Maine Climate Council Emissions Study

10/16/24

Prepared for:

Maine Climate Council

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Scenario Summary

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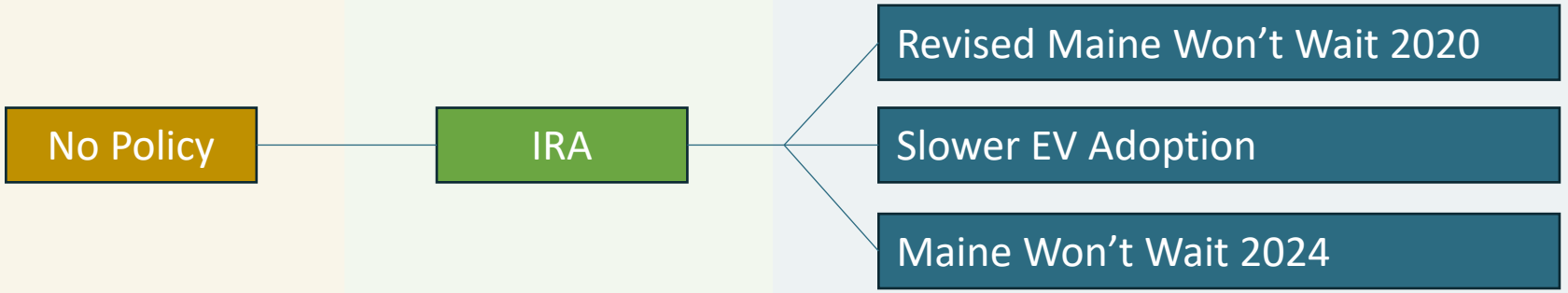
- No federal or state policy/incentives
- Point of comparison to assess all measure impacts

- Federal incentives
- What emissions reductions are driven economically by the Inflation Reduction Act (IRA)?

- Meets Maine electricity and emissions policy targets
- Explore barriers to achieving targets



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Results

Targets Across Scenarios - 2030

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Description	Revised Maine Won't Wait 2020	Slower EV Adoption	Maine Won't Wait 2024
Number of Light-duty EVs on the Road	219,000	66,000	135,000
EV/PHEV Share of New Light-duty Vehicle Sales in 2030	70.5%	15%	53%
Reduction in Light-duty VMT per Vehicle	20%	20%	20%
ZEV Share of New Medium and Heavy-duty Vehicle Sales	33.5%	2.5%	17.5%
Number of Medium and Heavy-Duty EVs on the road	5,000	2500	3000
Reduction in Heavy-duty VMT per Vehicle	4%	4%	4%
Number of Households with Retrofit Heat Pumps (installed after 2018) and Legacy Fossil Systems	130,000	130,000	130,000
Number of Households with Whole-Home Heat-Pump Systems	116,000	116,000	116,000
Commercial building management service demand reductions	0%	0%	10%
Newly Weatherized Households (after 2019)	35,000	35,000	35,000
Industrial Energy Demand (% Renewable)	35%	41%	37%
Hydrogen-derived Fuel (percent of Maine's energy demand)	0.5%	3.2%	1.3%

Targets Across Scenarios - 2050

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Description	Revised Maine Won't Wait 2020	Slower EV Adoption	Maine Won't Wait 2024
Number of Light-duty EVs on the Road	1,420,000	1,330,000	1,420,000
EV/PHEV Share of New Light-duty Vehicle Sales in 2050	100%	99%	100%
Reduction in Light-duty VMT per Vehicle	20%	20%	20%
ZEV Share of New Medium and Heavy-duty Vehicle Sales	100%	23%	100%
Number of Medium and Heavy-Duty EVs on the road	83,000	16,000	81,000
Reduction in Heavy-duty VMT per Vehicle	4%	4%	4%
Number of Households with Retrofit Heat Pumps (installed after 2018) and Legacy Fossil Systems	46,000	46,000	46,000
Number of Households with Whole-Home Heat-Pump Systems	481,000	481,000	481,000
Newly Weatherized Households (after 2019)	105,000	105,000	105,000
Industrial Energy Demand (% Renewable)	78%	79%	78%
Hydrogen-derived Fuel (percent of Maine's energy demand)	20%	31%	20%

Emissions Reductions by 2030

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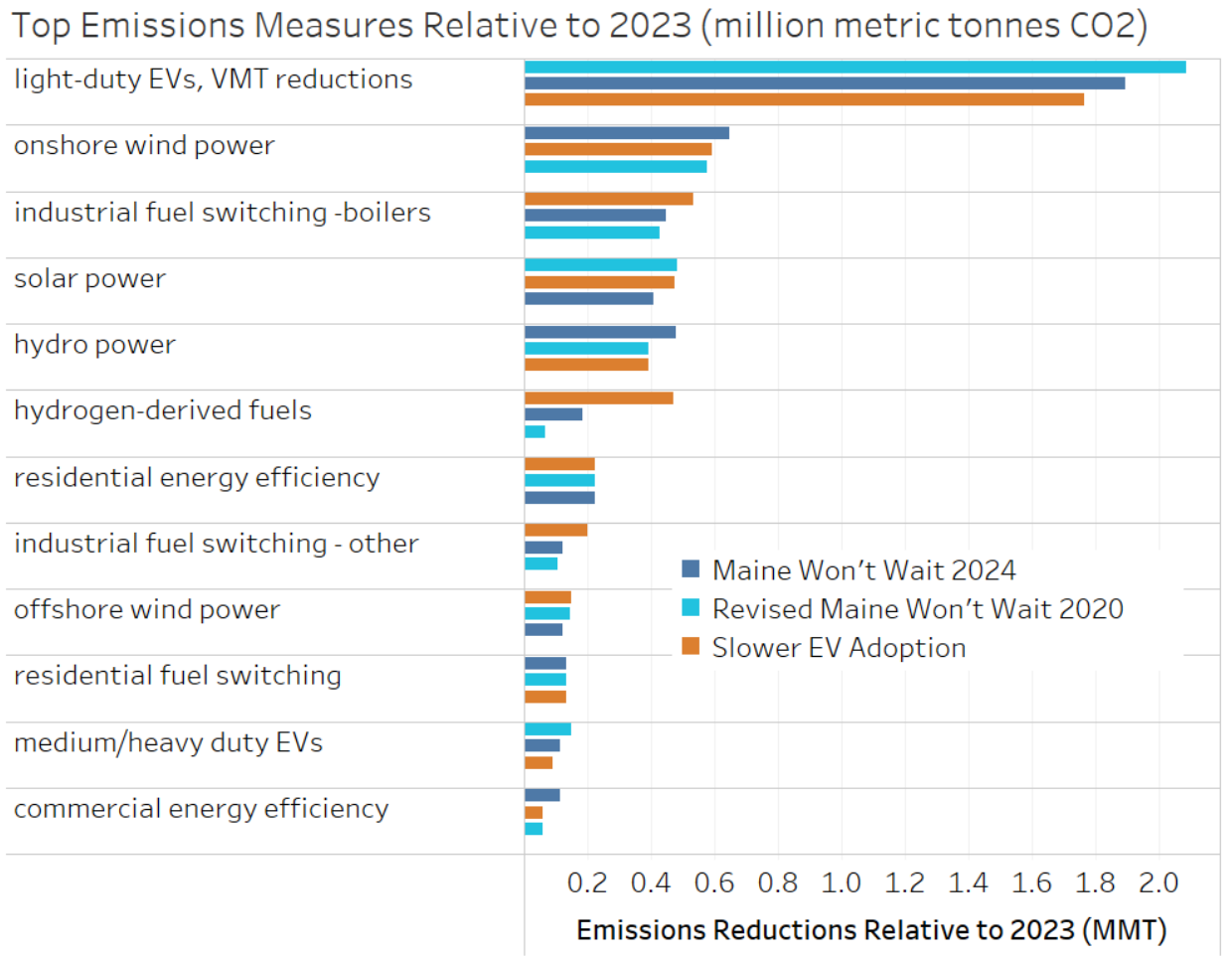
- Largest emissions reductions by 2030 relative to the No Policy case come from vehicle electrification
  - Efficiency gains and switch to cleaner energy
- Maine's planned renewable electricity additions transition away from fossil fuels in electricity by 2030
  - Relative to 2023, emissions reductions from switching to renewable energy a major component of overall emissions reductions
  - Onshore wind and solar replacing natural gas in electricity mix
- Fuel switching in industrial boilers also contributes to emissions reductions



Emissions Reductions by 2050

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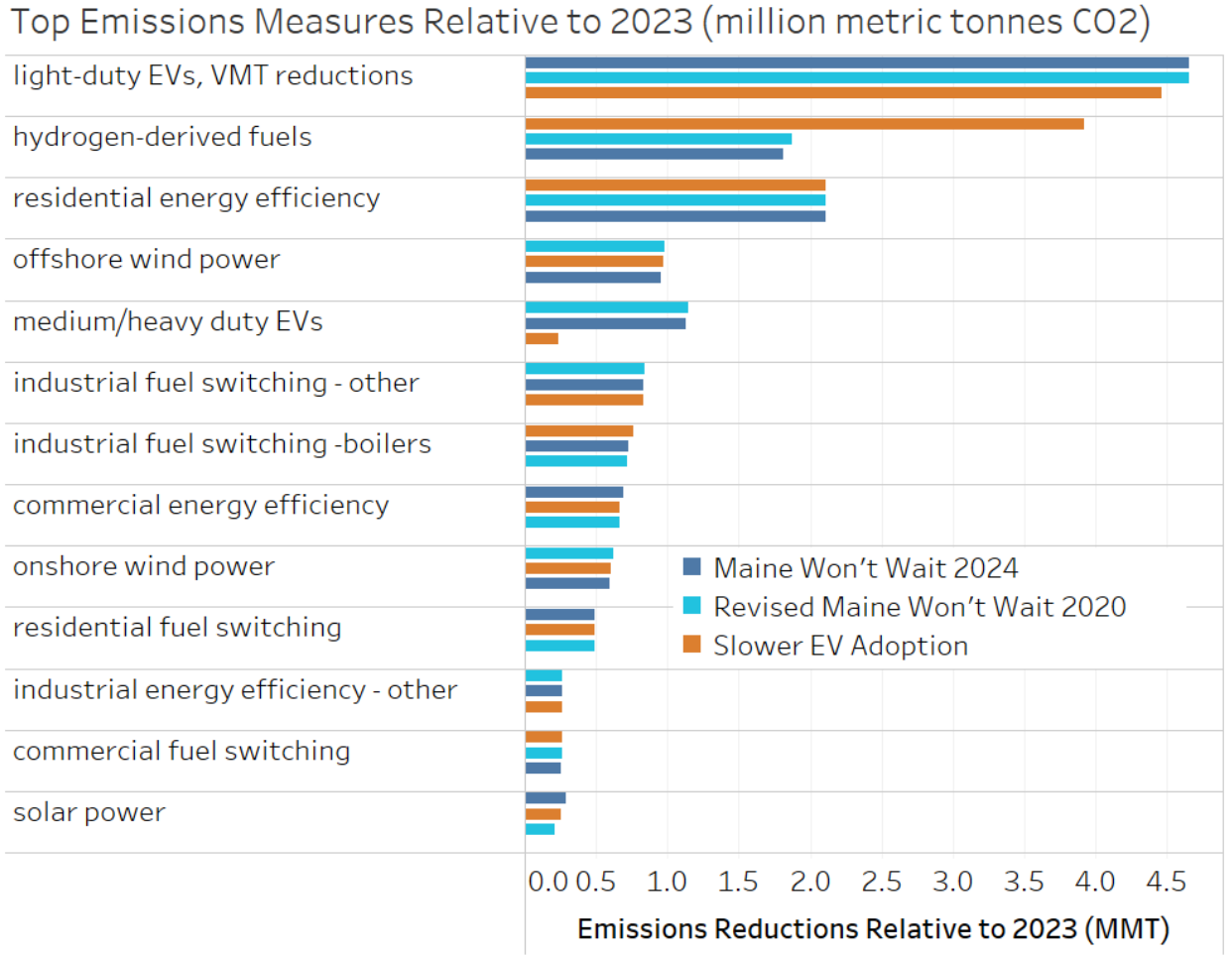
- Light duty stocks in Slower EV Adoption have almost caught up to Maine Won't Wait 2024 by 2050 however medium and heavy-duty have not
- Largest difference is in the hydrogen derived fuels required to meet the emissions targets in 2050
- Efficiency and fuel switching in buildings and industry are important across all scenarios, achieving significant reductions over 2023



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Key Themes and Conclusions (draft)

Vehicle Electrification is the Largest Source of Emissions Reductions in the Near-Term

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- Tradeoff challenge: Moving more slowly in one sector of the economy requires faster emissions reductions in others
  - What is feasible and what achieves the state's objectives?
- Electric vehicles are the largest opportunity to reduce Maine's emissions
- Slower EV Adoption relies on more expensive and speculative actions
  - Hydrogen-derived fuels replace some of the fossil fuels used in the state
  - Not clear how fast a hydrogen economy can scale before 2030: Important in the long-term, but the industry may need time to grow
- Maine Won't Wait 2024 is a goldilocks scenario
  - Backs away from large hydrogen-derived fuel demand with achievable electric vehicle targets

Electric Vehicles Key to Cost Effective Reductions

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- Electric vehicles are forecast to cost the same or less than an internal combustion engine vehicle sometime before 2030
- Higher rates of electric vehicle adoption will:
  - Lower vehicle costs for consumers
  - Lower total energy demand and fossil fuel demand
  - Reduce the need for expensive clean fuels
- Balance between meeting emissions targets most cost effectively and the realistic rate of adoption of electric vehicles
  - Faster rates of electric vehicle adoption are desirable but may be hard to achieve
  - Maine Won't Wait 2024 is a middle ground that avoids the need for large amounts of hydrogen-derived fuels with realistic near-term sales targets

Renewable Energy is Key to Achieving the Targets

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- Renewables are the source of clean energy to supply new electric loads and decarbonize fuel supplies in the future
  - Without achieving planned renewable builds, Maine will not meet the 2030 emissions target, at least not without significant imported hydrogen-derived fuels

Building Efficiency is Key to All Scenarios

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- Energy efficiency and electrification in buildings are significant contributors to meeting Maine's 2030 emissions target
- Without achieving building heat pump adoption goals, more speculative emissions reduction measures may be needed in the near-term, including more hydrogen-derived fuels production
- The consequences of not achieving the targets in buildings may make meeting Maine's emissions targets more difficult if hydrogen-derived fuels production cannot be ramped up fast enough

THANK YOU

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Allocation of carbon savings to different measures

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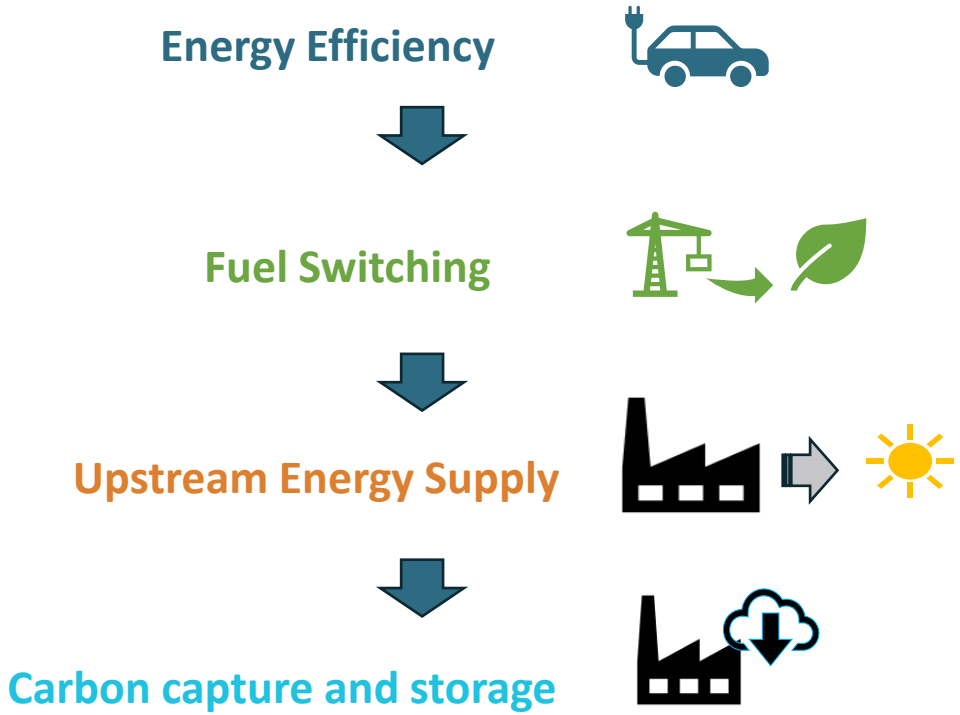
- Allocation methodology for energy efficiency (both same-fuel energy efficiency as well as the efficiency that comes from fuel switching, e.g. EVs); fuel switching; upstream energy decarbonization (e.g. solar displacing gas power plants); carbon capture and storage
- This allocation methodology is run for every reduction wedge, creating a curve of emissions reductions available (by measure)

Allocation for each wedge has a "loading order" to allocate emissions reductions



Electric car example of carbon reduction allocation by measure

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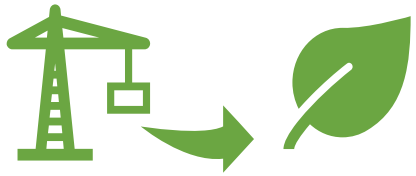
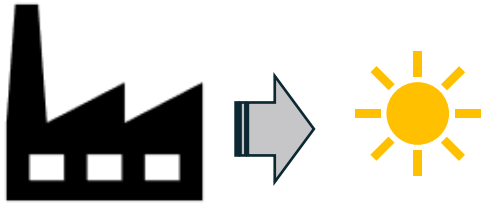
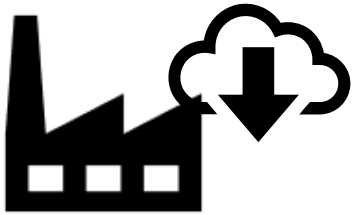
The **energy efficiency** component of an EV is the energy demand reduction associated with electrification multiplied by the emissions intensity of the original diesel/gasoline

The **fuel switching** component of EVs against a fossil baseline would be the energy demand of EVs multiplied by the difference in emissions intensity between gasoline and delivered grid electricity



The **upstream emissions savings** are calculated as the product of the change in emissions intensity of the energy carrier multiplied by the baseline energy demand for the carrier [1]





The **carbon capture and storage** component is straightforward and calculated directly as the amount of physical CO2e stored

1. Example if a coal electricity system is replaced with 50% gas and 50% renewables. The reductions would be allocated to renewables as:50% * (Emissions Factor of Coal–Emissions Factor of Renewables)/ (50% * (Emissions Factor of Coal–Emissions Factor of Renewables) + 50% * (Emissions Factor of Coal–Emissions Factor of Gas)