Carbon Tax Assessment for Hawai‘i Economic and Greenhouse Gas Impacts

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Presented by
Makena Coffman
Director, Institute for Sustainability and Resilience
Professor, Urban and Regional Planning
Research Fellow, UHERO

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Research Team

- Paul Bernstein, PhD Operations Research
  - Climate and Energy Analyst, UHERO
- Maja Schjervheim, MURP
  - Climate and Energy Analyst, UHERO
- Sherilyn Hayashida, PhD Economics
  - Formerly with the University of Hawai‘i Public Policy Center
  - Research Fellow, UHERO
- Sumner La Croix, PhD Economics
  - Professor Emeritus, Department of Economics, University of Hawai‘i
  - Research Fellow, UHERO

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Broad Motivation

- National-level carbon pricing scheme shown in numerous studies to be efficient and effective (Goulder, 2013; Metcalf, 2009; Newell and Pizer, 2003; Nordhaus, 2007; Stavins, 2008), as well as address leakage/competitiveness through a border carbon adjustment or output-based rebates (Fowlie and Reguant, 2020; Kaufman et al., 2020).

- Without consistent federal action, how should U.S. states proceed?

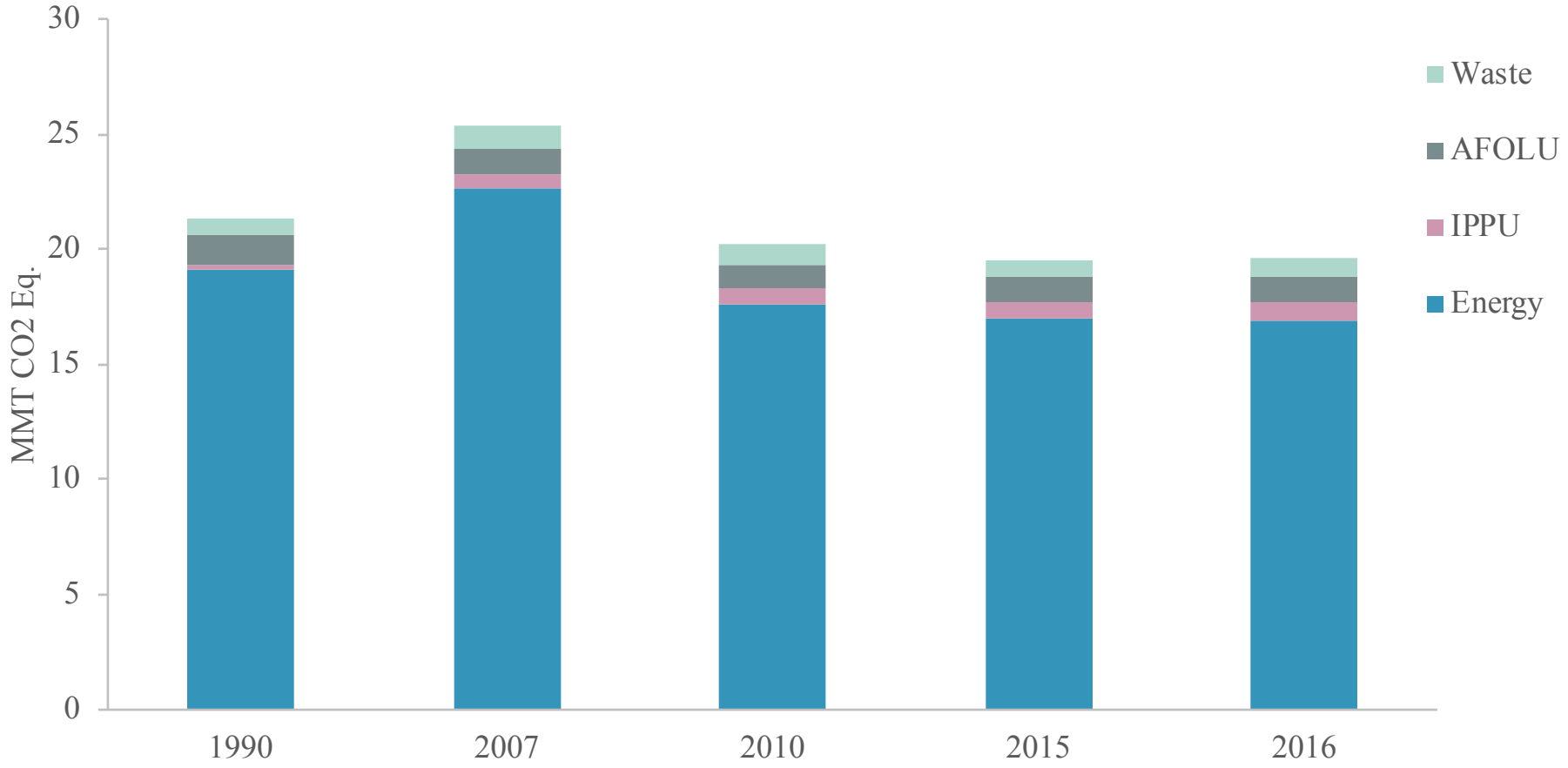
Hawai‘i’s Context

- Hawai‘i in 2018 set the goal to sequester more GHGs annually than produced “as quickly as practicable, but no later than 2045” (HRS §225P-5).

- Existing Renewable Portfolio Standard (RPS) requires Hawai‘i to reach 100% of net electricity sales from renewable sources by 2045 - 30% by 2020, 40% by 2030, and 70% by 2040 (HRS §269-92).

- What could be the role of a carbon price in achieving state goals?

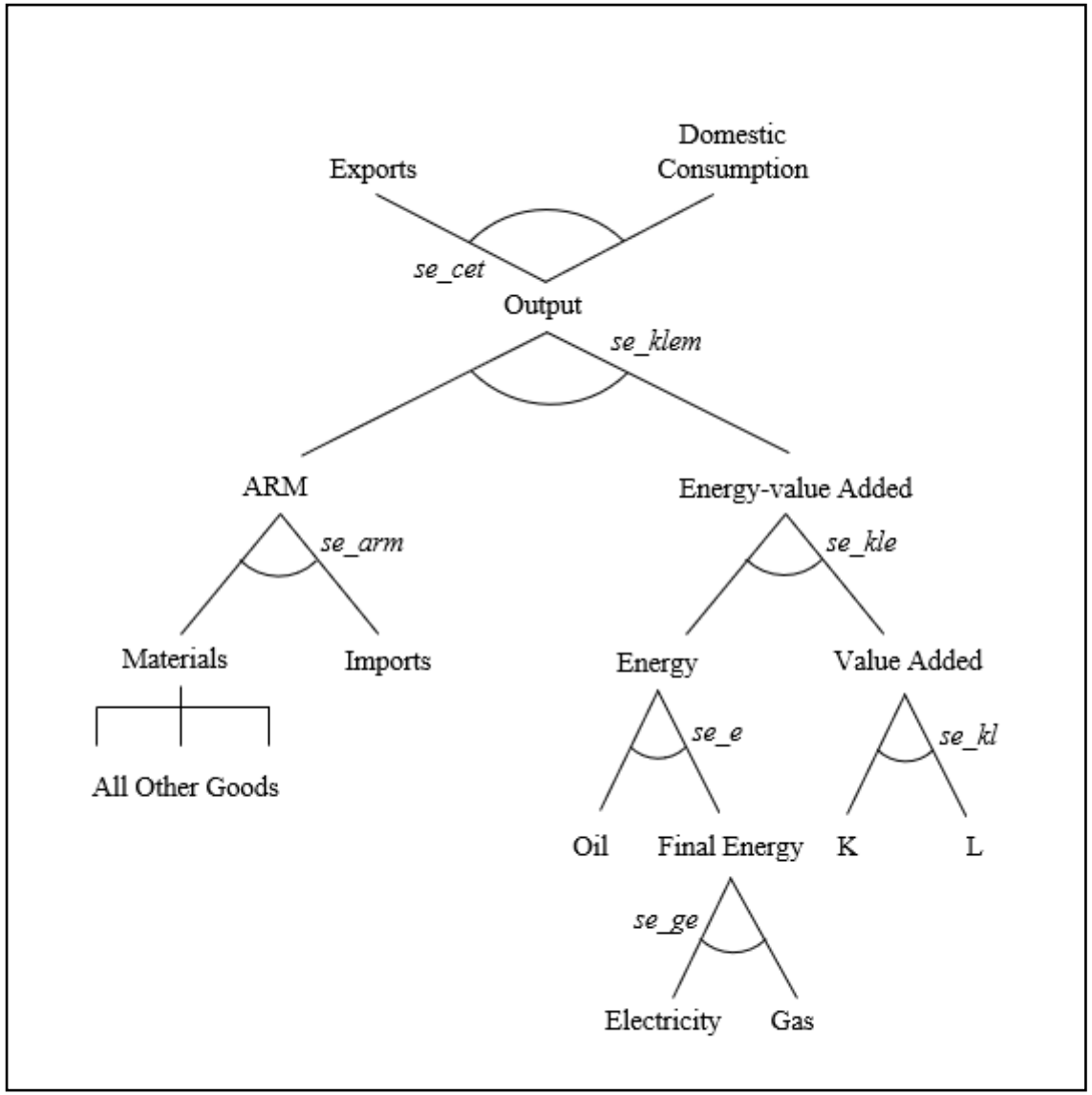
Hawai‘i’s GHG Emissions



Adapted from Hawaii Greenhouse Gas Emissions Report for 2016: Final Report, Available: https://health.hawaii.gov/cab/files/2019/12/2016-Inventory_Final-Report_December2019-1.pdf

Data & Methods

- Computable General Equilibrium Model of Hawai‘i’s Economy
  - Recursive Dynamic Model, calibrated in 2012, solving for 2016, 2019, 2025-2045 in 5-year increments with Gross State Product and Visitor Spending Forecasts
  - Model represents “long-run” economic conditions, represents sectors using common nesting structure and assumes competitive markets
  - Coded in GAMS/MPSGE
- State 2012 Input-Output Study + National Consumer Expenditure Survey + 2016 State GHG Inventory
- Baseline Constraints: RPS (=72% RE Generation by 2045), Electric Vehicle (EV) Adoption (=34% EVs on the road by 2045), and Energy Efficiency improvements (Based on AEO 2020)


Exports
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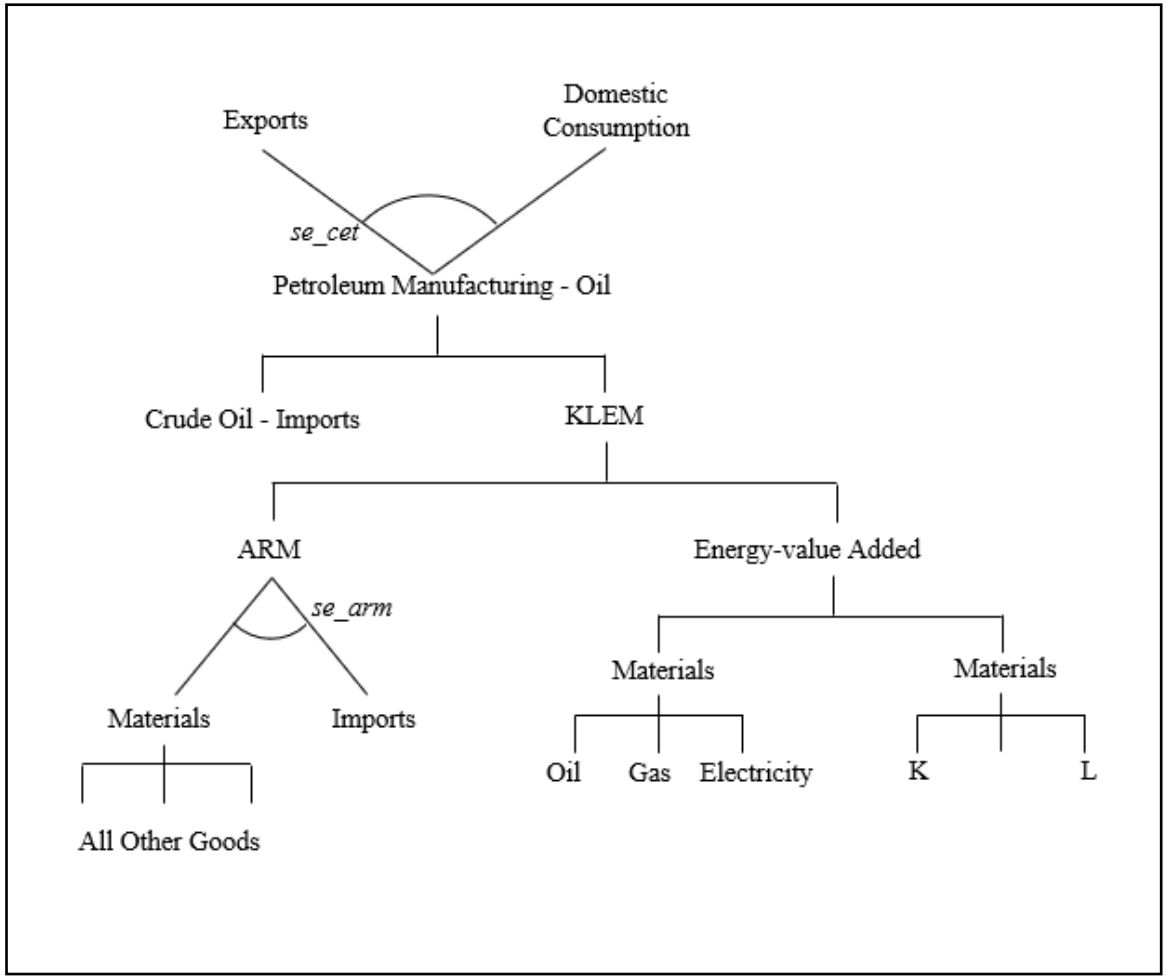
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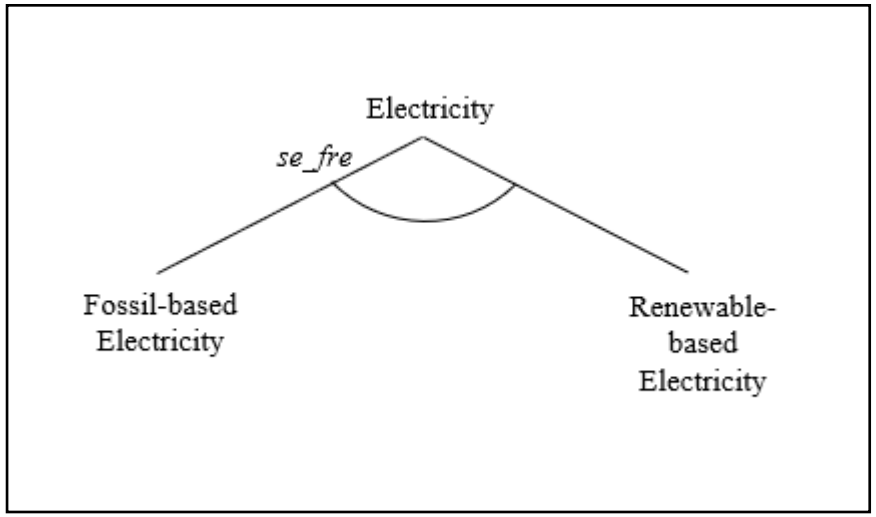
Electricity
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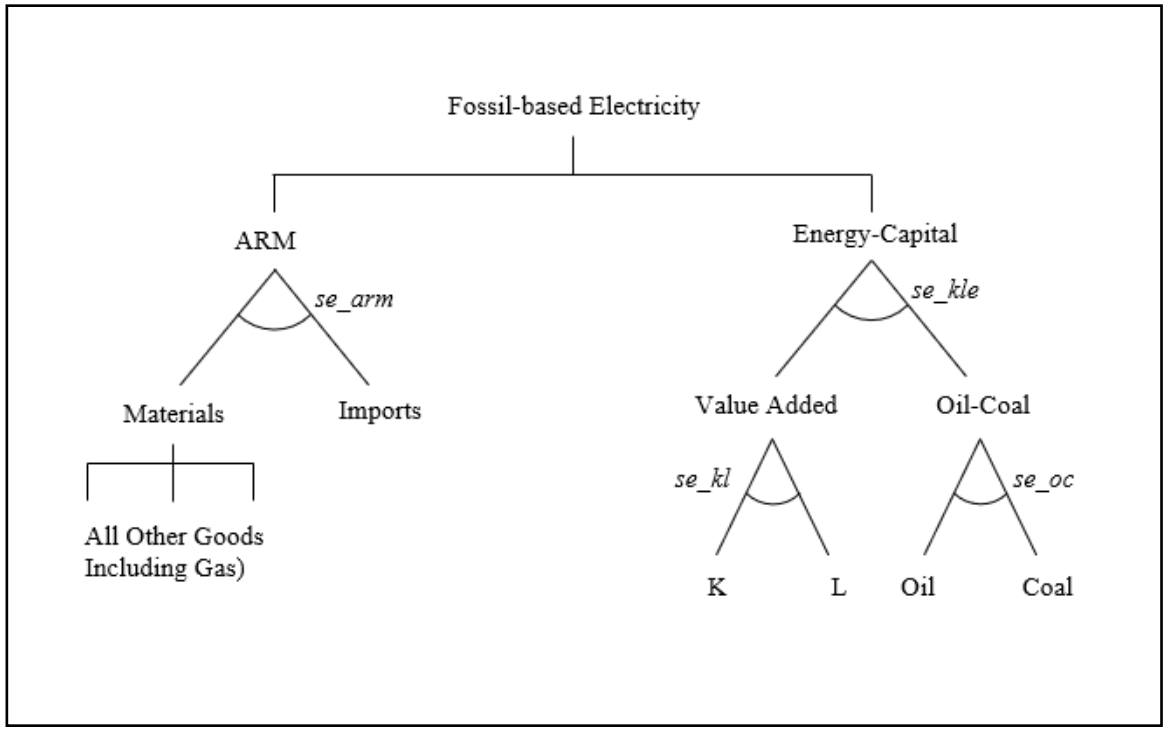
Fossil-based Electricity
Renewable-based Electricity


Fossil-based Electricity
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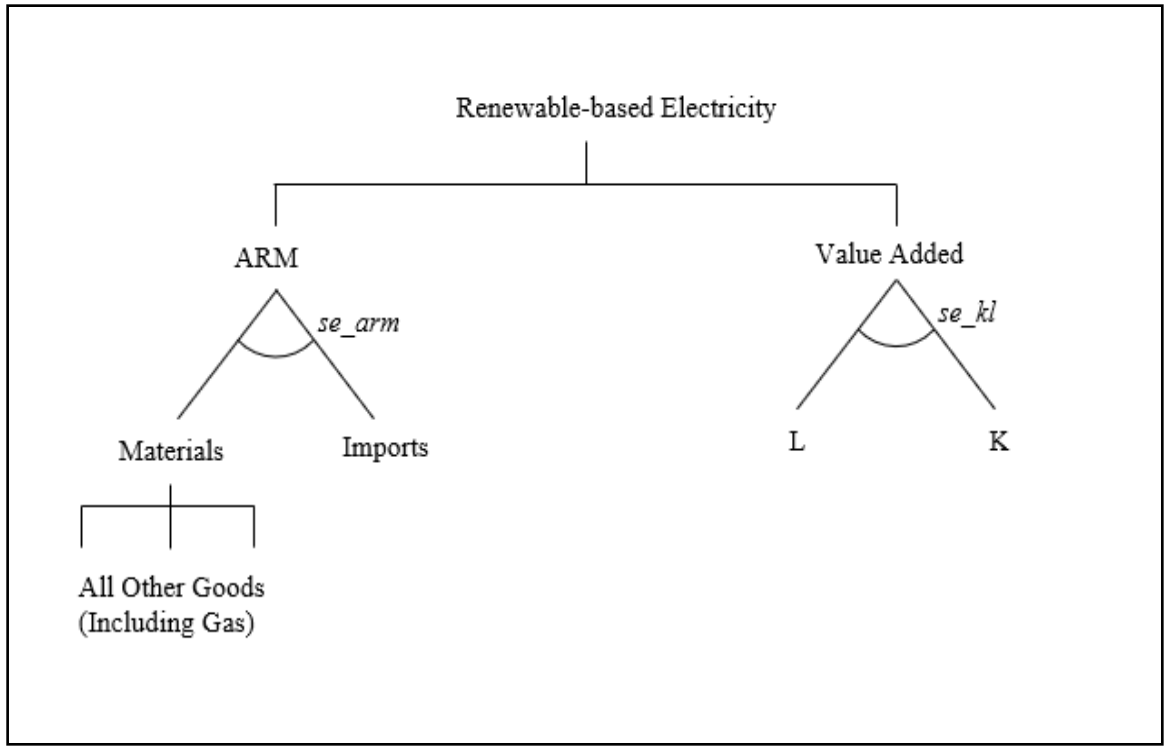
Renewable-based Electricity
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Imports
All Other Goods (Including Gas)
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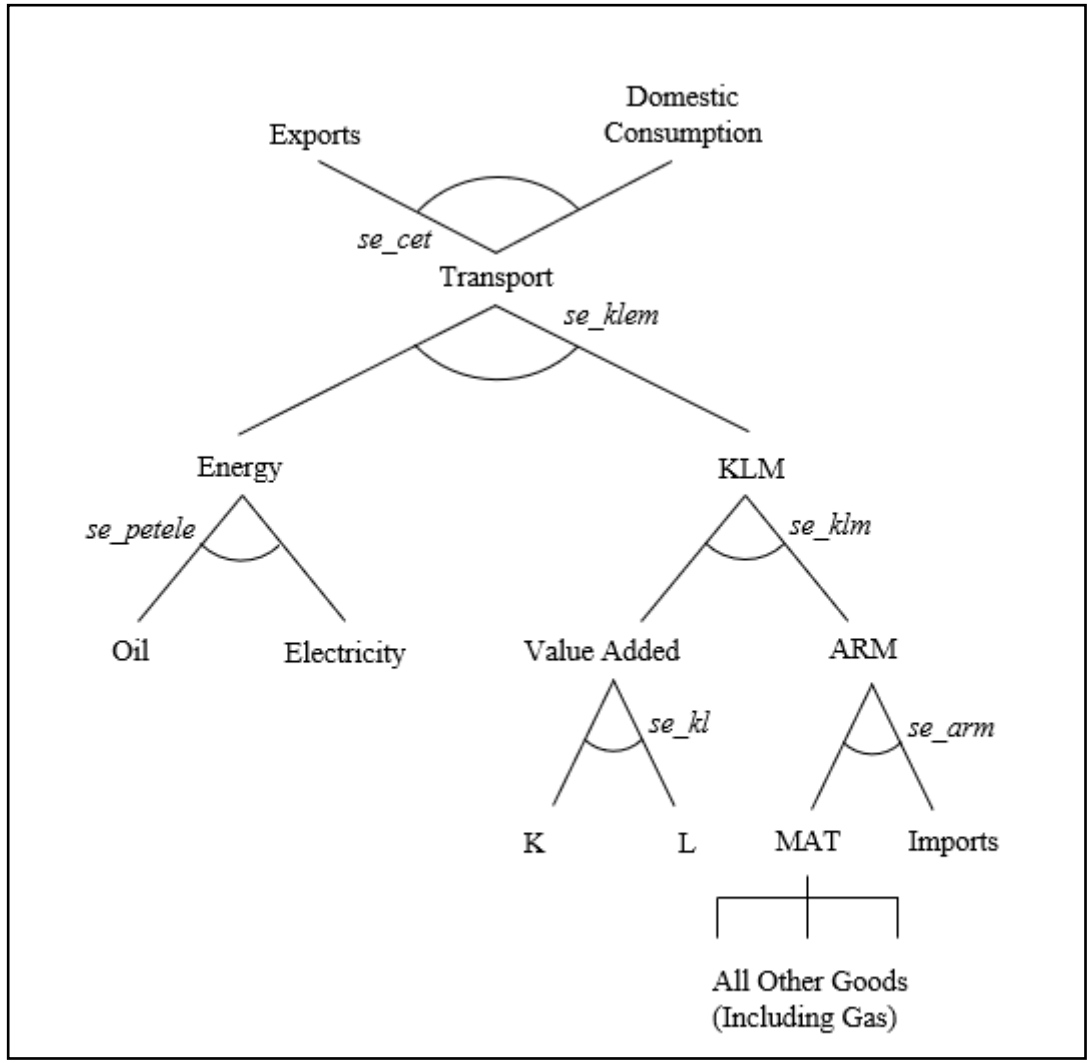
Exports
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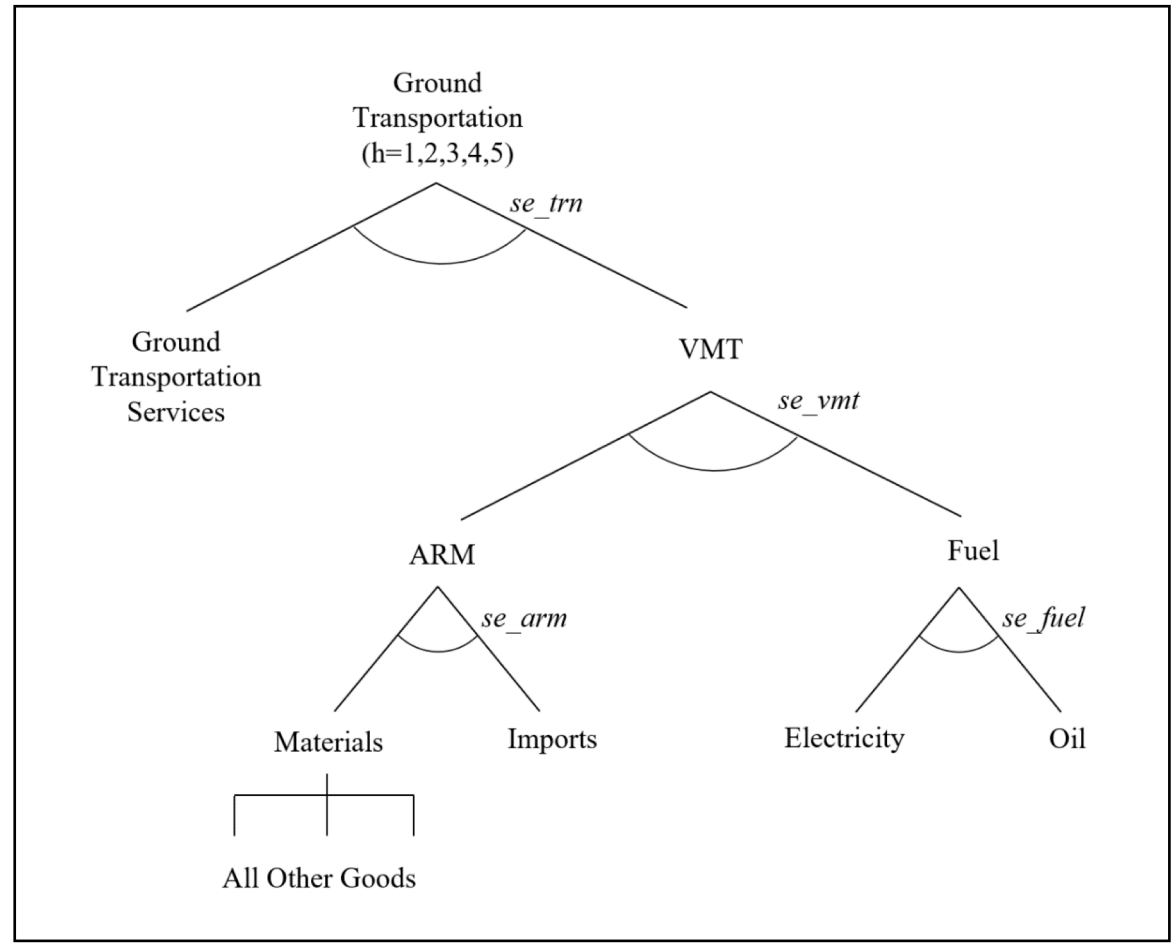
Imports
All Other Goods
(Including Gas)


Ground Transportation (h=1,2,3,4,5)
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Ground Transportation Services
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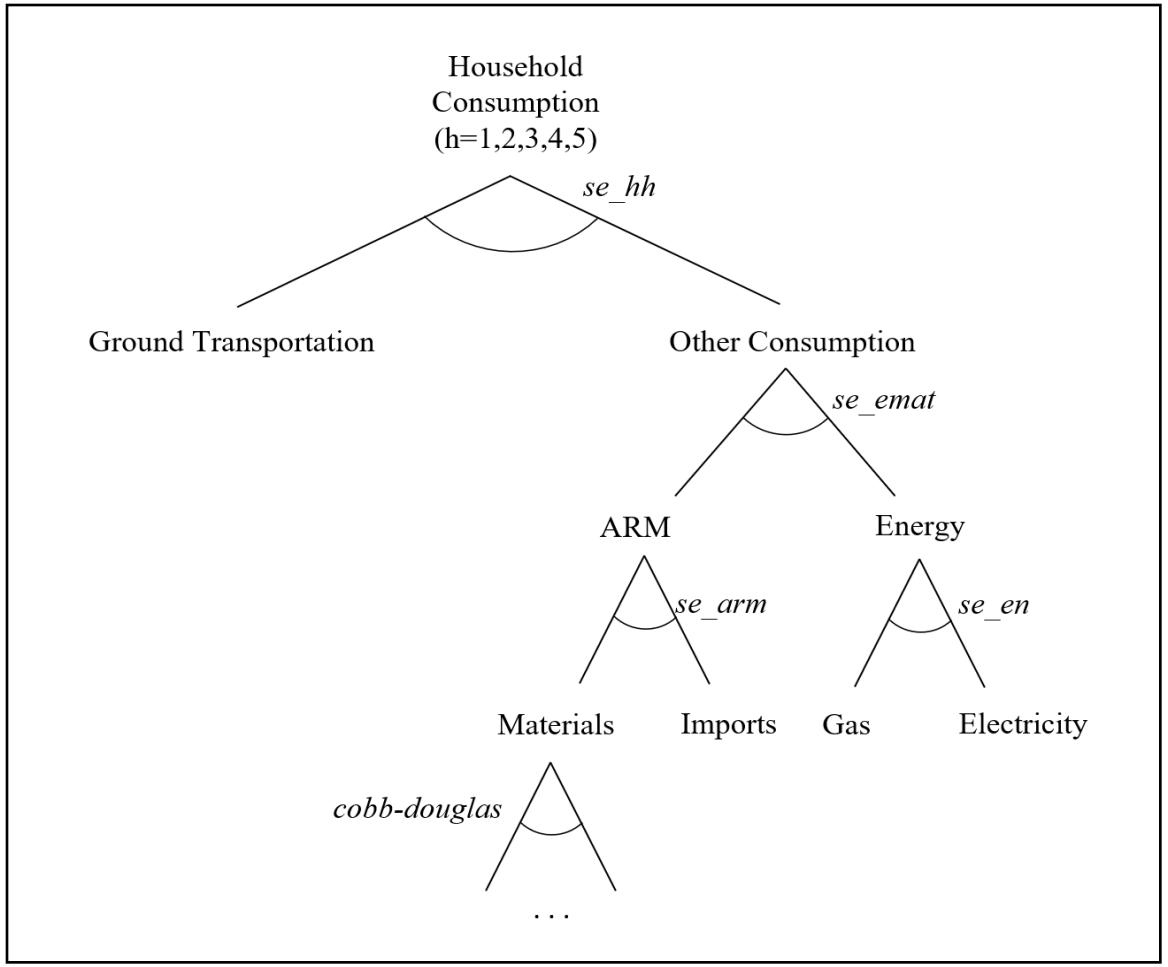
Materials
Imports
Electricity
Oil
All Other Goods


Household
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(h=1,2,3,4,5)
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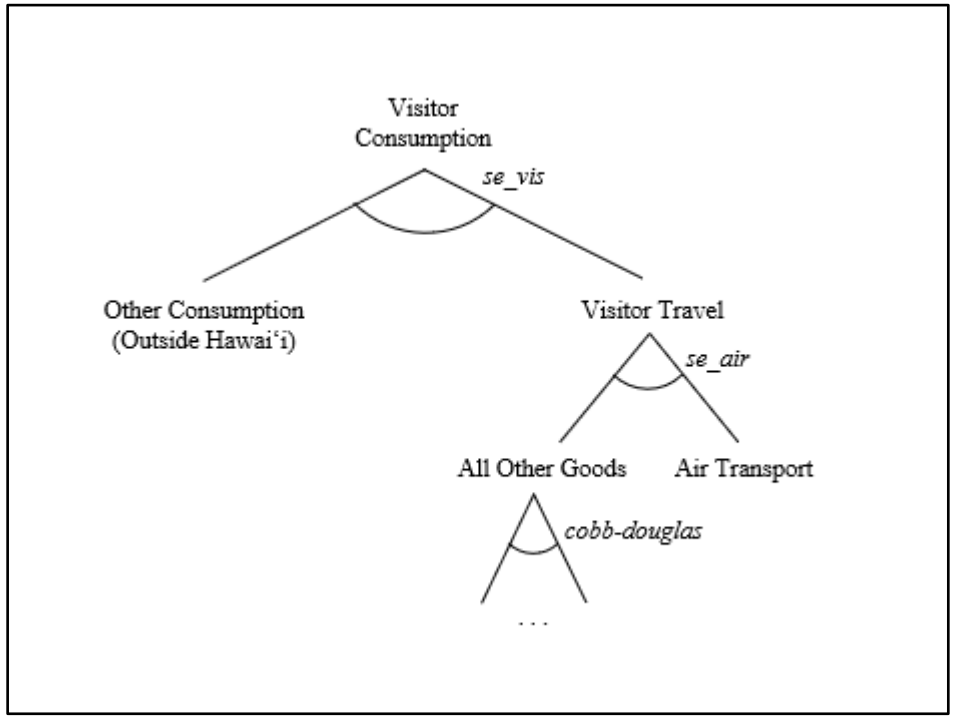
Visitor
Consumption
se_vis
Other Consumption
(Outside Hawai'i)
Visitor Travel
se_air
All Other Goods
Air Transport
cobb-douglas
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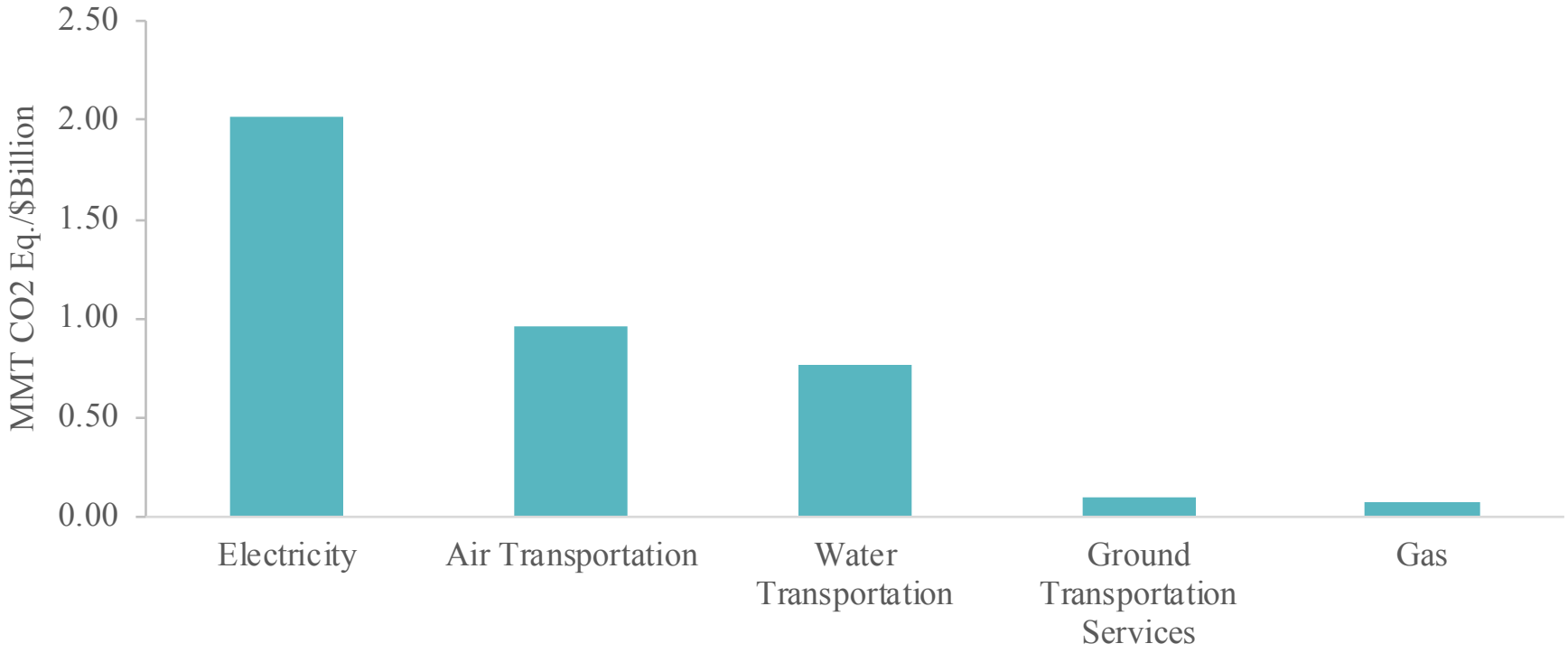
Household Expenditures by Sector by Income Quintile

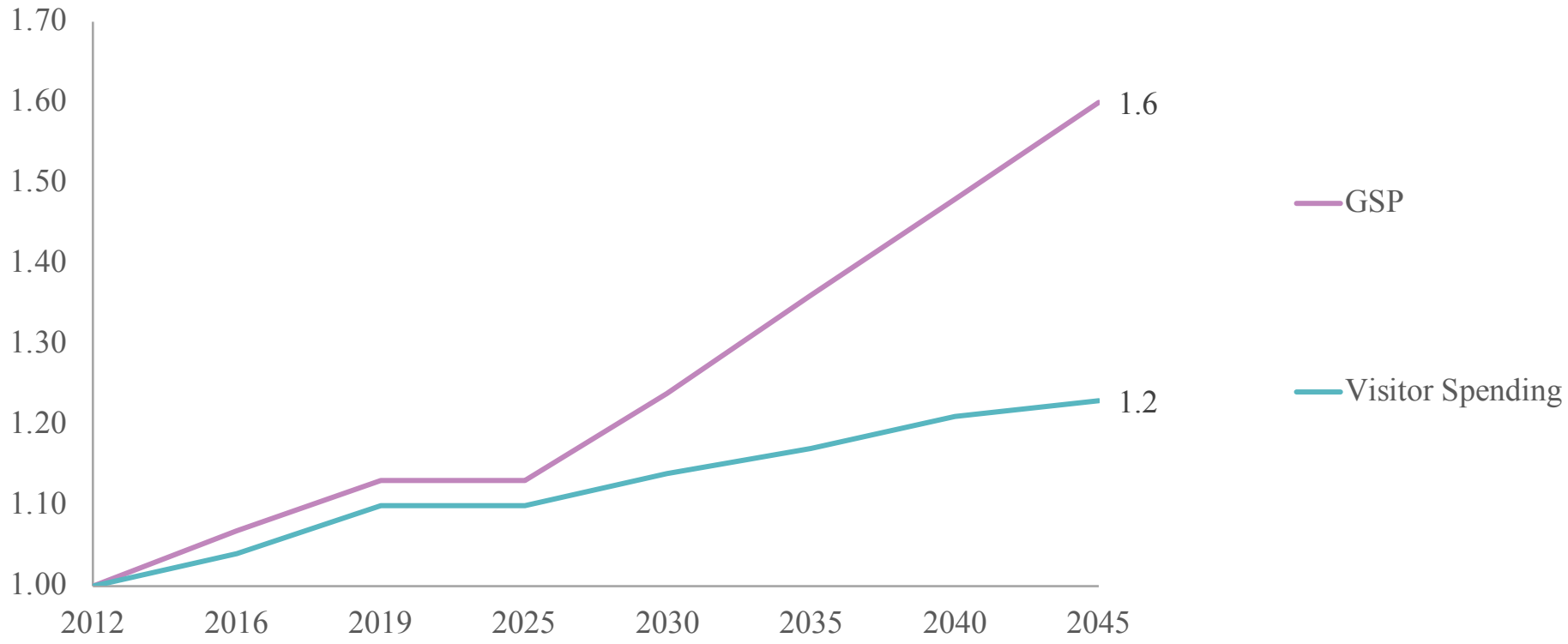
	Lowest 20 percent	Second 20 percent	Middle 20 percent	Fourth 20 percent	Highest 20 percent
Petroleum	**4.3%**	**4.5%**	**4.5%**	**4.2%**	**3.1%**
Electricity	**4.6%**	**4.0%**	**3.3%**	**2.7%**	**1.9%**
Gas	**0.3%**	**0.3%**	**0.2%**	**0.2%**	**0.2%**
Water Transportation	**0.0%**	**0.1%**	**0.1%**	**0.7%**	**0.6%**
Air Transportation	**0.6%**	**0.8%**	**0.8%**	**1.0%**	**1.4%**
Ground Transportation Services	**0.8%**	**0.8%**	**0.7%**	**0.6%**	**0.7%**
Water & Other Utilities	0.0%	0.0%	0.0%	0.0%	0.0%
Waste Management	0.0%	0.0%	0.0%	0.0%	0.0%
Agriculture & Forestry	0.9%	0.8%	0.7%	0.7%	0.5%
Construction	0.0%	0.0%	0.0%	0.0%	0.0%
Wholesale and Retail Trade	11%	14%	13%	13%	13%
Real Estate and Rentals	25%	22%	21%	20%	18%
Other Manufacturing	1.9%	2.5%	2.1%	1.9%	1.6%
Other Services	29%	31%	34%	36%	39%
Federal Government	3.8%	2.5%	2.0%	1.5%	0.8%
State & Local Government	4.2%	2.8%	2.2%	1.6%	0.9%
Imports	13%	14%	16%	16%	18%
Sum	100%	100%	100%	100%	100%

Annual Expenditures on Electricity, Ground Transportation and Air Travel by Household Income

GHG-Intensity of Energy and Transportation Services Sectors (MMT CO_2 Eq./$Billion)



Baseline Gross State Product and Visitor Spending Forecast Normalized to 2012



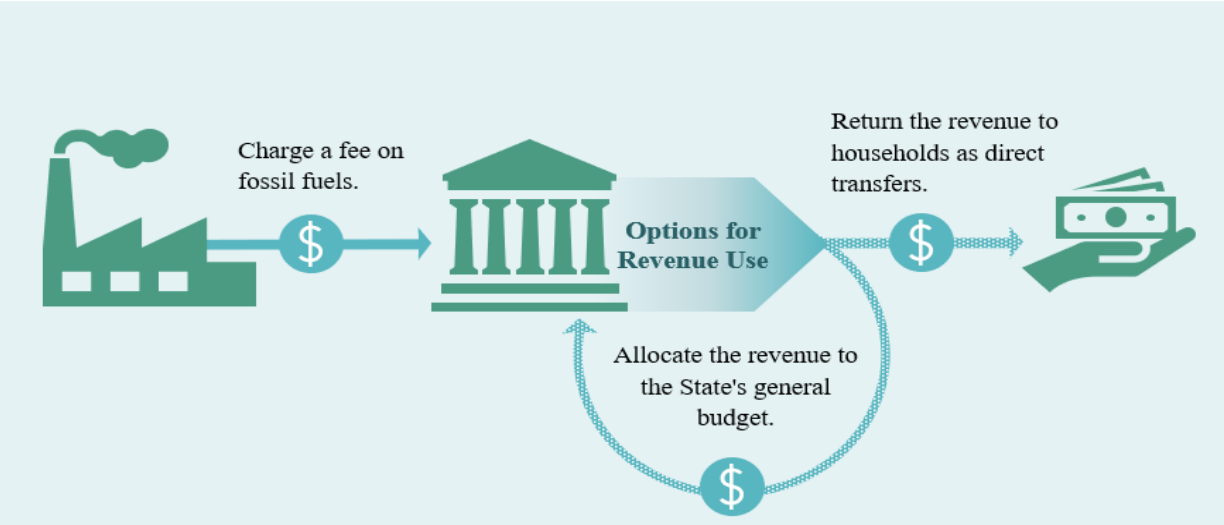
Four Core Scenarios

Two Carbon Tax Levels ($2012/MT CO2 Eq.)

Year	"$70/MT CO_2 Eq."	"$1,000/MT CO_2 Eq."
2025	$50	$240
2030	$54	$430
2035	$60	$620
2040	$65	$810
2045	$70	$1,000

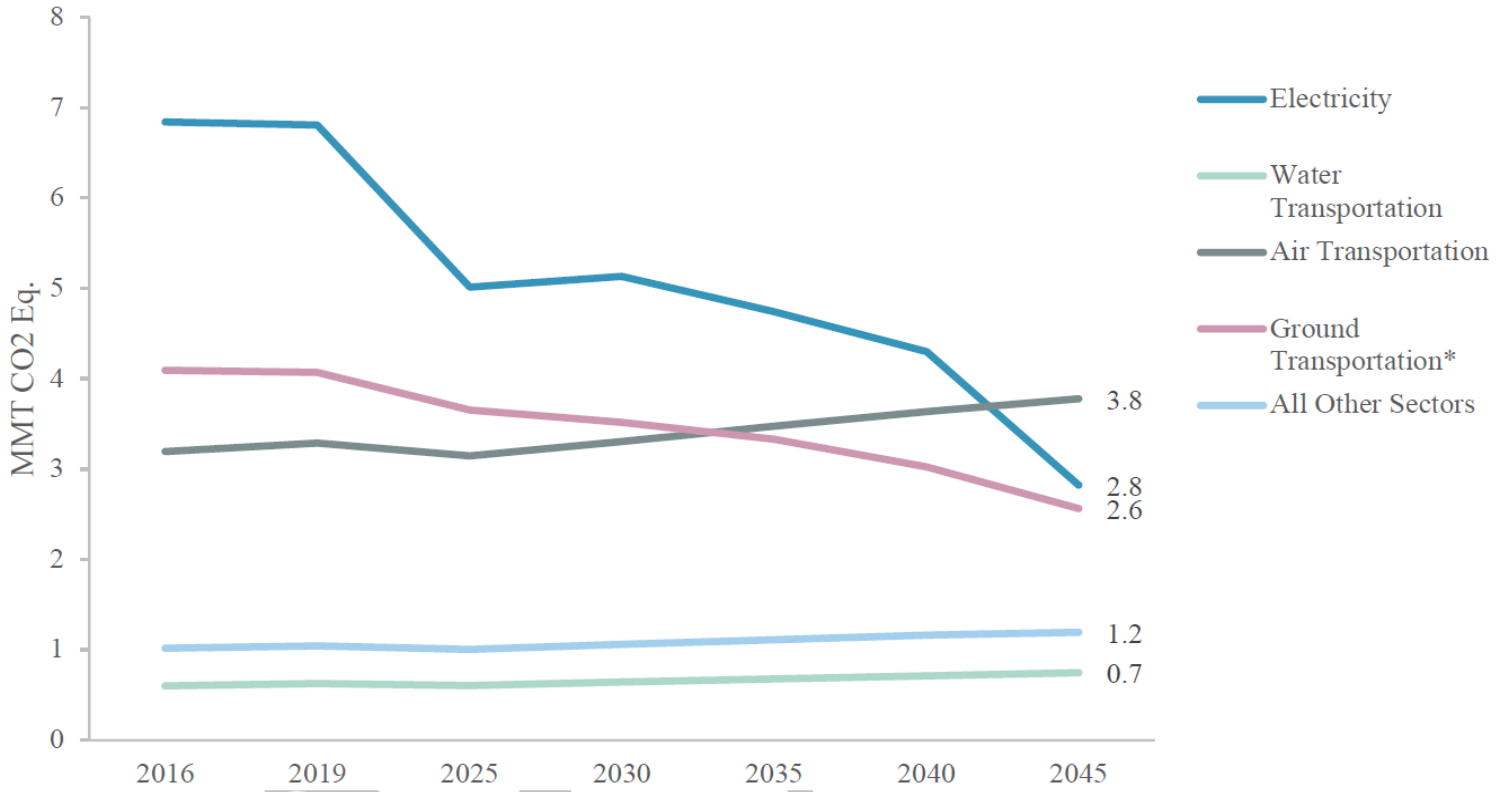
$50/MT CO_2 Eq ~ $0.45/gallon of gasoline ~ $19/barrel
$70/MT CO_2 Eq ~ $0.65/gallon of gasoline ~ $26/barrel
$240/MT CO_2 Eq ~ $2.00/gallon of gasoline ~ $90/barrel
$1000/MT CO_2 Eq ~ $9.00/gallon of gasoline ~ $373/barrel

Two Revenue Uses

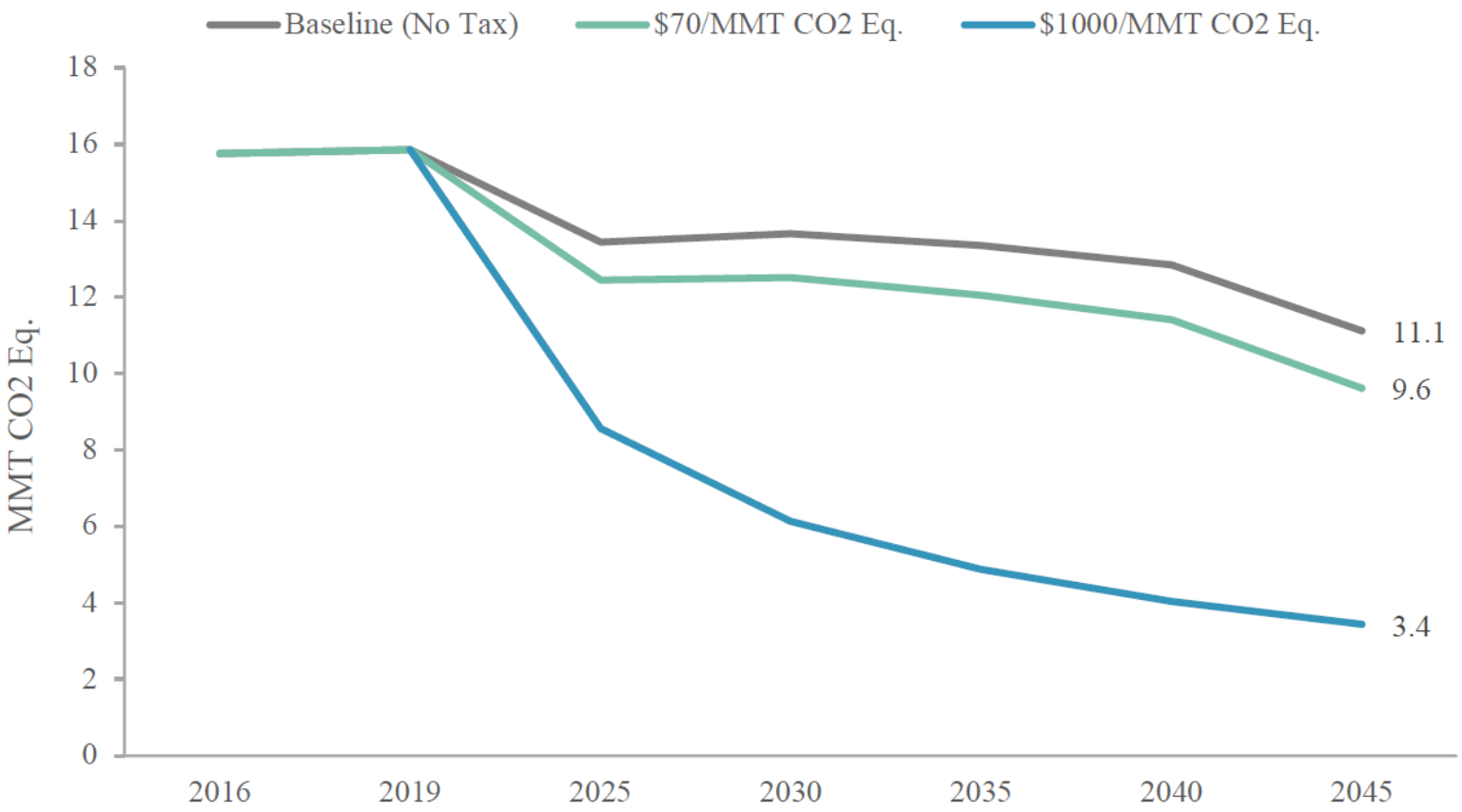


In all scenarios the tax revenues from aviation fuel are returned to the state government.

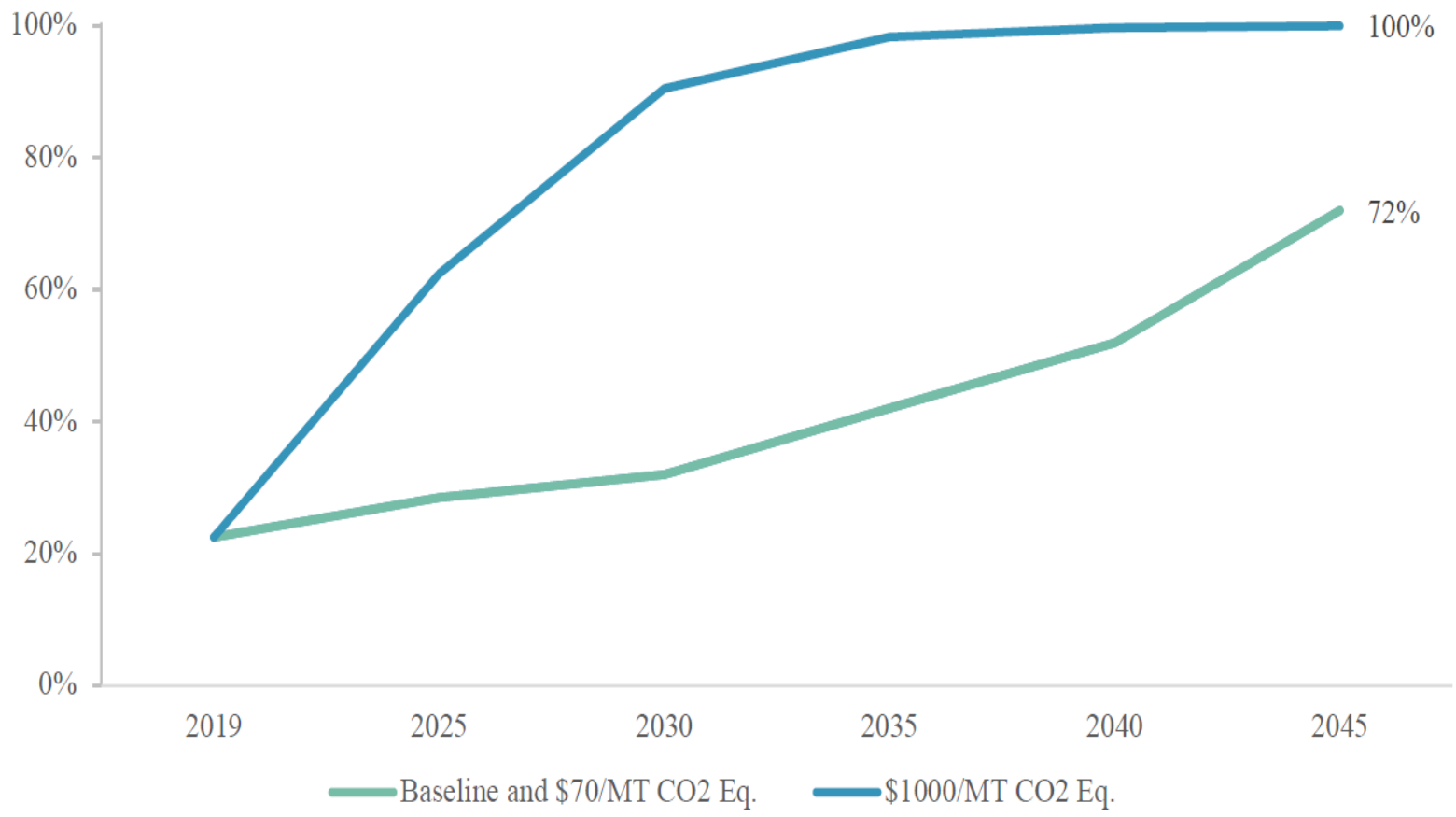
Baseline GHG Emissions by Sector 2016-2045



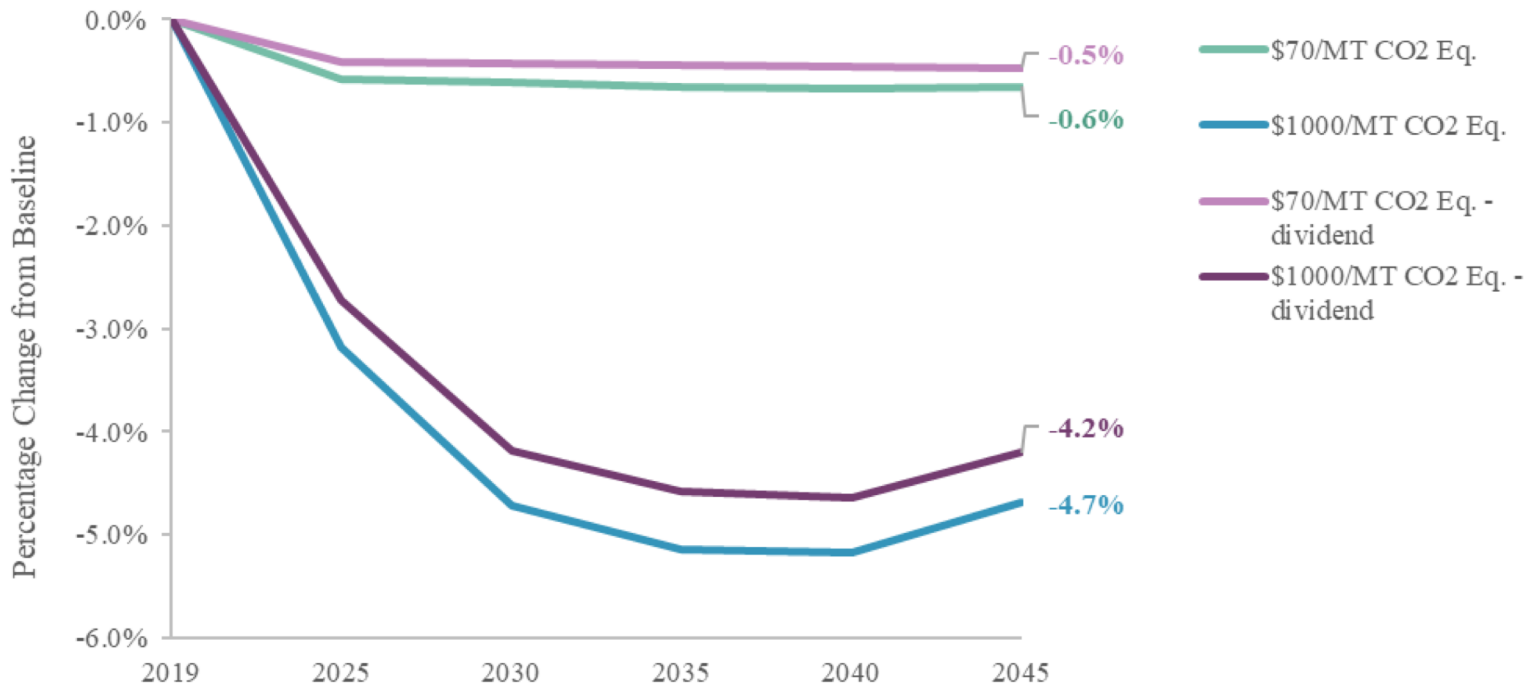
GHG Emissions in Baseline and Carbon Tax Scenarios, 2016-2045



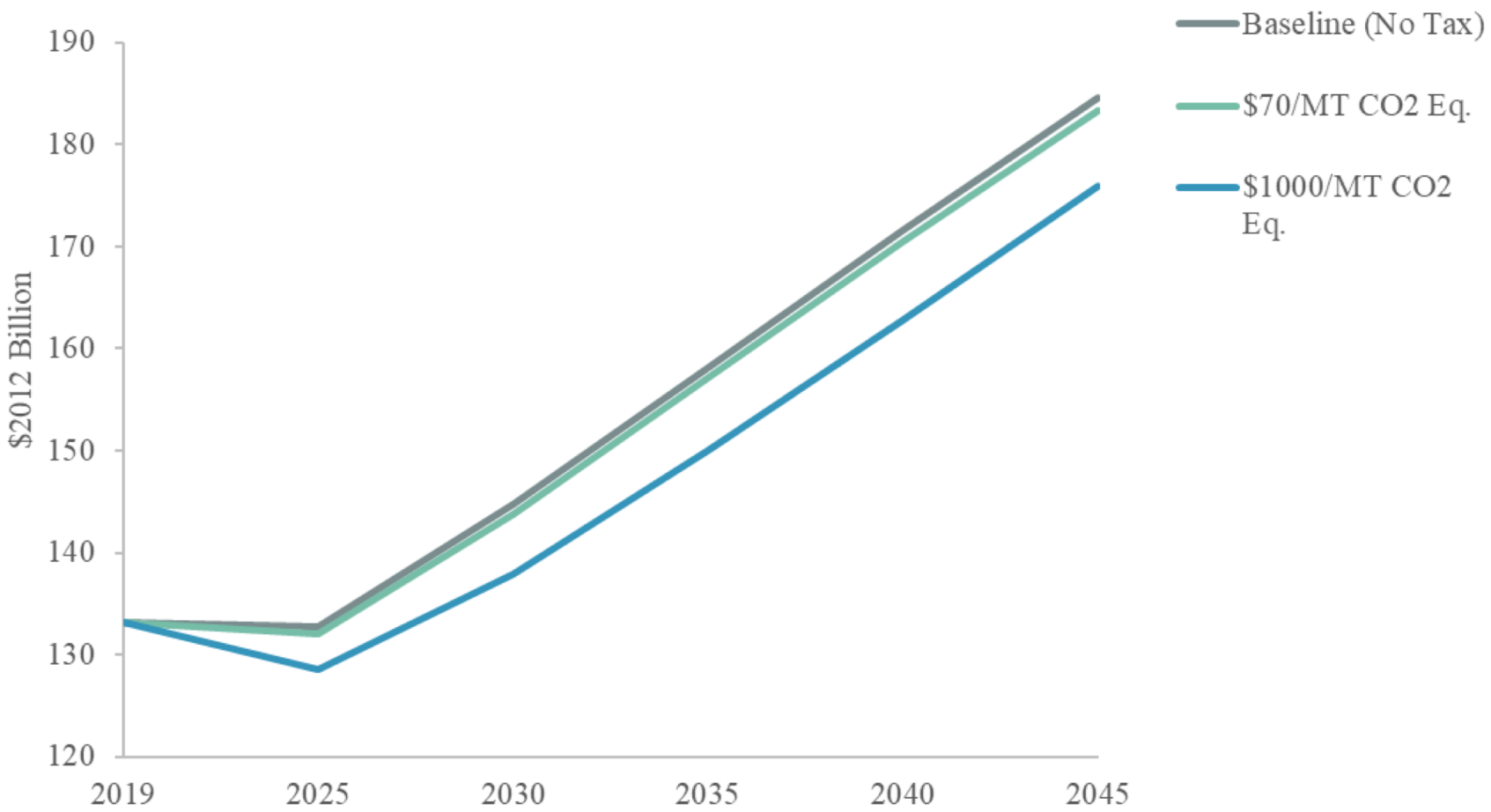
Baseline and Carbon Tax Scenarios: % of Electricity from Renewable Energy, 2019-2045



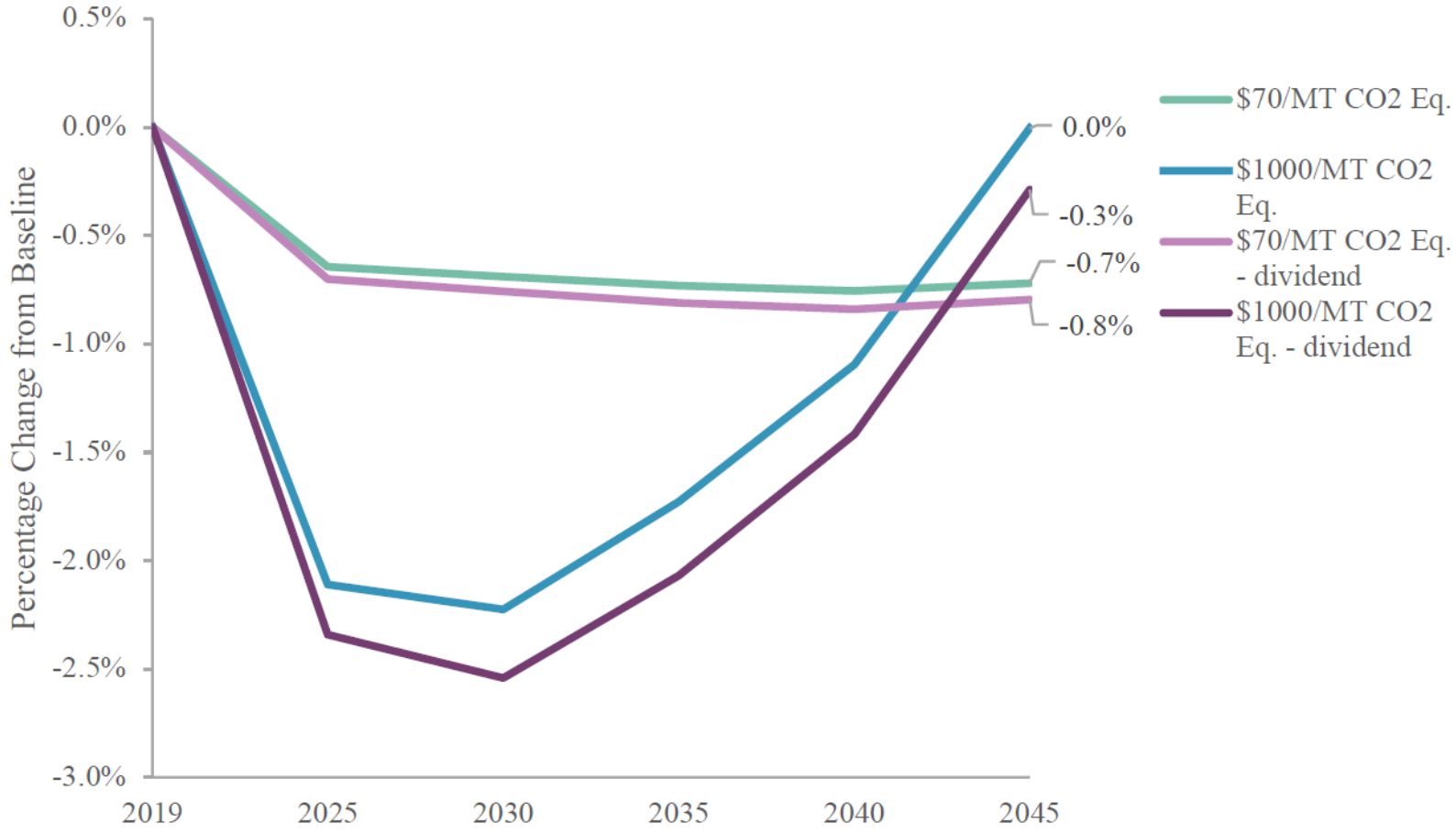
Change in Total Output from Baseline under Carbon Tax and Revenue Scenarios, 2019-2045



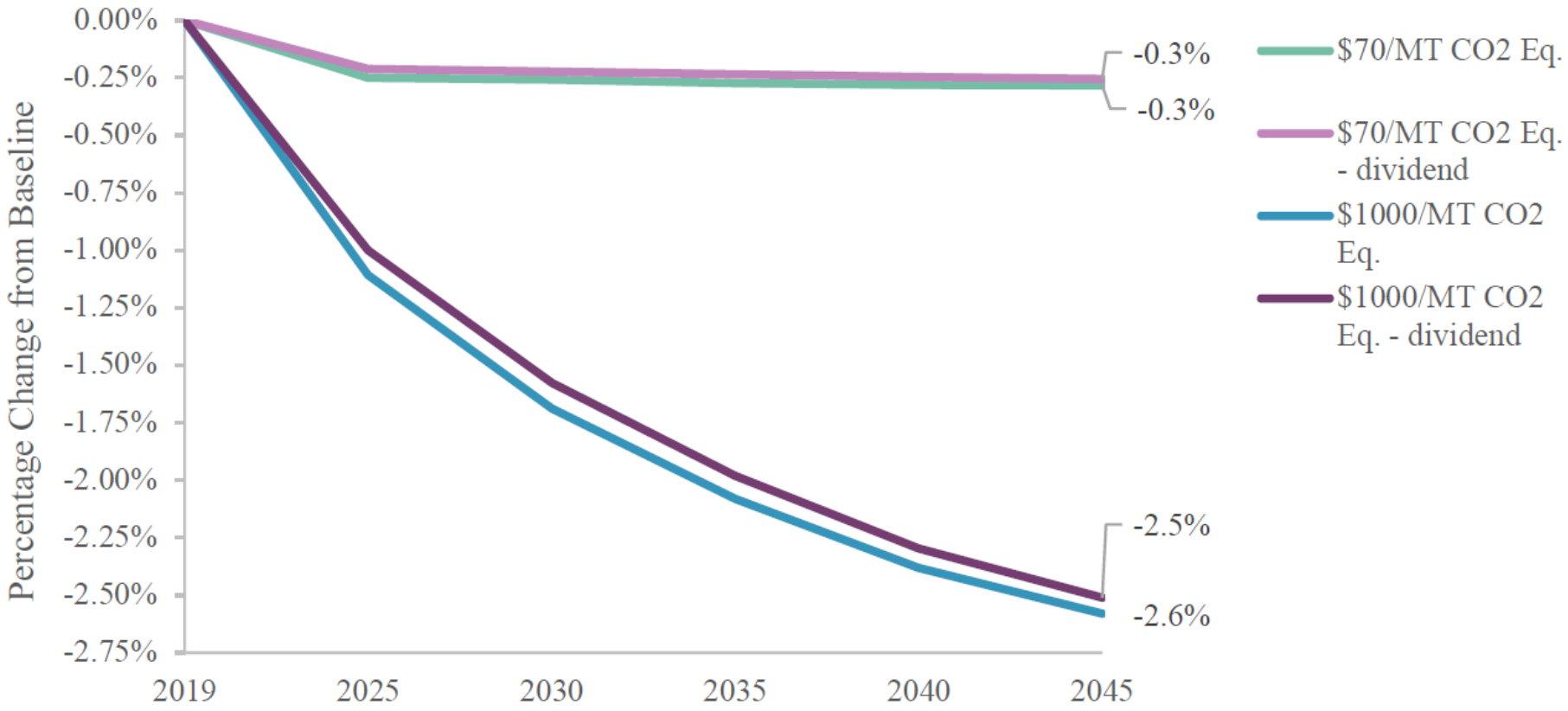
Total Output in the Baseline and Carbon Tax Scenarios, 2019-2045



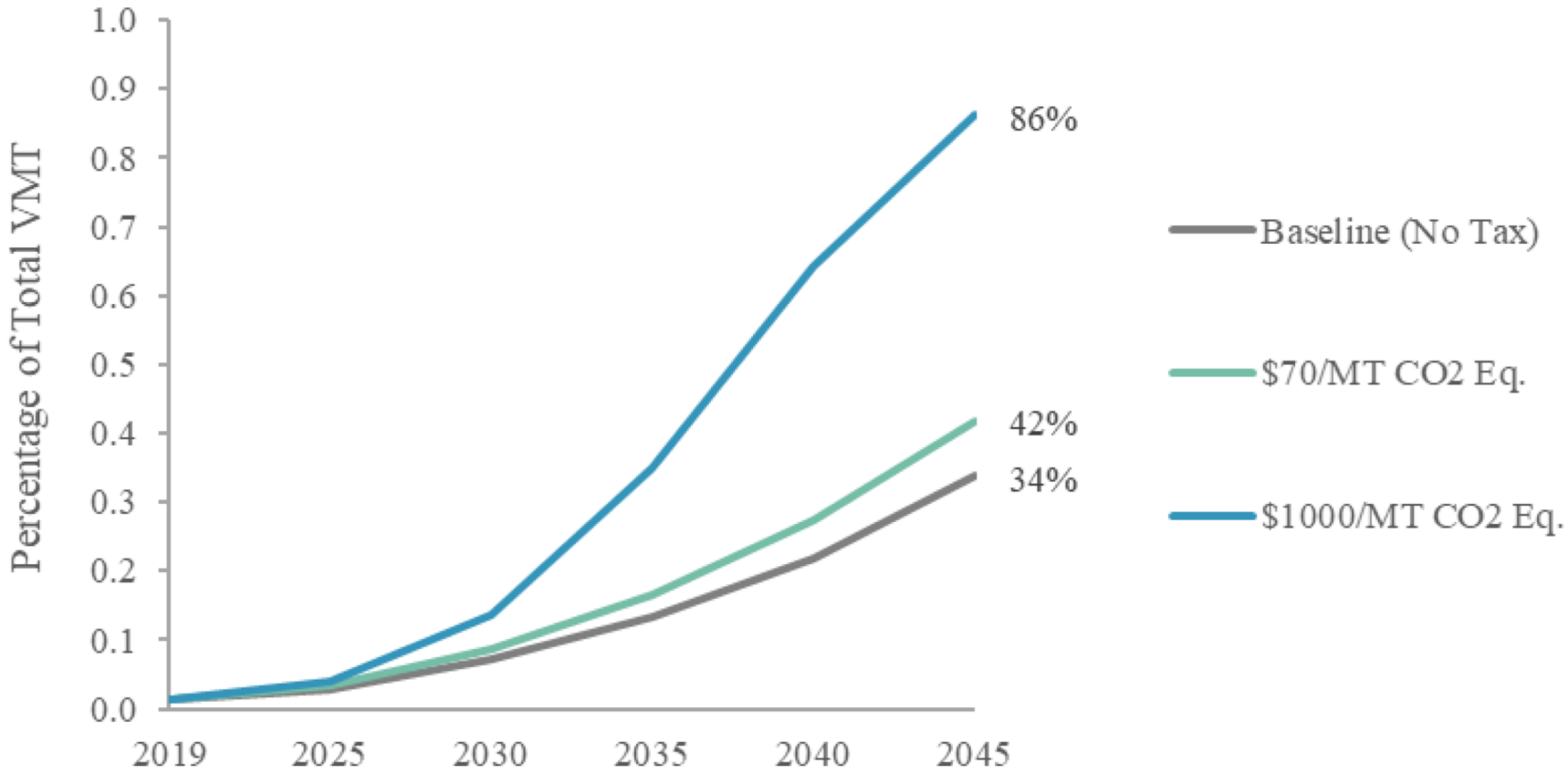
Change in Imports from Baseline under Carbon Tax and Revenue Scenarios, 2019-2045



Change in Visitor Spending from Baseline under Carbon Tax and Revenue Scenarios, 2019-2045

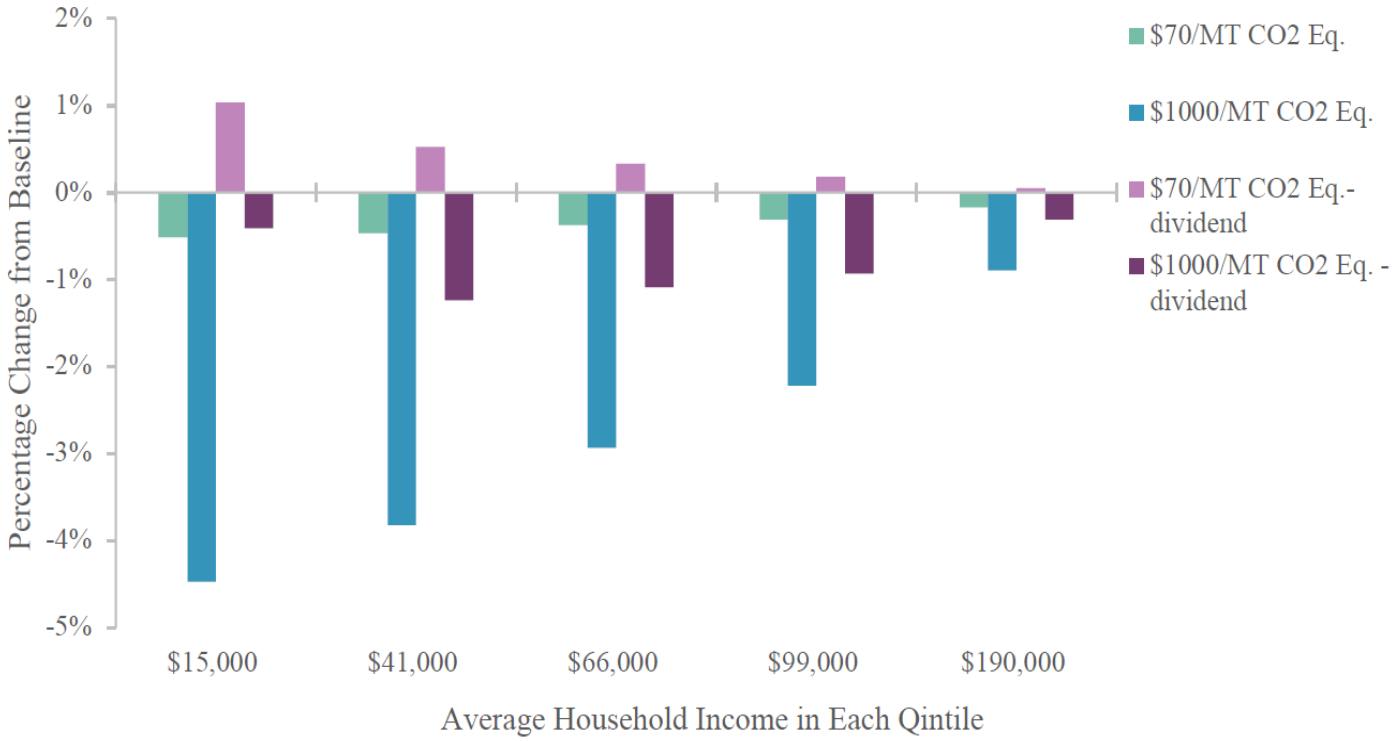


Share of Vehicle Miles Travelled by Electric Vehicles



Change in Household Welfare from Baseline under Carbon Tax and Revenue Scenarios, 2025

Change in Household Welfare from Baseline under Carbon Tax and Revenue Scenarios, 2045



Carbon Tax Revenues to Government and Households by Scenario

	2025	2030	2035	2040	2045
State Government Revenue ($2012 Million)					
$70/MT CO_2 Eq.	$580	$630	$670	$690	$610
$1,000/MT CO_2 Eq.	$1,900	$2,400	$2,600	$2,800	$2,800
$70/MT CO_2 Eq. - dividend	$110	$120	$140	$150	$170
$1,000/MT CO_2 Eq. - dividend	$410	$690	$980	$1,300	$1,600
Household Revenue ($2012/household)					
$70/MT CO_2 Eq. - dividend	$980	$1,000	$1,100	$1,000	$850
$1,000/MT CO_2 Eq. - dividend	$3,000	$3,400	$3,300	$2,900	$2,400

Key Takeaways

1. A carbon tax plus dividend in Hawai‘i is progressive.
2. Visitors pay the carbon tax through the goods and services they purchase while in Hawai‘i.
3. A very high carbon tax can result in large overall welfare declines. Meeting Hawai‘i’s goal of net negative emissions requires new technologies to be cost effective.
4. A carbon tax set at the Obama Administration’s federal SCC (resulting in a 40% reduction of GHGs from 2019 levels) has small impacts on the overall economy. Giving revenues back to households in equal shares makes households (as measured) economically better-off.

For the complete study, see https://energy.hawaii.gov/carbon-pricing-study

Questions?

Presentation References

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For a full set of study references, see https://energy.hawaii.gov/carbon-pricing-study