

Oregon Department of **ENERGY**

Getting to Zero Energy: Program and Policy Challenges and Opportunities

National Energy Code
Conference

Blake Shelide
May 2019



OREGON
DEPARTMENT OF
ENERGY

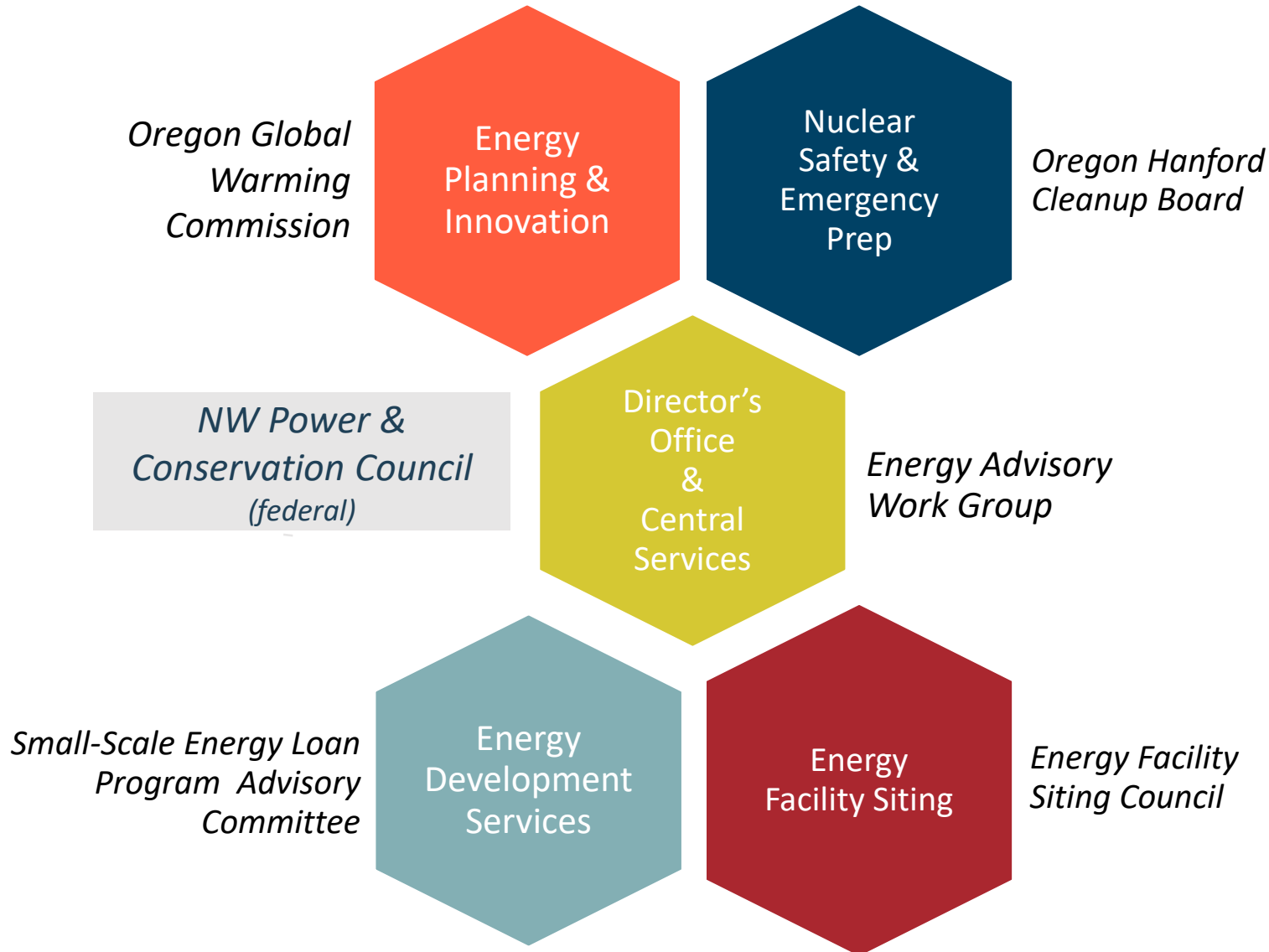
OUTLINE FOR TODAY

- About the Oregon Department of Energy
- Oregon's Energy Production & Consumption
- Greenhouse Gas Emissions & Changing Policy Context – Local and State
- Opportunities and Challenges
- Energy Code Developments, Executive Order
- Recap

BUT FIRST: WELCOME & A FUN QUIZ



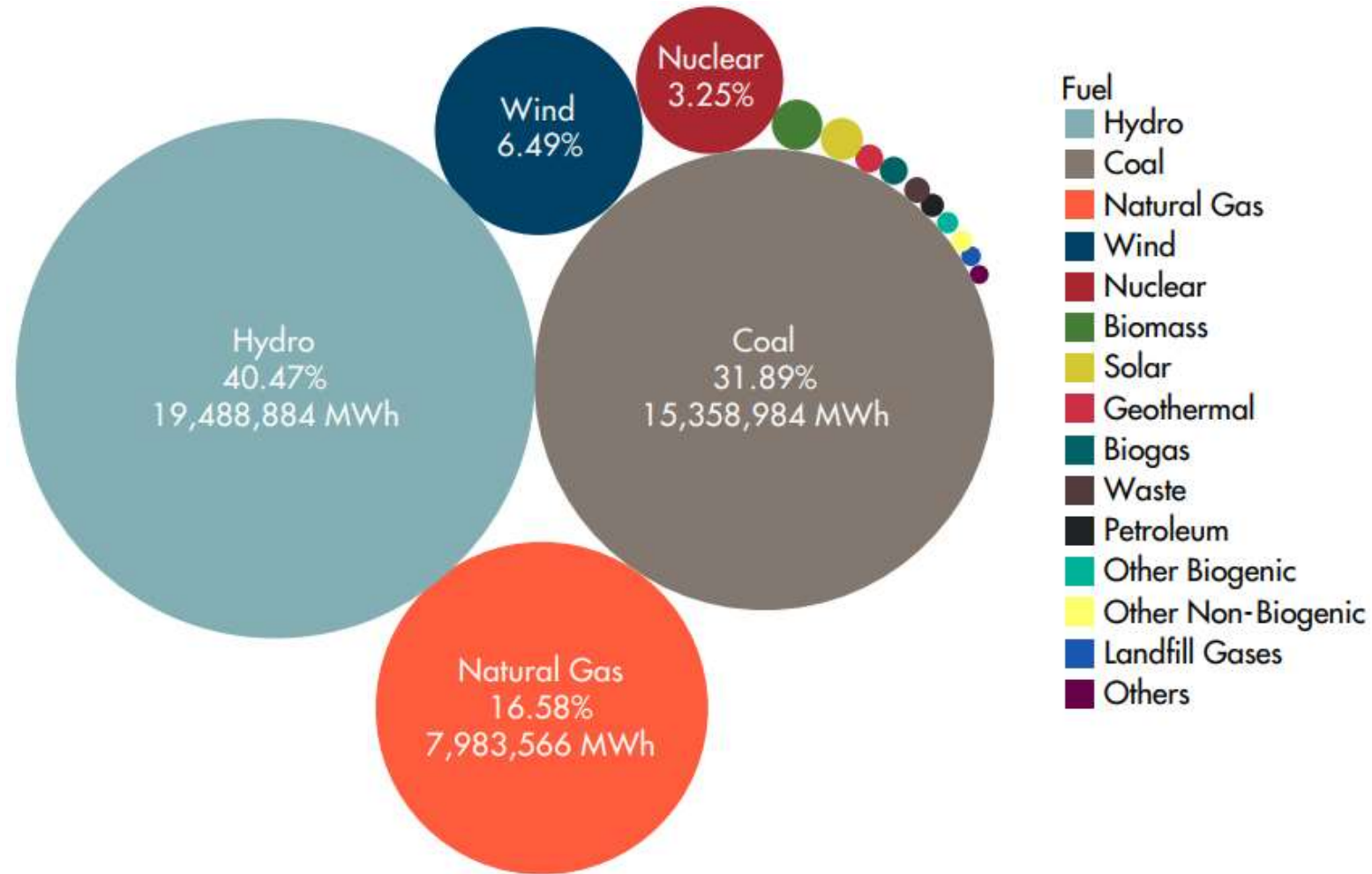
ABOUT THE OREGON DEPARTMENT OF ENERGY



Department Structure and Background

- Mission: *Leading Oregon to a safe, clean, and sustainable energy future*
- About 80 staff members

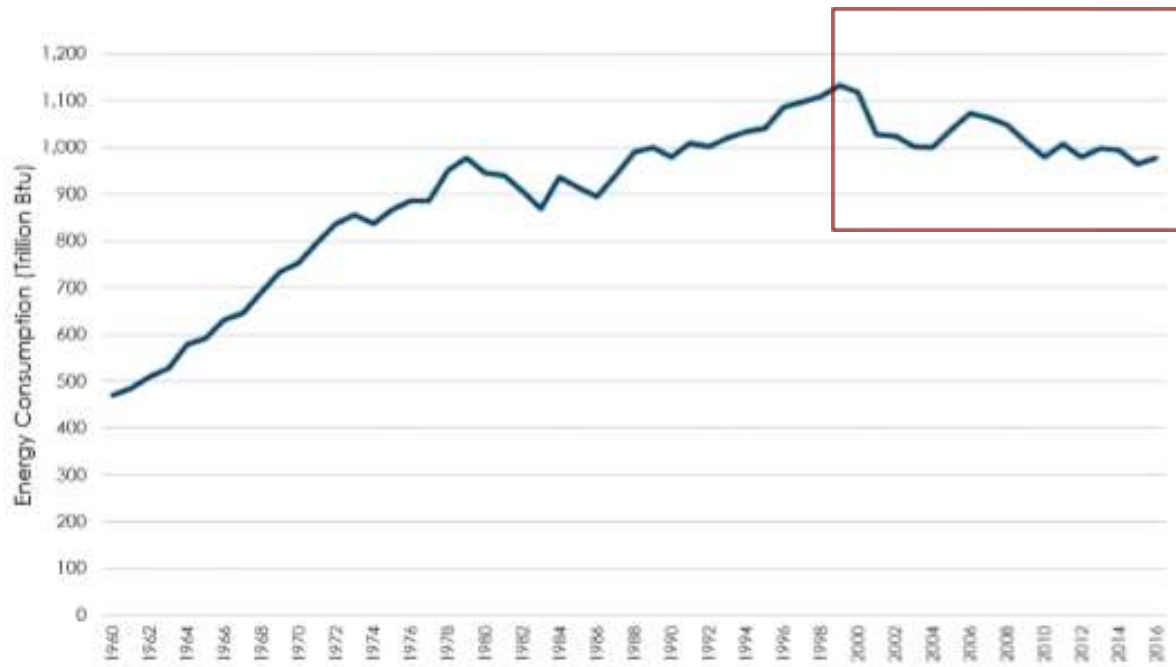
Oregon Electricity Resource Mix



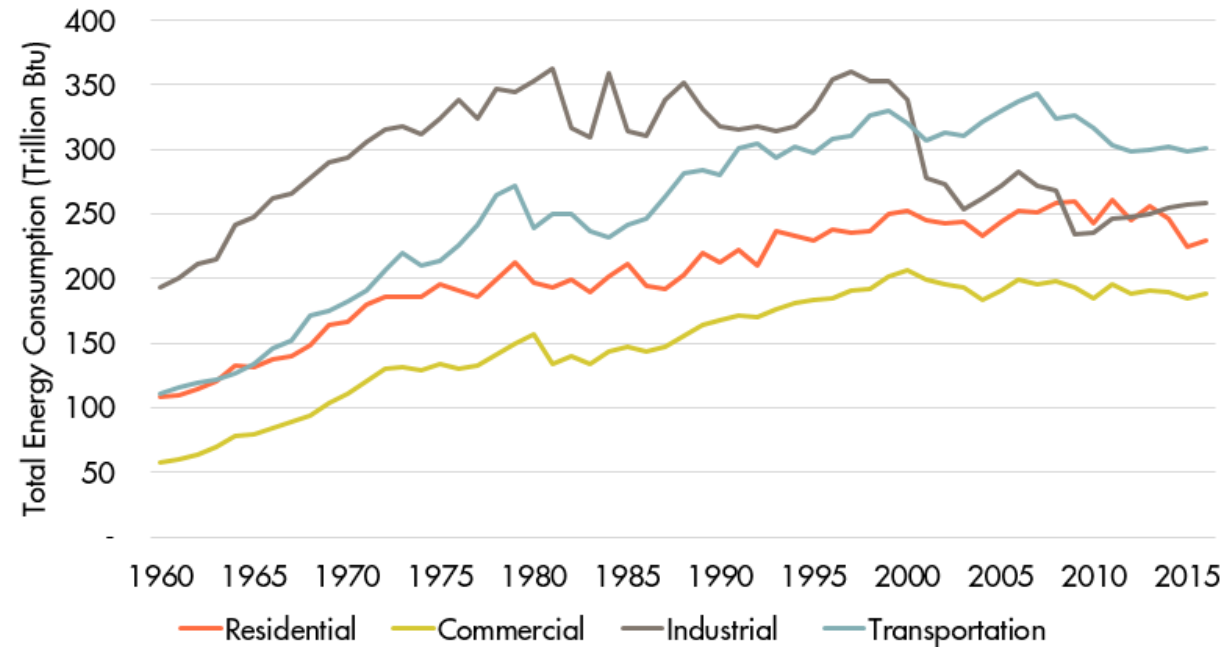
Resources Used to Generate Oregon's Electricity

Based on a three-year average (2014-2016), this chart shows the energy resources used to generate the electricity that is sold to Oregon's utility customers.

ENERGY CONSUMPTION OVER TIME

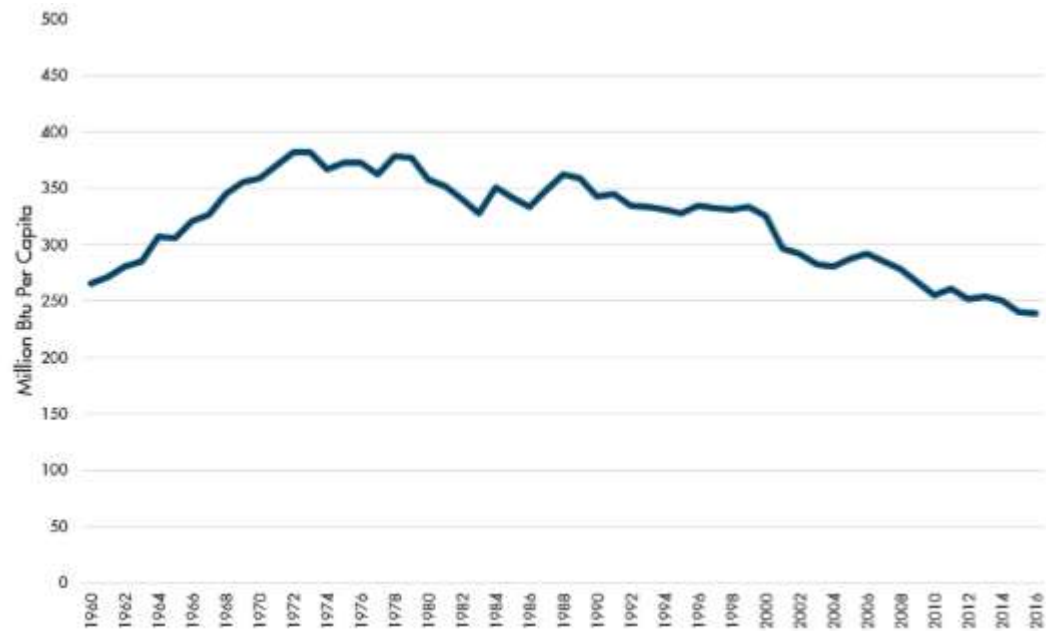


Oregon's Total Energy Consumption Over Time

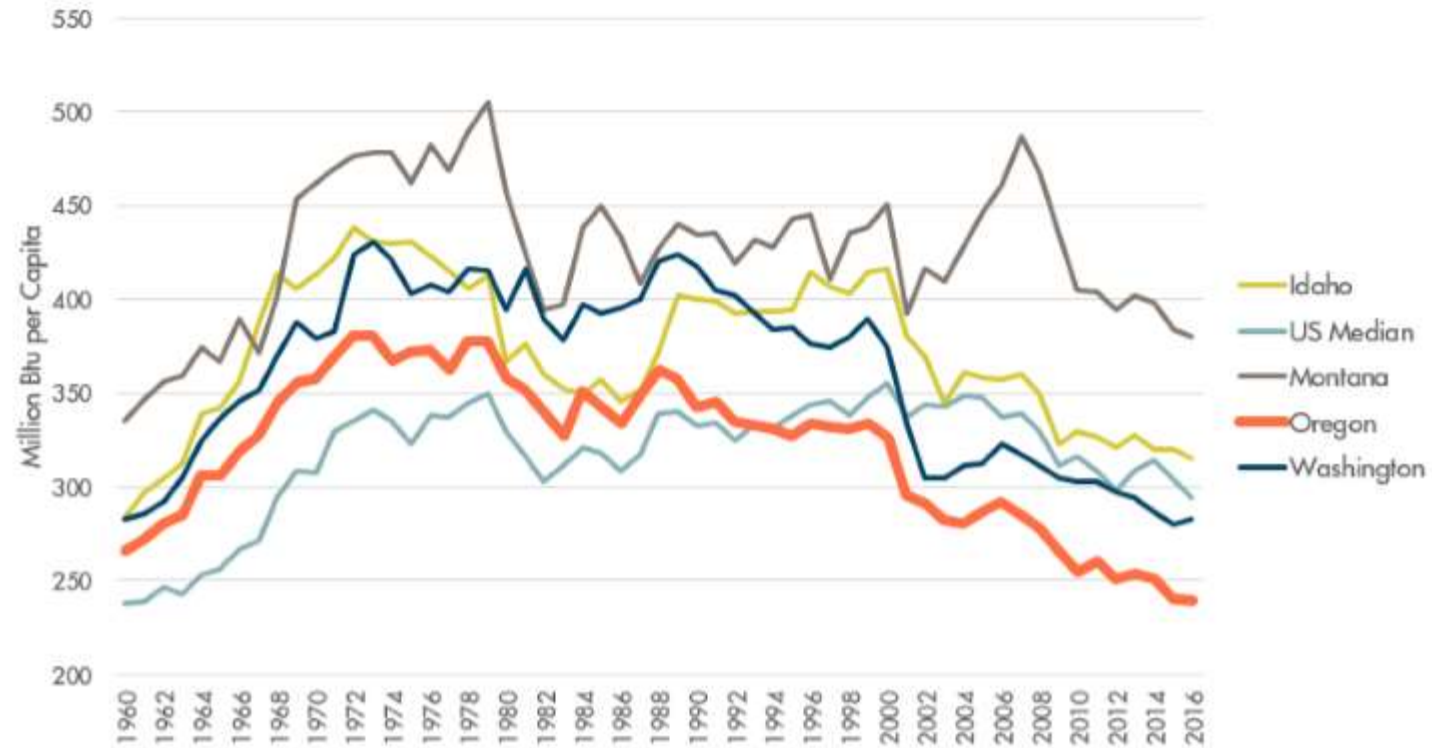


Oregon's Energy Consumption by Sector Over Time

PER CAPITA ENERGY CONSUMPTION OVER TIME



Oregon's Per Capita Energy Consumption Over Time



Oregon's Per Capita Energy Consumption Over Time Compared to Northwest States

Energy Consumption & Oregon's Economy

Between 2000 and 2016:



19%
Oregon
Population

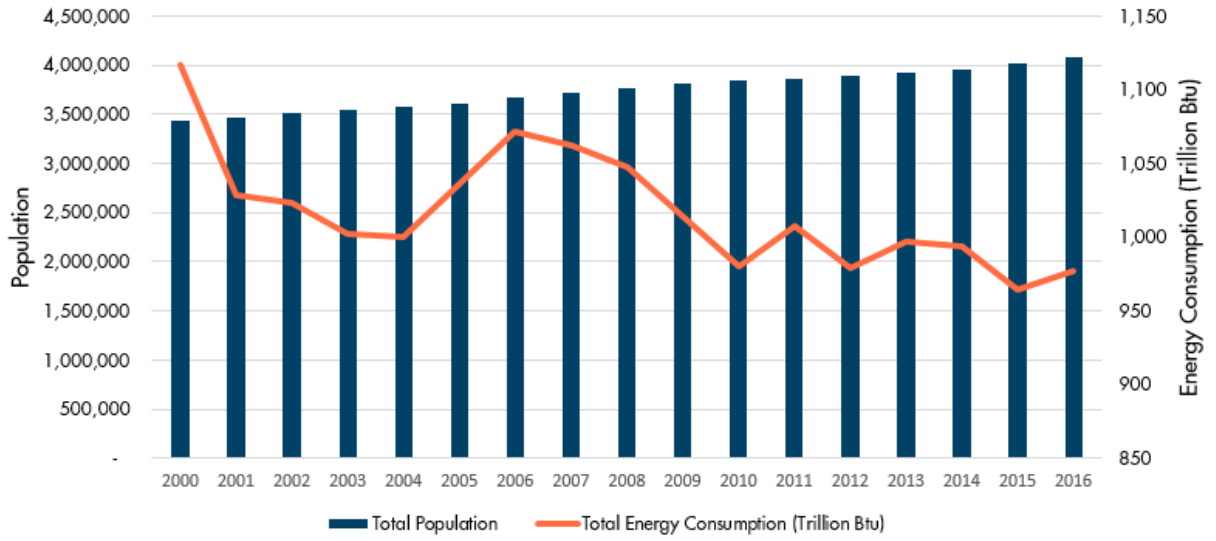


93%
Oregon
GDP

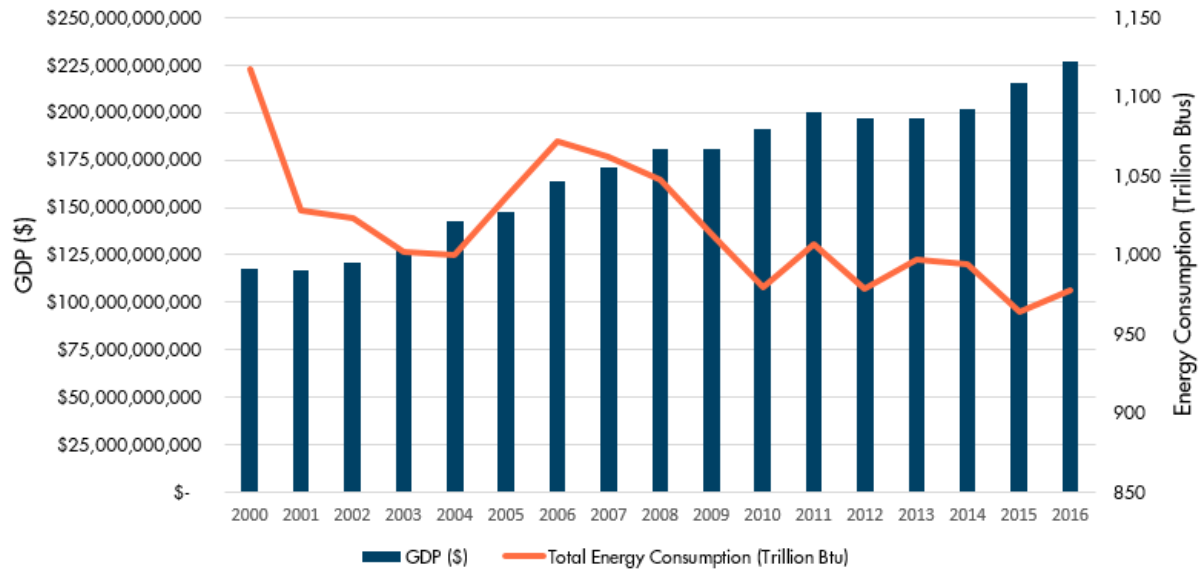


12.5%
Oregon Energy
Use

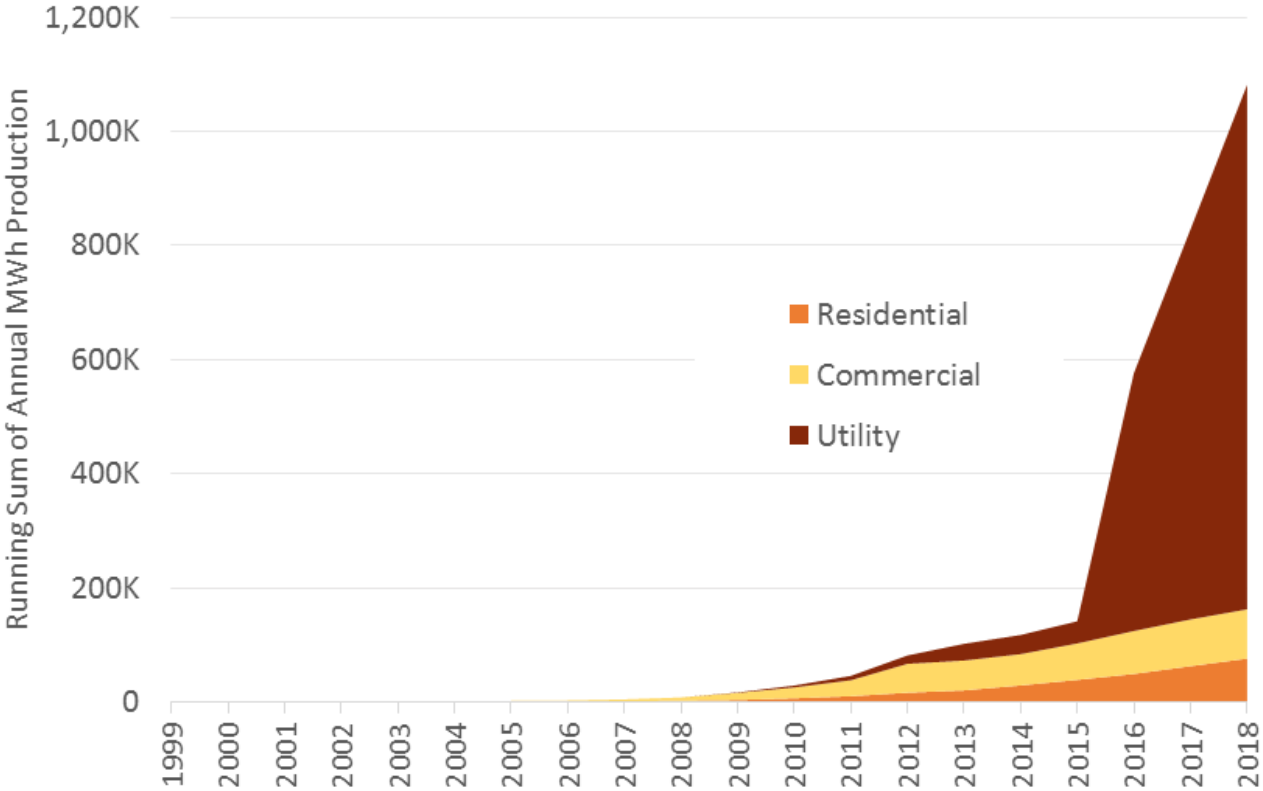
*Oregon's Population and Energy Consumption: 2000-2016
Consumption axis starts at 850 Tbtu*



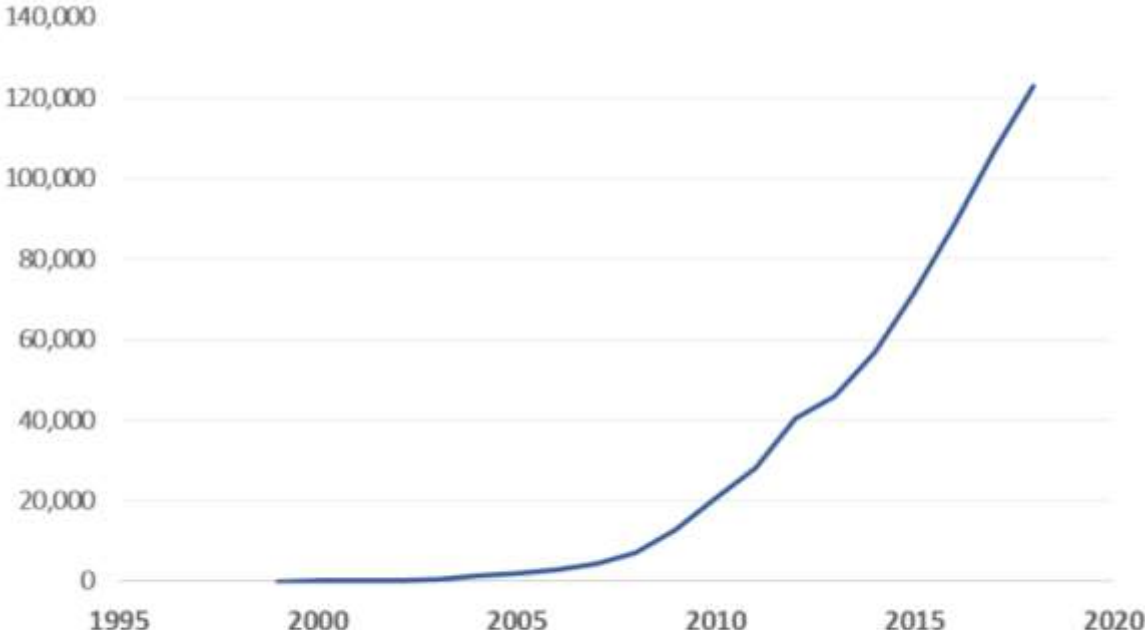
*Oregon's GDP and Energy Consumption: 2000-2016
Consumption axis starts at 850 Tbtu*



RENEWABLE ENERGY



Running Total of PV Production in Oregon Over Time

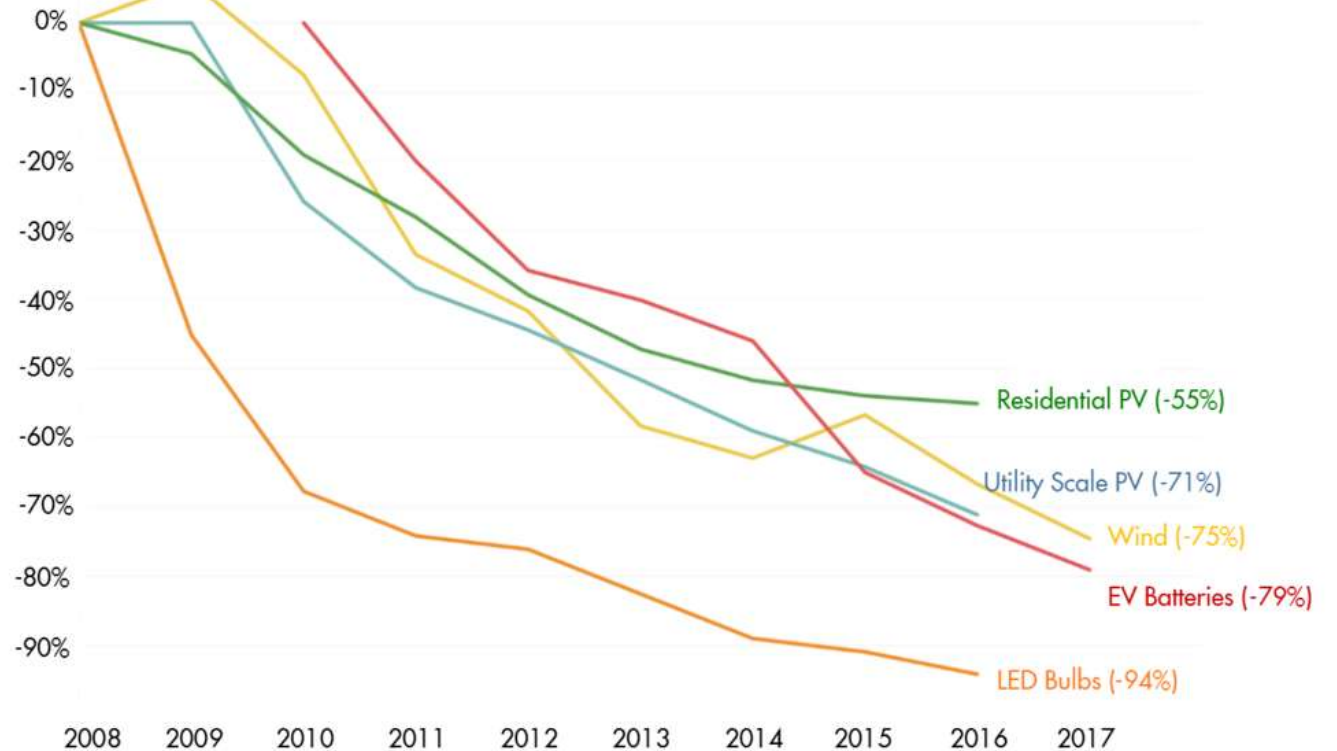


Running Sum of DC Capacity (kW) Commercial and Residential



RENEWABLE ENERGY

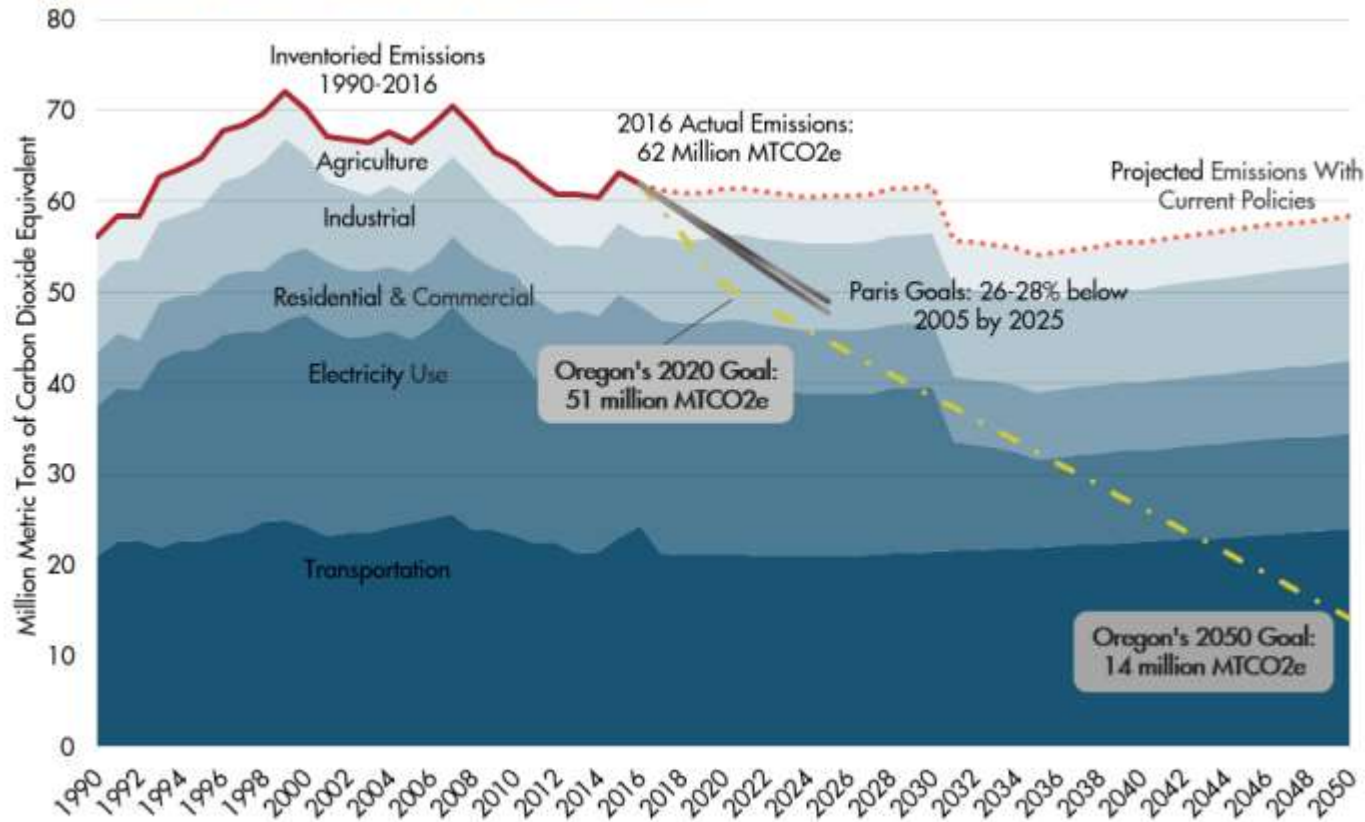
- Explains the growth of renewable energy capacity and consumption in Oregon.
- Impacts policies, growing demand
- Presents challenges and opportunities as Oregon integrates more variable renewable electricity onto the grid



Cost Reductions in Clean Energy Technologies

OREGON GHG REDUCTION GOALS

Figure 2.6: Oregon's Projected GHG Emissions vs. Goals²⁰



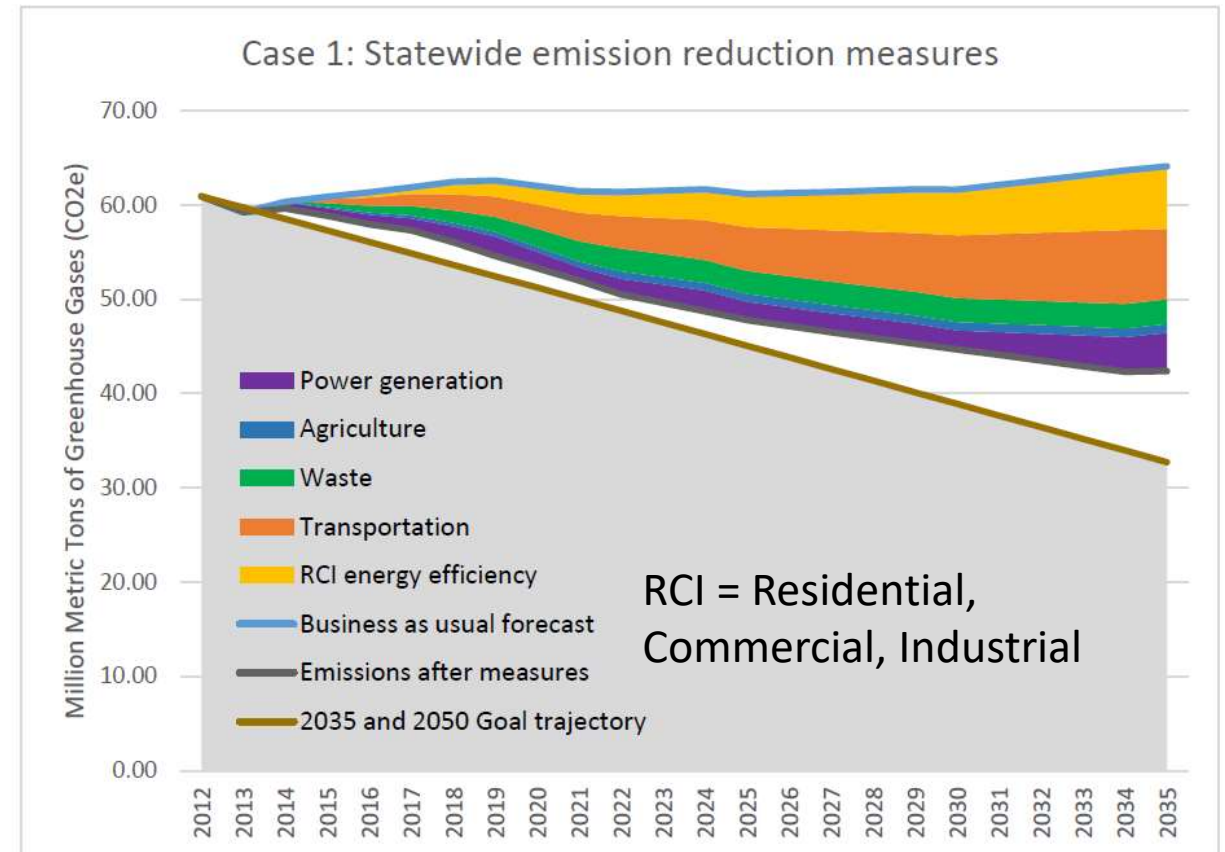
2007 House Bill 3543 set statewide statutory GHG reduction goals:

- By 2010, arrest the growth of Oregon's greenhouse gas emissions and begin to reduce greenhouse gas emissions.
- By 2020, achieve greenhouse gas levels that are 10 percent below 1990 levels.
- By 2050, achieve greenhouse gas levels that are at least 75 percent below 1990 levels.

BUILDINGS & OREGON GHG REDUCTION GOALS

What role do buildings play toward Oregon's broader goals?

- Improve the energy efficiency and reduce the associated GHG emissions of the new building stock
- Critical piece of broader greenhouse gas reduction goals
- Combined with many other generation and demand side efficiency and renewable initiatives, contribute to progress toward goals



Oregon Global Warming Commission, Biennial Report to the Legislature 2015

CLIMATE CHANGE POLICY - LOCAL



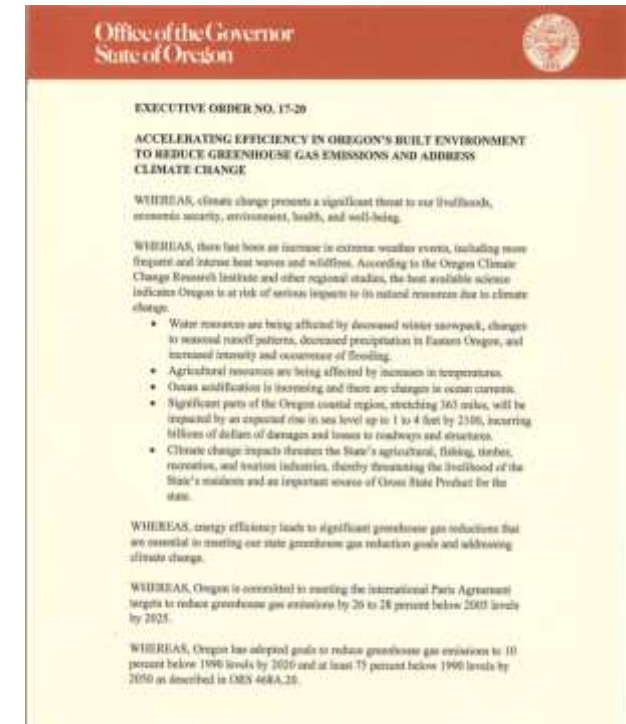
Table 2.1: Jurisdictions in Oregon Taking Climate Change Actions

	GHG Inventory	GHG Mitigation Goal	Climate Adaptation Goal	Focus Areas for GHG Mitigation				
				Renewable Energy	Transportation & Land Use	Buildings	Materials Management	Carbon Sequestration
Ashland	✓	✓	✓	✓	✓	✓	✓	✓
Beaverton	✓	Carbon neutral by 2050; 1.5°C goal	→	✓	✓	✓	✓	✓
Bend	✓	✓	→	→	→	→	→	→
Clackamas County	✓	80% reduction by 2050		✓	✓	✓	✓	✓
Corvallis	✓	✓	✓	✓	✓	✓	✓	✓
Eugene	✓	Carbon budget for city residents consistent with 350 ppm in atmosphere by 2100, requiring an annual average emission reduction of 7.6%		✓	✓	✓	✓	✓
Forest Grove					✓	✓	✓	
Gresham	✓	→						✓
Hillsboro	✓	✓		✓	✓	✓		
Hood River County	✓	Replace 30%, 50%, and 80% of fossil fuel power with renewable energy by 2030, 2040, and 2050 compared to 2016	✓	✓	✓			
Lake Oswego	✓		→	✓	✓	✓	✓	
Milwaukie	✓	Carbon neutral by 2050	✓	✓	✓	✓	✓	✓
Portland and Multnomah County	✓	80% reduction from 1990 levels by 2050	✓	✓	✓	✓	✓	✓
Salem	→	✓			✓	✓		
Washington County	✓			✓	✓	✓	✓	✓

Biosocial Energy Board — Page 19

CLIMATE CHANGE POLICY - STATE

- Executive Order 17-20: Energy Efficiency in the Built Environment
- Renewable Portfolio Standard
- Clean Fuels Program
- Ongoing discussion in the Legislature regarding cap and trade
- “Zero–Ready” Efficiency Standard for Building Code
 - Includes framework for analysis of building energy consumption + renewables to achieve “net zero” energy / carbon



Note: Oregon has min/max statewide code!



NET ZERO ENERGY BUILDINGS OPPORTUNITIES / CHALLENGES

- For Net-Zero “Decarbonized” buildings, building energy codes are a critical piece of the puzzle. Focus on performance.
- Opportunities and Challenges
 - Net metering limitations (ex: 25 kW in some OR locations) that are outside of building code scope
 - How to address sectors like multi-tenant / multi-meter commercial and residential with on-site renewables (virtual net metering?)
 - On-site renewables, storage, and grid interaction
 - Off-site renewable options “weighting”
 - Extending high efficiency + “renewables ready” framework

NET ZERO ENERGY BUILDINGS OPPORTUNITIES / CHALLENGES

- Opportunities and Challenges

- How cleaner grids impact “net zero carbon” calculation vs. “net zero energy”. Integration of cleaner grids and more efficient buildings
- Mixed fuels – different looks at “zero”
- Some building types are already at an EUI that is capable of Net Zero Energy or Carbon, but others may never get there
- Solar resources per site
- Plug loads
- Unoccupied buildings
- Local zoning
- Economics

EXECUTIVE ORDER 17-20

STATE BUILDING LEADERSHIP

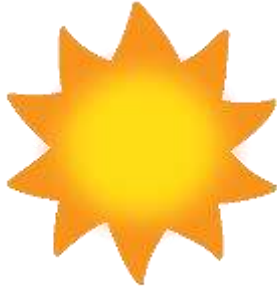
B. Carbon-Neutral Operations for New State Buildings. DAS and ODOE are directed to work with state agencies to ensure that new state owned buildings permitted after January 1, 2022 and used primarily for office and other commercial work space are designed to be able to operate as carbon-neutral buildings defined with full fuel-cycle considerations that are inclusive of, but not limited to, off-site renewable energy and other provisions of ASHRAE standard 189.1. In addition, DAS and ODOE are directed to analyze feasible options with the Department of Environmental Quality that would lower the embodied carbon of building materials in new construction of state buildings.

This is in conjunction with existing programs:

- SEED (State Energy Efficient Design): requires 20% better than code performance for new state buildings and major renovations
- “1.5% for Green Energy Technology”: new construction and major renovations for public buildings are required to dedicate 1.5% of project budget to “green energy technology” such as solar, geothermal, biomass

EXECUTIVE ORDER 17-20

SOLAR AND EV READY



A. Solar Ready Building Construction. The appropriate advisory board(s) and the Department of Business and Consumer Services Building Codes Division (BCD) are directed to conduct code amendment of the state building code to require all newly constructed buildings will be ready for the installation of solar panels and related technologies by October 1, 2020 for residential structures and October 1, 2022 for commercial structures. BCD may establish limited specific exemptions to this solar-ready policy for buildings where solar applications are infeasible.



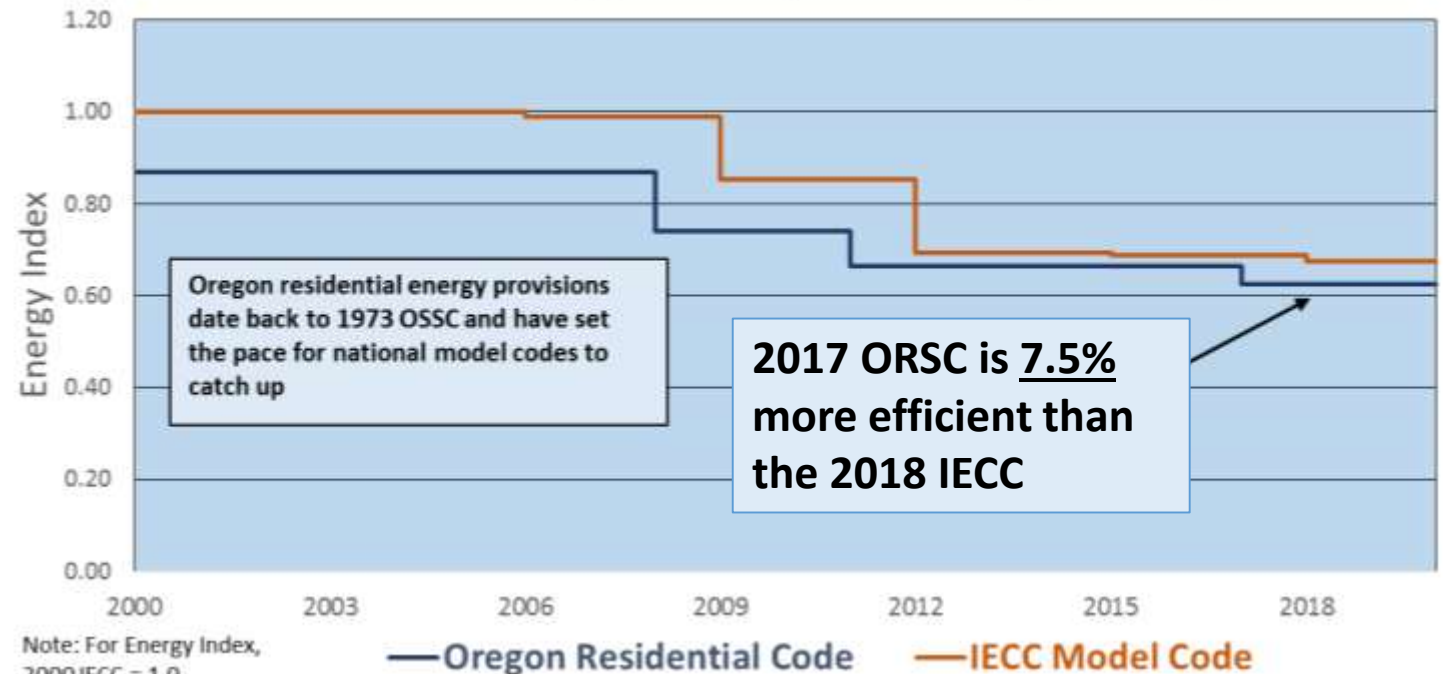
B. Electric Vehicle Ready Building Construction. The appropriate advisory board(s) and BCD are directed to conduct code amendment of the state building code to require that parking structures for all newly constructed residential and commercial buildings are ready to support the installation of at least a level 2 EV charger by October 1, 2022. BCD may establish limited specific exemptions related to types of parking lots, such as temporary parking lots.

EXECUTIVE ORDER 17-20 ZERO ENERGY READY HOMES

C. Zero-Energy Ready Homes. The appropriate advisory board(s) and BCD are directed to conduct code amendment of the state building code to require newly constructed residential buildings to achieve at least equivalent performance levels with the 2017 U.S. Department of Energy Zero Energy Ready Standard by October 1, 2023.



Residential Energy Code Progression - Energy Efficiency Index



EO calls for increasingly efficient homes in Oregon to continue Oregon's leadership path toward "zero energy ready"

EO 17-20, DIRECTIVE 4C ZERO ENERGY READY HOMES

What is the US DOE Zero Energy Ready Home?

- Prescriptive Path and Performance Path (uses HERS)
- Contains specifications for highly efficient envelope, heating, cooling, lighting, ventilation, water heating, and appliances
- **For some requirements, Oregon is already there**
- Includes other non-energy criteria such as indoor air quality, installation quality
- Oregon is looking to develop a prescriptive code that is based upon US DOE ZERH energy efficiency requirements



EO 17-20, DIRECTIVE 4C ZERO ENERGY READY HOMES



Comparisons (a few)



2017 Oregon Residential Code

Required whole-house ventilation per ASHRAE 62.2 at 1.2 cfm/W, with 60% heat recovery ventilator	→	Option 5 (partial) requires 62.2, no cfm/W rate or HRV required
Required ducts inside, testing, sealing	→	Option 5 or B (ducts inside or seal)
Mandatory ACH testing with performance threshold (2.5 ACH ₅₀ in climate zone 4, 2 ACH ₅₀ in climate zone 5)	→	Option 5 (sealing, but no ACH spec and no performance testing)
Hot water equipment, distribution, and piping	→	Option D HW equipment, but no optimized distribution
Slightly better windows with US DOE ZERH at U-0.27	→	OR base U-0.30, but couple of N1101.1(2) options require better

EO 17-20, DIRECTIVE 4C ZERO ENERGY READY HOMES



Comparisons (a few)



2017 Oregon
Residential Code

High efficiency appliances	→	Not regulated by code, but Oregon does have a number of appliance standards not preempted by Federal government (more detail later in presentation)
80% Energy Star Lighting	→	100% high efficacy lighting (2 exc.)
Envelope: minimum = 2012 IECC	→	Oregon already exceeding many envelope provisions, especially if any envelope options are chosen as the compliance pathway

EO 17-20, DIRECTIVE 4C ZERO ENERGY READY HOMES



Comparisons (a few)



2017 Oregon Residential Code

Building Component	2017 Oregon Residential Specialty Code (ORSC) v. ZERH			
	Component	2017 ORSC (5/A) ^a	ZERH	Notes
		CZ 4C & 5B	CZ 4C & 5B (DOE)	
Building Envelope	Wall Insulation - Above Grade	R-21 Intermediate ^c	R-20 or R-13 + 5 ^b	Intermediate framing = Studs located 16" O.C. with three-stud corners. Advanced = 24" O.C.
	Wall Insulation - Below Grade	R-15/R-21	R-15/R-19	R-15 cont. insul. on the int. or ext. of the home OR R-19/21 cavity insul. at the interior of basement wall.
	Flat Ceilings	R-49	R-49	Min. 6" depth at top plate at exterior of structure to achieve U-factor.
	Vaulted Ceilings	R-30	NR	Performance Path for IECC.
	Underfloors	R-30	R-30	IECC allows for reduction to R-19 if insulation is "sufficient to fill framing cavity."
	Slab Edge Perimeter	R-15	R-10/2 Feet	Full depth is req'd in ORSC. 2 Feet is depth of insul. in IECC and CZ4 of RMI. None in RMI's CZ5.
	Heated Slab Interior	R-10	R-5	Insulation to be installed under entire slab.
	Windows	U-0.30	U-0.27	Average of all windows & glazed doors. Windows have air leakage maximums.
	Skylights	U-0.50	U-0.55	U-factor tested in 20 degree plane in accordance with NFRC standards.
	Exterior Doors	U-0.20	U-0.30	Average of all windows & glazed doors. Doors have air leakage maximum in ORSC.

	Equal
	Exceed
	Mismatch ORSC/ZERH
	Need Improvement



EXECUTIVE ORDER 17-20

COMMERCIAL ENERGY CODE

D. Increasing Energy Efficiency in Commercial Construction. The appropriate advisory board(s) and BCD are directed to conduct code amendment of the state building code to require, by October 1, 2022, that newly constructed commercial buildings, averaged across building types, will exceed International Energy Conservation Code and ASHRAE 90.1 by achieving at least equivalent performance levels with the measurable prescriptive energy efficiency portions of the most current version of ASHRAE 189.1 that are construction-related.

EXECUTIVE ORDER 17-20 COMMERCIAL ENERGY CODE

Oregon **Building Codes Division** is moving towards quick adoption of ASHRAE 90.1 as state code within a year of publication

- ASHRAE 90.1-2016 by October 2019
- ASHRAE 90.1-2019 by October 2020



Incorporation of Architecture 2030 Framework for estimating energy consumption and renewables for a Zero Net Energy Building

Benefits of 90.1 include

- Quicker, less resource-intensive, streamlined adoption (more buildings under advanced code)
- More predictable
- Comprehensive cost analysis
- Supported (COMcheck)
- Federal declaration/certification becomes easy

Note: Oregon has min/max statewide code!

EXECUTIVE ORDER 17-20 COMMERCIAL ENERGY CODE

Code Compliance Form draft



Part I COMcheck information

Compliance path:

- Performance path
- Prescriptive path

COMcheck (Standard 90.1) results:

- Pass
- Fail *If using the performance path, submit the energy model report with this form

Prepared by or
under the supervisions of: _____

Date: _____

Part II Projected energy use

Enter the ZERO Code Calculator results for projected energy use.

Estimated building energy consumption: _____ MBtu/yr

Part III Estimated available renewables for the building

Enter the ZERO Code Calculator results for offsets.

Total renewable energy necessary to achieve Net Zero: _____ MBtu/yr

On-site potential PV rated capacity _____ kW

CHECKLIST AND APPLICANT SIGNATURE

COMcheck report and ZERO Code Calculator report must be submitted with this form.

- COMcheck report is attached
- Energy model report is attached (if COMcheck failed)
- ZERO Code Calculator report is attached

EXECUTIVE ORDER 17-20 COMMERCIAL ENERGY CODE

ASHRAE 90.1-2016 for OR Climate Zones

2016 Prototype EUIs Prototype Name	Indiv Building Type	
	4C	5B
OfficeSmall	23.3	25.7
OfficeMedium	27.2	30.3
OfficeLarge	62.7	70.1
RetailStandalone	40.4	47.0
RetailStripmall	48.1	52.7
SchoolPrimary	44.7	46.7
SchoolSecondary	35.7	40.2
OutPatientHealthCare	98.4	107.7
Hospital	113.2	112.9
HotelSmall	52.1	54.9
HotelLarge	77.4	81.5
Warehouse	14.2	16.8
RestaurantFastFood	557.1	591.0
RestaurantSitDown	357.1	377.3
ApartmentMidRise	40.3	44.3
ApartmentHighRise	42.3	47.1

- Some ASHRAE code-level buildings are approaching near on-site net-zero capable EUIs

Rough estimates based on Oregon solar resources for EUI that can be offset with PV*:

1-story: 45 kbtu/ft²/yr

2-story: 23 kbtu/ft²/yr

3-story: 15 kbtu/ft²/yr

....and so on

- But for some building types, on-site net zero is not feasible
- It is important to set up the framework for off-site pathways

EXECUTIVE ORDER 17-20 COMMERCIAL ENERGY CODE

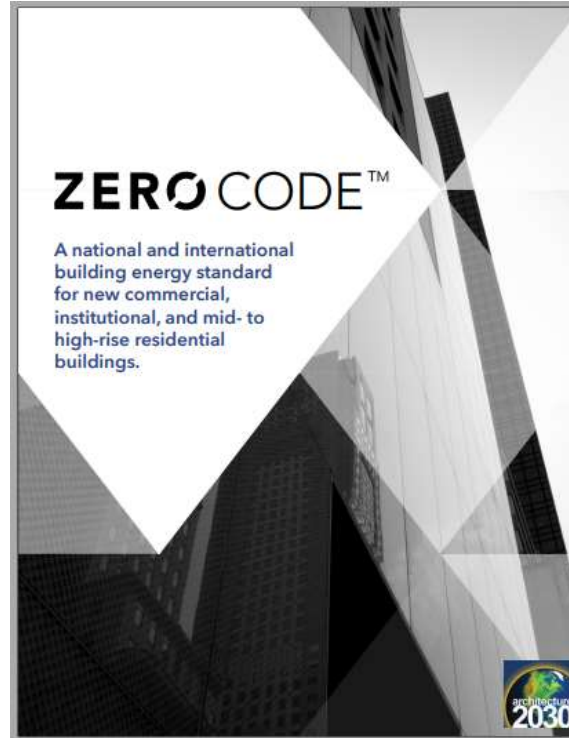
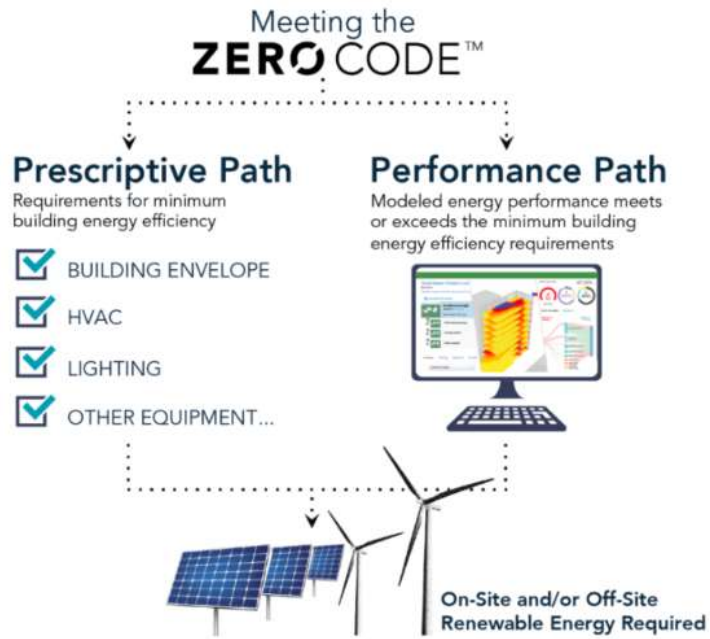
- From ASHRAE 1651-RP (2015), how low can we go (in terms of EUI)?

Table E3 – Energy Use and Change from Applying Measures

	Site Energy			So
	Base (kBtu/ft2-yr)	Measures (kBtu/ft2-yr)	Percent	
ApartmentHighRise	52.0	30.6	-41.2%	(k
ApartmentMidRise	49.0	30.7	-37.3%	
Hospital	120.3	67.6	-43.8%	
HotelLarge	89.1	54.1	-39.3%	
HotelSmall	66.9	47.7	-28.7%	
OfficeLarge	70.3	45.1	-35.8%	
OfficeMedium	34.0	11.3	-66.8%	
OfficeSmall	29.6	9.8	-67.1%	
OutPatientHealthCare	109.2	66.0	-39.6%	
RestaurantFastFood	578.8	409.5	-29.3%	
RestaurantSitDown	374.1	261.3	-30.2%	
RetailStandalone	45.9	18.6	-59.4%	
RetailStripmall	54.9	16.6	-69.7%	
SchoolPrimary	53.3	25.8	-51.6%	
SchoolSecondary	41.6	17.7	-57.5%	
Warehouse	17.2	6.4	-63.1%	

- Not considering cost-effectiveness
- But many building types can approach or cross over the EUI for net-zero ready
- Highlights the importance of off-site pathway to achieve net-zero
- Plug loads!

NET ZERO ENERGY FRAMEWORK



ZERO Code Energy Calculator

ABOUT YOUR BUILDING

Code Pathway: Prescriptive Performance

Country:

City:

Number of Stories:

Primary Building Use:

ON-SITE PV SYSTEMS

Enter on-site PV system generation potential below, or estimate on-site PV system generation potential using PVWatts. If your building has multiple PV systems enter them below.

Use PVWatts Enter Generation Potential

Set Default Values delete

Estimated Area for Collectors:

Module Type:

Losses (%):

Array Type:

Tilt (Degrees):

Azimuth (Degrees):

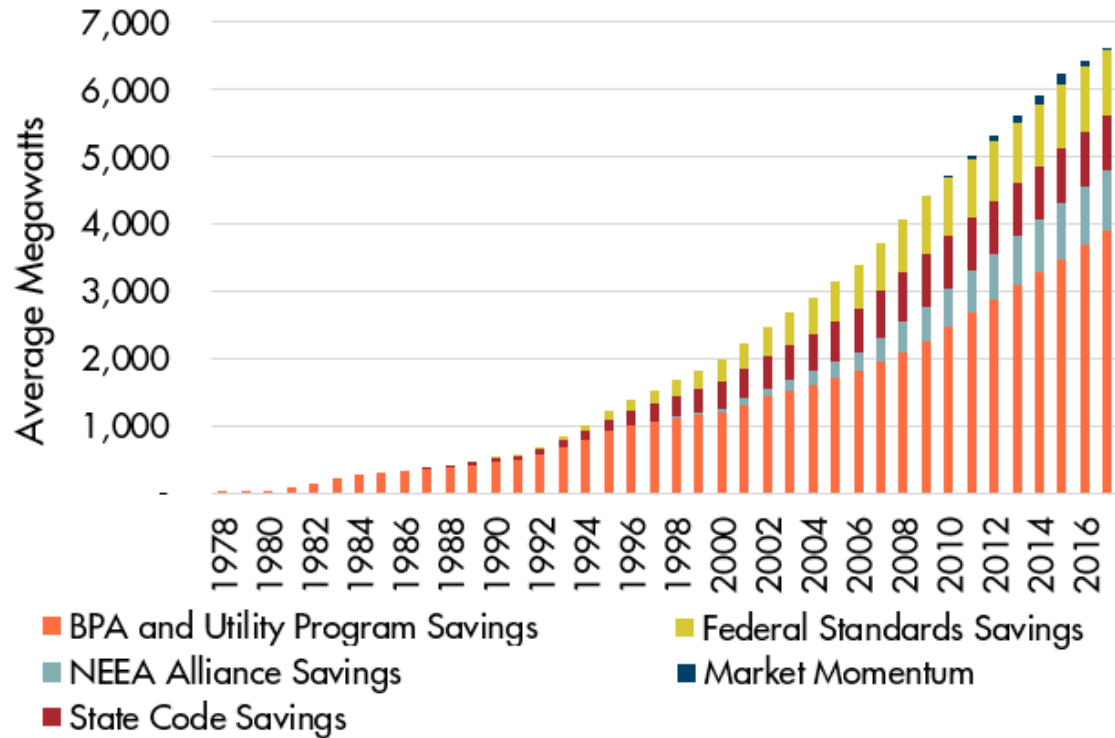


RECAP

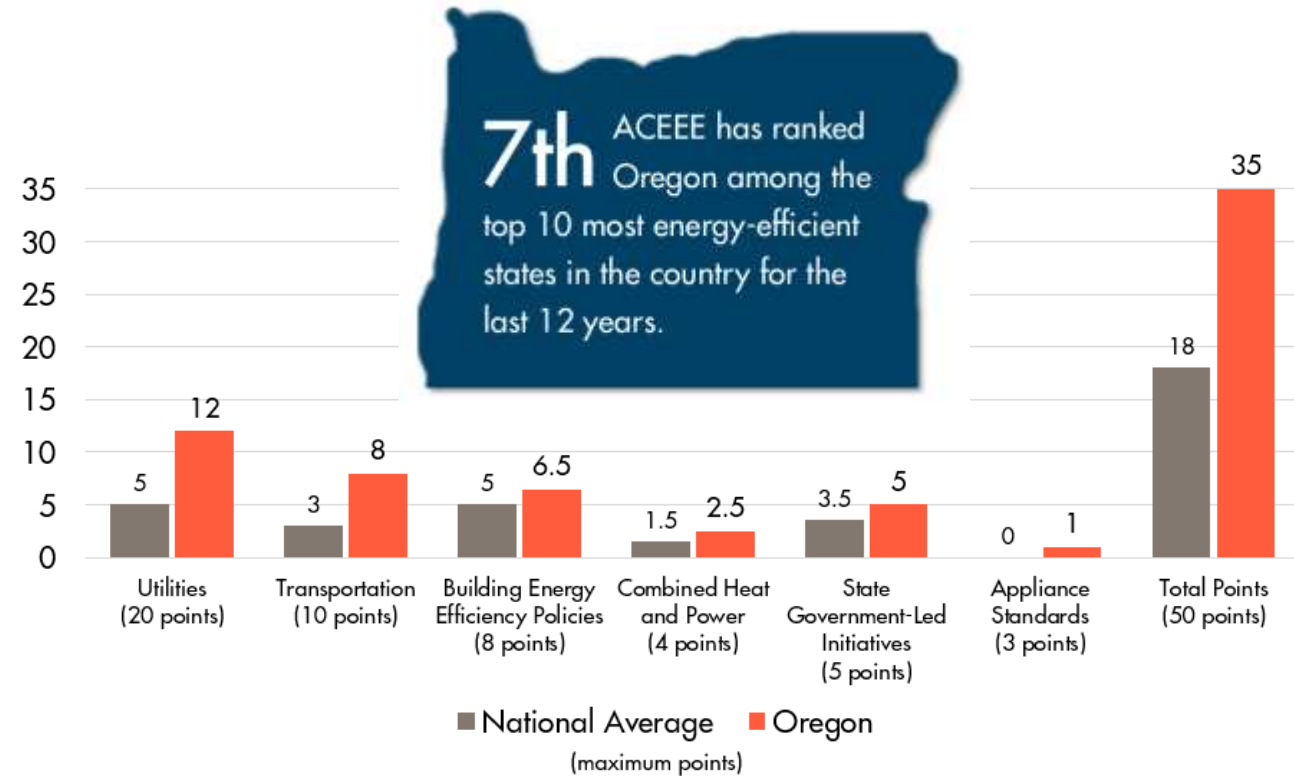
- Buildings are an important, critical piece
- State and local policy continues to move toward energy efficiency, renewable energy, and GHG reduction
- There are regulatory challenges to Zero Net Energy (ZNE) buildings (like net metering), and some of these are outside of the energy code scope
- Oregon's Building Codes Division (BCD) is developing framework in collaboration with stakeholders, leveraging Architecture 2030 to put Oregon on a path to ZNE, setting up an important framework for ZNE nationwide
- 90.1 fast adoption provides quicker, more predictable, supported method to achieve a high-performance building code sooner



REGIONAL AND STATE LEADERSHIP IN ENERGY EFFICIENCY



Cumulative Regional Savings from Energy Efficiency



American Council for an Energy Efficient Economy Energy Scorecard Results: Oregon vs. National Average

The region has a great track record that will continue into 2050 to meet these challenges



THANK YOU

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