RESOURCES for the FUTURE

NYSERDA-RFF Carbon Pricing Project

Lessons Learned from the Literature Review and Policy Design Experience

June 29, 2022

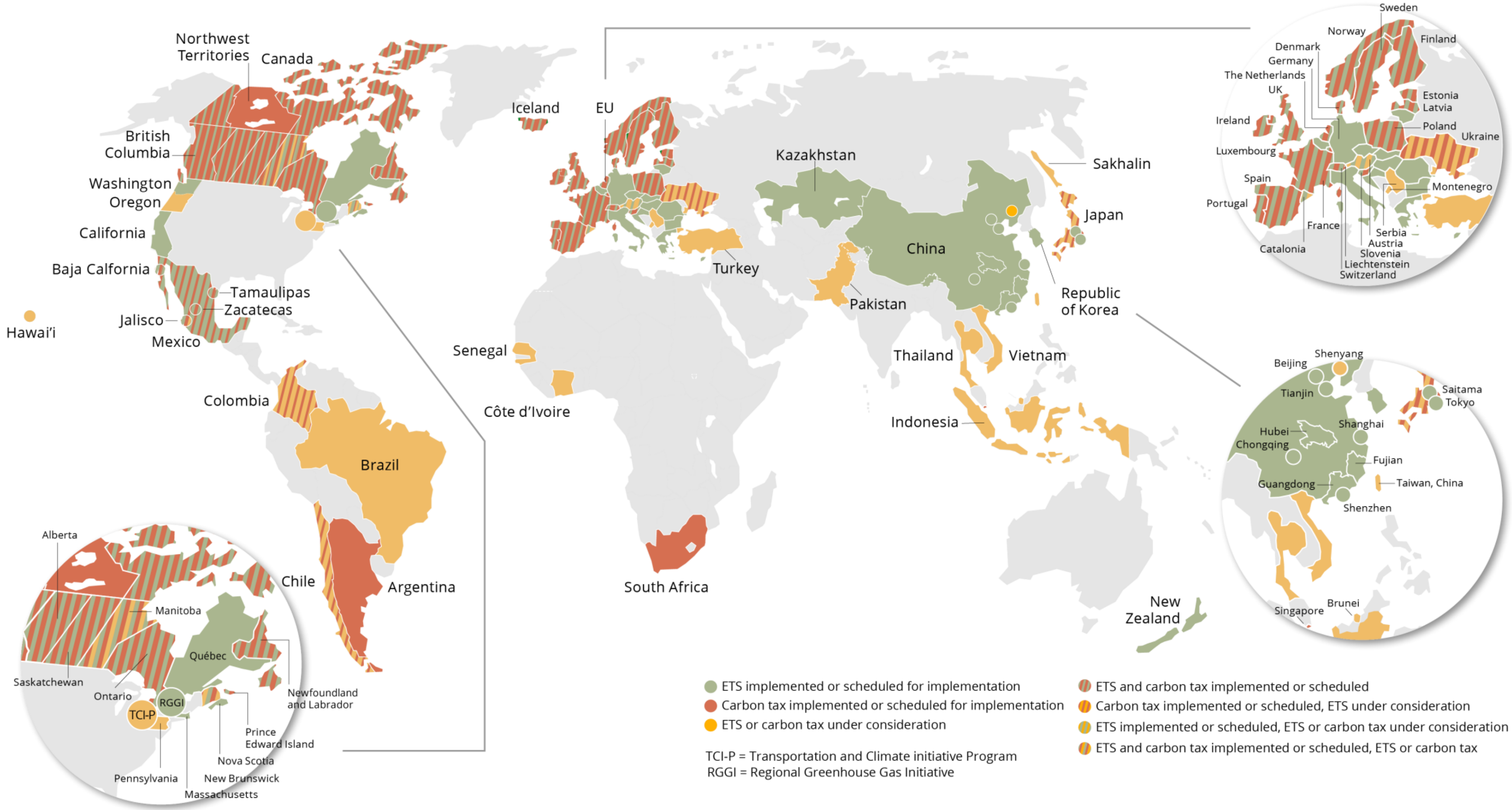
Outline of this presentation

- Global Trends
- New York Context
- Empirical Evidence from Other Jurisdictions
- Policy Design Considerations

Global Trends

What is the global adoption of carbon pricing and at what price levels?

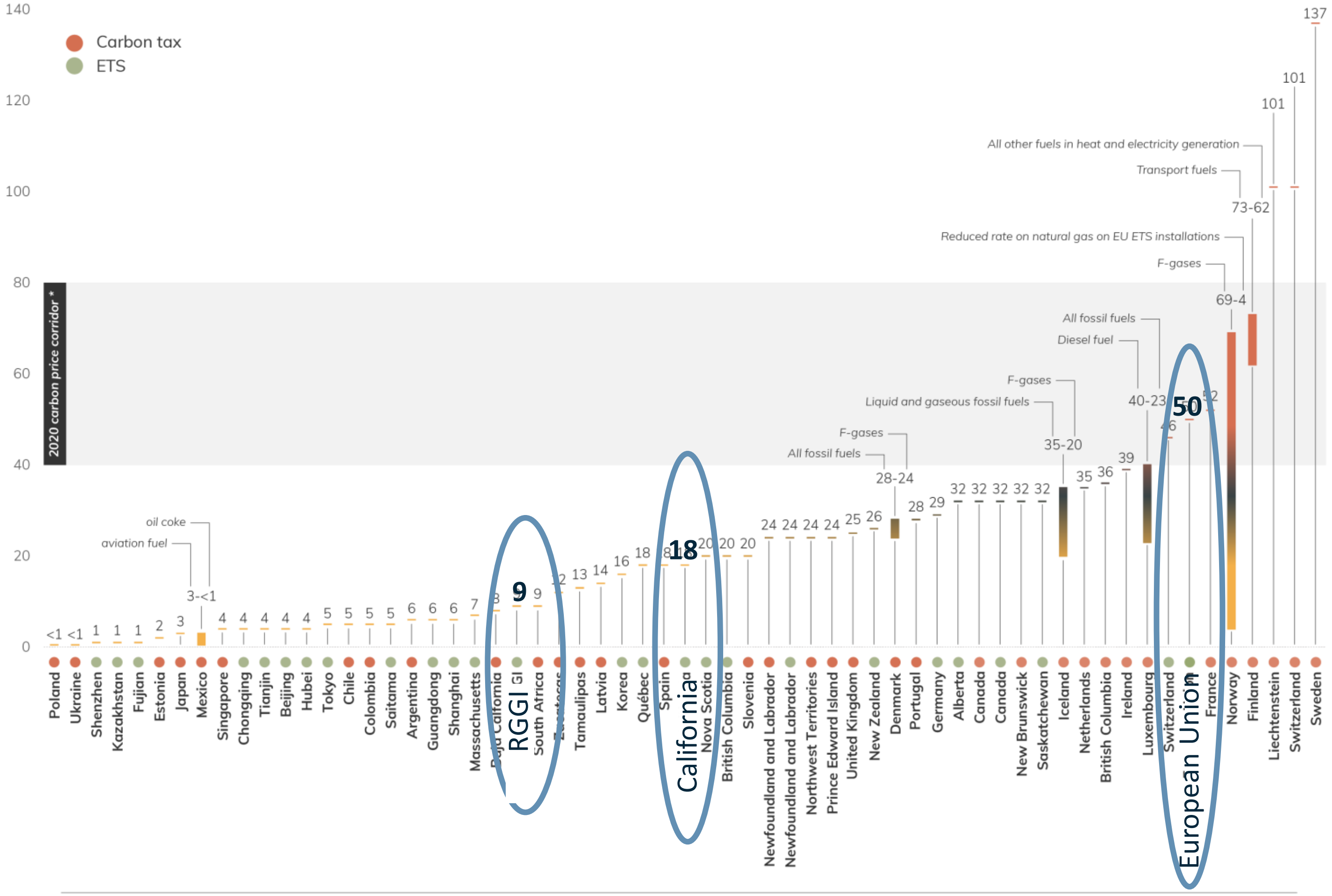
Carbon Pricing with Fees and Emissions Caps Worldwide



- ETS implemented or scheduled for implementation
- Carbon tax implemented or scheduled for implementation
- ETS or carbon tax under consideration
- ETS and carbon tax implemented or scheduled
- Carbon tax implemented or scheduled, ETS under consideration
- ETS implemented or scheduled, ETS or carbon tax under consideration
- ETS and carbon tax implemented or scheduled, ETS or carbon tax

TCI-P = Transportation and Climate initiative Program
RGGI = Regional Greenhouse Gas Initiative

Carbon Price Levels Vary Across the World (April 2021)



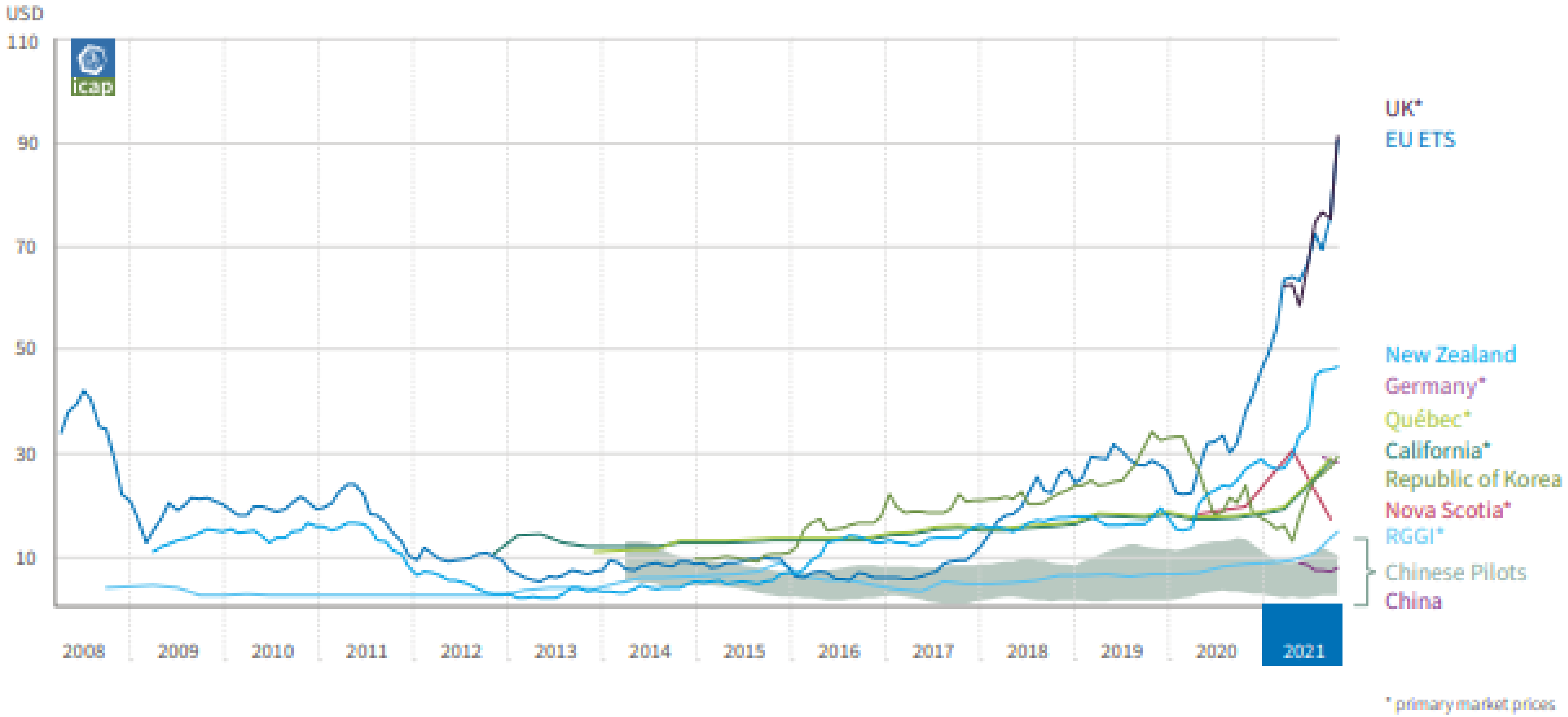
Nominal prices on April 1, 2021, shown for illustrative purpose only. China national ETS, Mexico pilot ETS and UK ETS are not shown in this graph as price information is not available for those initiatives. Prices are not necessarily comparable between carbon pricing initiatives because of differences in the sectors covered and allocation methods applied, specific exemptions, and different compensation methods.

* The 2020 carbon price corridor is the recommendation of the World Bank's 2017 High-Level Commission on Carbon Prices Report.

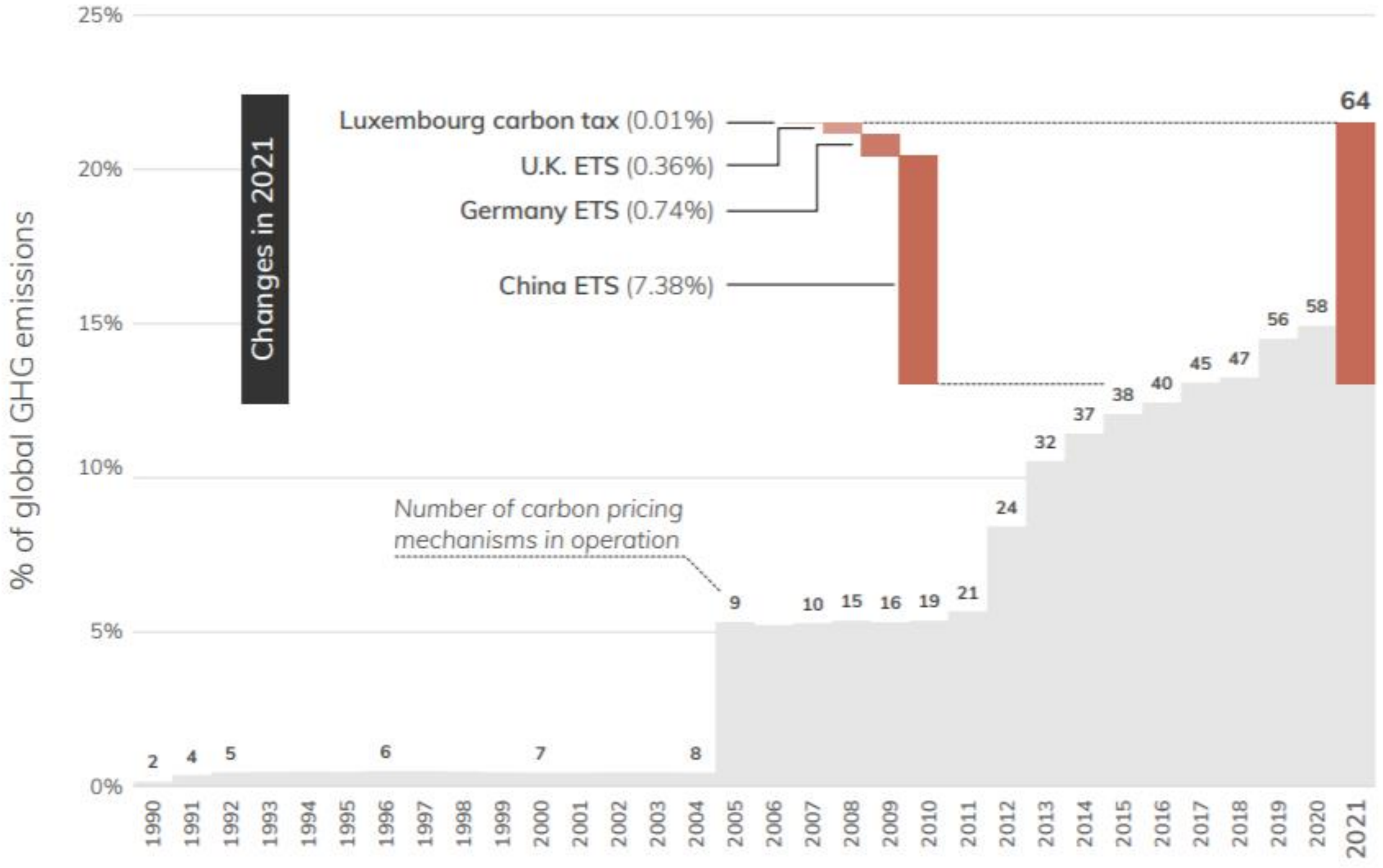
2022 updates (USD):

RGGI: $15
California: $29
EU: $77

Price Trends in Carbon Markets



The Share of Global GHG Emissions Covered by Carbon Pricing is Growing Over Time



The share of annual global GHG emissions for 1990 – 2015 is based on data from the Emission Database for Global Atmospheric Research (EDGAR) version 5.0 including biofuels emissions. From 2015 onward, the share of global GHG emissions is based on 2015 emissions from EDGAR.

New York Policy Context

How can carbon pricing fit into New York's path to decarbonization?

Why Do Jurisdictions Pursue Carbon Pricing?

- Pricing provides an efficient market signal to reduce emissions
  - Does not require policy makers to pick technologies and creates incentives for private actors to make clean investments and reduce fossil fuel use
  - Provides cost-effective implementation by harvesting low-cost emissions reductions
  - Internalizes the environmental cost of emissions in economic decisions
  - Carbon pricing involves price stability that yields a behavioral response that is three times greater than market-driven price variations of the same magnitude (Andersson 2019)
- Pricing enables two important goals:
  - Emissions reductions
  - Revenues that can be used for various purposes

Why Would Regulatory Policies Remain Important?

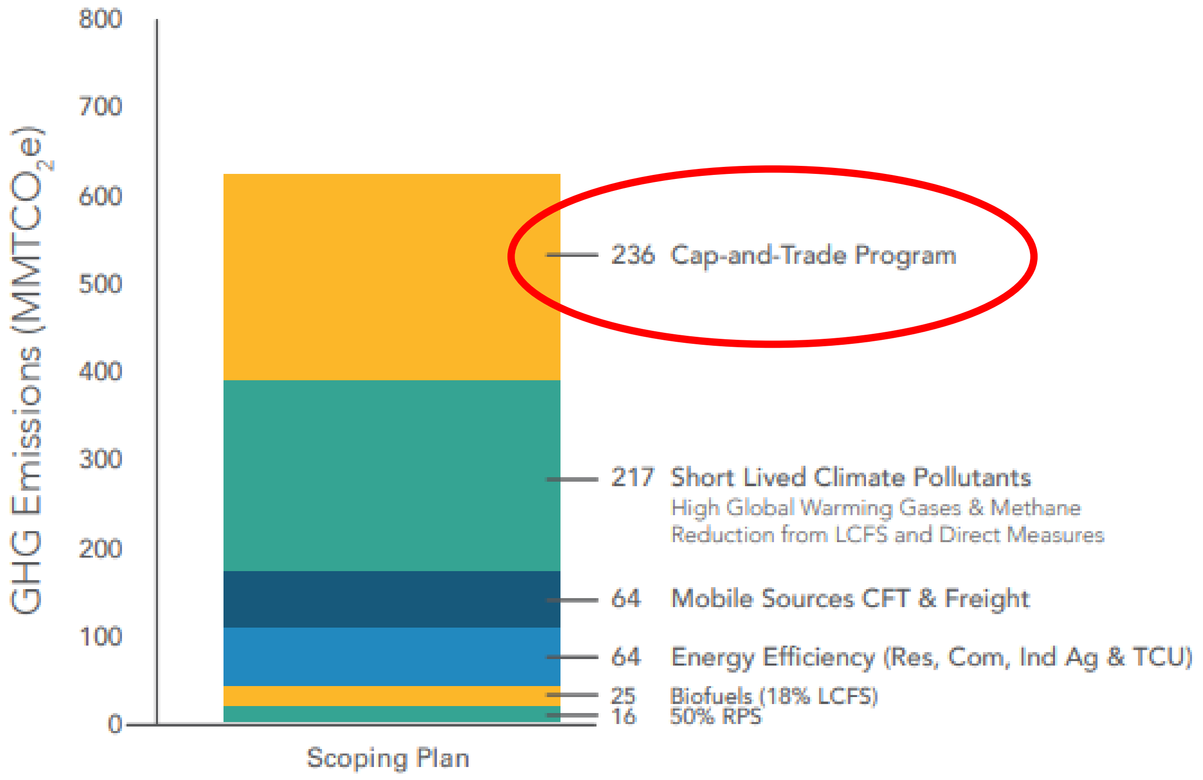
- Companion regulations addressing air quality and related measures drive equitable outcomes benefiting all communities
- A carbon price sufficiently high to by itself address the climate crisis may be unachievable
  - Politically because it implies sizable effects on consumer prices and energy access
  - Economically because it triggers economic and emissions leakage
- Industrial performance standards can ratchet to drive innovation and interact well with carbon pricing
- Public sector policies including infrastructure planning and standards coordinate private sector investments
- A recent IMF report (WP/22/66) finds that all countries that adopted carbon pricing did so late in a sequence of regulatory policies and countries that had larger policy portfolios tended to implement a higher carbon price

Example: California's scoping plan shows role of carbon pricing within broader policy context

- California's 2017 Scoping Plan illustrates reductions attributable to various regulatory measures

- The portion attributable to cap and trade is the residual necessary to achieve the state's 2030 goals

FIGURE 7: SCOPING PLAN SCENARIO – ESTIMATED CUMULATIVE GHG REDUCTIONS BY MEASURE (2021–2030)[64]



New York Policy Context

- Under the CLCPA, New York needs to reduce economywide greenhouse emissions to:
  - 60 percent of 1990 levels by 2030
  - 15 percent of 1990 levels by 2050
  - Net Zero emissions by 2050
- New York already has a suite of environmental policies in place:
  - Electricity (Clean Energy Standards, Offshore wind development, resource mandates, RGGI)
  - Transportation (Low and Zero Emissions Vehicle Mandates, Phase Out of Internal Combustion Engines)
  - Other sectors (Efficiency Standards for Buildings, Agriculture, Industry & more)

Pricing Policies Interact with other Decarbonization Policies

- Carbon pricing can “backstop” other policies to ensure emissions goals are reached
- Carbon pricing generates revenues for investments in additional measures
- CAC should consider the emissions impact of regulations, how they interact with emissions reductions achieved by carbon pricing, and how they impact potential revenues from carbon pricing
  - Under a carbon fee, stronger emission regulations reduce the influence of the fee on emissions reduction. The tax is unaffected, but revenues are reduced
  - Under an emissions cap, stronger emission regulations reduce the demand for allowances, the price of allowances, and revenue. Unless the emissions cap responds to allowance prices with a price floor or other measures, emissions outcomes are not affected by additional regulations*

*Carbon markets can be designed so allowance supply responds to price, helping to reduce emissions and maintain revenues

Pricing policies interact with regulatory policies: adding a carbon tax or cap to a ZEV mandate

- The carbon tax/cap would likely drive greater adoption of electric vehicles on its own, but the ZEV mandate will set a minimum level of electric vehicles in the new vehicle market (100% by 2035)
- The carbon tax/cap will still influence the behavior of individuals who have combustion vehicles by encouraging them to drive less and could potentially drive greater electric vehicle adoption by accelerating retirement of gas-powered vehicles.
- Emissions within this sector would decline more from the combination of policies than from a single policy, but...
- The differences:
  - Under a fixed cap, emission reductions will not change because total allowance supply is fixed to the level necessary to achieve its target. Allowance prices would decline because demand for allowances has fallen. Revenue would fall because the same number of allowances will sell for a lower price.
  - Under a tax, emission reductions will increase because the programs are unresponsive to one another, getting the jurisdiction closer to or exceeding its goal. Carbon price would remain unchanged since level is fixed. Revenue would fall because same price is applied over lower emissions.

Empirical literature on impacts

How have enacted carbon pricing policies impacted emissions, equity, and economic outcomes?

Emissions Reductions Resulting from a Carbon Policy

- Carbon Tax:
  - Murray and Rivers (2015) estimated that the carbon tax in British Columbia reduced greenhouse gas emissions by 5-15%
  - Sweden has the highest carbon tax in the world at $137 per ton
    - Studies have shown that Sweden's carbon tax (which applies mainly to transportation and buildings) has reduced emissions in those sectors since its inception
    - Runst and Thonipara (2020) note empirical evidence suggests that the policy has encouraged efficient electric heat pump adoption in homes
    - Andersson (2019) finds transportation-related emissions declined by 11 percent
- Emissions Cap:
  - Carbon market allowance prices have been modest, supporting modest emissions reductions through fuel switching in the power sector. More prominently, the emissions cap provides a backstop (with other policies promoting reductions)
  - Murray and Maniloff (2015) find that RGGI has driven about half of the region's emission reductions in the power sector since the program's inception

Macroeconomic Effects

- Empirical studies and simulation models suggest carbon pricing policies have not significantly impacted GDP growth, employment, or inflation:
  - Economic Activity (GDP)
    - Europe (Metcalf and Stock 2020) and British Columbia (Murray and River 2015) have not experienced negative effects on GDP as a result of carbon pricing policies
    - Simulations show only slight reductions in economic growth compared to BAU with $25 or $50 carbon prices (McFarland et al, 2018)
  - Inflation
    - Carbon prices in Europe and Canada have not had significant effects on inflation and may have been deflationary (Konradt and Weder di Mauro, 2021)

Macroeconomic Effects Cont.

- Employment
    - Evidence is mixed but one study finds that British Columbia's revenue-neutral carbon tax had a small statistically significant positive effect on employment (Yamazaki, 2017)
    - Simulations show decreased employment in covered sectors but increased employment in uncovered sectors, leading to a negligible effect overall (Hafstead and Williams 2018)
- A carbon price will raise fuel prices
    - Cronin et al. (2019) look at simulation results of a $25 per ton carbon price and find that it would increase fuel prices 18%, 10%, and 86% for oil, natural gas, and coal, respectively (relative to 2017 prices, when adjusted to 2021 prices)

Impacts on Disadvantaged Communities

- In their simplest form, carbon prices distribute air quality and emissions benefits without consideration for historical inequities or vulnerabilities of certain populations or geographic areas. Program design can increase benefits in DACs
- Existing emission cap programs have not shown evidence of an increase in pollution in disadvantaged communities:
  - Experience with RECLAIM in LA (Fowlie et al, 2012) and California's emissions cap program (Walch 2018, Hernandez-Cortes and Meng 2020) show no evidence of negative effects on disadvantaged communities, with evidence that the programs reduced co-pollutants
  - Pastor et al. (2022) use data on emissions and comparisons across affected facilities to argue that air quality improvements may be less in disadvantaged communities than in other communities
  - Hernandez-Cortes and Meng (2022) use an air dispersion model and comparisons of affected and nonaffected facilities to conclude that cap and trade narrows the gap in air quality between DACs and other communities
- Co-pollutants and equity remain important to consider:
  - With a relatively lenient cap, emissions could increase at capped facilities, increasing local air pollutants. This was true in early rounds of the EU ETS with clustering of industry emissions, but these fell with stricter caps (Stuhlmacher et al., 2019)
  - An equity viewpoint has asked if emissions are declining *at least as quickly* in historically overburdened communities as in others
  - Legacy exposure and cumulative effects of pollution in overburdened communities appear associated with greater sensitivity to pollution (Spiller et al. 2021)

Leakage

- Evidence suggests emissions leakage in electricity can be important unless it is mitigated:
  - *Without* California's restrictions on electricity imports, simulations indicate that the program would have led to increases in emissions roughly equal to 45% of the in-state reductions (Caron et al., 2015)
- Emissions leakage also can be important in industry if it is not mitigated
  - Simulations show that a modest carbon price, *without* adjustment mechanisms such as output-based allocation, could lead to reduced employment and manufacturing output in covered regions to the benefit of neighboring uncovered regions (Casey et al., 2020; Gray, Linn and Morgenstern 2016)
  - Fowlie and Reguant (2021) find low leakage risk for several emissions intensive industries that are not highly trade exposed.
- Policy may protect against economic leakage
  - California implements a border carbon adjustment to regulate the emissions intensity of imported electricity. Observed patterns of GHG emissions across the western electricity market suggest that despite the adjustment there remains some residual leakage (Fowlie and Burtraw 2022).

Carbon Pricing Design

What design elements does the CAC need to consider?

Design Key Findings from the Literature

1. **Carbon Fee versus Emissions Cap:** A similarly stringent carbon fee and emissions cap yield comparable air pollution outcomes

2. **Revenues and Addressing Distributional Concerns**: Directing carbon revenues toward tax breaks or dividends to households can reduce or eliminate the regressivity of carbon pricing. Revenues can also drive investment in further emissions reduction

3. **Mitigating Leakage**: Carbon pricing policies can create emissions and economic leakage, but policy design options (like a border carbon adjustment or output-based allocation) can be used to mitigate those

4. **Sector Coverage:** Carbon pricing can be implemented economywide or in targeted sectors

5. **Designing for Policy Interactions**: Carbon pricing policies should be designed to work well with other policies to overcome the waterbed effect. One option under cap and invest is price-responsive supply. A central decision is the use of carbon revenues for investments

Carbon Fee *versus* Emissions Cap

- In theory, either approach could lead to the same efficient outcome… in practice, there are benefits and drawbacks of each

Carbon Fee	Emissions Cap
+ Provides greater certainty over cost	+ Provides greater certainty over emissions
+ Less administrative complexity	+ Easier to link with other programs
- More volatile emissions outcomes	- Cost uncertainty
- May be more difficult to implement and require new legislation	- Higher risk for policy interactions

- However, each approach can be designed to mimic the other
- An emissions cap may be a straight-forward extension of regulatory authority for an agency, and may not require new legislation
- Recent emissions cap programs have opted for a cap-and-invest model which directs carbon revenues toward program-related investments to accelerate emissions reductions. Carbon tax revenues can be directed to a similar purpose

Carbon Fee – Setting the Level

- Social marginal damages method
  - In theory, most efficient option is to set the fee at the estimated social marginal damages, but in practice, this is extremely difficult politically and estimates vary:
    - In June 2021, NY DEC recommended a central estimate of the social cost of carbon of $121
    - The Biden Administration's latest central estimate is $51 per ton, which will be updated soon
- Emissions target method
  - Estimate a carbon fee based on a desired level of emissions reductions
  - Kaufman et al. (2020) model carbon fee levels needed to get to net-zero by 2050 as between $34 and $64 in 2025 and between $77 and $124 per ton in 2030

Carbon Fee – Setting the Level Cont.

- Fill the gap
  - Coverage and level of the carbon fee can be set to capture emissions that are un-regulated or under-regulated by other policies
- A Tax Adjustment Mechanism (TAM) automatically adjusts the tax levels in response to emission reductions levels (Hafstead and Williams, 2020)

Cap-and-Invest Design Considerations

- Cap level and trajectory
  - Cap can be set using emissions trajectories and understanding of technical feasibility of reductions by sector
- Banking and borrowing
  - Simulations suggest that banking is welfare-improving while borrowing is not (Kuusela and Lintunen 2020). Many authors have pointed to potential moral hazard of emissions borrowing
  - Real-world experience: Schmalensee and Stavins (2017) find empirical evidence that banking improved price stability in the EU
- Free allowance allocation vs auctions
  - Free allowances benefit regulated entities and can protect trade exposed industry (and benefit consumers in the form of lower product costs). However, auctions raise revenues that can be reinvested
  - Real-world experience: RGGI was the first program to use an auction, and this model has been copied in other programs. Since the program's inception, auctions have raised over $4.8 billion in revenue and likely led to economic benefits exceeding that amount (Hibbard et al. 2018)

Cap-and-Invest: Addressing Uncertainty

- Price floor and ceiling
  - Prevent the price from rising above or falling below specific thresholds
  - Price floor first introduced in RGGI; CA has added a hard price ceiling; intended in WA
- Cost and emissions containment reserves
  - Allowances supply is expanded or contracts when prices exceed specific thresholds
  - Used in RGGI and California; intended in WA
  - Can help maintain or grow auction proceeds, and ensure additional policies yield incremental emissions reductions under the cap.

General Design - Revenue Use

- Carbon pricing can be regressive if revenues are not redistributed. The most important factor determining distribution outcomes is how revenues are used:
  - Reducing income tax can make a carbon policy less regressive (Williams et al. 2015)
  - Using revenue for lump-sum rebates makes carbon policy progressive (Williams et al. 2015)
  - Modeling results also show that expanding the Earned Income Tax Credit can also make a policy more progressive (Burtraw et al., 2009)
  - In California, over 50% of auction revenues attributable to state-owned allowances have been invested in disadvantaged communities; allowance revenues associated with utility emissions are periodically refunded to customers of investor-owned utilities; a similar approach is expected in Washington
- Carbon pricing revenue can also be used to fund additional climate investments
  - RGGI revenues are mainly used for energy efficiency upgrades (54%), clean energy investments (14%), greenhouse gas abatement (10%), and direct bill assistance (15%)
  - In the EU, guidelines direct member states to invest at least 50% of auction proceeds in climate program related goals. Some member states have greatly exceeded this target

Addressing Distributional Concerns

- Program design options include incorporating co-benefits into climate policies and not treating all tons abated equally (Boyce and Pastor 2013). For example:
    - The RECLAIM Program created two zones for compliance, the coastal zone could sell allowances to the inland zone but not vice versa (Johnson and Pekelney 1996). Pastor et al. (2022) suggest no-trade zones could be declared in highly polluted areas
    - Washington’s emissions cap program design aims to restrict the use of offsets in communities that fail to achieve air quality standards, and restricts linking with other jurisdictions pending an EJ analysis
    - Another approach would be to require more than one allowance per ton of emissions from facilities that affect disadvantaged communities
- Directing investment of carbon proceeds to disadvantaged communities can accelerate emissions reductions in those communities, improve air quality, and build resilience to climate change

General Design- Addressing Leakage

- Border Carbon Adjustment (BCA): Can be designed to tax imports, relieve exports of the carbon fee, or both
  - **Experience** – California regulates imported electricity under the emissions cap
  - **Drawbacks** – Could be difficult to implement legally
    - The Dormant Commerce Clause of the Constitution precludes state regulation of interstate commerce. A BCA must be designed to treat in-state and out-of-state activities in a nondiscriminatory way
- Output-based Allowance Allocation: Creates an incentive to maintain production in the state and reduce the impact of the program on product prices. Burtraw et al. (2017) find it to be an effective method at reducing leakage
  - **Experience** – California and the EU distributes allowances to the industrial sector this way
  - **Drawbacks** – Subtracts from auction revenues

General Design - Sector Coverage

- Carbon pricing may apply economy-wide or to specific sectors
    - Covered sectors may be selected because they are thought to be more "responsive" to carbon pricing (the marginal cost of abatement is relatively low)
    - Under carbon pricing, more responsive sectors (like the power sector) disproportionately contribute to emissions reductions, less responsive sectors (like transportation) disproportionately contribute to revenues in the short term and may become more responsive in the long term
    - Some sectors may be exempt because of trade exposure or difficulty in correctly identifying associated emissions

Wrapping up

What are the key takeaways for the CAC?

Conclusions for the CAC

- Policies that do not price carbon directly have accounted for the lion's share of emissions reductions in the US and globally
- An expanding role for carbon pricing can improve cost effectiveness and help shape expectations to unlock private investments
- The use of carbon pricing revenue is an important aspect of policy design
- Policy design options can help mitigate potential emission leakage and regressive impacts
- An emissions cap approach may avoid the need for new legislation
- Cap-and-invest policies can be designed to work well with other policies by making allowance supply responsive to price

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Appendix

Additional content for reference

Implementation Findings from the Literature

- **Garnering Political Support**: Policies that address local concerns such as air quality, mitigate social inequities, or build careers in a clean energy economy can improve political support
- **Improving Policy Durability**: Policy sequencing can also be used to build policy support and accelerate technological development. Everywhere carbon pricing was preceded by and coexists with regulatory policies
- **Viable Alternatives**: When carbon pricing is not possible, other pricing policies (such as tradable performance standards) can achieve nearly as efficient outcomes. Many of these policies work well with carbon prices
- **Administration:** implementing carbon pricing requires enabling authority, data, and a compliance agency

Data, Administration & Authority

- Carbon pricing requires a detailed accounting of carbon emissions. Examples of emissions data sources include:
  - Title V facilities report criteria pollutants, GHG's and HAPs annually (e.g., major sources for HAPs and criteria pollutants pursuant to 6 NYCRR Subpart 202-2)
  - Part 75 – CO_2 data reported to EPA and uploaded to RGGI CO_2 Allowance Tracking System for fossil generators over 15 MW.
  - Part 98 – GHG emissions reported to EPA for facilities emitting over 25K MTCO2e
- A carbon pricing policy requires legal authority, which can take a variety of forms
  - No additional authority needed for cap & invest program, falls under same authority as RGGI