



The Impact of Carbon Pricing

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“Since the dawn of the industrial revolution, the atmosphere has served as a free dumping ground for carbon gases. If people and industries are made to pay heavily for the privilege, they will inevitably be driven to develop cleaner fuels, cars and factories. Most of the industrialized world has accepted the need for either carbon taxes or strict regulation.”

3 Nov 2006, New York Times editorial

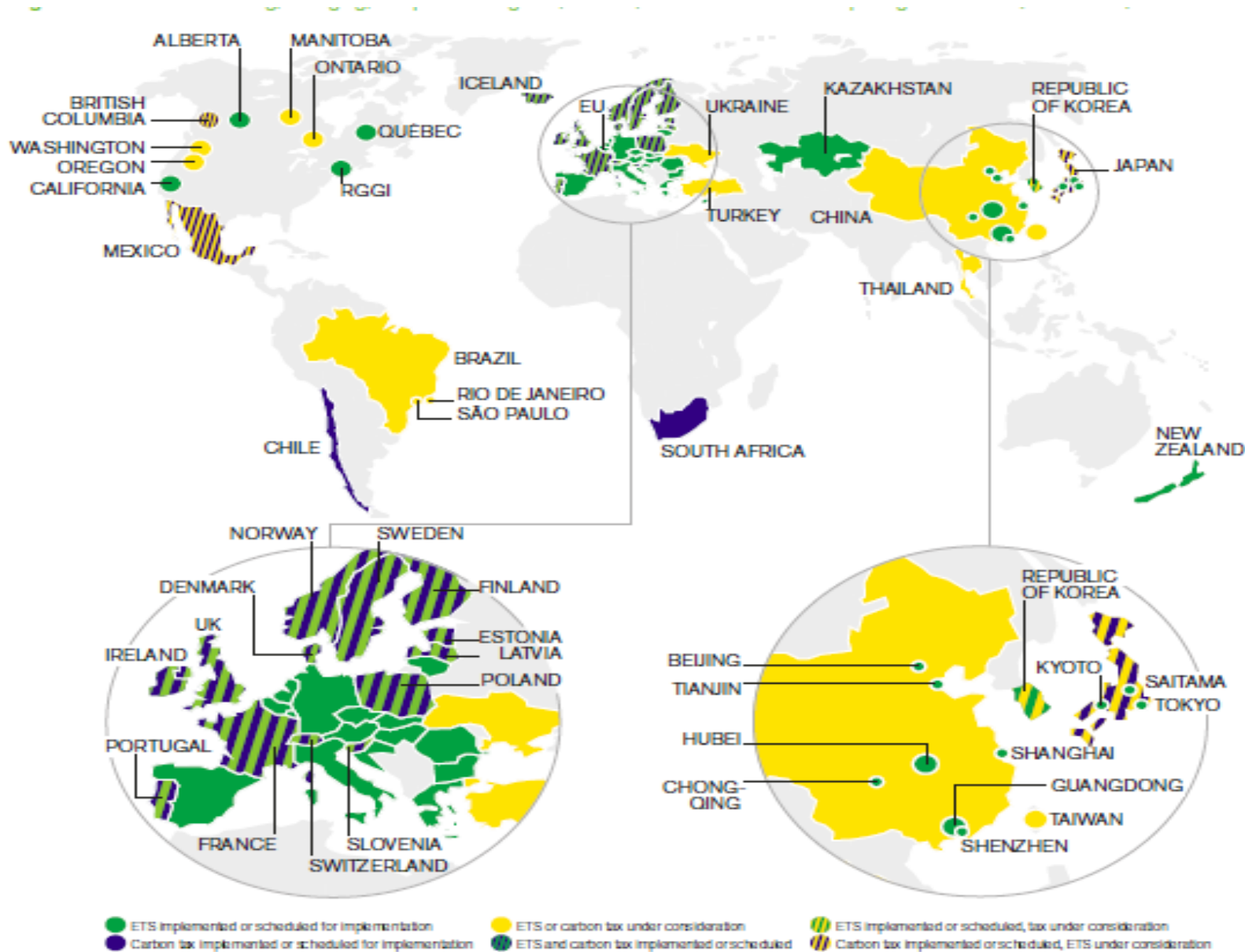
“Nuclear will make the difference between the world missing crucial climate targets or achieving them.”

“The future of our planet and our descendants depends on basing decisions on facts, and letting go of long-held biases when it comes to nuclear power.”

3 Dec 2015, The Guardian, James Hansen, Kerry Emanuel, Ken Caldeira and Tom Wigley

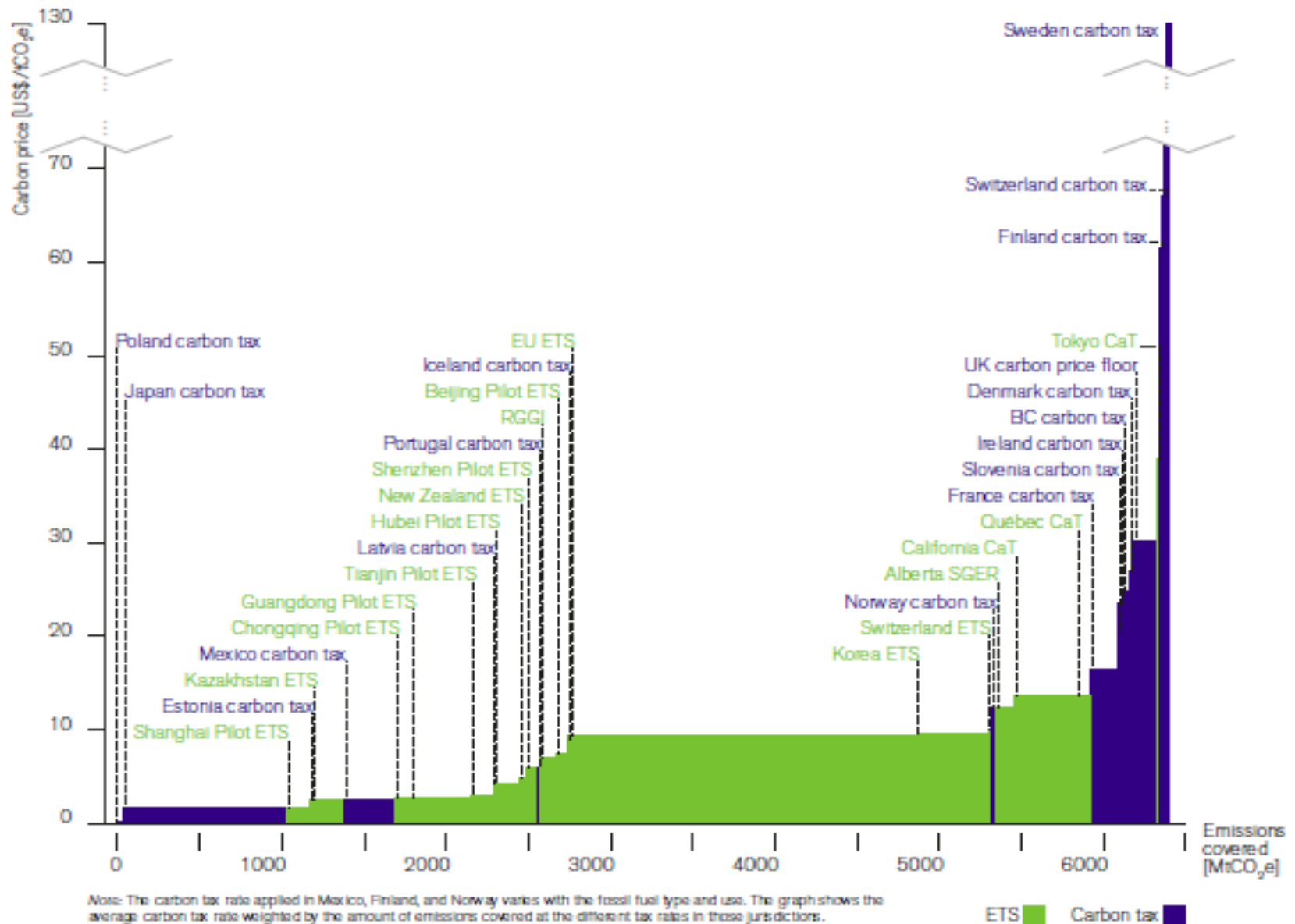
State and Trends of Carbon Pricing

(World Bank 2015)



State and Trends of Carbon Pricing

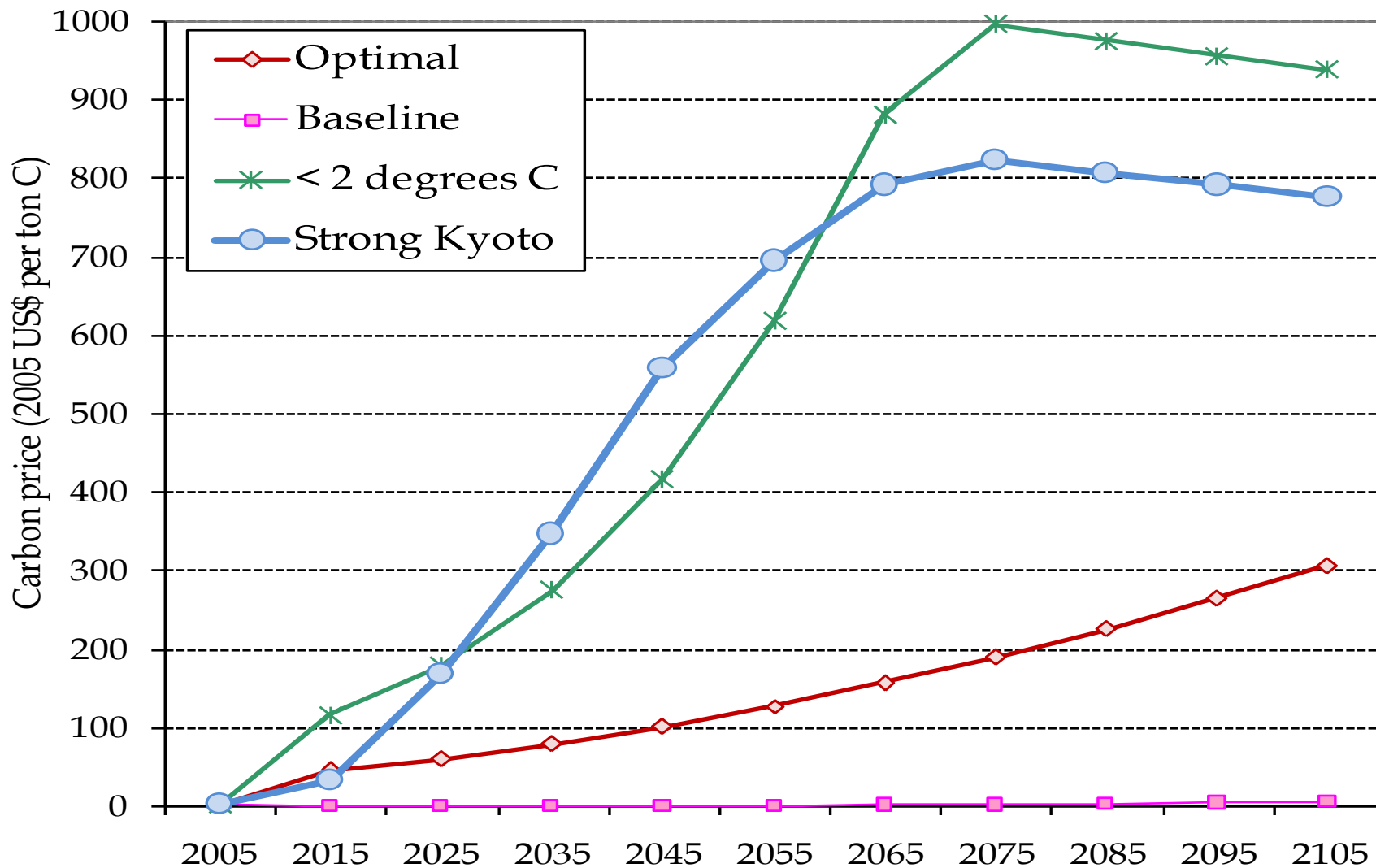
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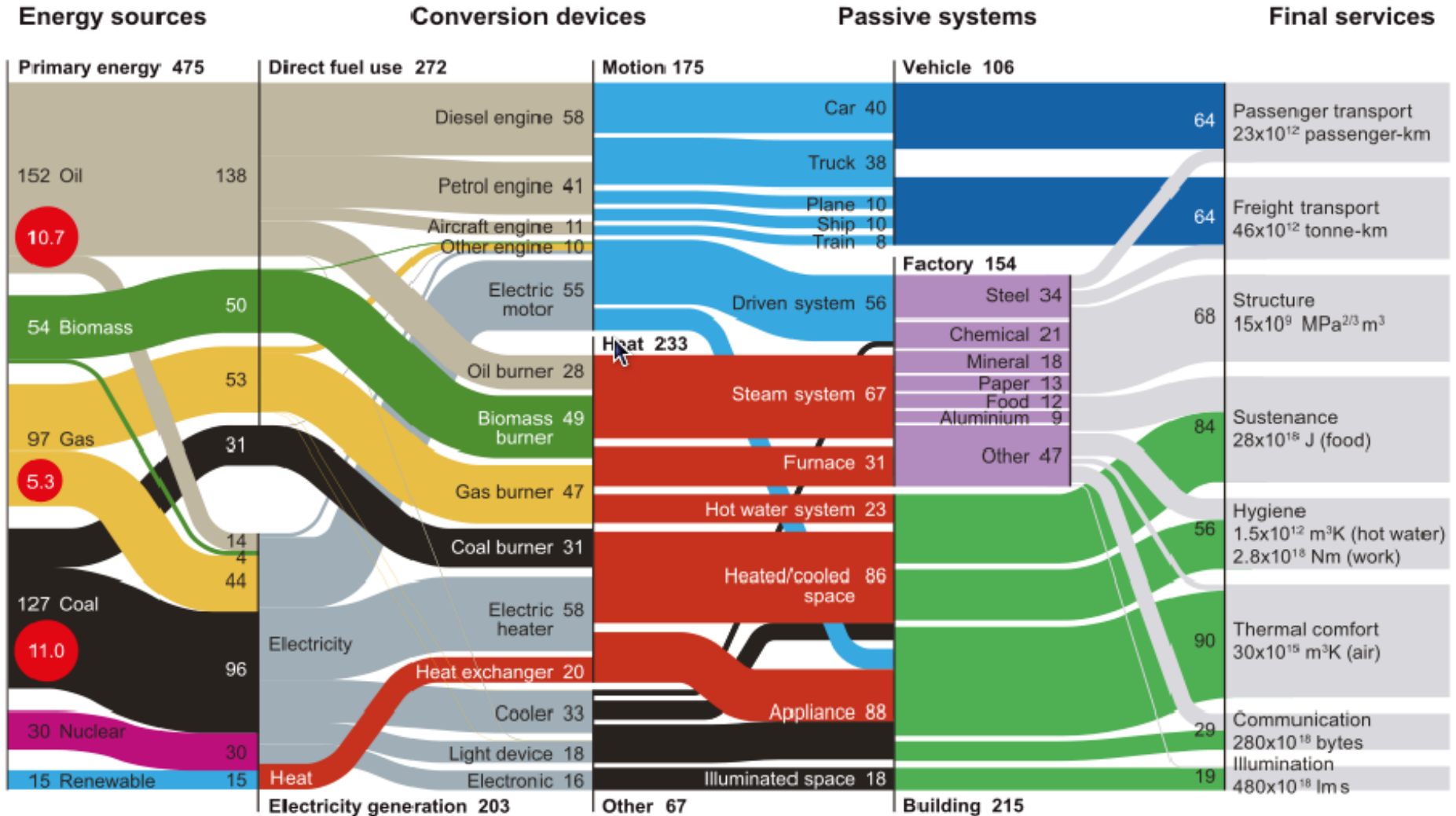
Price & mechanism	Emissions included	Use of revenue
Cap & Trade Carbon Tax	Electricity Transportation Industrial Commercial Residential Other	What revenue? Government use or revenue neutral?

	Cap & Trade	Carbon Tax
Emission level	Declining cap	<i>Market responds with lower emissions</i>
Carbon price	<i>Market responds with increasing price</i>	Increasing carbon tax

Social cost of global warming?



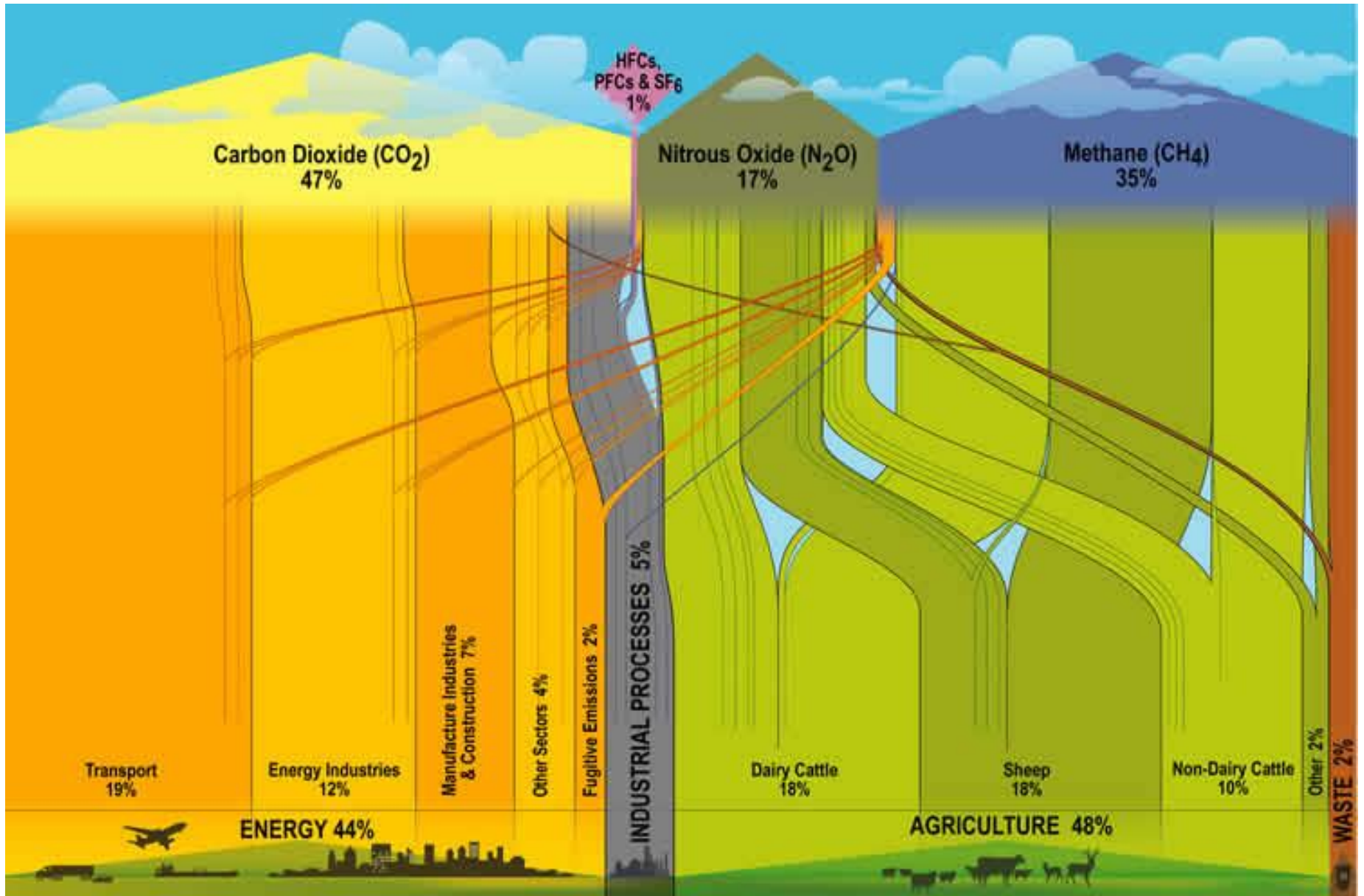
Emissions



Annual global flow of energy in 2005, EJ [10¹⁸ joules]

Annual global direct carbon emissions in 2005, Gt CO₂ [10⁹ tonnes of CO₂]

Emissions



- Carbon tax charged at origin for all greenhouse gas emitting energy fuels (e.g., oil, gas, coal)
- Carbon tax increases over time
- Revenue is returned to the public
- Limited role of government
 - Hands off revenue
 - Eliminate all subsidies and ad-hoc carbon control
- Will this support nuclear?

Economic Impact

- Controlling carbon
 - Increase costs to consumers
 - Negative impact on economy

- Little political interest in increasing costs to voters or in depressing national economy
 - Small steps only
 - Wait for economy to improve

- A promise of carbon tax approach is recycling of revenue to mitigate negative impact on economy

De-carbonize electricity by 2050?



- Requires long-term shift in generation assets
 - Retire combustion-based generation
 - Add zero-carbon options (e.g., nuclear & renewables)

- Generation asset changes due to
 - Subsidies (e.g., renewables)
 - Political decisions (e.g., nuclear closure in Germany)
 - Environmental limits (e.g., coal power plants in US)
 - Generation planning (e.g., U.S. regulated/UK EMR)
 - Retirement (despite life/license extension)

- Carbon pricing?

Nuclear investment needs certainty



- Nuclear generation investments are large, with long lead time, long asset life, need for long-term revenue adequacy and certainty
- Carbon pricing driven by government carbon policies – inherently uncertain (e.g., Australia)
- Key questions:
 - Carbon prices high enough to drive investment?
 - How long will generation asset changes take?
 - Will investors believe that carbon prices will remain?
 - What happens to existing generation assets?
 - Traditional vs. reformed electricity industry?

- UK EMR focused on carbon goals, but uses methods separate from carbon pricing
- *“Existing measures such as the carbon price floor or the Emissions Trading Scheme do not adequately meet the market failure which exists in the UK market.”*
- Different perspective:
HPC incentives = project-specific deal to get nuclear power built, with implicit carbon price embedded in overall incentive package

- CPP flawed approach to existing nuclear
 - Assumes existing nuclear operates until end of extended license period
 - More than 12 existing nuclear power plants are in danger of early retirement for economic reasons

- A different perspective – apply carbon benefits in targeted unit-specific programs
 - Keep existing nuclear units in markets alive
 - Illinois Low Carbon Portfolio Standard
 - New York Clean Energy Standard
 - Planning in regulated utilities (e.g., Vogtle, Summer), where premium for nuclear = implicit carbon price

Observations

- Electricity market failure – carbon pricing may help, but not clear

- Carbon pricing is uncertain
 - Governments wary of economic impact
 - Little confidence in strong **and** long-term carbon pricing
 - Doubt that carbon pricing will support new nuclear

- Rethink economy-wide carbon approach and focus on specific projects (existing and new)

- Treat nuclear more like renewables?



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