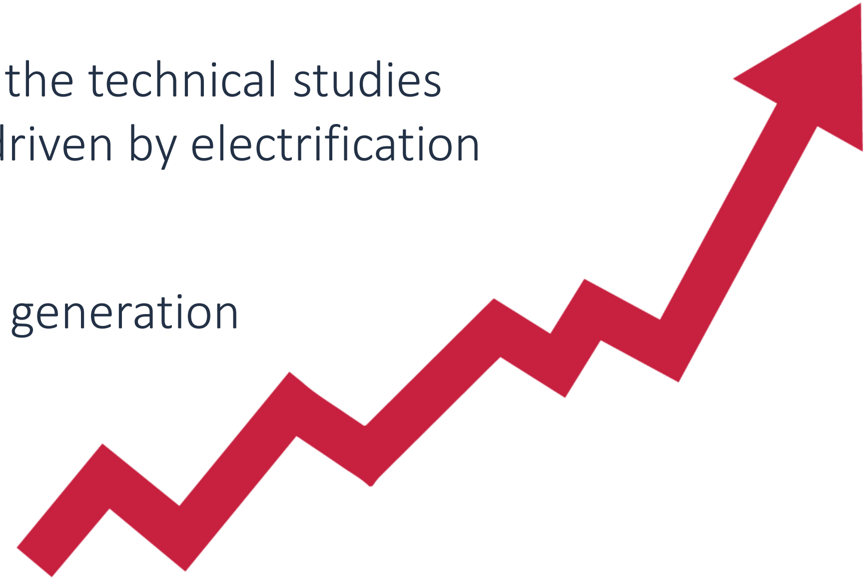
Key Findings:

- Achieving these policies is possible!
- Four pillars of decarbonization identified:
    - energy efficiency,
    - electrification of end uses,
    - cleaner electricity, and
    - develop low-carbon fuels
- There are multiple pathways to achieve policies by mid-century, each with its own tradeoffs

Charting a Course for Oregon's Energy Future

Part II: Electric Sector

- Growing the electric sector: Consensus in the technical studies that demand for electricity will increase, driven by electrification of vehicles and some natural gas end uses
- Cleaning the electric sector: Existing fossil generation will also need to be replaced



Key Findings:

- Energy efficiency continues to play an important role
- Significant amount of new renewable generation required (likely in the tens of gigawatts in Oregon)
- Need to balance tradeoffs involved with clean energy choices—land use impacts, fish and wildlife concerns, total costs, and more

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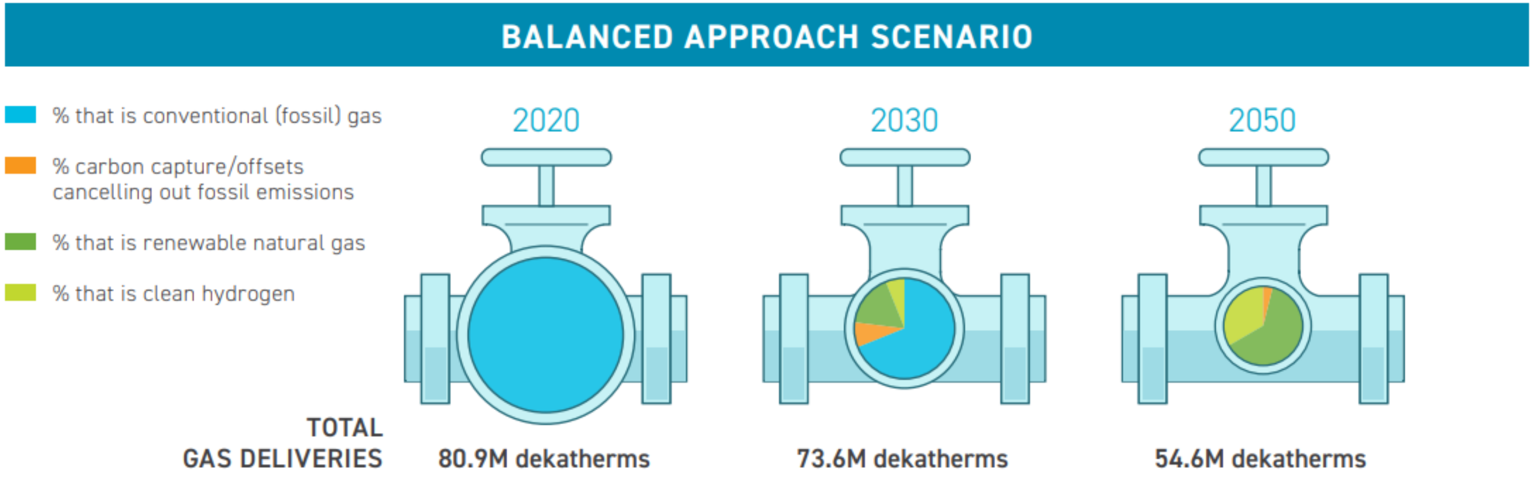
Charting a Course for Oregon's Energy Future

Part III: Natural Gas Sector

- Electrification: Most studies find that it is more cost-effective to achieve decarbonization policies by electrifying a lot of current uses of natural gas—such as for electric generation and for many heating applications
- Strategic use of gas: In other instances, the continued use of gas resources may prove the most cost-effective path to achieving clean energy policies

Key Findings:

- Many studies identify a continued need for some dispatchable gas resources
- To achieve policy targets, the gas will need to become cleaner over time by using RNG, carbon capture, or renewable H2



2020: 100% conventional (fossil) gas
2030: 69% conventional (fossil) gas, 8% carbon capture/offsets cancelling out fossil emissions, 17% renewable natural gas, 6% clean hydrogen
2050: 0% conventional (fossil) gas, 4% carbon capture/offsets cancelling out fossil emissions, 62% renewable natural gas, 33% clean hydrogen*

* Carbon capture in 2050 begins to sequester biogenic CO_2 emissions from renewables, meaning that the scenario has shifted to a carbon-negative system.

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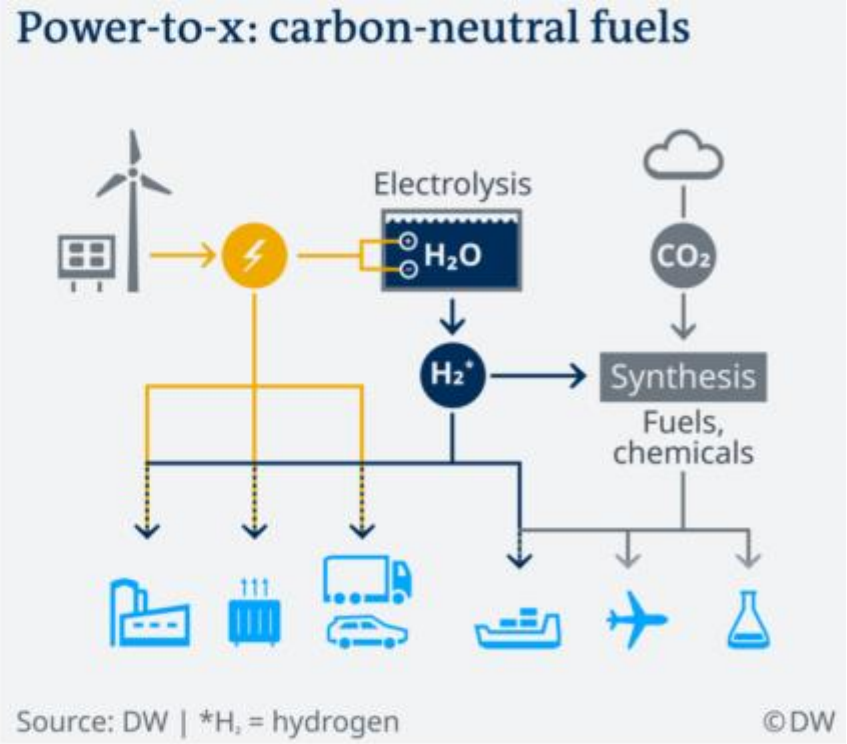
Charting a Course for Oregon's Energy Future

Part IV: Transportation Sector

- Electrification: Electrifying road vehicles – passenger vehicles, trucks, and buses – is a key element of most deep decarbonization studies. Many studies indicate that sales of new passenger vehicles will need to be all electric by 2035 to achieve significant decarbonization by 2050.



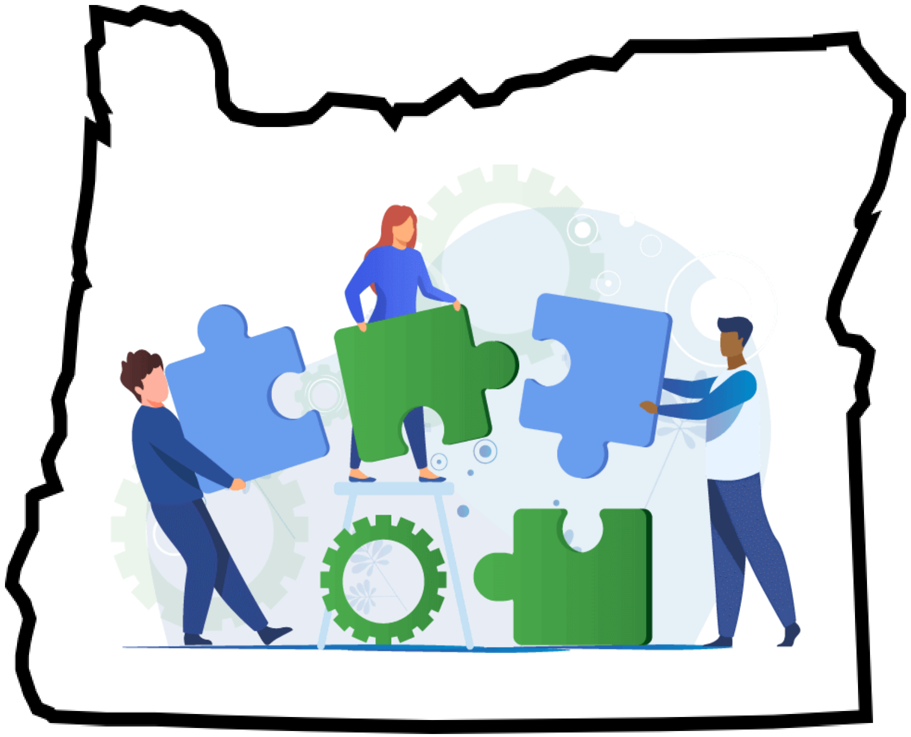
- Equity: A transition to clean transportation requires thoughtful deliberation and robust engagement with industry, communities, drivers, and governments. There is an opportunity to build a more equitable transportation system from the ground up.

Key Findings:

- Electrify as many vehicles as possible as soon as possible.
- Use lower-carbon liquid fuel alternatives, such as renewable diesel, for vehicles that cannot be electrified in the near-term.
- Plan for zero-carbon liquid fuel alternatives to decarbonize vehicles that cannot be electrified.

Charting a Course for Oregon's Energy Future

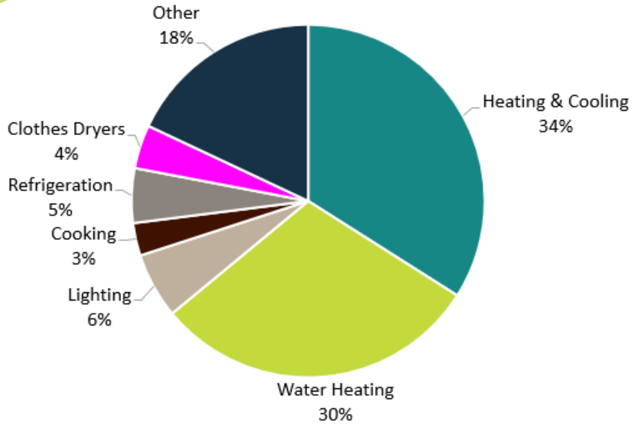
Part V: Pathway Tradeoffs



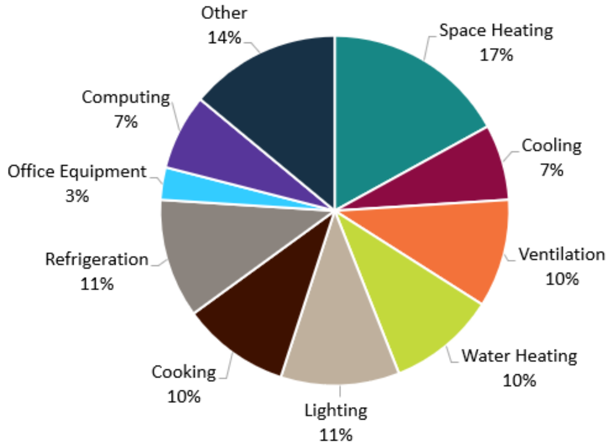
- The costs of failing to achieve mid-century clean energy and climate policy goals fall inequitably across Oregonians
- Technical analysis shows us that there are multiple technology pathways to achieve mid-century policy goals
- Significant choices remain, and the tradeoffs of those choices must be carefully considered
- Can Oregonians work together to chart an intentional course for the state's energy future that balances these tradeoffs?

Energy Efficiency Policy Opportunities in Existing Buildings

Residential Energy End-Uses



Commercial Energy End-Uses



- Energy consumption in buildings is responsible for about 22.4 million metric tons, or nearly 35% of annual Oregon greenhouse gas emissions.
- Existing buildings hold the greatest potential for reducing energy consumption and associated greenhouse gas emissions in the building sector.
- Successful existing voluntary energy efficiency programs have made Oregon a leader in energy efficiency and GHG reductions, but more is required to access the large pool of potential energy efficiency and GHG reductions in the existing building stock.
- There are multiple strategies and programs that can support higher adoption of energy efficiency technologies for existing buildings.
- Policy design should be informed by robust data and new programs should establish specific targets and goals to ensure programs are efficient and effective.

Local Energy Perspectives on Workforce and Supply Chain

Building Energy Controls Apprenticeship Program at Lane Community College

- While labor market disruptions due to the pandemic have largely resolved, long-term workforce issues have re-emerged: generational turnover, shortages of workers with critical skills, and challenges with caretaker needs and affordable housing.
- The clean energy transition presents challenges for training and recruitment of workers with needed skills but also positions the energy industry as an attractive employer at the forefront of meaningful societal change.
- Pandemic-driven supply chain disruptions have pushed energy project developers to plan further ahead to procure materials and equipment and have created pressures to increase domestic manufacturing.

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2022 Report Recommendation

The state would benefit from an **energy strategy** to align policy development, regulation, financial investment, and technical assistance in support of an intentional transition to a clean energy economy. This strategy could identify specific pathways to meet the state's policy goals that maintain affordability and reliability, strengthen the economy, and prioritize equity while balancing tradeoffs to maximize benefits and minimize harms. Ultimately, this strategy could be used to **make informed decisions and motivate action**.

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Questions/Comments?

RESOURCES:

Report online: energyinfo.oregon.gov/ber

ODOE's website: www.oregon.gov/energy