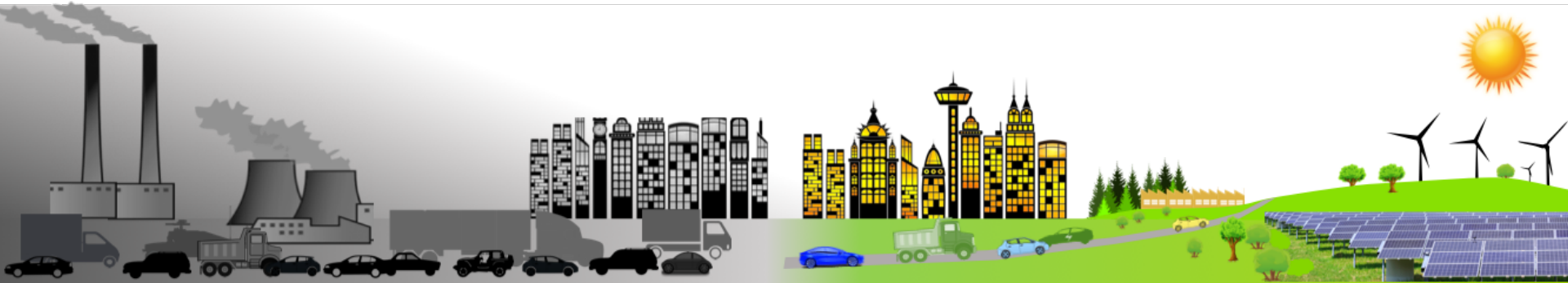
Free riders? Bring ‘em on!

Eric Strid
Columbia Gorge Climate Action Network
April 15, 2021 webinar recording (starts at 47:00)

The US will save trillions by decarbonizing

We’re trapped by our infrastructure

Halving emissions by 2030 requires more urgency



Climate Change in Ten Words

It’s real.

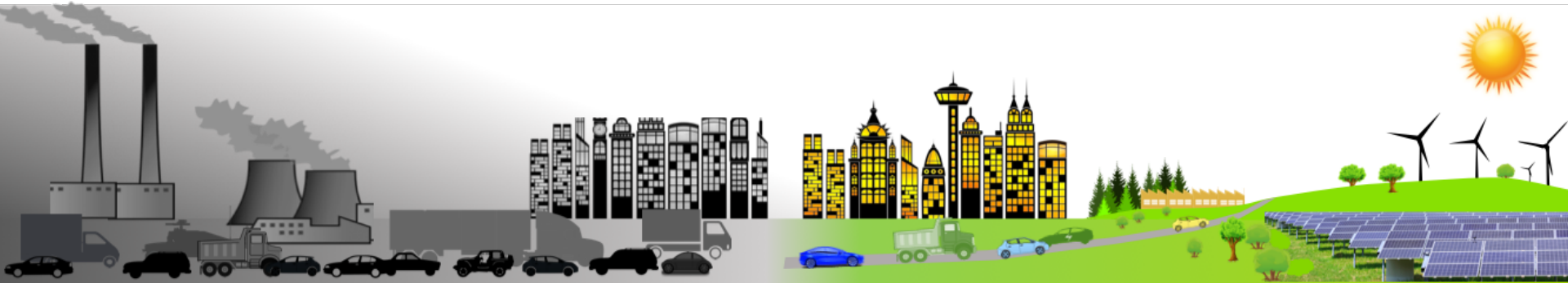
It’s us.

It’s bad.

Experts agree.

There’s hope.

Source: YPCCC



The Fossil-Fuel Story

Yes, climate change is real.

Yes, fossil fuels are a big cause--that's our customers' fault.

But there are no affordable options!

The ultimate climate change challenge: free riders

The real story: The US will save trillions

The “magic”:

- Clean energy has zero fuel cost
- The technologies keep getting cheaper
- Clean energy typically ~3X as efficient

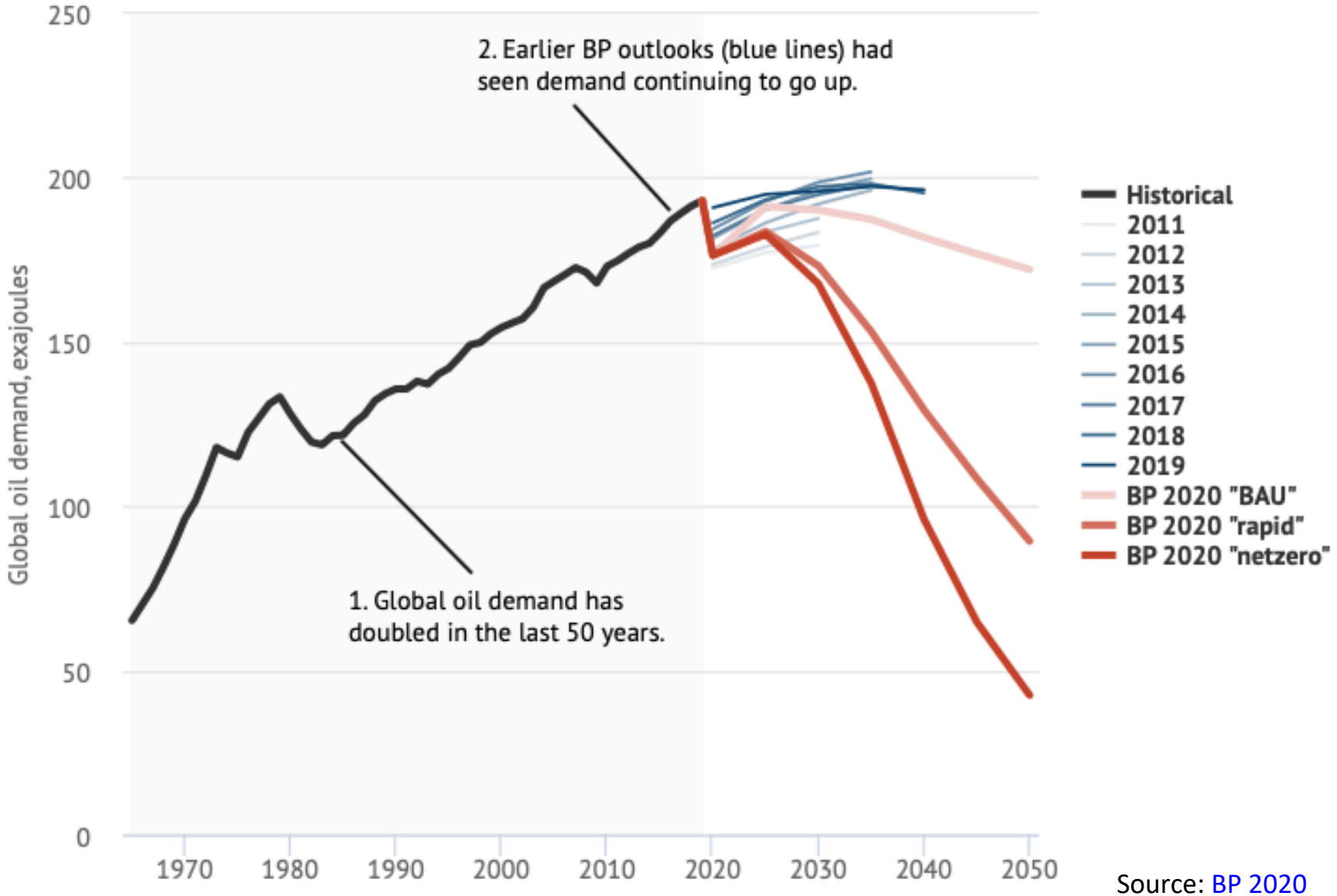
Some numbers:

- 2018 US expenditures on fossil fuels: $1.27 trillion
- Equivalent cost with today’s renewables: ~$0.7 trillion
- Equivalent cost with 2025 renewables: ~$0.5 trillion

Sources: EIA, Lazard 2020

BP now concedes that oil demand has already peaked – and could soon plummet

Last year's outlook had seen peak oil still being 15 years away



Source: BP 2020

It's in every jurisdiction's own best interest to decarbonize

Local and immediate co-benefits of decarbonization:

- Lower fuel costs
- Lower maintenance costs
- Much lower toxic emissions
- Keep energy spending in the region
- More efficient grid
- More resilient energy sources

There's no need to scare people about invisible gases that will melt glaciers somewhere in 50 years.

Fears of free riders or tragedy of the commons are irrelevant.

Politically, we should talk about money, not carbon.

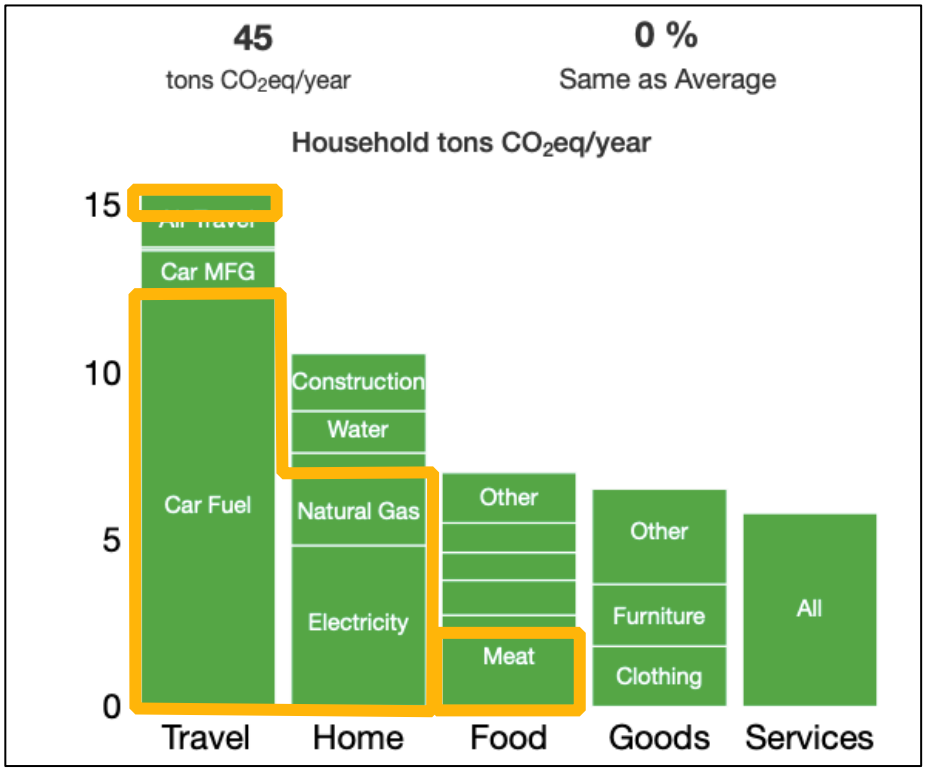
We’re trapped by our infrastructure

Microeconomic example: the average Oregon household

- How much would 45% GHG reduction by 2030 cost?
- The necessary technologies all exist
- We vote for and lock in most of our emissions when we choose our housing and transportation

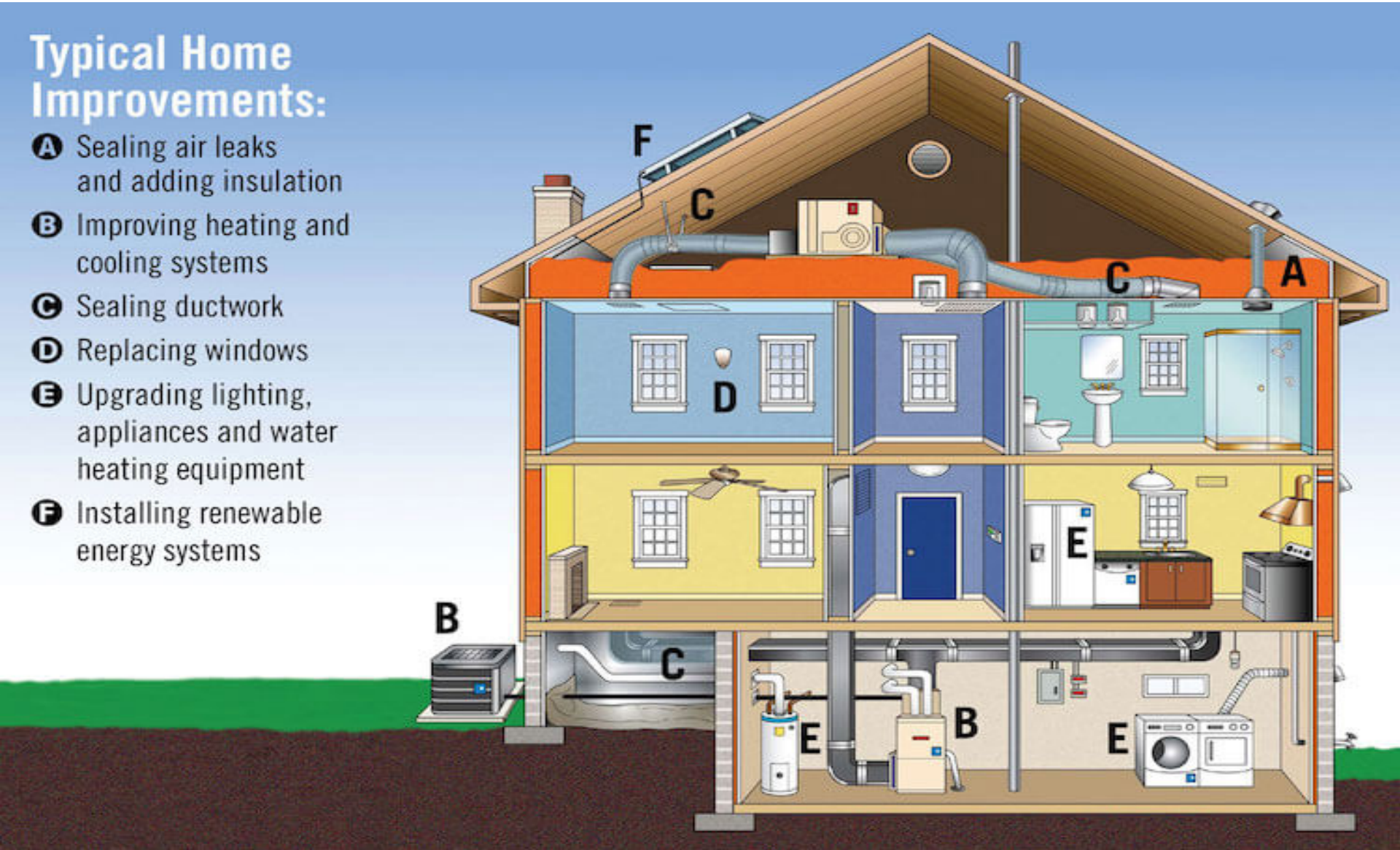
Answer: average household would save about $3000/year!

Electric vehicle
Heat pumps
½ the air travel
Less meat



Energy efficiency, heat pumps, electrify

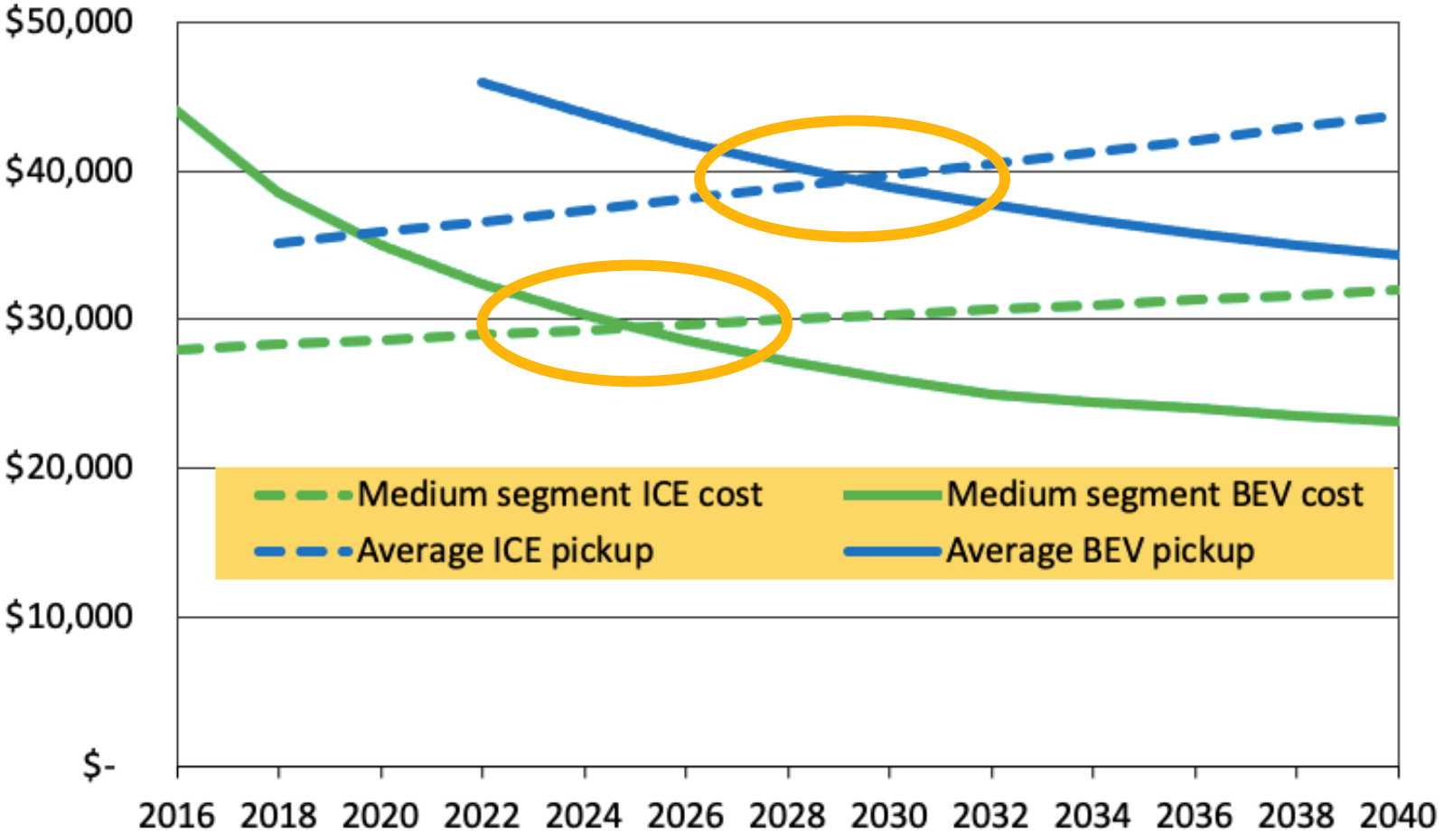
Payback periods range from 2 to 20 years



EV payback periods approaching zero

Battery electric vehicles (BEVs) cheaper to purchase than internal combustion engine (ICE) vehicles by 2022-2028.

BEV pickups cheaper to purchase by 2026-2032.



Source: BNEF; pickup assumes 150 kWh battery

Halving emissions by 2030 requires more urgency

We’re doing urgent mobilizations

6 million vaccinations per day

Global race for EV production!

Better policies would help

- No states, few countries do comprehensive, long-term planning
- Objectively and quantitatively analyze the options
- Leverage the clean-energy revolution
- Must steer new infrastructure purchases to zero emissions
  - $600B/yr spent on new consumer vehicles
  - $1.4 trillion/yr spent on new construction, ~half that for residential

More financing would help

Clean energy is cheaper to operate, thus a financing hurdle

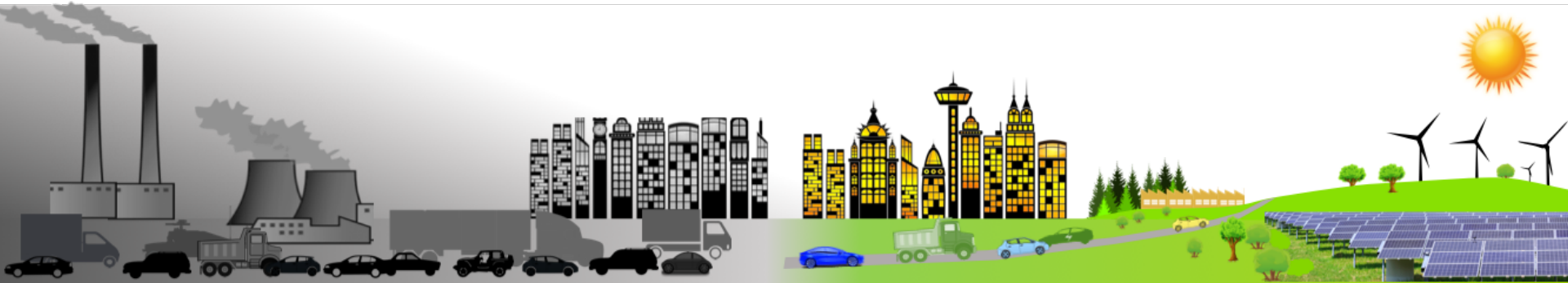
- Green banks/revolving loan funds
  - CT and NY state green banks demonstrating 3-10X leverage of public funding, while also repaying the state
  - Federal green bank bill would seed state or local green banks
  - Hood River County Energy Plan envisions a $25 million fund
- Consumers and companies need innovative options for financing decarbonization
  - Upgrading buildings and vehicles
  - Zero-interest loans to companies for R&D and deployment of clean energy products
- Displaced workers need retraining

What's in the infrastructure bill?

- American Jobs Plan $2 trillion of investments includes
  - $586 billion for transportation, $174 billion for electric vehicles
  - $327 billion for water, internet, electric
  - $378 billion for homes, schools, buildings
  - $980 billion for workforce & innovation
- Rare opportunity to invest in the right stuff!
- Now is the time to lobby your legislators in DC

Next Steps

- Talk to others about climate and decarbonization
- Calculate your infrastructure emissions & costs
- Advocate more urgency in replacing infrastructure
  - Policies that steer new purchases of new vehicles, buildings
  - More financing options for clean-tech businesses and upgrading homes & vehicles



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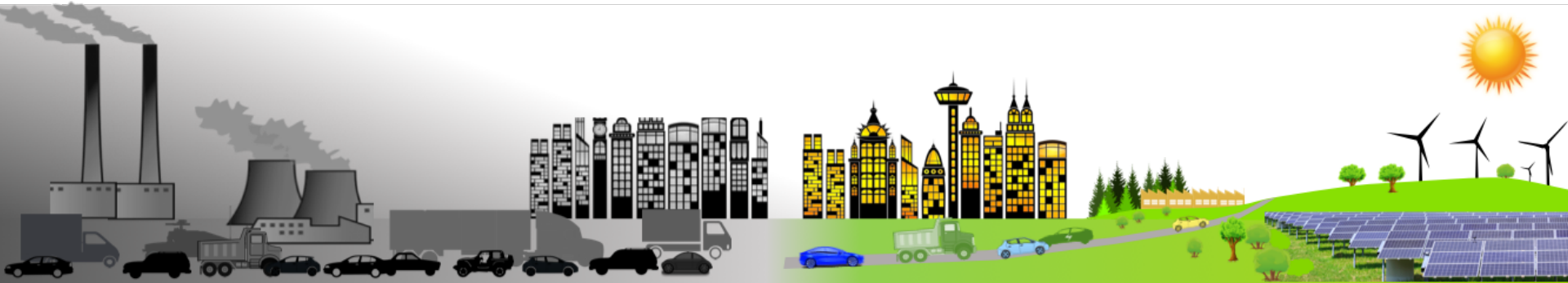
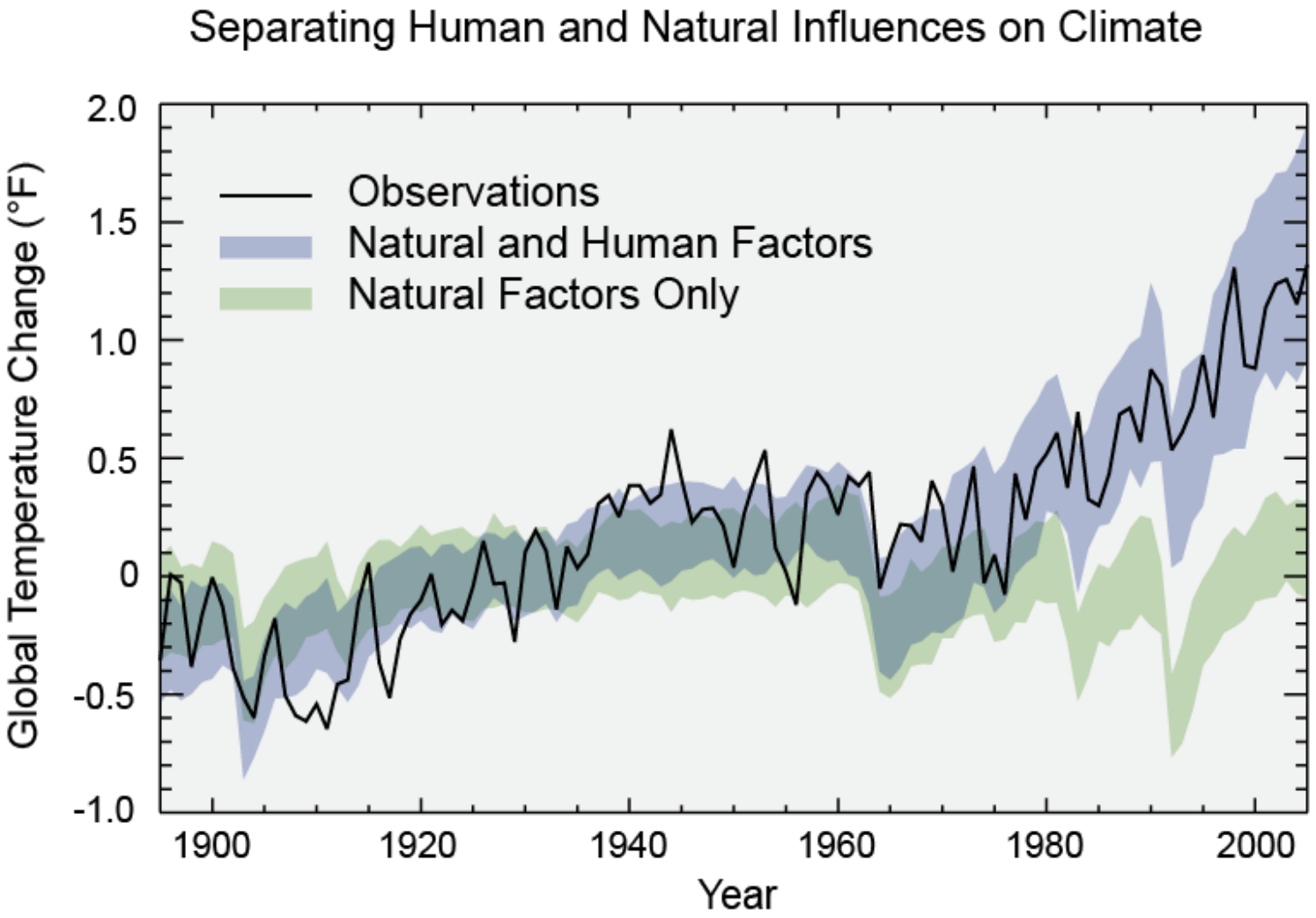
- Saul Griffith and Ezra Klein, How to solve climate change and make life more awesome, podcast Dec. 16, 2019
- Saul Griffith and Sam Calisch, No Place Like Home --Fighting climate change (and saving money) by electrifying America's households
- Earth Advantage and RMI, Build Back Better Homes: How to Unlock America's Single-Family Green Mortgage Market, March 2021
- Tony Seba, Rethinking The Future — Clean Disruption and the Collapse of the Oil, Coal, and ICEV Industries
- E. Strid, How to Decarbonize Oregon's Energy
- E. Strid, Design your own decarbonization of OR or WA
- InsideEVs: Compare Electric Cars: EV Range, Specs, Pricing & More Feb. 2021
- State policy design for opening EV floodgates Nov. 2019
- 100% EV Sales by 2025 Achieves 2030 IPCC Target While Saving the US Trillions Dec. 2019



Climate data has been clear for decades



1982: Exxon predicted today's CO_2 levels and warming

2018: Five oil majors agree with climate scientists in court

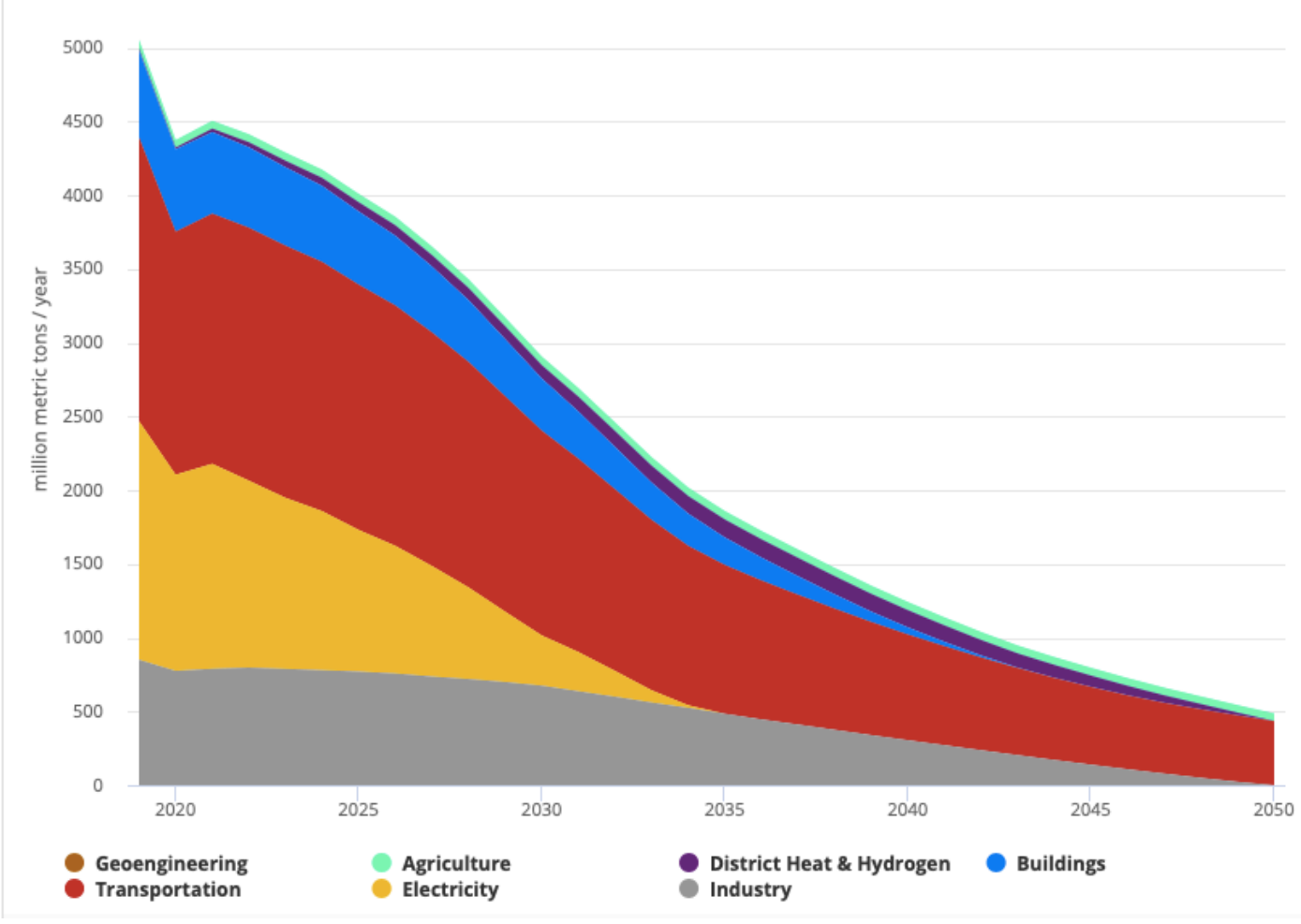
Why I pursue this

We do not:

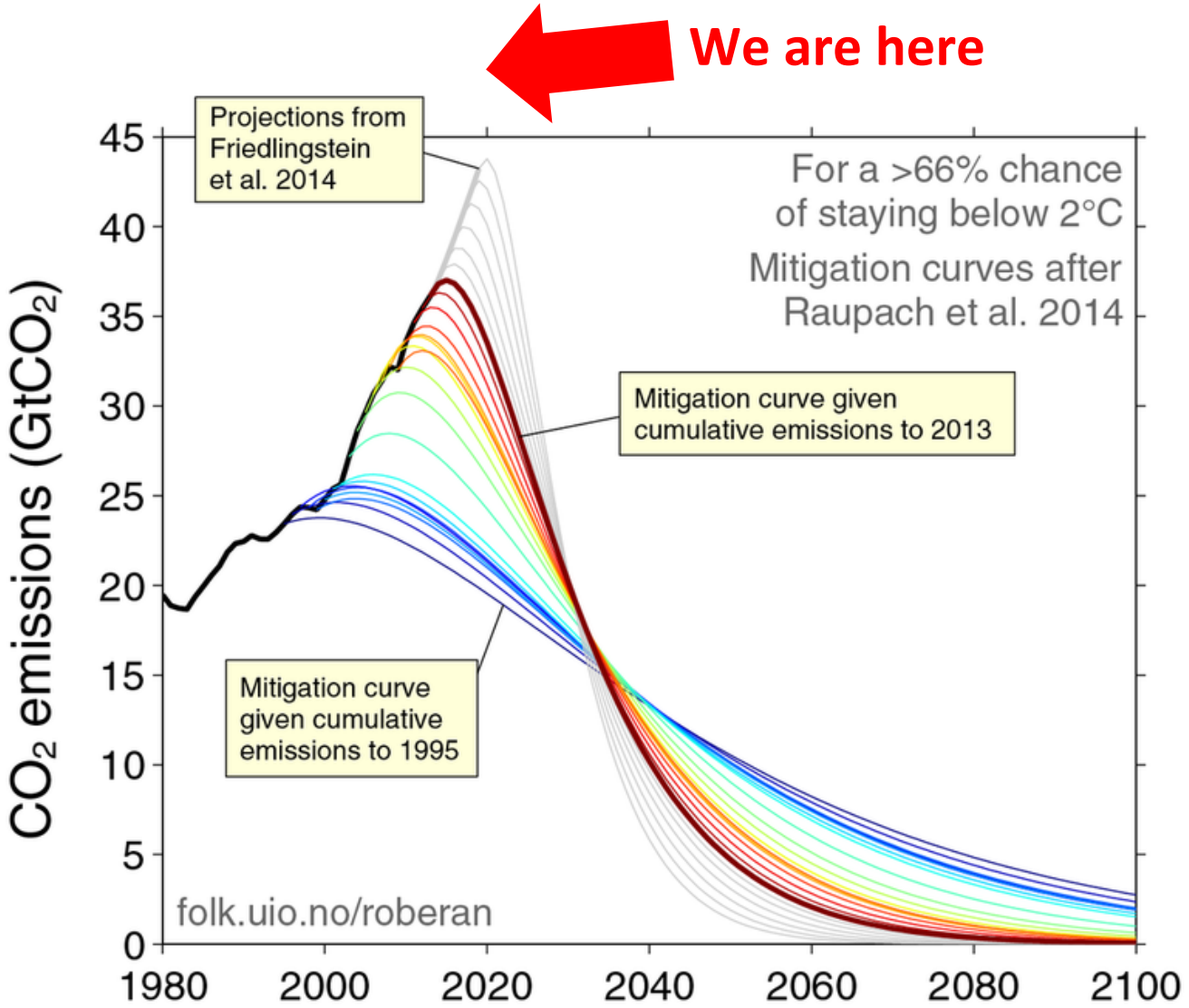
1. Pursue the necessary decarbonization targets.
   - E.g., 45% by 2030 does not mean 10% by 2027
   - We need exponential, out-of-the-box solutions
2. Leverage the clean-energy transition
   - Market forces already disrupting utilities, transportation
   - Co-benefits of decarbonization much larger than SCC
3. Objectively and quantitatively analyze options
   - Does anyone analyze what is working and what isn't?
4. Plan comprehensively through 2030 and 2050
5. Demand effective and efficient climate policies
   - Minimize the MAC

Better policies would help

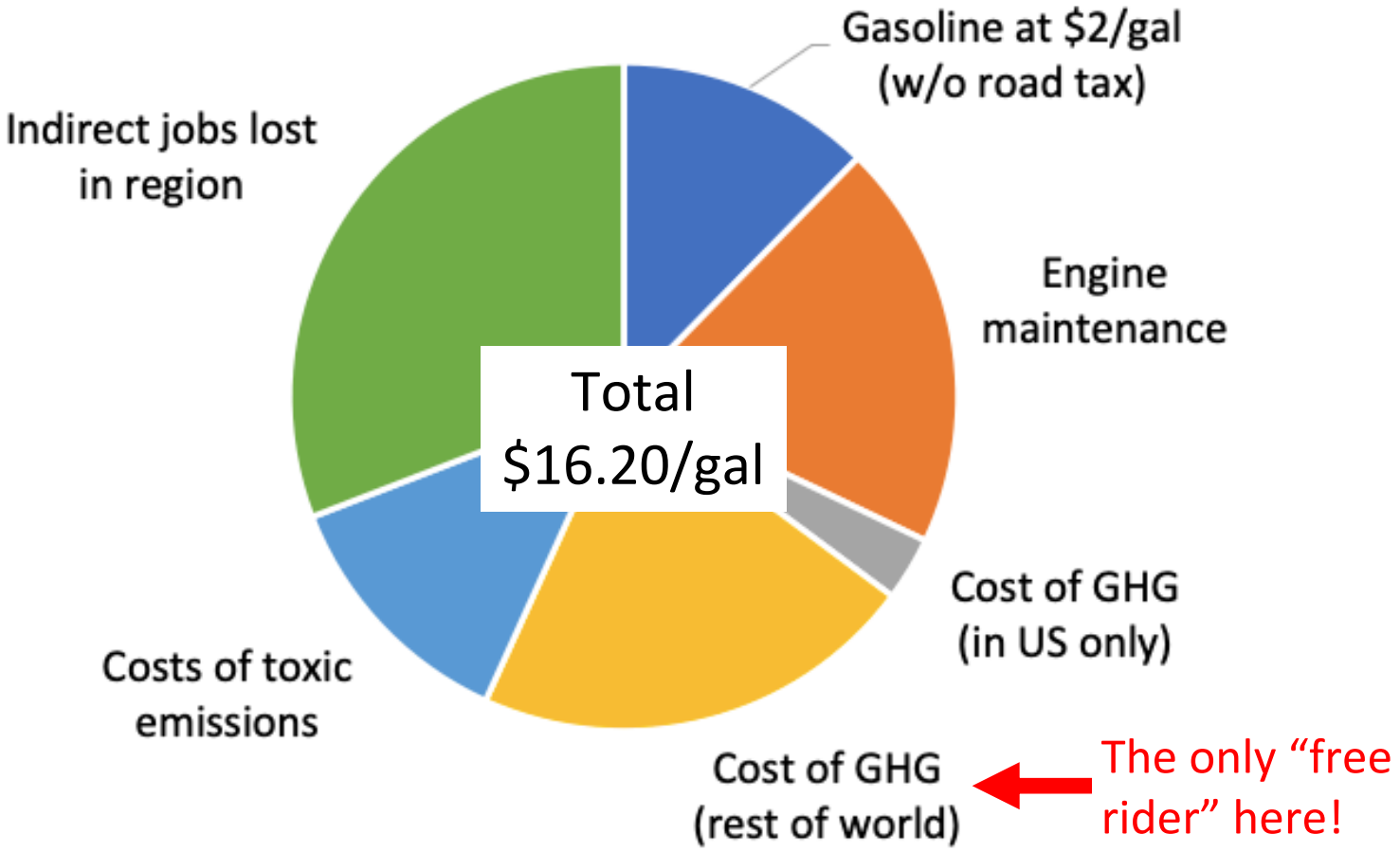
- Objectively and quantitatively analyze the options
- Energy Policy Simulator is free and open-source



No time left for incremental policies



Fossil fuel cost example: gasoline in OR



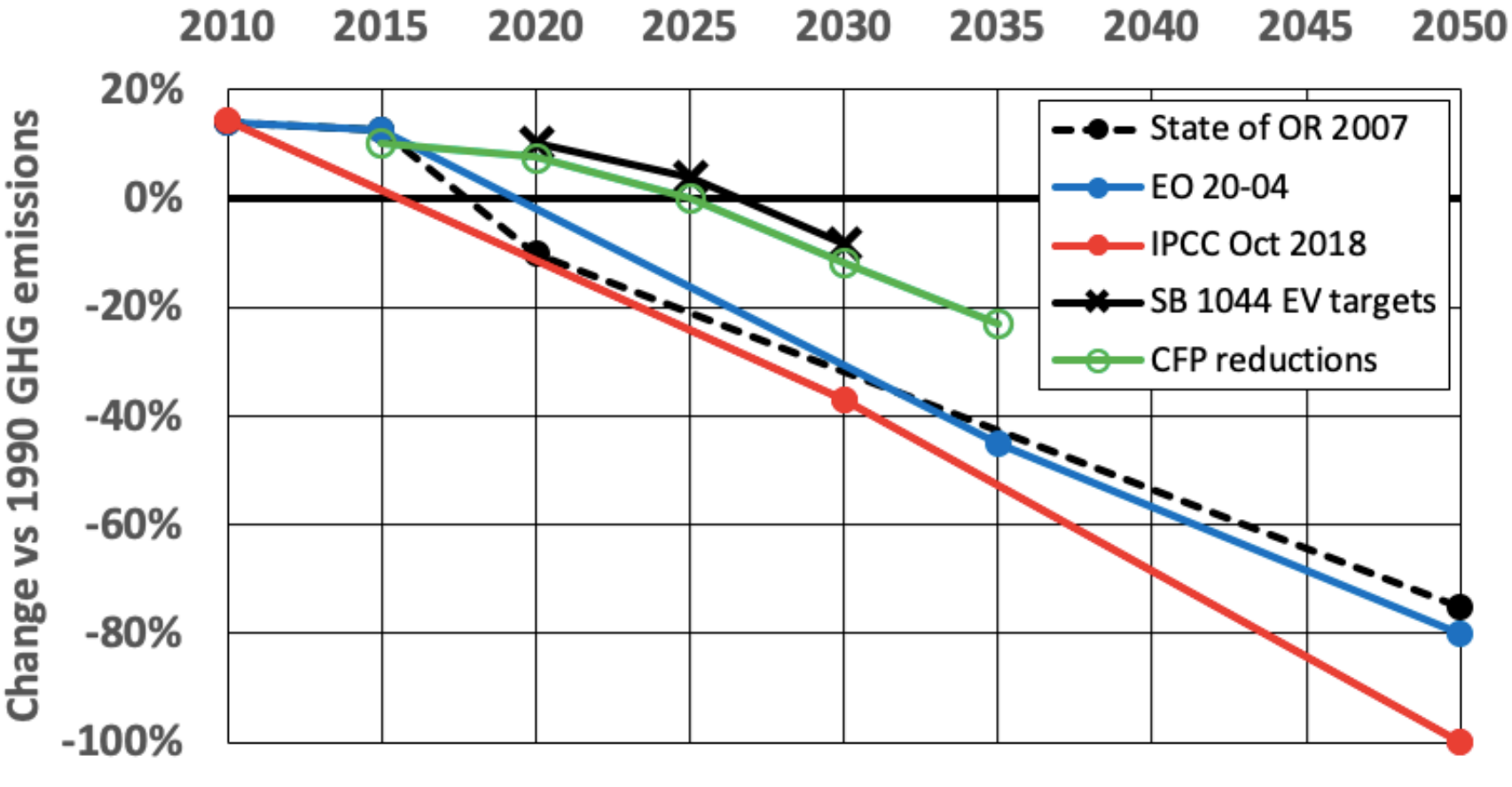
- EV equivalent: fuel ~$1/gal + maintenance ~$0.20/gal
- No need to hype the dangers of a gas we exhale…

Sources: Engine maintenance, GHG, toxics, indirect jobs

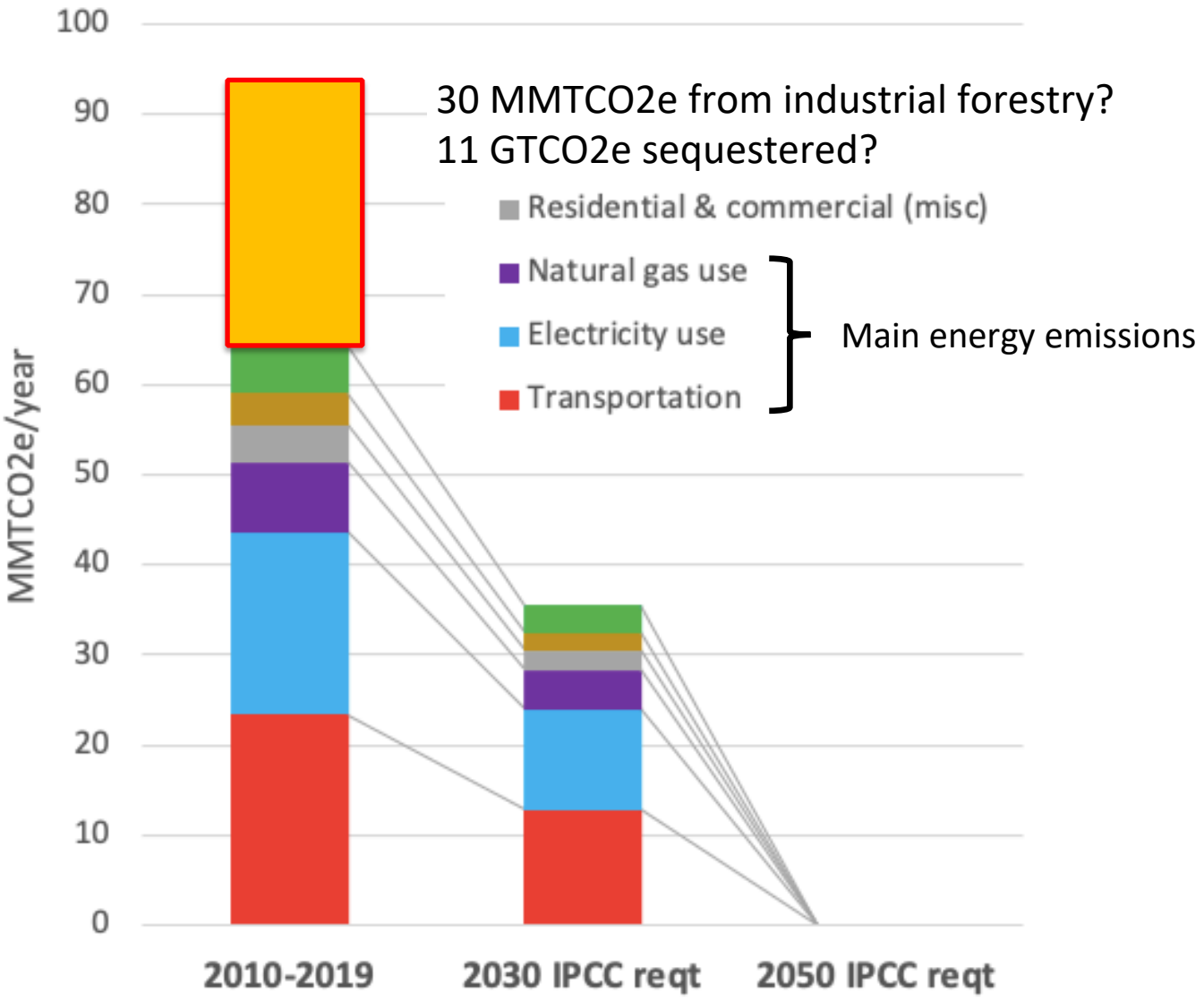
Status and Aspirational Goals

Recent EO 20-04

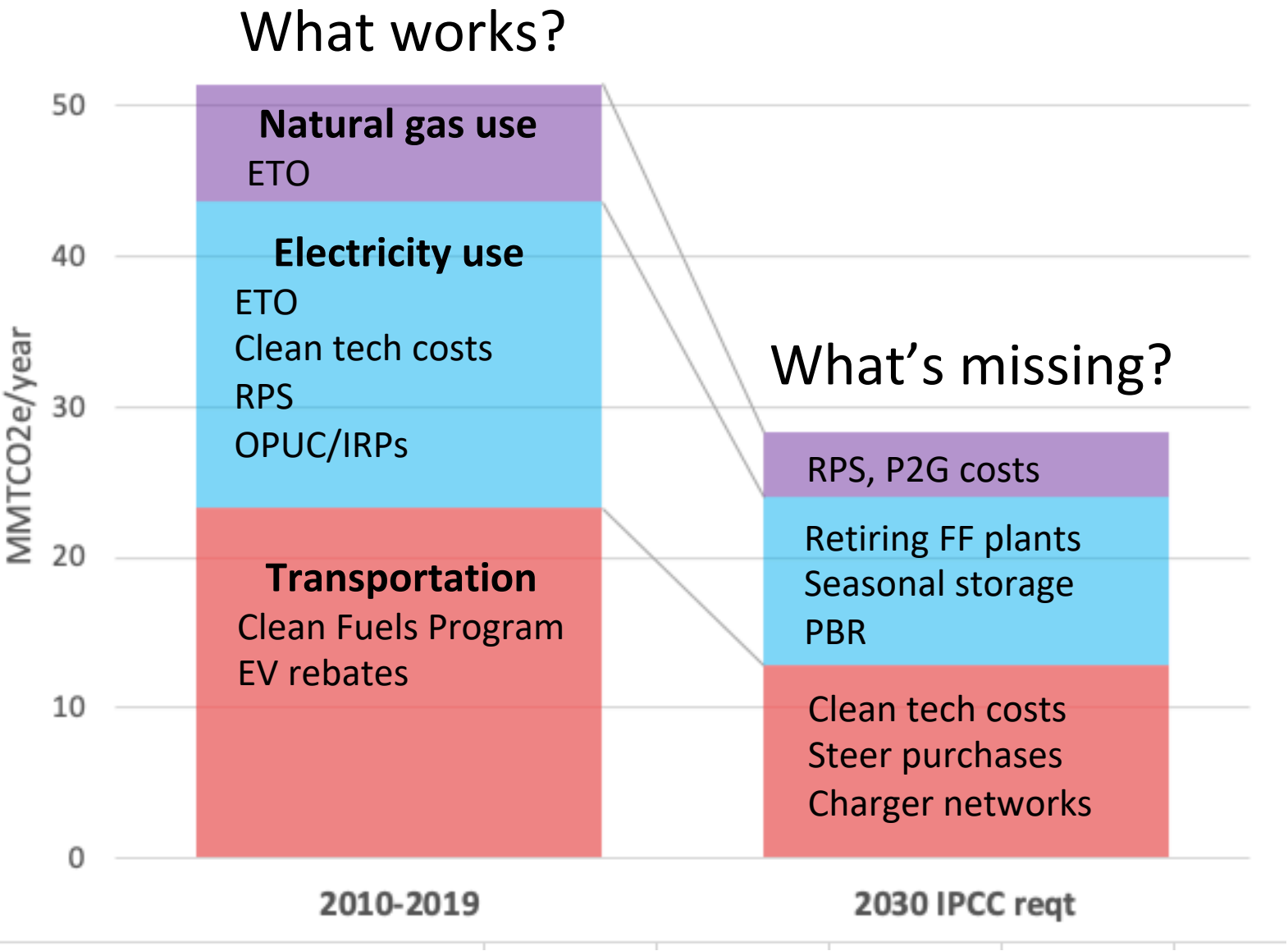
- Extends CFP to 2030 and 2035; avoids market-based policies
- Implies that agencies will create sectoral plans for 2035…



Oregon GHG Emission Sectors



The main emissions: energy



Physical, economic, and policy layers

Forces and constraints that must harmonize
Analogous to software layers in a complex system

Policy Layer
Governance, policies, legal controls

The policy/governance layer must control the economics

Economic Layer
Daily commerce, business, employment

The economy is like a big computer finding lowest costs

Physical Layer
Science, technologies

The physical layer is our ecosystems and physical creations

Solutions must work for every layer

The physical layer

Sector	MMTCO2e	Needs
Transportation	**23.3**	
Gasoline (LDVs)	12.1	Deploy ZEVs
Diesel (MDV/HDV)	6.7	Develop ZEVs
Aviation	1.8	Develop biofuels
Residual (shipping)	0.7	Research fuels
Other	2	
Electricity use	**20.3**	
Residential	8.3	Deploy wind and solar farms Develop seasonal storage
Commercial	6.8	
Industrial	5.2	
Natural gas use	**7.8**	
Residential	2.6	Develop power to gas and seasonal storage
Commercial	1.7	
Industrial	3.5	

- Most constraining
- Simplest to specify
- IPCC 2030 => attack all sectors in parallel
- Challenges and opportunities are sector-specific

Decarbonizing Oregon's Energy

Sector	Oregon MMTCO2e	Physical requirements
Transportation	**23.3**	
Gasoline (LDVs)	12.1	Deploy ZEVs
Diesel (MDV/HDV)	6.7	Develop ZEVs
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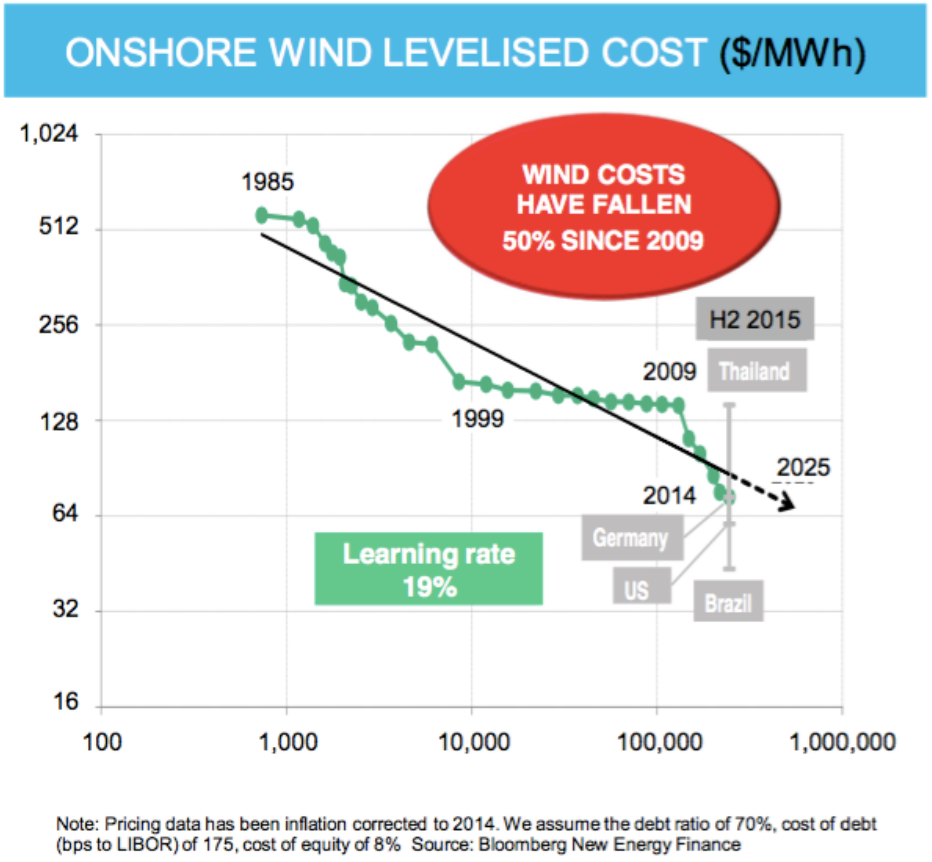
Other	2	
Electricity use	**20.3**	
Residential	8.3	Deploy wind and solar farms Develop seasonal storage
Commercial	6.8	
Industrial	5.2	
Natural gas use	**7.8**	
Residential	2.6	Deploy heat pumps Research options for cement, steel, misc.
Commercial	1.7	
Industrial	3.5	

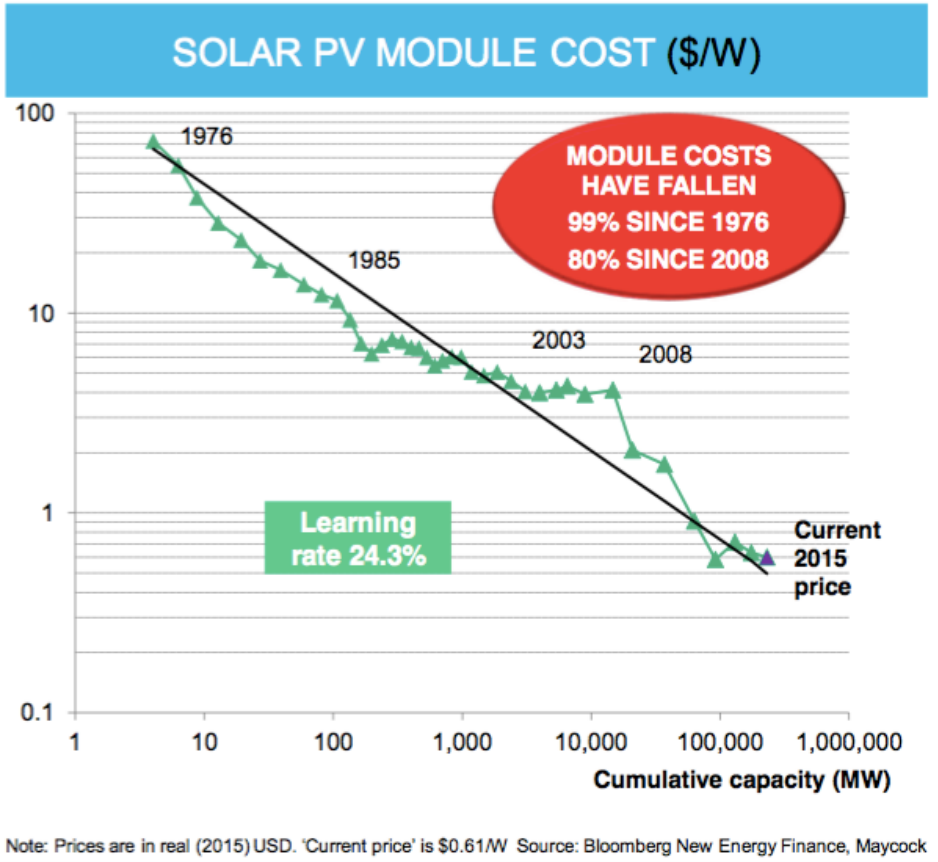
- Physical requirements are the most constraining and simplest to specify
- Halving by 2030 requires attacking all sectors at once
- Challenges and opportunities are sector-specific

Transportation and housing dominate residential emissions

Clean energy "breakthroughs" are all production learning rates



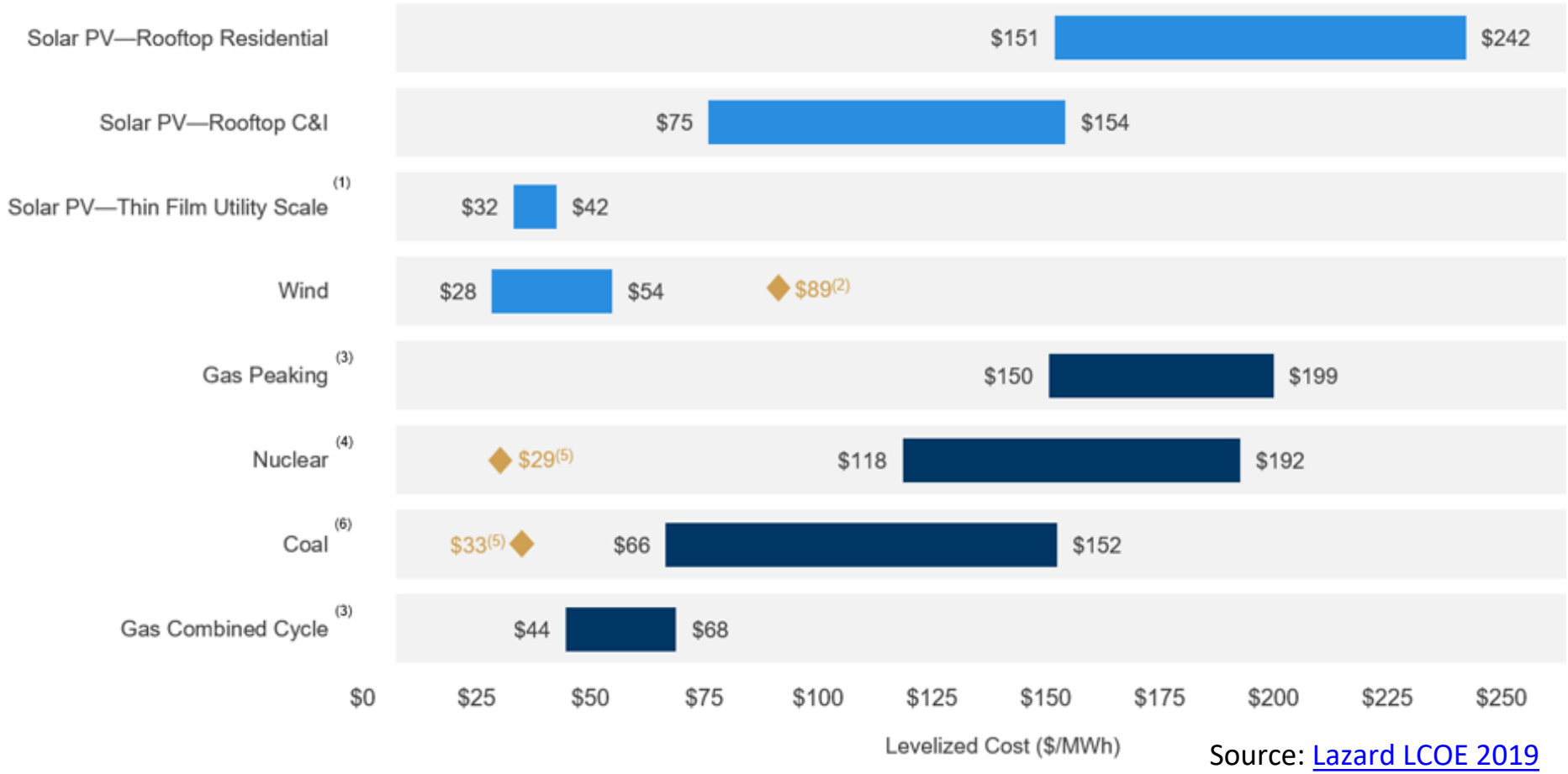
Note: Pricing data has been inflation corrected to 2014. We assume the debt ratio of 70%, cost of debt (bps to LIBOR) of 175, cost of equity of 8% Source: Bloomberg New Energy Finance



Note: Prices are in real (2015) USD. 'Current price' is $0.61/W Source: Bloomberg New Energy Finance, Maycock

- *Learning rates derive from increasing efficiencies as we build more*
- *No technology breakthroughs needed to extrapolate*

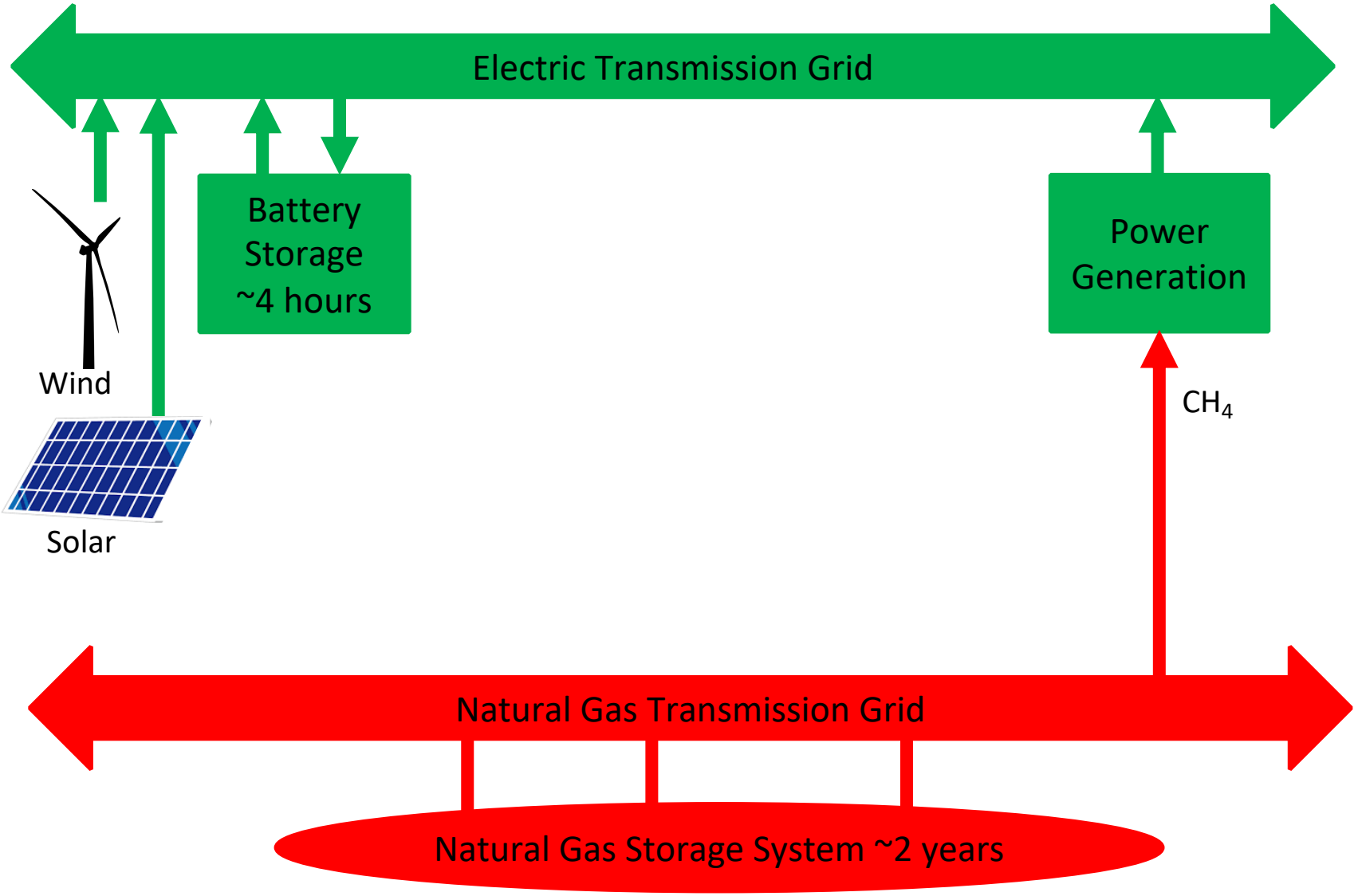
Levelized Cost of Energy ($/MWh)



Source: [Lazard LCOE 2019]

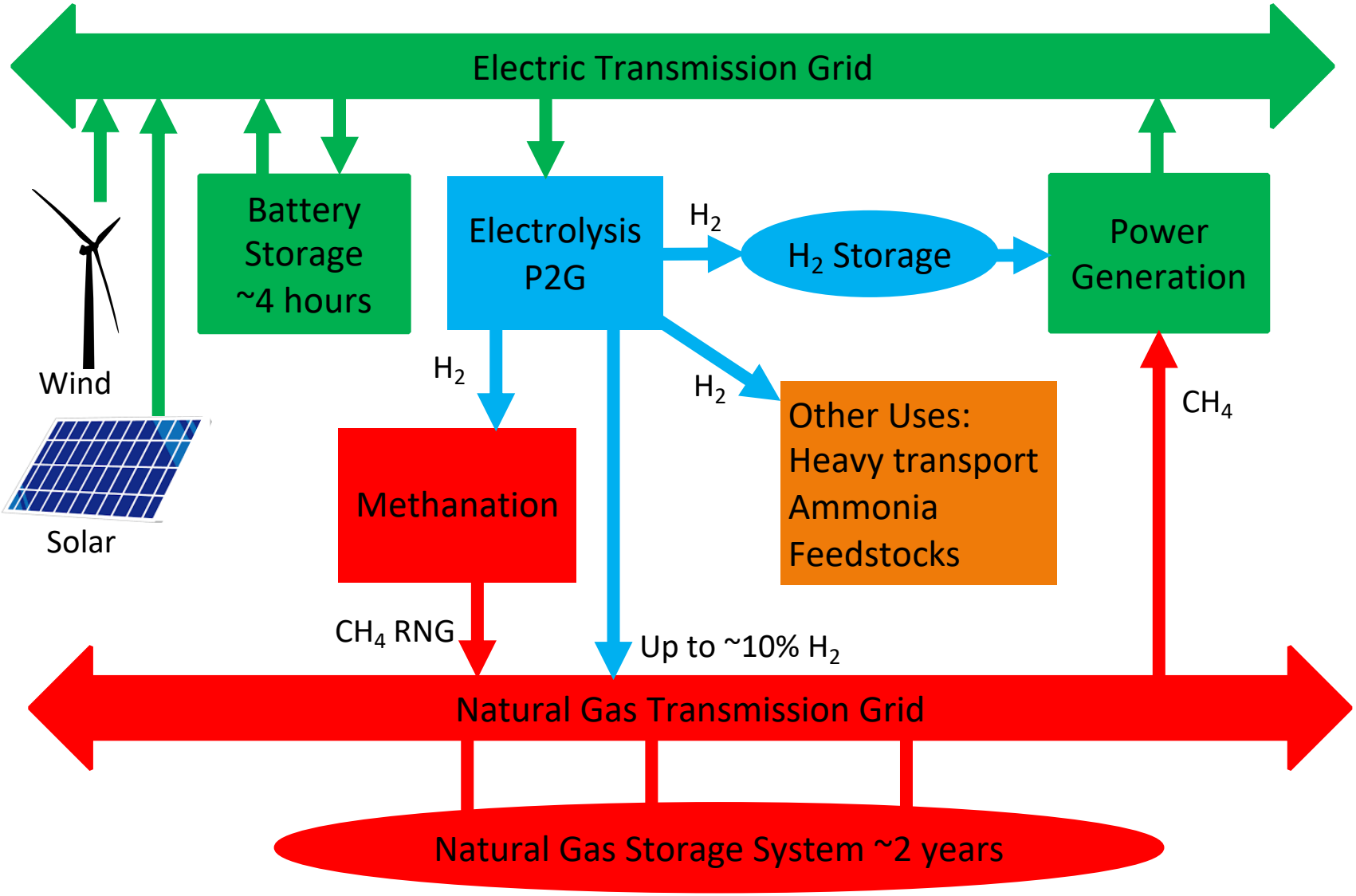
- Unsubsidized, global averages in 2019
- Cheaper to build and operate wind or solar farm than to operate a coal plant
- Wind, solar, and storage will continue to disrupt

Need: two months of seasonal storage



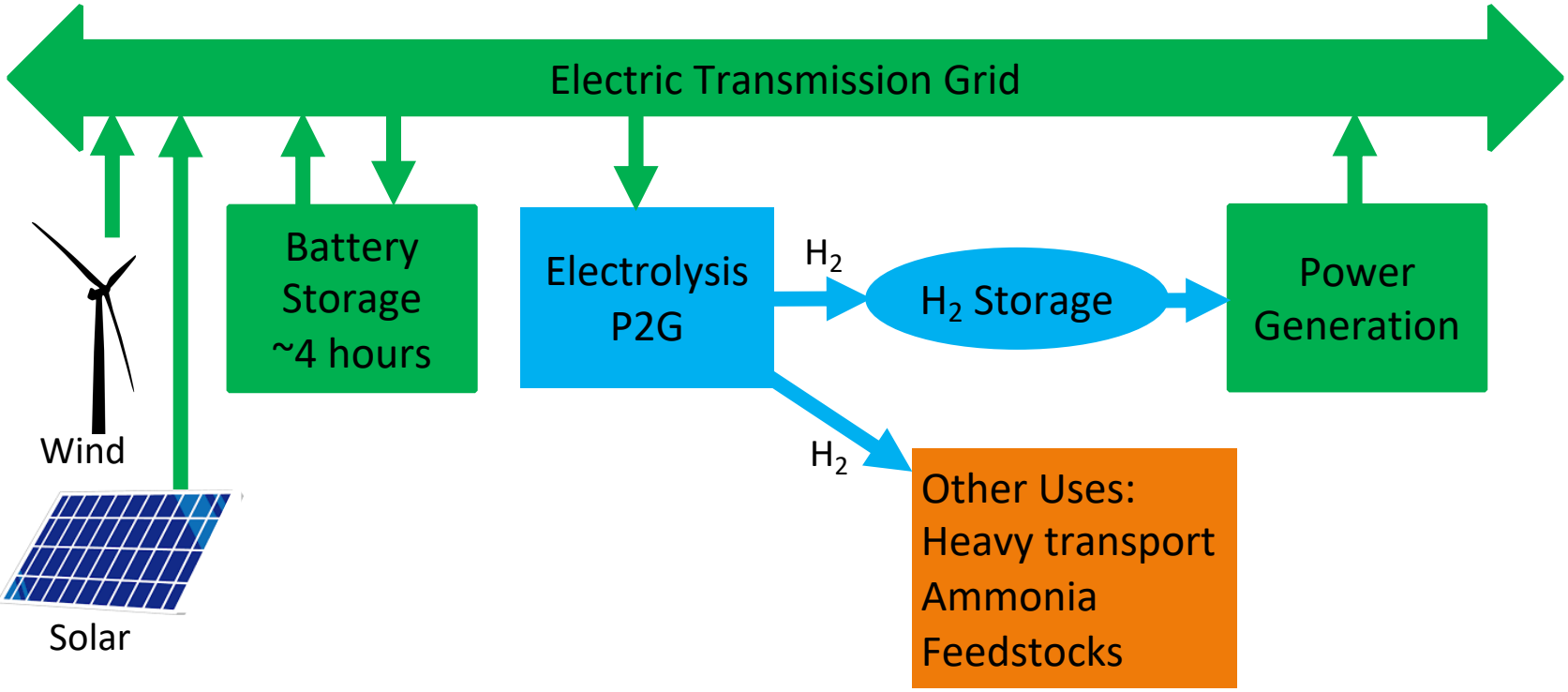
Renewable H2 Alliance

How could green hydrogen be used?

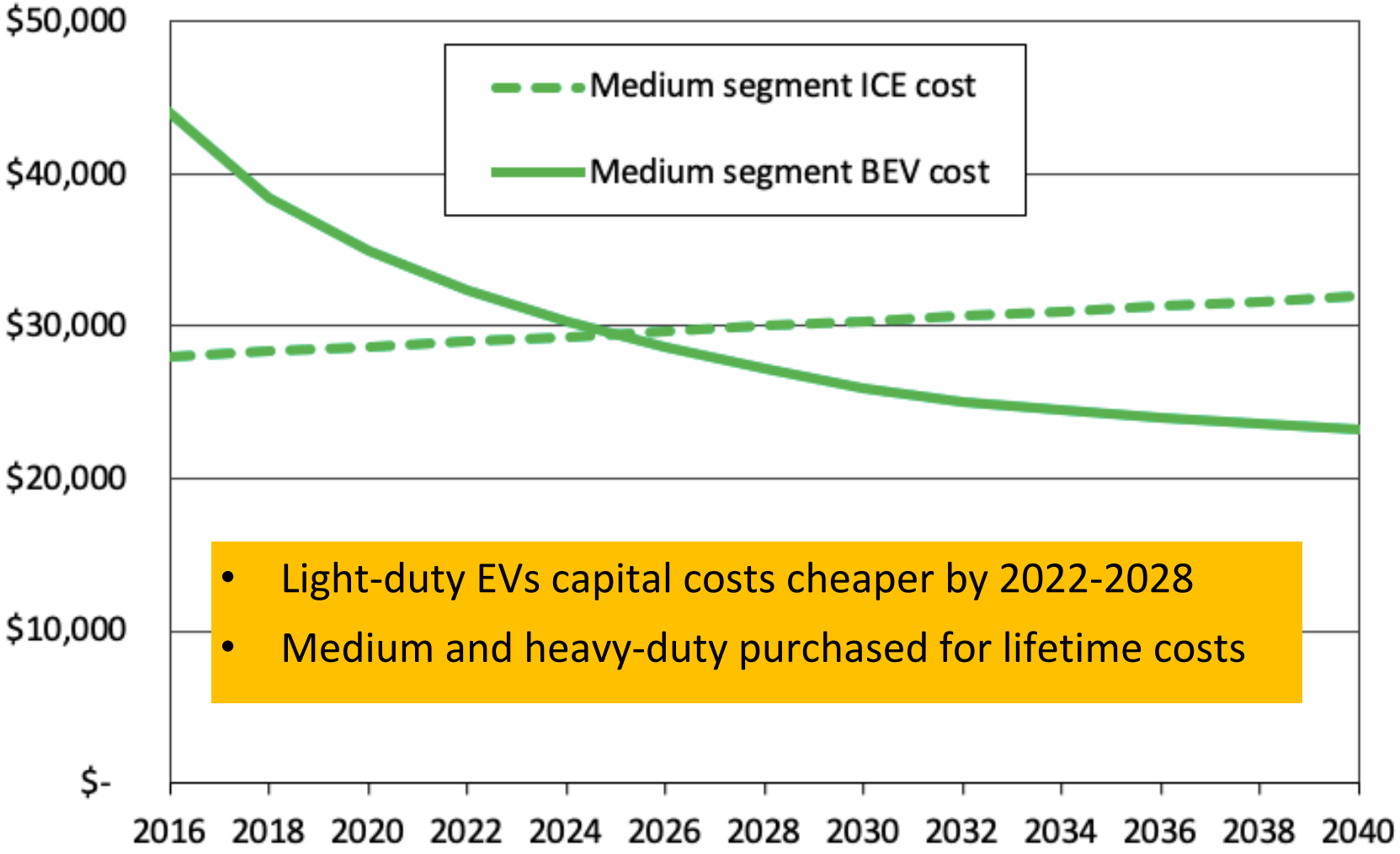


Renewable H2 Alliance

How should green hydrogen be used?



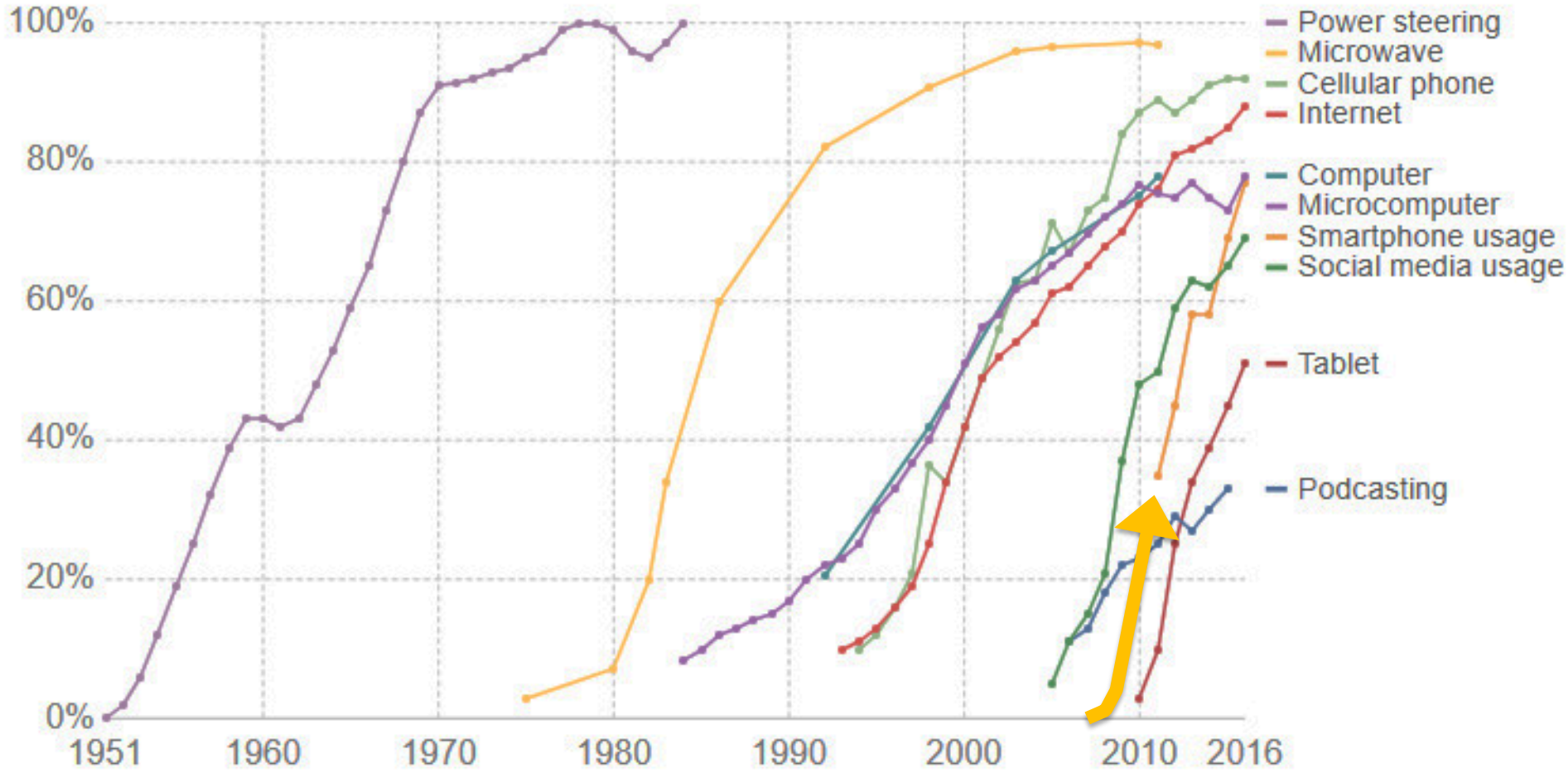
EV capital costs



- Light-duty EVs capital costs cheaper by 2022-2028
- Medium and heavy-duty purchased for lifetime costs

Source: BNEF

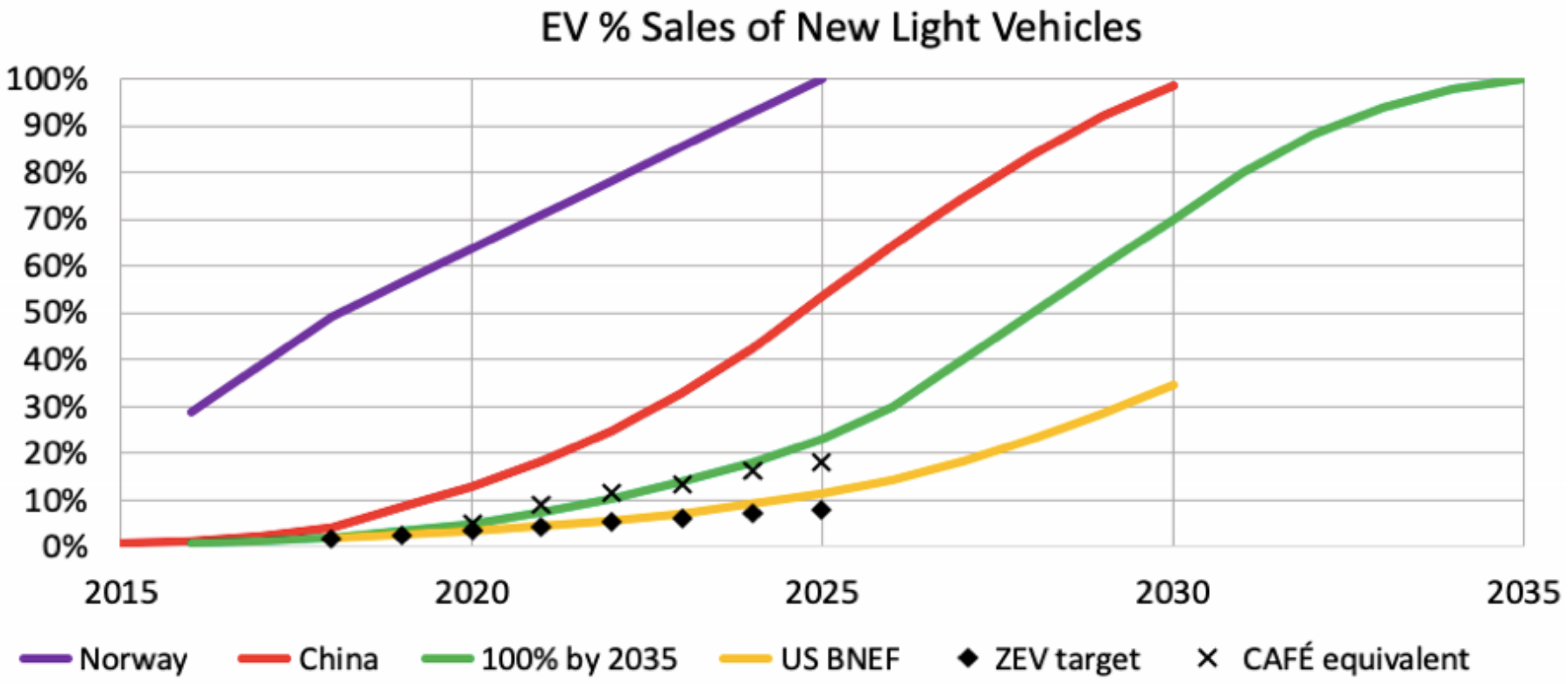
Examples of technology disruptions



Classic “S” curve of market share <u>resets all competitors</u>

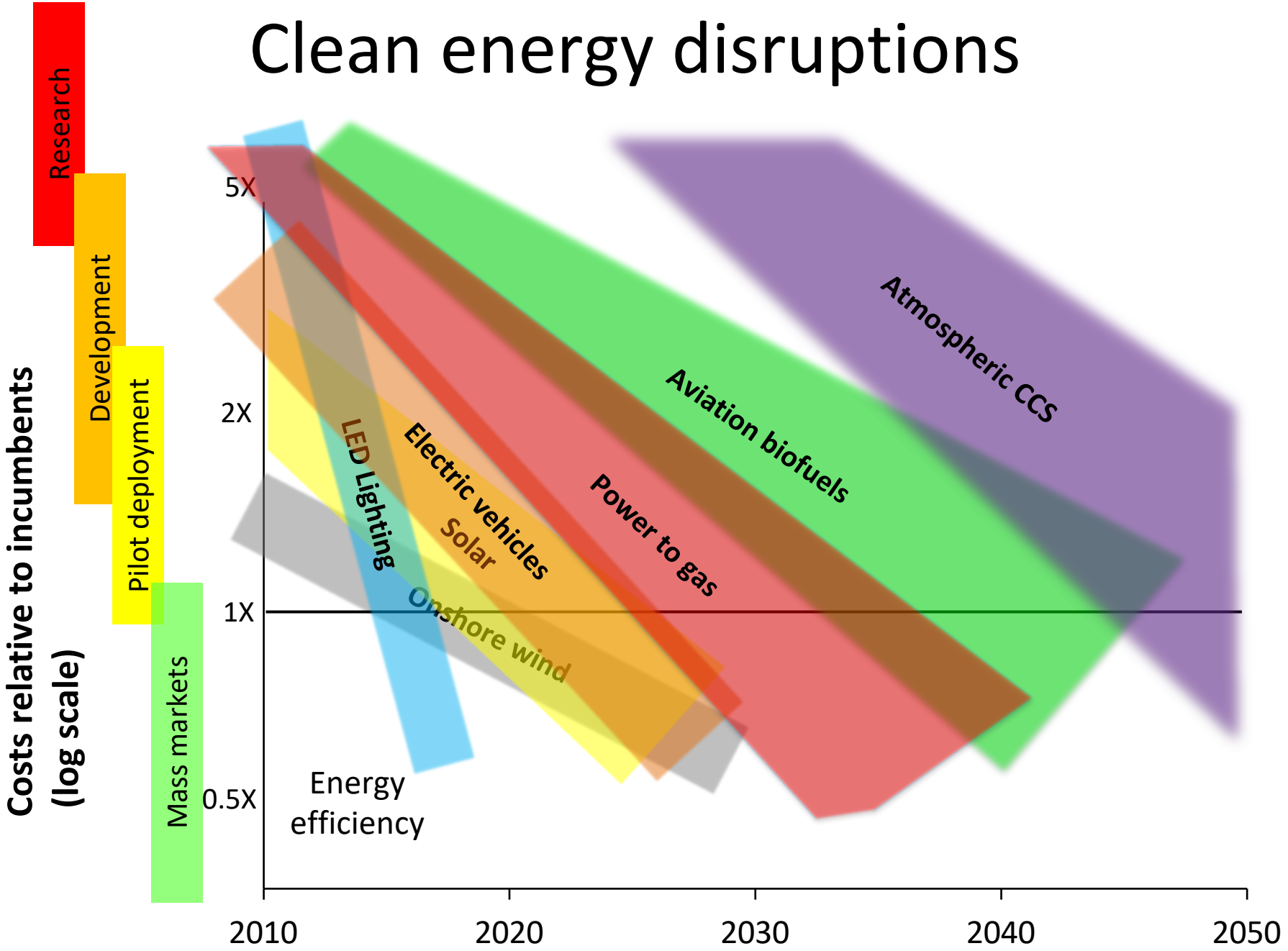
EV forecasts

- Conventional wisdom: EVs driven by policies
- *Business-as-usual increasingly driven by markets*



Source: [Strid Energy Report March 2019]

Clean energy disruptions



P2G, biofuels, and A-CCS are guesstimates; all others extrapolated from learning rates.

Paradigm shifts

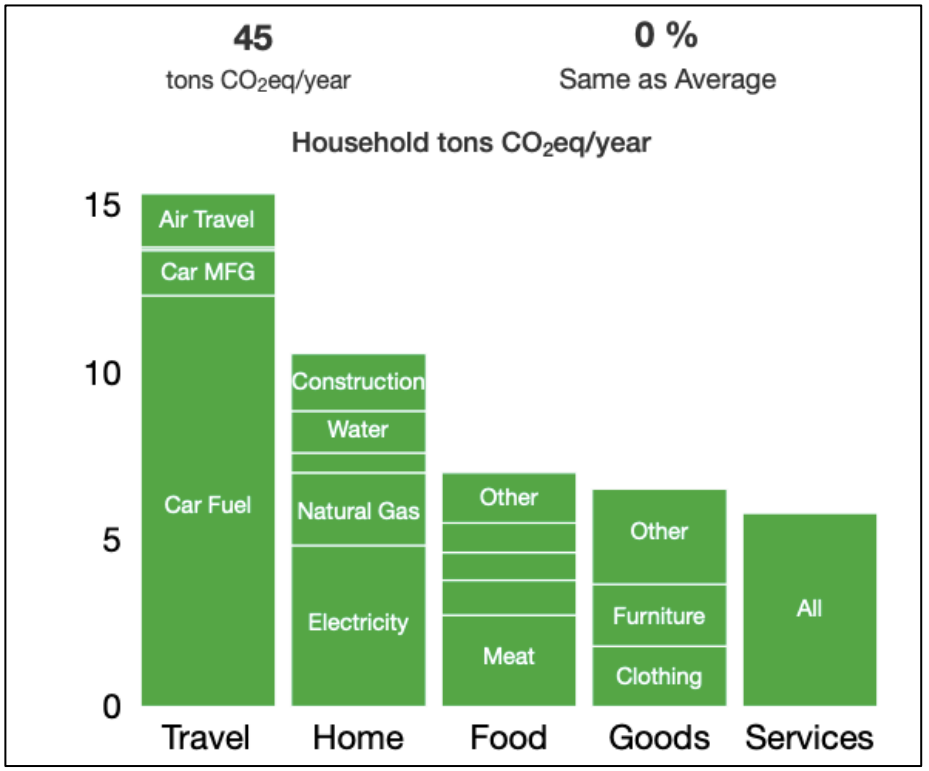
- It's too late for incremental changes
- Clean tech cost trajectories already making fossil fuels uneconomic in the largest sectors
  - Subsidies critical before the chasm; policies too slow after
- Challenges and opportunities are sector-specific
  - Generation needs mandates and PBR
  - Light-duty EVs need carrots and sticks
  - Medium- and heavy-duty EVs need development
  - Buildings need stricter codes
  - Aircraft, P2G, shipping, cement need RD&D (R&D&deployment)
  - Int'l Maritime Organization: collect fees for industry RD&D
  - Financing opportunities specific to each

The economic layer

- Microeconomic example: average Oregon household
- How to price carbon?
- EV adoption scenarios
- Financing opportunities & examples

Microeconomic example: the average Oregon household

- How much would 45% GHG reduction by 2030 cost?
- The necessary technologies all exist
- We vote for and lock in most of our emissions when we choose our:
  - Housing
  - Transportation



45% by 2030 for average OR household

Example actions*	Before MTCO2e	After MTCO2e	Capital cost (10 yrs)	Savings per year	Payback (years)
Buy one EV (5% vs 6% normal annual replacements)	6.8	0	$0	$2400	
Second vehicle 20% less carbon-intensive (22 mpg)	5.5	4.4	0	0	
100% clean electricity & heating fuels** (5% repl. rate)	7.6	0	buy RE: 0 HP: $2,000	(160) $200	10
Cut 50% of air travel	1.6	0.8	0	180	
Cut 50% servings of meat/fish/eggs	2.8	1.4	0	0	
15% fewer goods & services, 15% less embodied GHG	12.3	8.6	0	460	
(other consumption)	8.6	8.6			
Totals	**45.2**	**23.8**	**$2,000**	**$3,080**	**<1**
X 1.6 million OR households	**72 M**	**38 M**	**$3.2 B**	**$4.9 B**	**<1**

* Scope 3

** Insufficient RNG capacity

Sources: Coolclimate calculator; BER; 2019 costs

Microeconomic example: the average Oregon household

- ~~How much would 45% GHG reduction by 2030 cost?~~

- How much would 45% GHG reduction by 2030 SAVE?

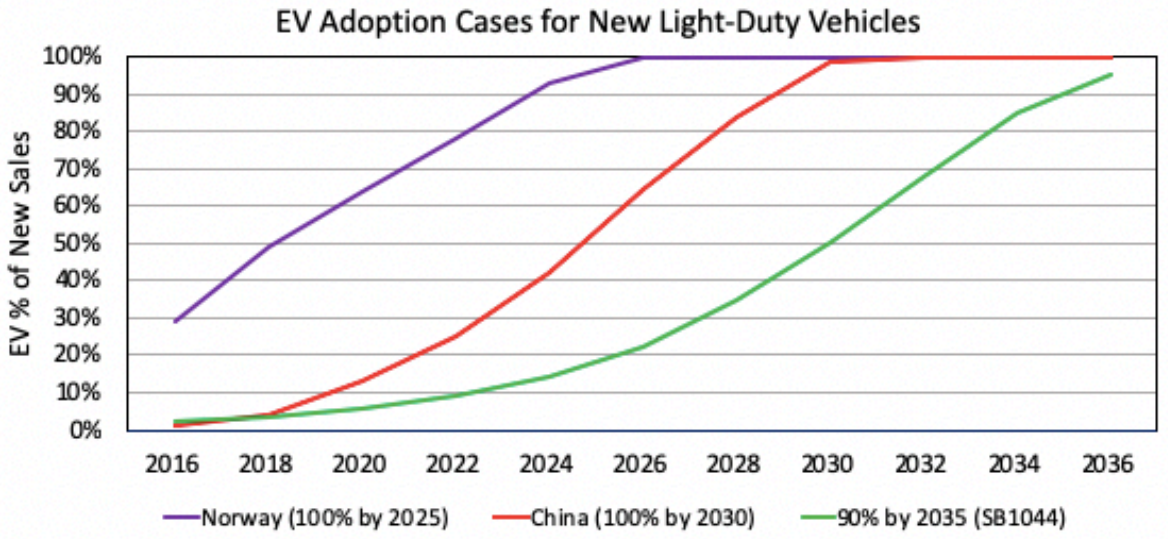
How to price carbon?

- It's too late for incremental policies
- We must install new infrastructure

	Fee and dividend	Revenue-neutral tax	Tax and invest	Cap & invest	Lifetime emission fee
What is taxed?	Fuel sectors ~$20/ton	Fuel sectors ~$20/ton	Fuel sectors ~$20/ton	Fuel sectors ~$20/ton	New infrastructure ~$100/ton
Stable price?	YES (too low)	YES (too low)	YES (too low)	NO (& too low)	YES
How is revenue spent?	Give it back	Offset other taxes	Invest in projects	Invest in projects	Doesn't matter
Does it steer spending?	NO	NO	Only the revenue spent	Only the revenue spent	YES
Does it work?	Untested	NO (BC)	Untested (i1631)	Inefficient (CA, RGGI)	YES (Norway)

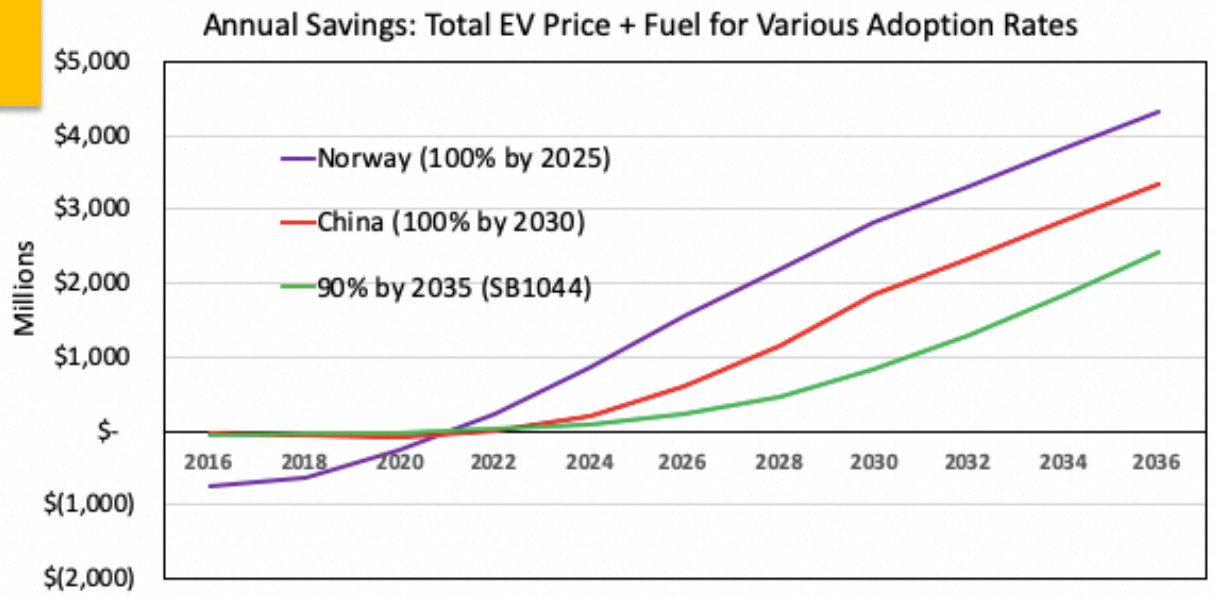
EV adoption scenarios for Oregon

- Norway has about the same population, average income, and vehicle sales as Oregon



- The faster we adopt, the more we save

- OR CFP similar to China line through 2025, then less



Source: Strid Energy Report Nov 2019

Financing opportunities & examples

- PACE programs
- State or US green bank/revolving loan funds
- Transit bus battery financed by utility
- More innovation needed for EVs, other

Funding and financing options for EV buses

Instrument	Sustainable	Scalable	Customer Balance Sheet Treatment
Taxpayer funding			
Polluter funding (carbon price)			
Ratepayer funding (rebates)			
Debt financing (bonds)			Balance sheet liability
Lease financing			Balance sheet liability
Utility tariffed on-bill investment			

Highly sought grants

Financing

Source: Holmes Hummel

The policy layer

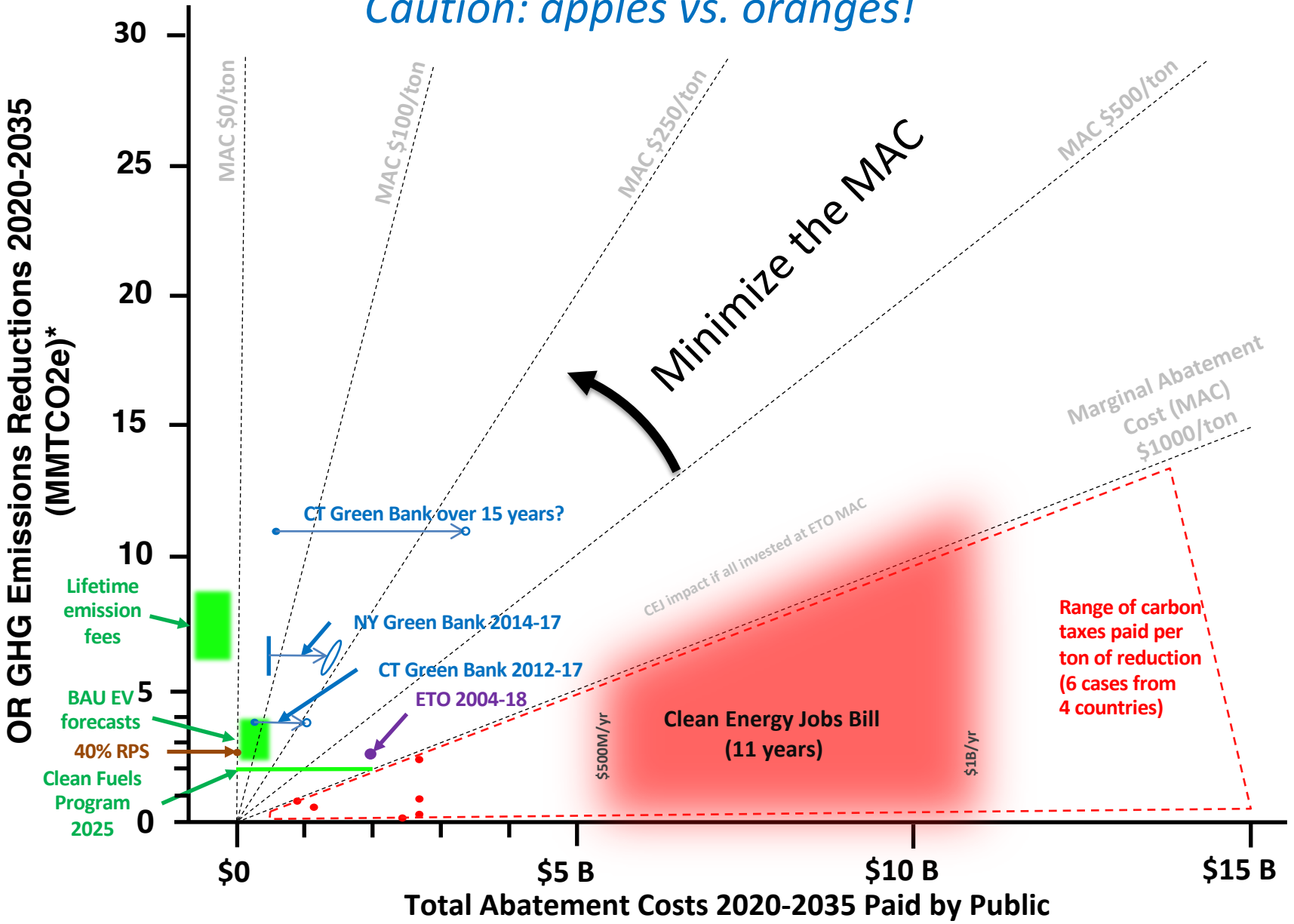
- Types of policies
  - Mandates—e.g., Clean Air Act, Clean Water Act, ban on fracking
  - Regulation—OPUC, RPS enabled by clean tech
  - Carrots are expensive
  - Sticks are unpopular
  - Financing can make money while leveraging private money
- States must navigate around federal policies
  - Electricity: FERC authorities
  - Vehicles: Clean Air Act allows only CA to require alternate vehicle performance--if EPA grants it
- Oregon lacks a comprehensive, long-term plan
  - EO 20-04 requires planning by agencies
  - Target a draft plan and superior policies for 2021 session

Policy examples address physical needs

Sector	MMTCO2e	Needs	New policies
Transportation	**23.3**		Lifetime emission fee on new LDVs in classes with 2 ZEV models. Fees pay for chargers and rebates.
Gasoline (LDVs)	12.1	Deploy ZEVs	
Diesel (MDV/HDV)	6.7	Develop ZEVs	Electric utilities finance EVs & EVSE.
Aviation	1.8	Research fuels	Fees/organize this sector for RD&D.
Residual (shipping)	0.7	Research fuels	Fees for RD&D performed by sector.
Electricity use	**20.3**	Deploy wind and solar farms. Develop seasonal storage.	Utilities finance EVs & EVSE. Fund early FF retirements with EV load growth. Subsidize seasonal storage. PBR targets to deploy new tech.
Residential	8.3		
Commercial	6.8		
Industrial	5.2		
Natural gas use	**7.8**	Develop power to gas and seasonal storage.	No new hookups until utility is on IPCC 2030 GHG trajectory. Subsidize RNG & H_2 delivered. PBR targets to deploy new tech.
Residential	2.6		
Commercial	1.7		
Industrial	3.5		

Mapping Benefits vs. Costs

Caution: apples vs. oranges!



* 2015 total OR emissions were 65 MMTCO2e