How to Decarbonize Oregon's Energy

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Columbia Gorge Climate Action Network

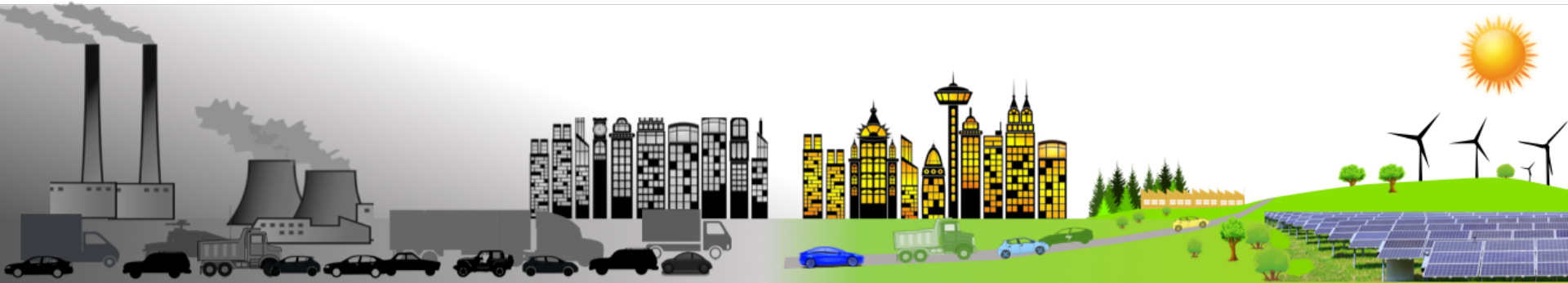
Webinar April 7, 2020; recording link

Motivations

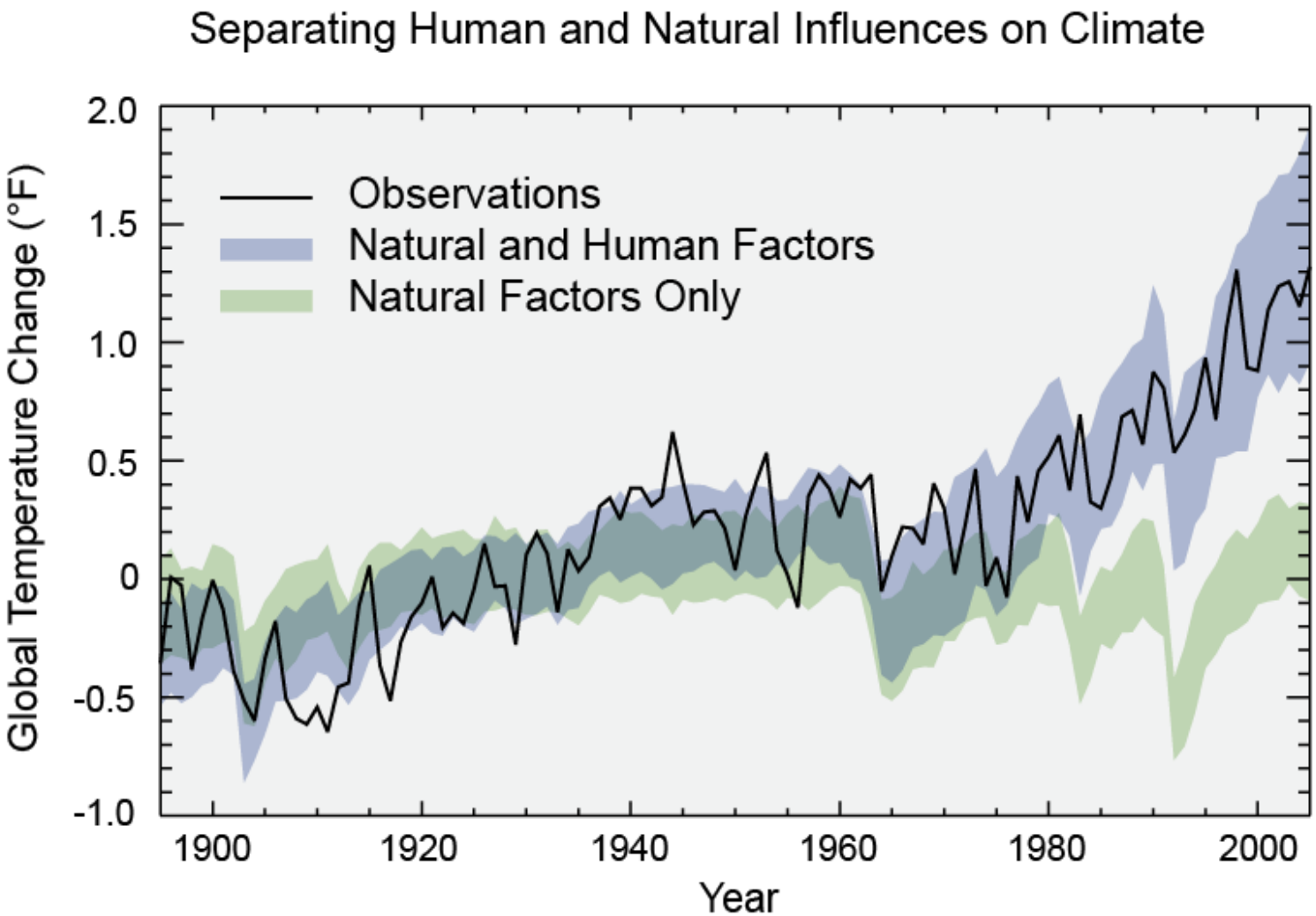
Solving the physical layer

Relevant economics

Policies that work



Climate data has been clear for decades



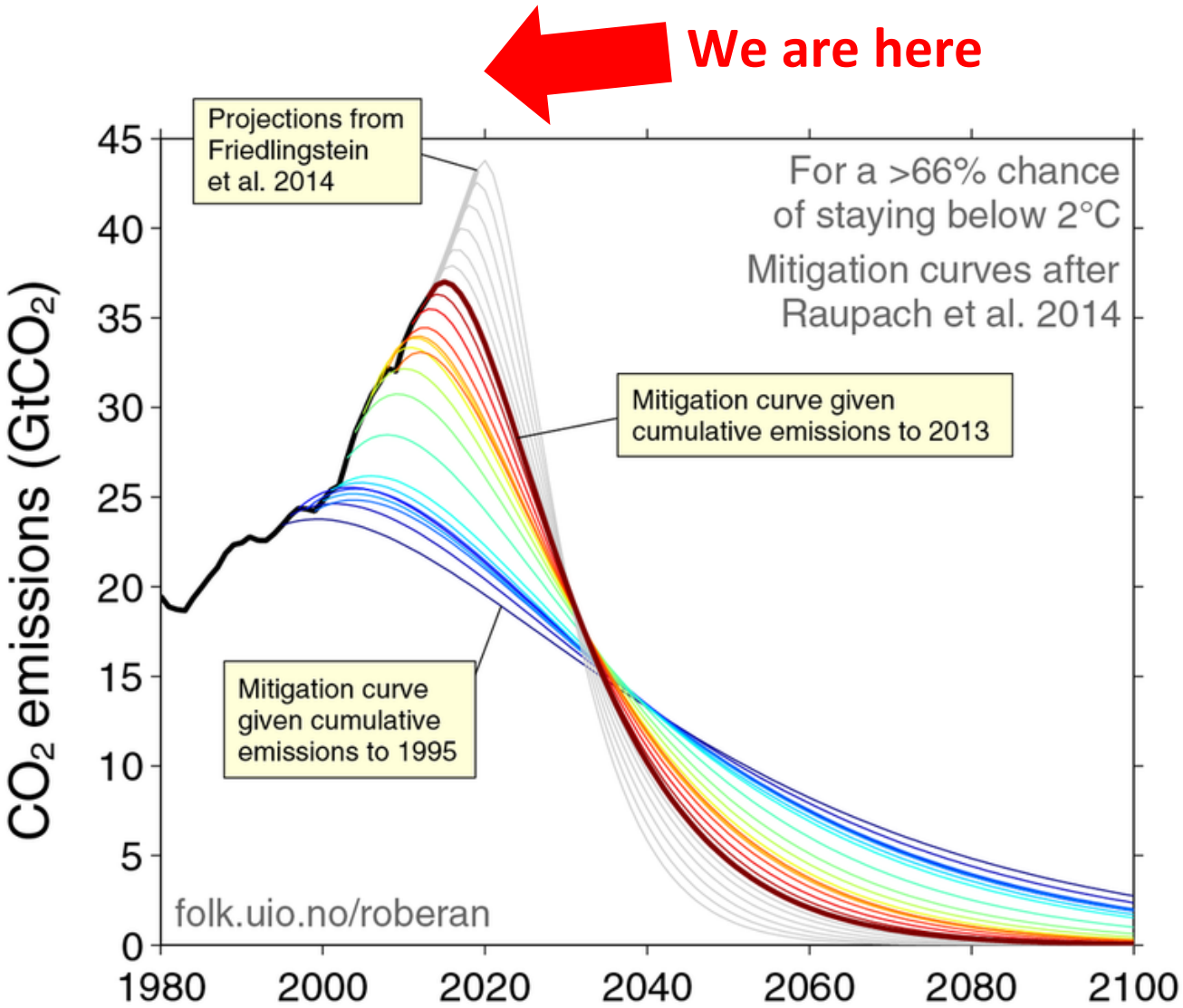
1982: Exxon predicted today's CO_2 levels and warming
2018: Five oil majors agree with climate scientists in court

Introduction: why I pursue this

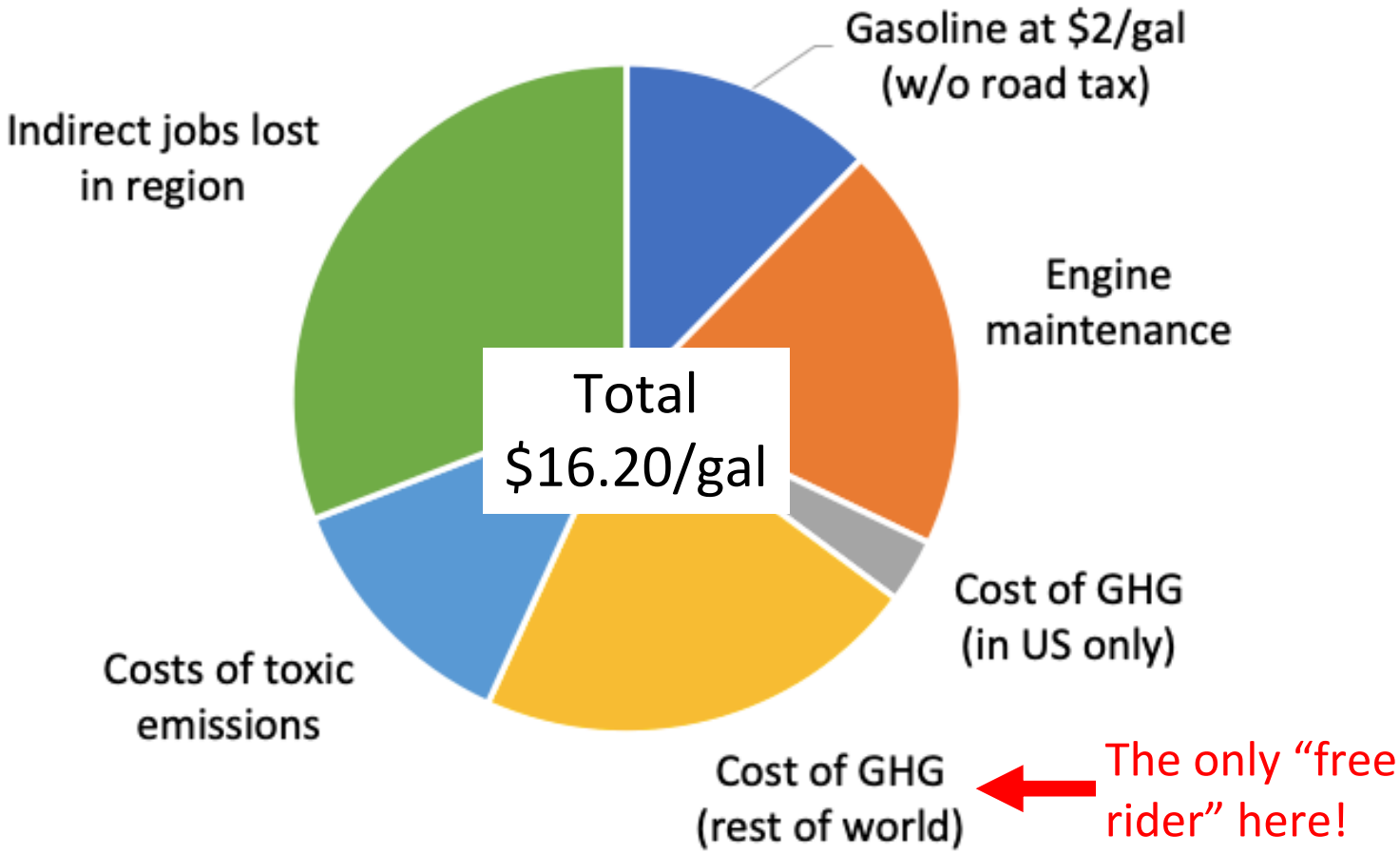
We do not:

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

No time left for incremental policies



Fossil fuel cost example: gasoline in OR



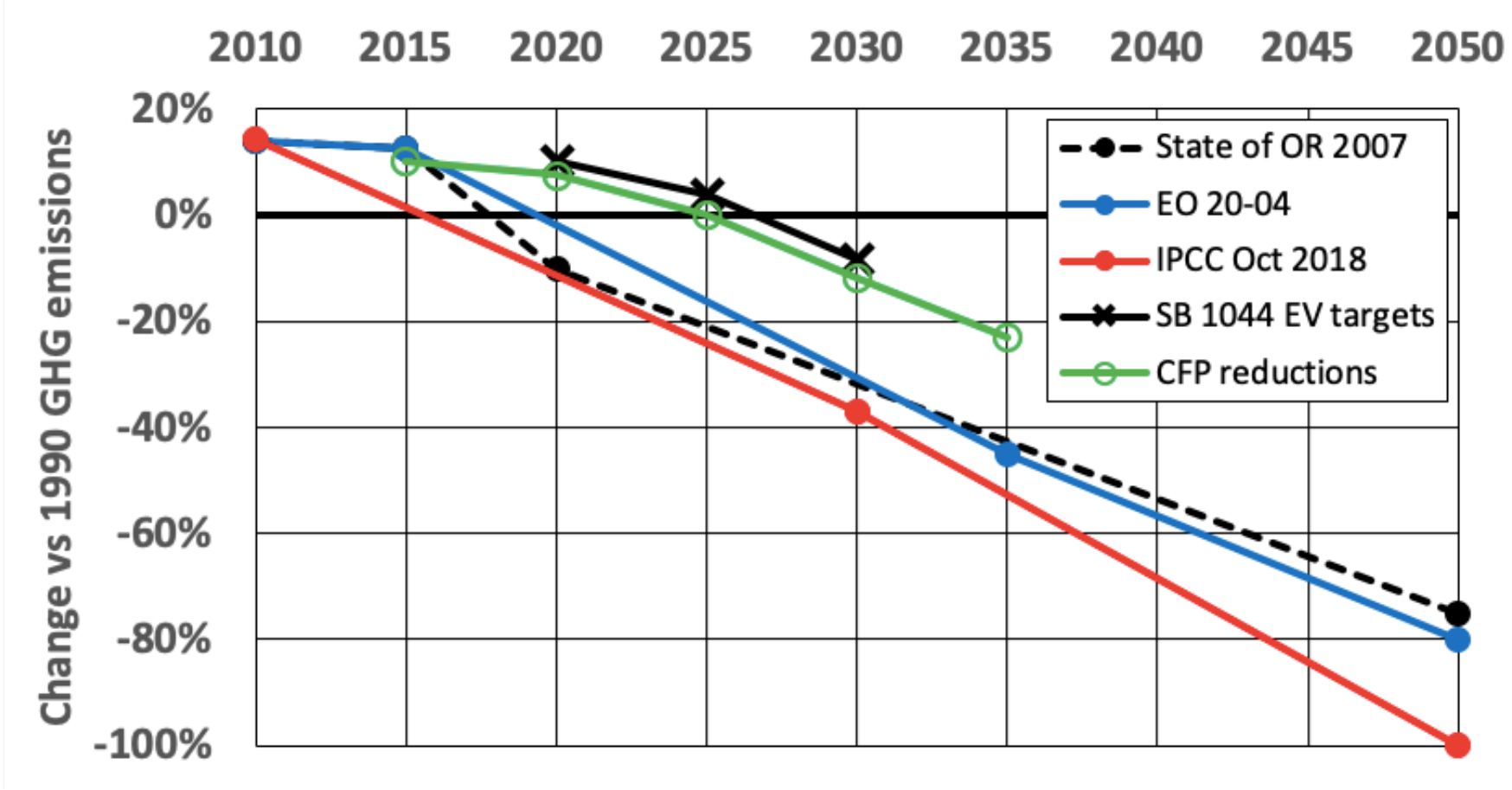
- EV equivalent: fuel ~$1/gal + maintenance ~$0.20/gal
- No need to hype the dangers of a gas we exhale…

Sources: Engine maintenance, GHG, toxics, indirect jobs

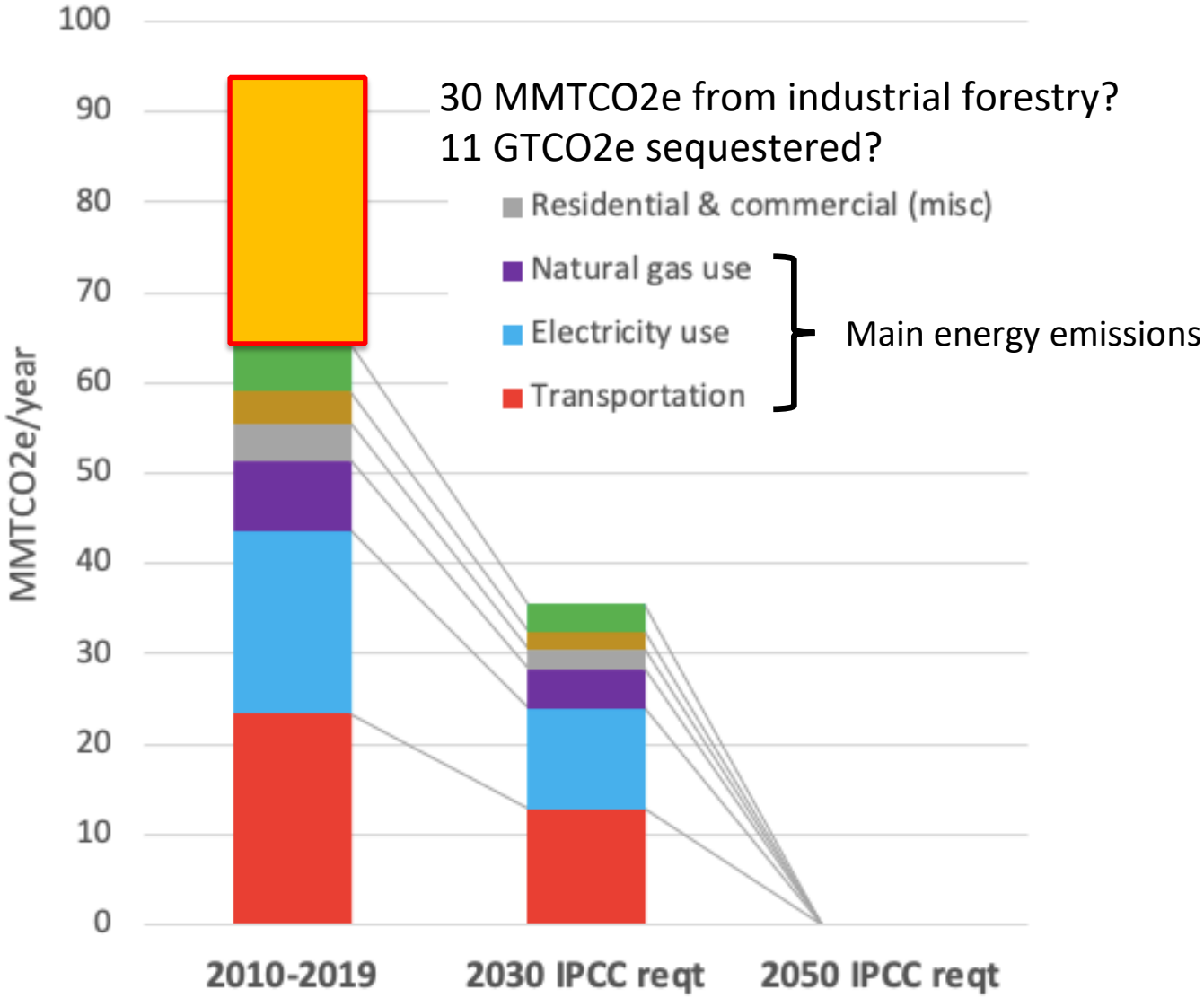
Status and Aspirational Goals

Recent EO 20-04

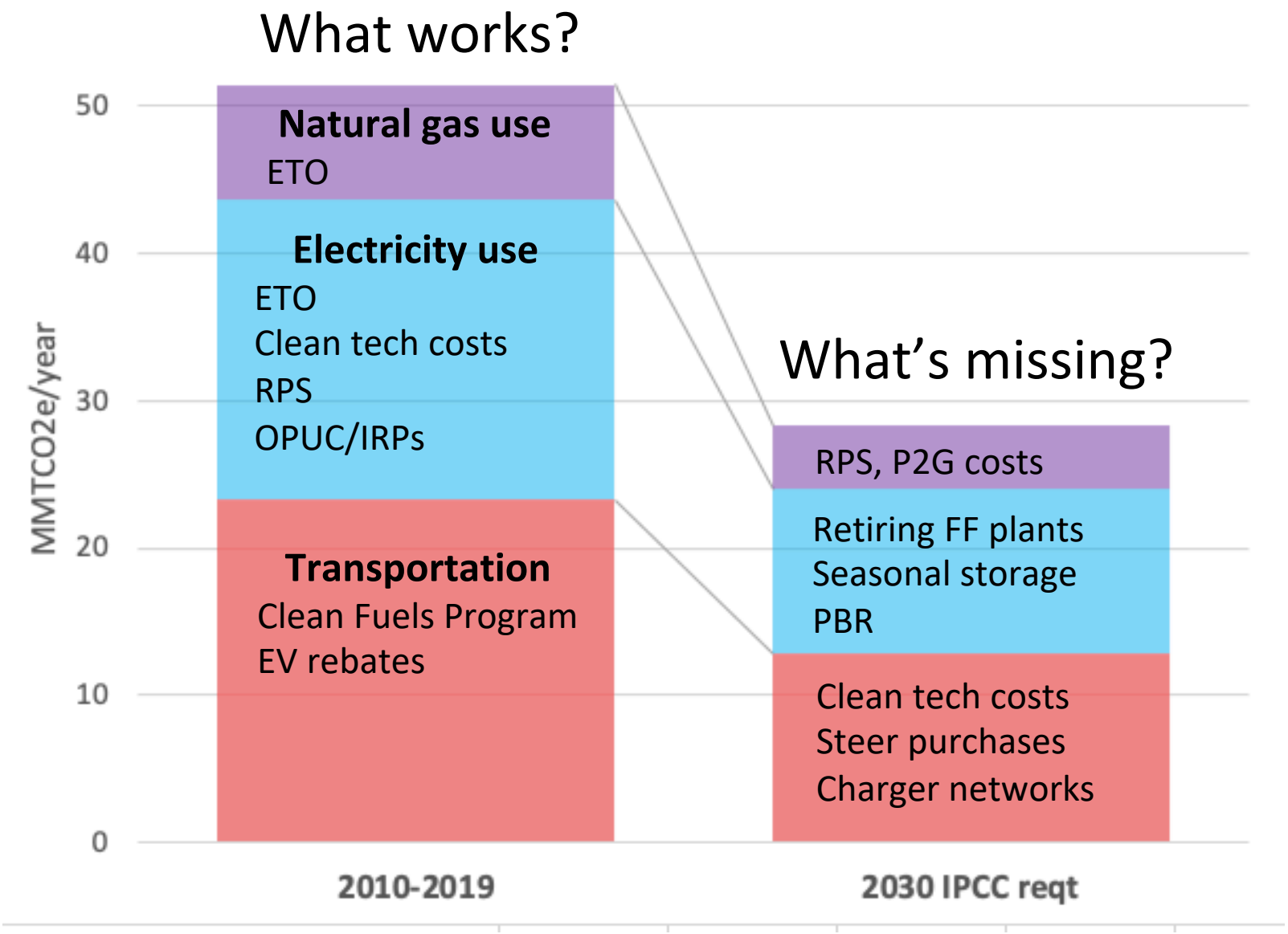
- Extends CFP to 2030 and 2035; avoids market-based policies
- Directs agencies to create sectoral plans for 2035



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

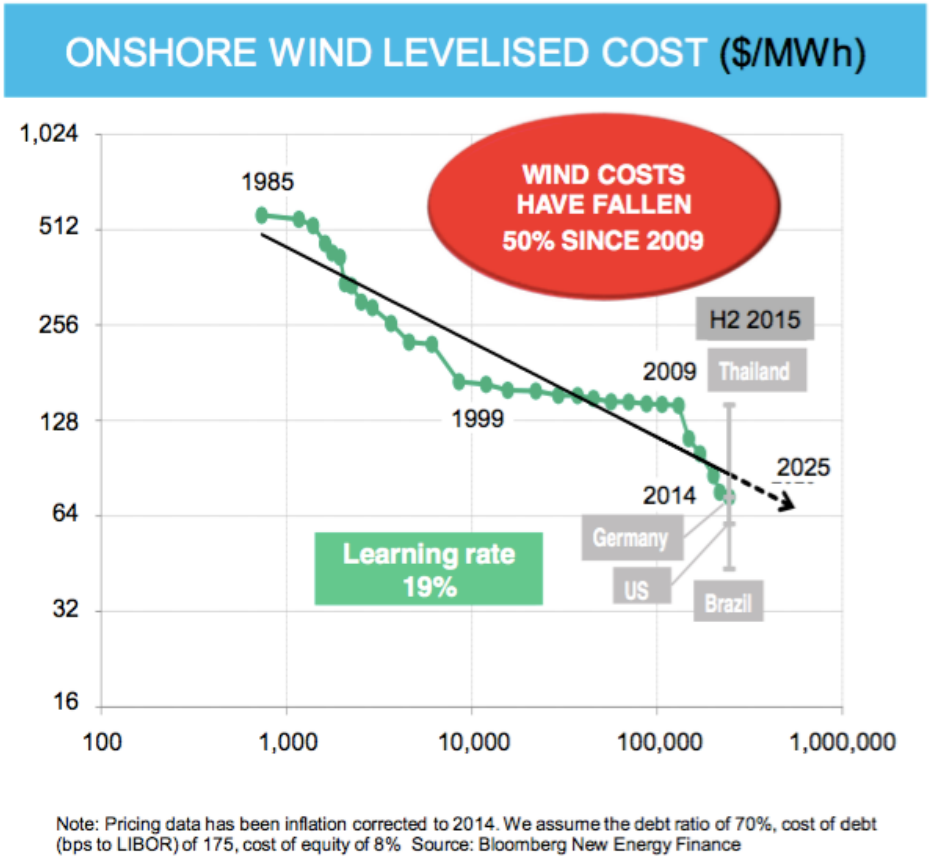
Solutions must work for every layer

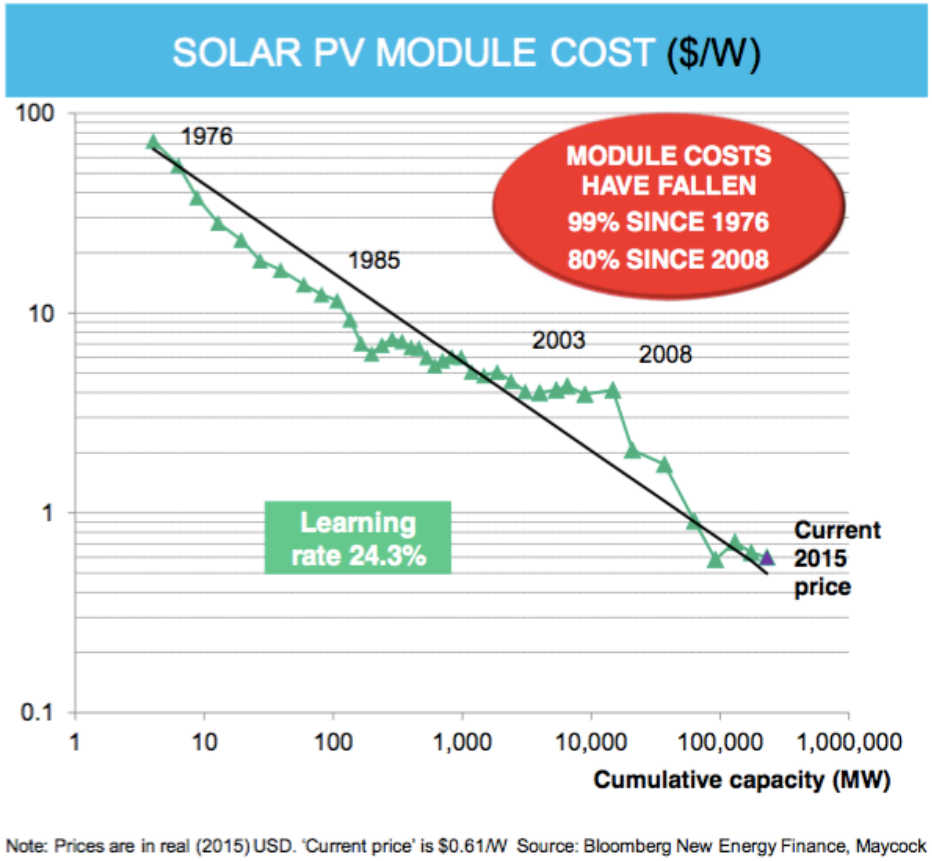
The physical layer

Sector	MMTCO2e	Needs
Transportation	**23.3**	
Gasoline (LDVs)	12.1	Deploy ZEVs
Diesel (MDV/HDV)	6.7	Develop ZEVs
Aviation	1.8	Research fuels
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

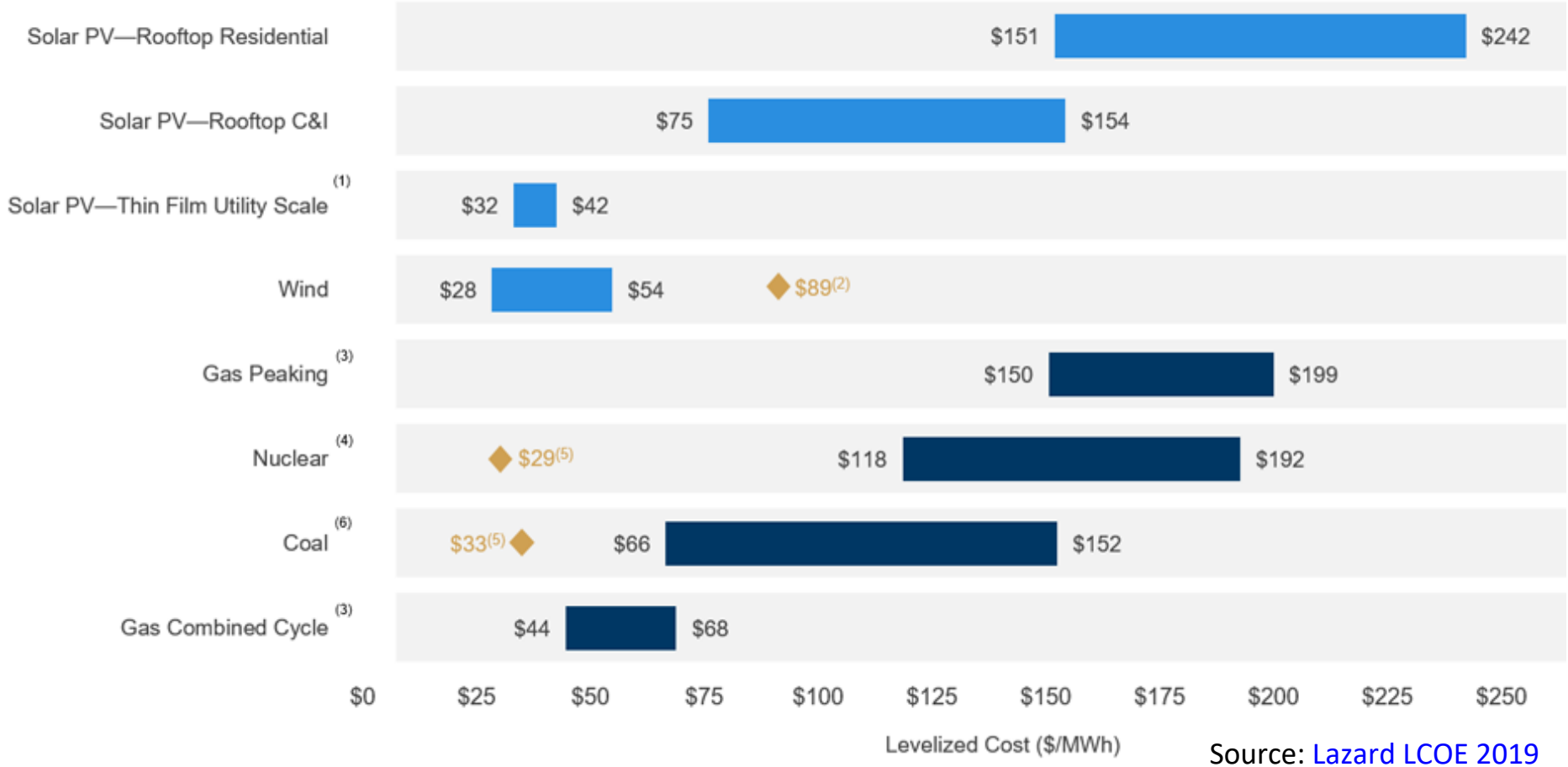
Clean energy "breakthroughs" are all production learning rates





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

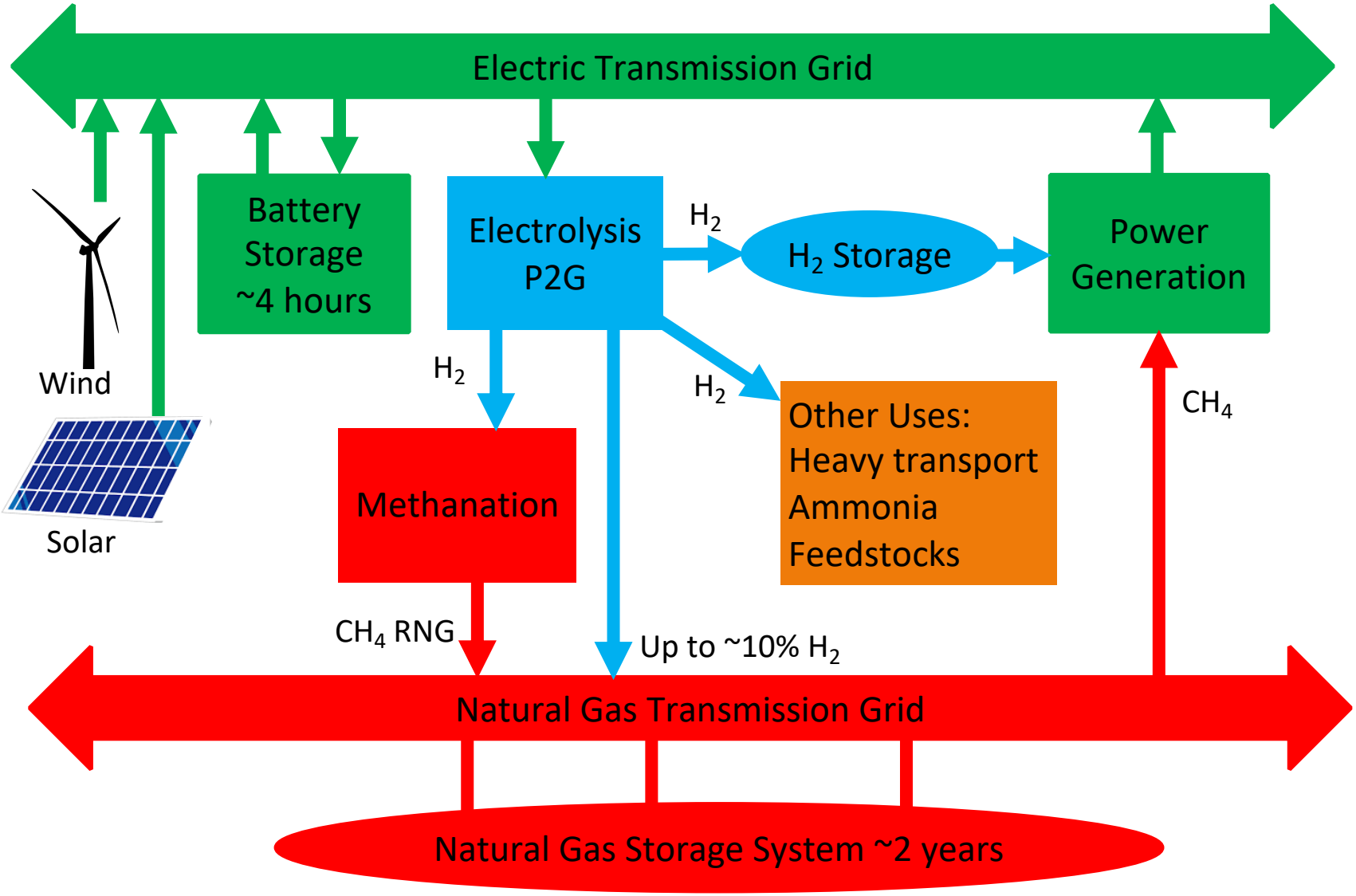
Levelized Cost of Energy ($/MWh)



Source: [Lazard LCOE 2019]

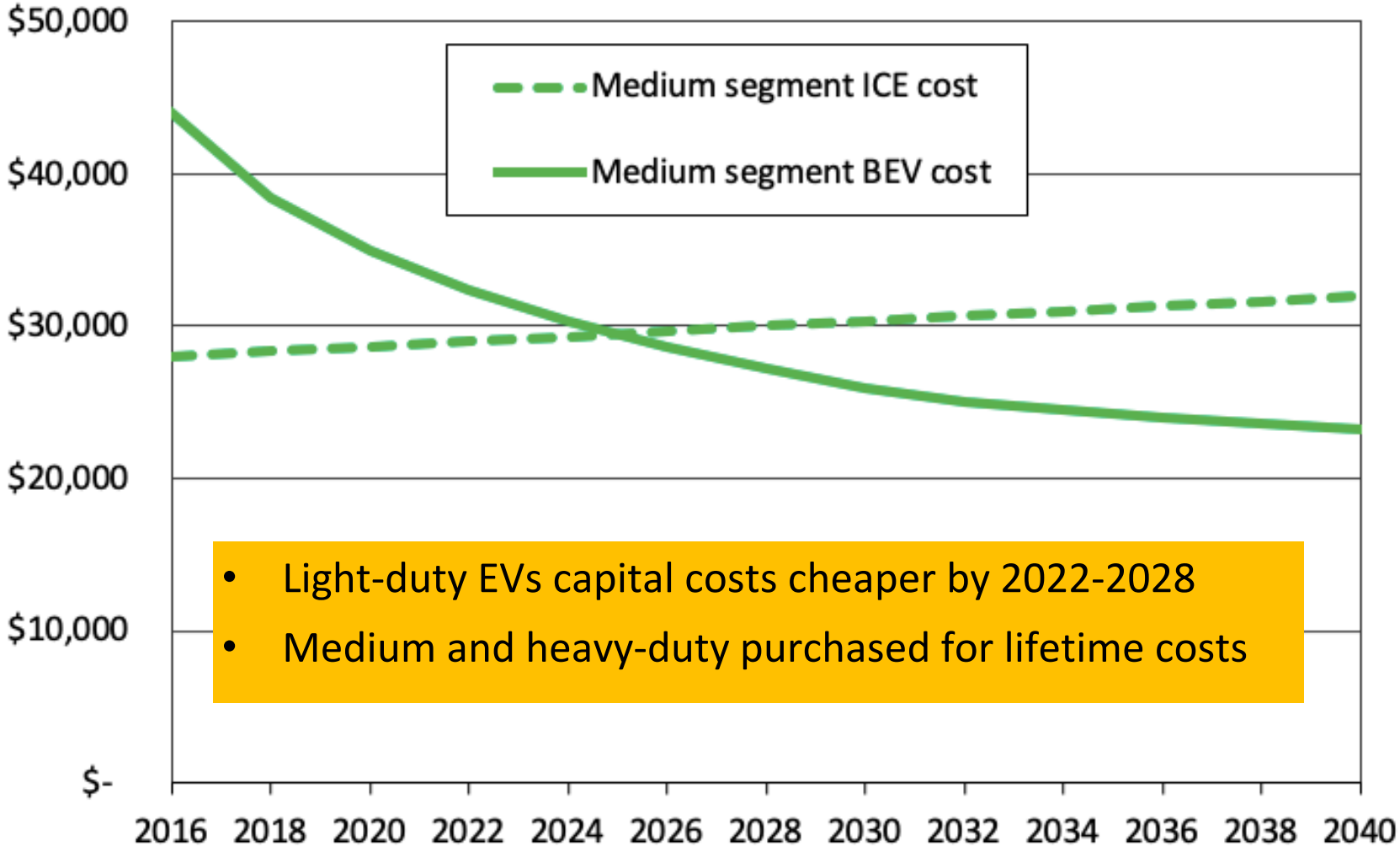
- Unsubsidized, global averages in 2019
- Cheaper to build and operate wind or solar farm than to operate a coal plant
- Wind, solar, and storage will continue to disrupt

Need: two months of seasonal storage



Renewable H2 Alliance

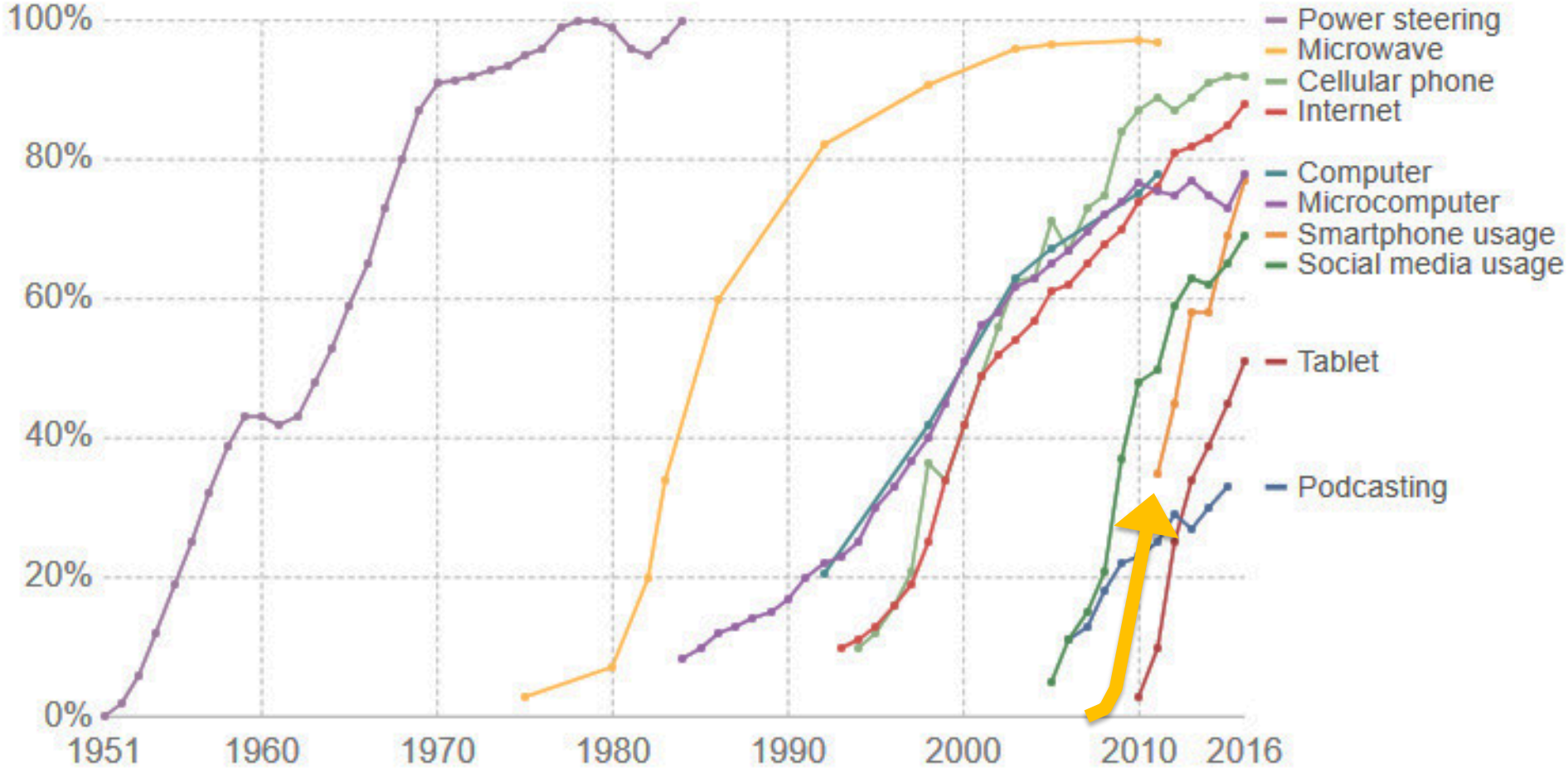
EV capital costs



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

Source: BNEF

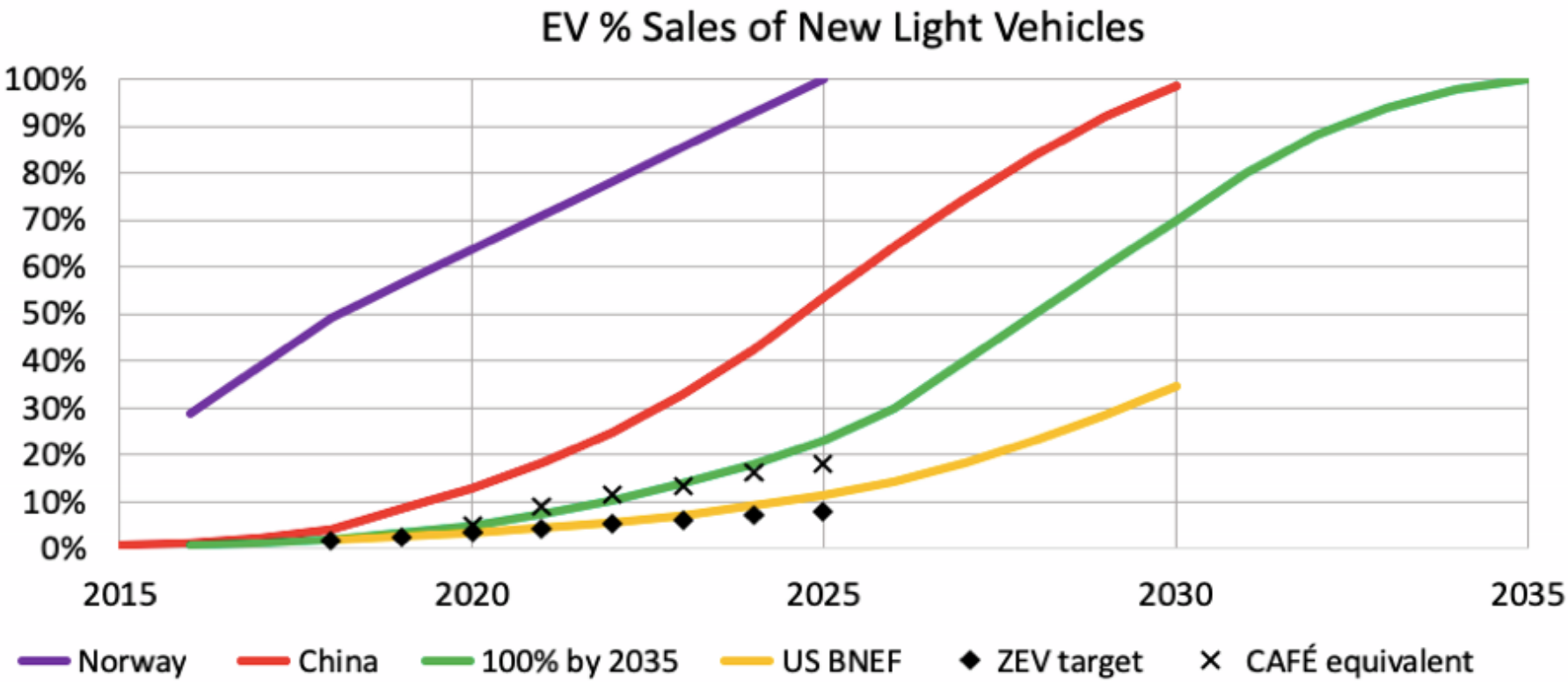
Examples of technology disruptions



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

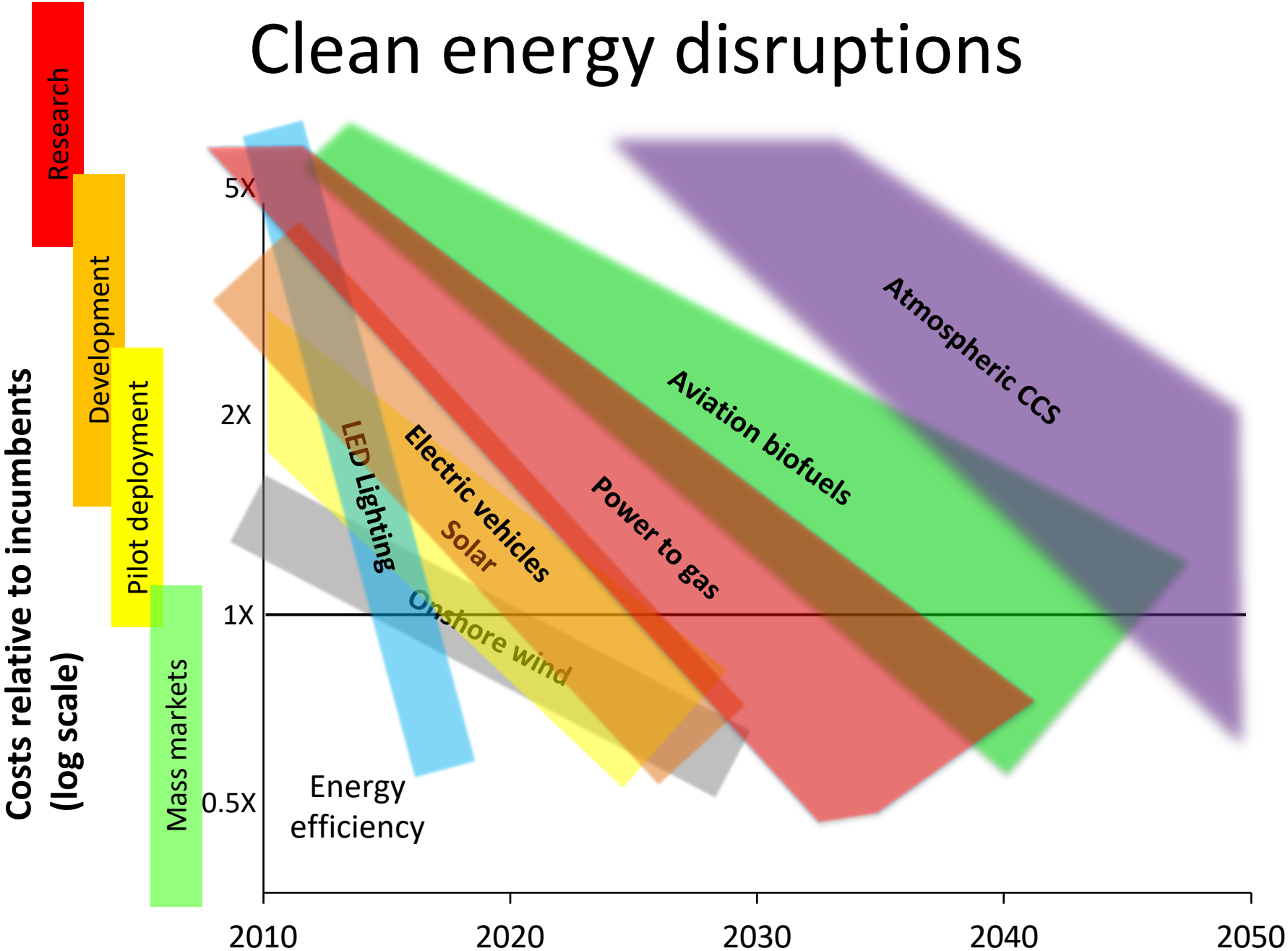
EV forecasts

- 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

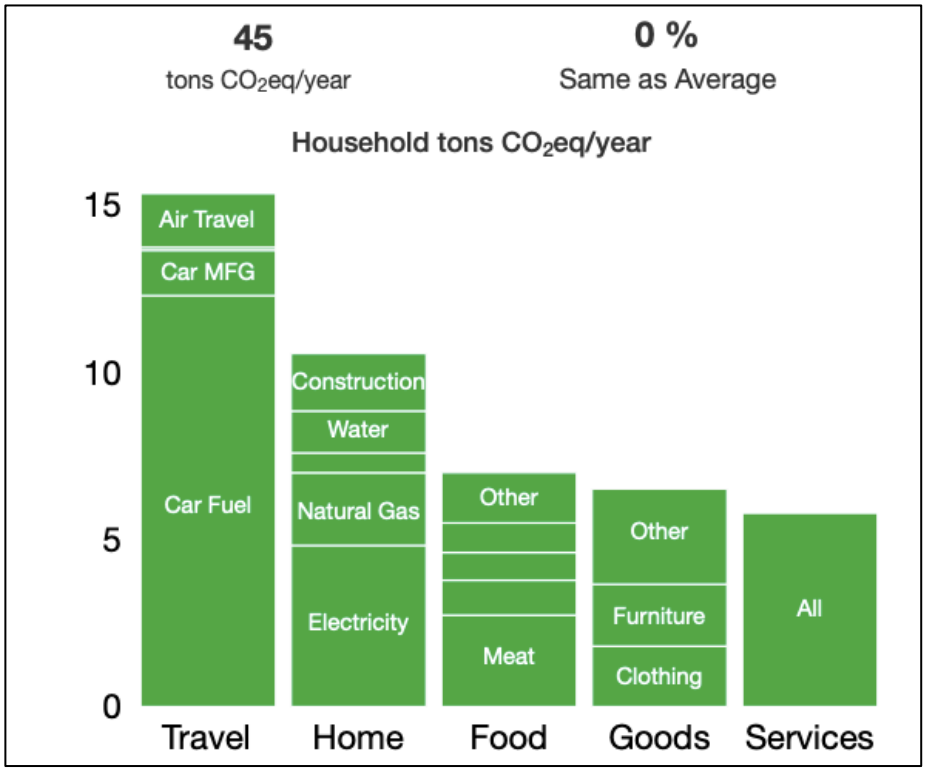
- It's too late for incremental changes
- Clean tech cost trajectories already making fossil fuels uneconomic in the largest sectors
  - Subsidies critical before the chasm; policies too slow after
- Challenges and opportunities are sector-specific
  - Generation needs mandates and PBR
  - Light-duty 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?

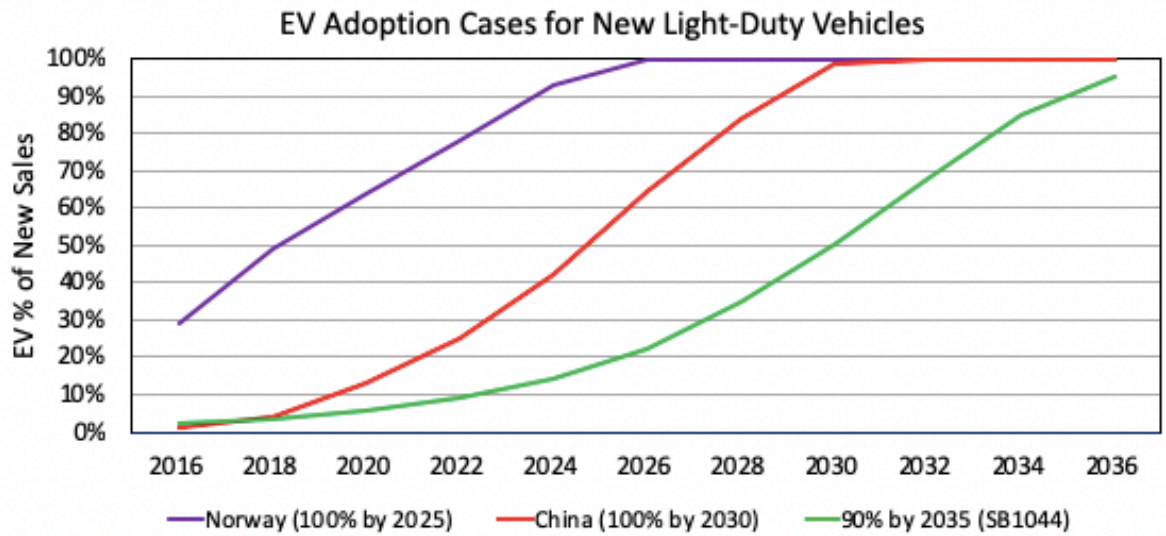
How to price carbon?

- 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)

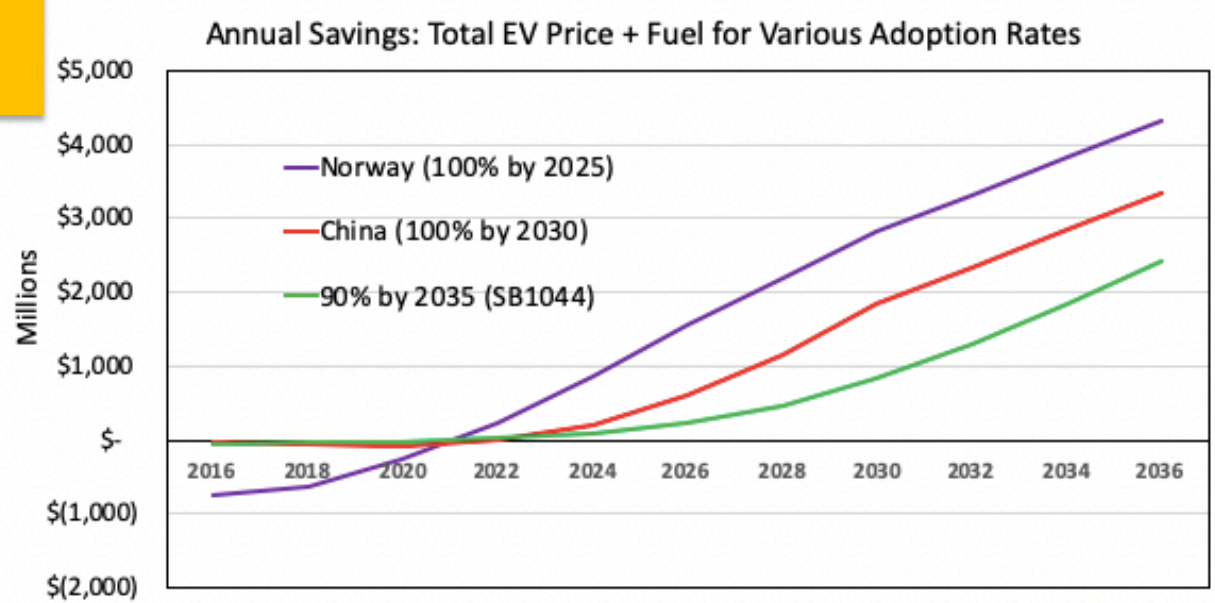
EV adoption scenarios for Oregon

- 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

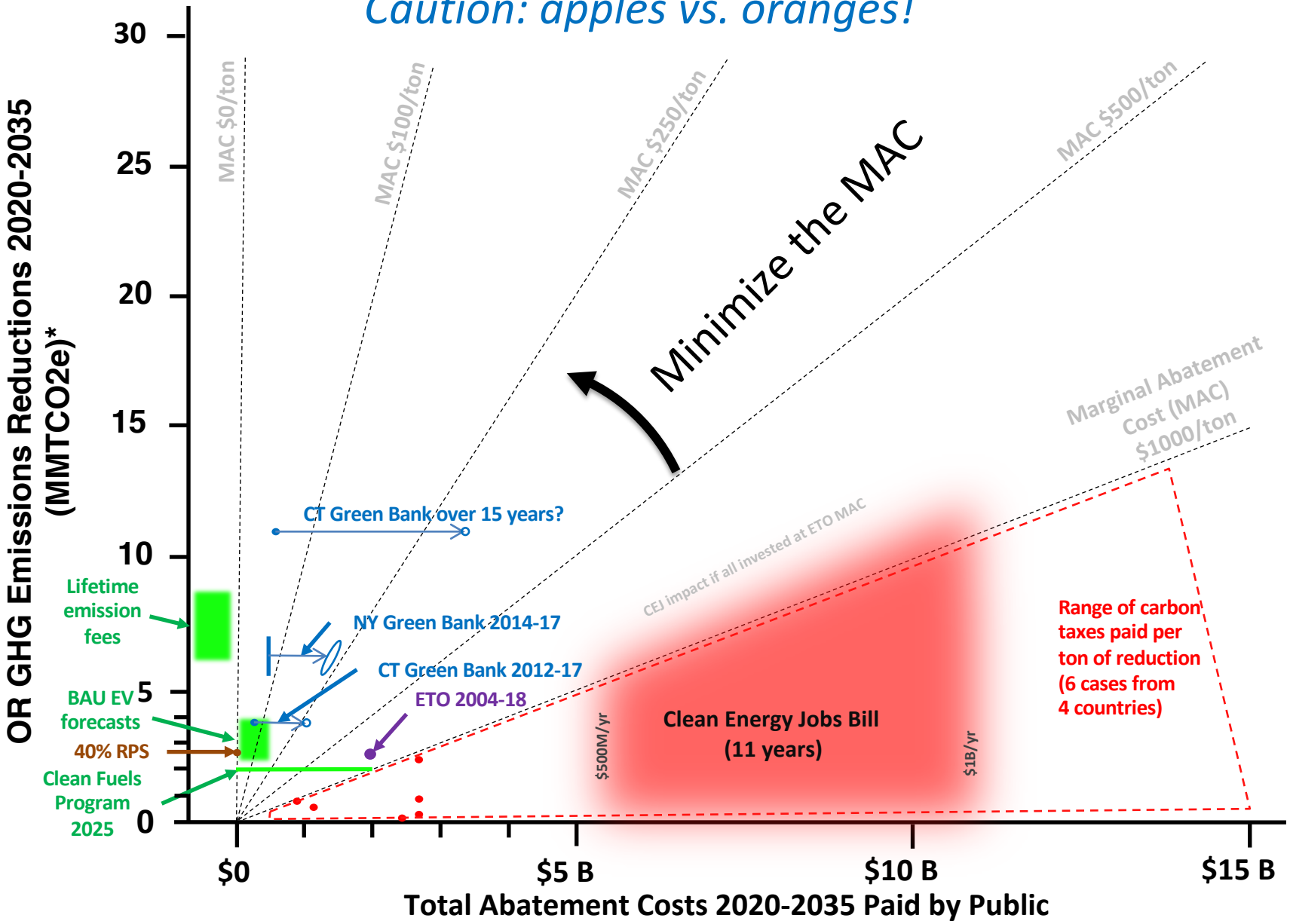
- Types of policies
  - Mandates—e.g., Clean Air Act, Clean Water Act, ban on fracking
  - Regulation—OPUC, RPS enabled by clean tech
  - Carrots are expensive
  - Sticks are unpopular
  - Financing can make money while leveraging private money
- States must navigate around federal policies
  - Electricity: 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!

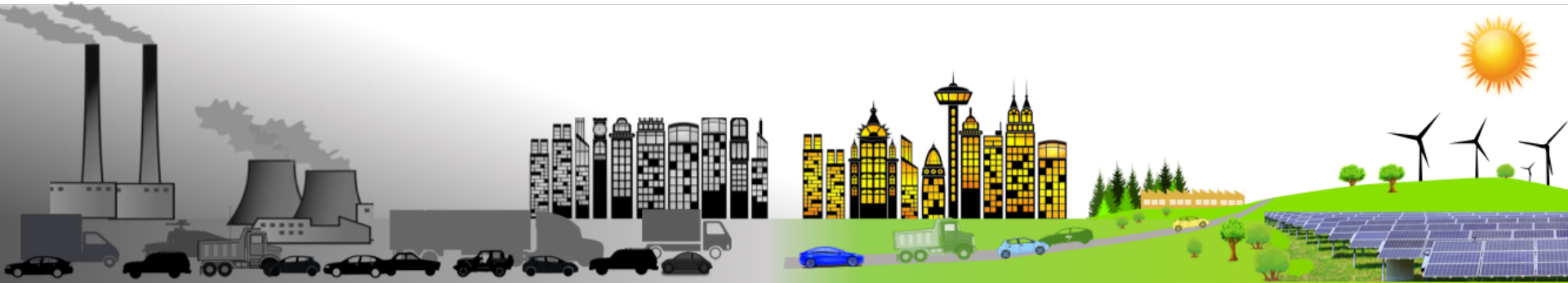


* 2015 total OR emissions were 65 MMTCO2e

Summary

1. Pursue the necessary decarbonization targets.
2. Leverage the clean-energy transition
3. Objectively and quantitatively analyze options
4. Plan comprehensively through 2030 and 2050
5. Demand effective and efficient climate policies

We can do this.



Climate change and COVID-19

- Society will change, but how and how much?
  - Trust science more?
  - Distracted with rebuilding the economy?
  - Desire to rebuild with more sustainability/resilience?
- Business-as-usual changes in deployments, etc.
- Mostly speculation at this point…