Modelling Results

Policy analysis

November 15, 2022

SSG

Building performance standards

1	Building performance standards		1a	1b	1c	1d
			Direct emissions need to reach 5% below 2035 levels in the BAP by 2035		Direct emissions need to reach 40% below 2035 levels in the BAP by 2035	
			Existing residential, commercial and multi-family buildings			
			All building sizes	Buildings ≥ 35,000 ft2	All building sizes	Buildings ≥ 35,000 ft2
2	Promote, incentivize and or subsidize energy efficiency and heating/cooling		2a	2b	2c	2d
			50% of buildings are retrofitted by 2050, thermal energy requirements reduced by 15%		100% of buildings are retrofitted by 2035, thermal energy requirements reduced by 50%	
3	Decarbonize institutional/public buildings					
4	Promote, incentivize or subsidize					
5	Assess and material-related					
6	Enact energy-efficient building codes					

Summary Charts

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Response to Questions from the Task Force

Task Force members have raised questions with respect to the modelling approach. The response of the modelling team to each of the questions or comments is detailed in the following table.

Comment/question from the Task Force	Adjustment to the modelling approach	Details
What is the definition of "plug load"? How will the reductions be accomplished?	No change	Plug loads are energy used by equipment that is usually plugged into an outlet. These sources would include equipment such as appliances, computer equipment and AV equipment. Plug loads are not related to general building lighting, heating, ventilation, cooling, and water heating, and typically do not provide comfort to the occupants. Modern technology usually incorporates a variety of power modes with most electronic devices (computers, stereos, tvs) drawing power even when they are turned off. Some strategies involved in reducing plug load include • Upgrading equipment • Turning equipment off when not in use • Employing plug-load automation and controls • Promoting beneficial occupant behaviour The following source is a good resource for commercial buildings but many of these strategies can be applied to residential buildings as well. Plug Load Frequently Asked Questions (FAQ)	GSA
The use of the AVERT tool	No change	EPA's AVERT tool calculates the change in air pollutants as a result of electricity generation on an hourly basis. The change in outputs is calculated within the model used by the modelling team. While AVERT has a higher temporal resolution, it does not include the full energy system. Additionally, the AVERT tool doesn't project future emissions as the generation mix changes.
The inclusion of Renewable Natural Gas (RNG)	RNG is included in Policy 1	RNG is included in Policy 1. Policy 1 is a Building Performance Standard that applies GHG targets, but does not specify how those GHG targets will be achieved. The amount of RNG available to Oregon is based on the current state of the RNG supply for the US. The total RNG supply in 2040 in the US is assumed to be 3,750 trillion BTUs. Power to gas/Methanation was excluded from this total. This total was shared out to Oregon according to the population of Oregon relative to the total US population, resulting in a total of 47.5 trillion BTUs of RNG available to Oregon by 2040. RNG was distributed to the residential building sector based on the share of natural gas left in this sector after the policy mechanism was implemented. "Best use"

1a Building Performance Standard

Target	Direct emissions need to reach 5% below 2035 levels in the BAP by 2035
Building types	Existing residential, commercial and multi-family buildings
Building sizes	All building sizes

5b Assess and disclose material-related emissions

3b Decarbonize institutional/public buildings

| Target | New buildings after 2023 are carbon neutral |

2a Promote, incentivize or subsidize energy efficiency and heating/cooling

6b Enact energy-efficient building codes

Target	50% of existing buildings are retrofitted by 2050, thermal energy requirements	A 40% reduction in new building energy consumption from the 2006 Oregon codes
Building types		
Building sizes		

Impact on

Indicator

1. GHG emissi...
2. Economic i... lifecycle abate... cost
3. Energy effi...
4. Resiliency

U2 Modify Energy Trust of Oregon's Mission

Target	• Change Energy Trust of Oregon's (ETO) mission to lead with greenhouse gas (GHG) emissions reductions and equity instead of leading with fuel-neutral energy efficiency • Direct the PUC to consider GHG reduction in Energy Trust/utility conservation programs. • Remove barriers to customer choice through ETO funds and other programs that provide efficiency incentives to replace bulk fuels with a more efficient electric system (rather than a forced switch). • ETO programs should be made available statewide.

Note: This policy was not assessed quantitatively; a qualitative assessment of the policy has been undertaken using the same framework. This assessment is based on our understanding of the policy intention and our best assessment of its impacts.

Indicators

1. GHG emissions	↓ Decreases emissions	Aligning ETO's mission with GHG emissions reductions will reduce emissions
2. Economic impact-lifecycle abatement cost	Negligible cost per ton of emissions reduced	ETO can bundle measures which cost money with measures that save money to ensure savings per ton of emissions reductions
3. Energy efficiency	↓ Decreases energy consumption	ETO programs will reduce energy consumption and increase efficiency under this policy
4. Resiliency	↑ Increase resilience	ETO programs which save energy and address equity will increase resilience
5. Public health and air quality	↓ Decreases health costs	ETO programs that reduce GHG emissions will improve health outcomes and decrease health costs

1

Policies

1	Building performance standards	1a	1b	1c	1d
		Direct emissions need to reach 5% below 2035 levels in the BAP by 2035		Direct emissions need to reach 40% below 2035 levels in the BAP by 2035	
		Existing residential, commercial and multi-family buildings			
		All building sizes	Buildings ≥ 35,000 ft2	All building sizes	Buildings ≥ 35,000 ft2
2	Promote, incentivize and or subsidize energy efficiency and heating/cooling	2a	2b	2c	2d
		50% of buildings are retrofitted by 2050, thermal energy requirements reduced by 15%		100% of buildings are retrofitted by 2035, thermal energy requirements reduced by 50%	
		All building types			
		Buildings ≥ 50,000 ft2	Buildings ≥ 30,000 ft2	Buildings ≥ 50,000 ft2	Buildings ≥ 30,000 ft2

Policies

3	Decarbonize institutional/public buildings	3a	3b
		New buildings after 2035 are carbon neutral	New buildings after 2023 are carbon neutral
		50% of buildings are retrofitted by 2045; thermal energy requirements reduced by 15%; plug load reduced by 15%	100% of buildings are retrofitted by 2035: thermal energy requirements reduced by 50%; Plug load reduced by 50%
4	Promote, incentivize, and/or subsidize heat pumps	4a	4b
		80% of covered buildings have a heat pump installed by 2040	100% of buildings that are covered have a heat pump installed by 2035
		New and existing residential and commercial buildings	

Policies

5	Assess and disclose material-related emissions	5a	5b	5c	
		Reduce embodied carbon from construction by 20% by 2030, compared to 2015	Reduce embodied carbon from construction by 60% by 2030, compared to 2015	Reduce embodied carbon from construction by 100% by 2050, compared to 2015	
		Residential and commercial buildings			
6	Enact energy-efficient building codes- Existing	6a	6b	6c	6d
		50% of existing buildings are retrofitted by 2050, thermal energy requirements reduced by 15%, plug load reduced by 15%		100% of existing buildings are retrofitted by 2035, thermal energy requirements reduced by 50%, plug load reduced by 50%	
		Existing residential and commercial buildings			
		Buildings ≥ 50,000 ft2	Buildings ≥ 30,000 ft2	Buildings ≥ 50,000 ft2	Buildings ≥ 30,000 ft2
	Enact energy-efficient building codes- New	A 40% reduction in new building energy consumption from the 2006 Oregon codes		A 80% reduction in new building energy consumption from the 2006 Oregon codes	
		New residential and commercial buildings			
		Buildings ≥ 50,000 ft2	All buildings	Buildings ≥ 50,000 ft2	All buildings

Policy number

2a Promote, incentivize and or subsidize energy efficiency and heating/cooling

Policy details

Target	50% of buildings are retrofitted by 2050, thermal energy requirements reduced by 15%
Building types	All building types
Building sizes	Buildings ≥ 50,000 ft2

Impact on GHG Emissions Relative to All Building Policies Analysed

GHG rating bar

←Policy with the lowest reduction   Policy with the highest reduction→
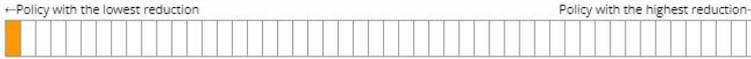
Indicators

Indicators

1. GHG emissions	↓ Decreases emissions	**-70,000 metric ton CO2e** average annual GHG emissions avoided emissions (2022-2050)
2. Economic impact- lifecycle abatement cost	↓ Saves money per ton of emissions reduced	**-$591** net present value of a metric ton of avoided GHG emissions with a 3% discount rate
3. Energy efficiency	↓ Decreases energy consumption	**-2,000,000 MMBTU** average annual avoided energy consumption (2022-2050)
4. Resiliency	↑ Increases resiliency	**877,000 homes** with retrofits that increase resiliency against heat, cold and severe weather events
5. Public health and air quality	↓ Decreases health costs	**-$9 million** average annual avoided public health costs (2022-2050)

6. Household expenditures	↑ Increases household energy costs	**4.46%** change household energy expenditures between 2022 and 2050
7. Economic impact-employment	↑ Employment	**440** average annual person years of employment created (2022-2050)
8. Social cost of carbon	↓ Decreases the social cost of carbon	**-$5.1 million** average annual avoided damage from climate change globally (2022-2050)

Background

1. GHG Emissions
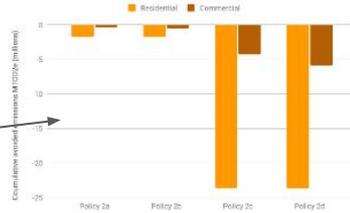
Cumulative avoided emissions

Figure 1: Energy Efficiency Policy scenarios, cumulative GHG emissions reduction by sector, 2022-2050

Annual emissions

Figure 2: Energy Efficiency Policy scenario 2a, annual GHG emissions reductions resulting from scenario 2a relative to total projected GHG emissions from buildings in Oregon

CPP contribution
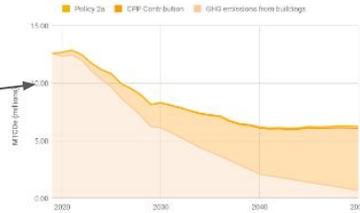
Figure 3: Energy Efficiency Policy scenario 2a, annual GHG emissions reductions resulting from scenario 2a relative to total projected GHG emissions from buildings in Oregon, with reductions from CPP

2. Economic Impact, Costs and Savings
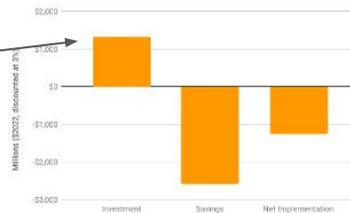
Net present value

Figure 4: Building Performance scenario 2a, NPV over the study period

Annual costs and savings
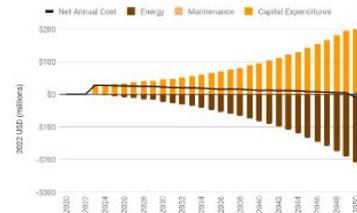
Figure 5: Building Performance scenario 2a, net annual costs or savings

Cumulative Avoided Emissions

Sum of annual avoided emissions

Background
1. GHG Emissions

Residential   Commercial

Figure 1: Energy Efficiency Policy scenarios, cumulative GHG emissions reduction by sector, 2022-2050

Policy 2c   GHG emissions from buildings

MTCOe (millions)

15.00
10.00
5.00
0.00

2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050

Emissions eliminated by the action (kT)

Net Present Value

2. Economic Impact, Costs and Savings

Figure 2: Building Performance scenario 1a, NPV over the study period

Figure 3: Building Performance scenario 1a, net annual costs or savings

Discounted back to 2022$

Costs + Savings = Net Costs (+)/Savings(-)

Abatement Cost

2. Economic Impact, Costs and Sav[ings]
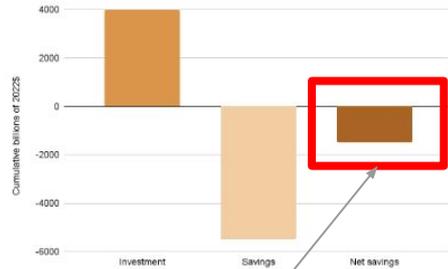
Figure 2: Building Performance scenario 1a, NPV over the study period

Background
1. GHG Emissions

Figure 1: Energy Efficiency Policy scenarios, cumulative GHG emissions reduction by sector, 2022-2050

Net present value (+/-) / Cumulative avoided emissions = Abatement cost ($/MtCO2e)

3. Energy Efficiency

Cumulative avoided energy
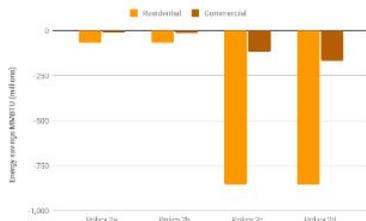
Figure 6: Energy Efficiency Policy scenarios, cumulative energy savings by sector, relative to the reference scenario
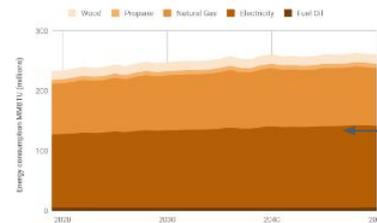
Figure 7: Energy Efficiency Policy scenario 2a, energy consumption by energy source

Annual energy by source

4. Resiliency

Cumulative # of dwellings retrofit
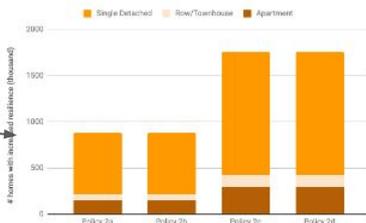
Figure 8: Energy Efficiency Policy scenarios, # of homes with increased resilience by 2050

5. Public Health and Air Quality

Cumulative avoided health costs
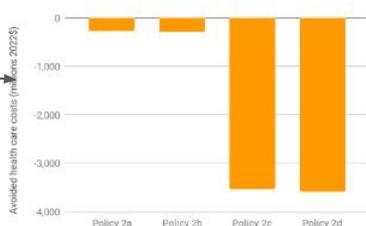
Figure 9: Building Performance Scenarios, avoided cumulative health costs
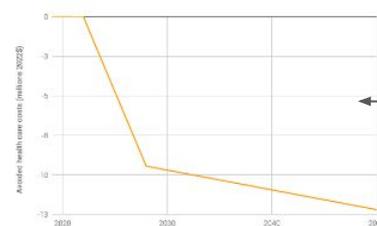
Figure 10: Building Performance Scenario 2a, avoided annual health costs

Annual avoided health costs

6. Household Expenditures

Household energy savings
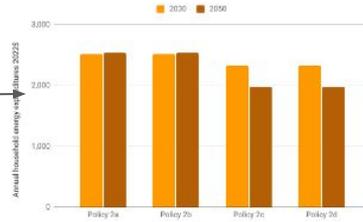
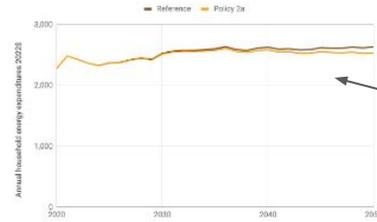Figure 11: Building Performance Scenarios, annual household energy expenditures

Annual household energy costs

Figure 12: Building Performance scenario 2a, annual household energy expenditures relative to the reference scenario

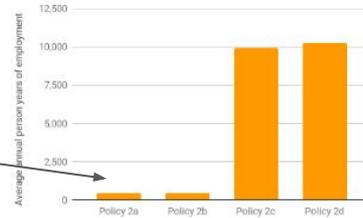## 7. Economic Impact, Employment

Person years of employment

Figure 13: Building Performance scenarios, cumulative person years of employment

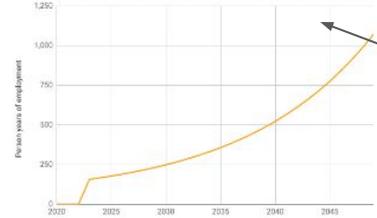Annual person years of employment

Figure 14: Building Performance scenario 2a, annual person years of employment

8. Social Cost of Carbon

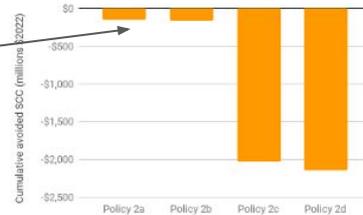Cumulative avoided social cost of carbon

Figure 15: Energy Efficiency Policy scenarios, cumulative avoided social cost of carbon
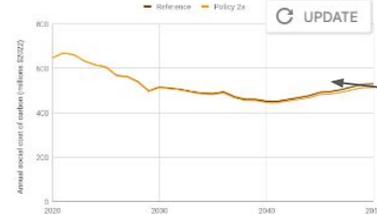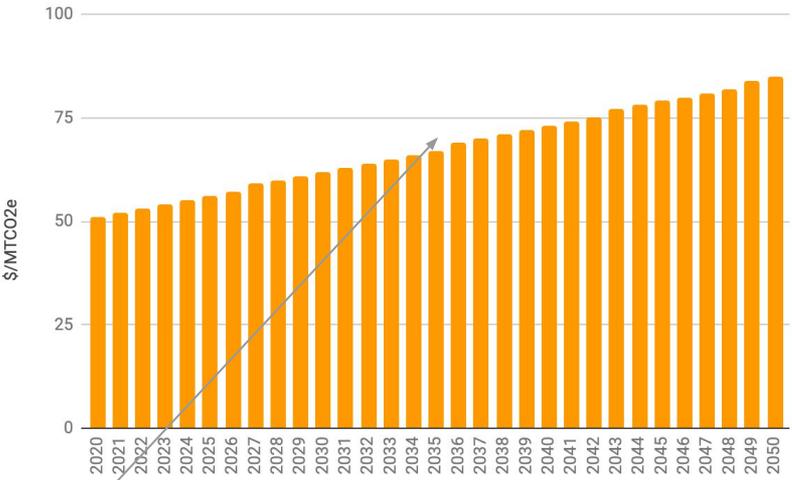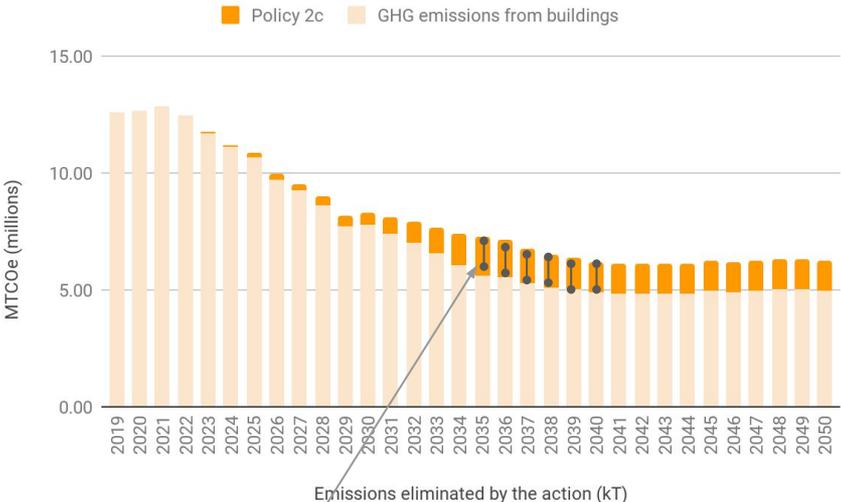
Annual social cost of carbon

Figure 16: Energy Efficiency Policy scenario 2a, annual avoided social cost of carbon relative to the reference scenario

Social Cost of Carbon

Annual GHG reduction **x** Annual Social Cost of Carbon ($/MTCO2e)

Integrated Scenarios

Rationale	Description
Synergies/feedback	When one policy changes the conditions for another policy: thermal envelope and heat pumps.
Avoid double counting	When two policies act on the same building: retrofit of public sector building and retrofit of commercial buildings.
Policy impact	The impact of one policy in the context of another policy: A heat pump displacing the emissions associated with a furnace powered by RNG.
Total impact	The addition of two policies in time; ensuring coherence in time and space.

Integrated Scenarios

A	B	C	D	E
Go slow, focus on large buildings	Medium efficiency, focus on large buildings	Medium GHG reductions, non-prescriptive	Maximum efficiency	Maximum GHG reductions, non-prescriptive
- Enact energy-efficient building codes 6a - Promote, incentivize, and/or subsidize heat pumps 4a - Decarbonise public buildings 3a - Assess and disclose material-related emissions 5a*	- Promote, incentivize and or subsidize energy efficiency and heating/cooling 2a - Promote, incentivize, and/or subsidize heat pumps 4a - Enact energy-efficient building codes 6a	- Building Performance Standard 1d - Decarbonise public buildings 3b - Assess and disclose material-related emissions 5b*	- Promote, incentivize and or subsidize energy efficiency and heating/cooling 2d - Promote, incentivize, and/or subsidize heat pumps 4b - Enact energy-efficient building codes 6d	- Building Performance Standard 1c - Decarbonise public buildings 3b - Assess and disclose material-related emissions 5c*

*Embodied emissions reductions require a different accounting approach