Can Financial Engineering Help Save the Planet?

CARBON LINKED BONDS OVERVIEW

ASU

MARCH 1 2024

Gro Intelligence × Kepos Capital

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Three Orders of Magnitude Misquote

Billions versus Trillions

The New York Times

Taxpayers are subsidizing fossil fuels more than ever

Countries around the world paid a staggering $1.3 billion to make fossil fuels more affordable in 2022, almost triple the bill from two years earlier, according to a report released today by the International Monetary Fund...

The I.M.F. report calculated a much higher subsidy total of $7 billion when indirect costs were included — especially the amount that governments should charge to account for global warming and local air pollution. — *Manuela Andreoni*

A correction was made on August 24, 2023: *An earlier version of this article misstated the value of fossil fuel subsidies. It is $1.3 trillion, not $1.3 billion.*

Source: "*Steel Is Getting Cleaner.*" New York Times, August 24, 2023. https://www.nytimes.com/2023/08/24/climate/steel-is-getting-cleaner.html#:~:text=Electric%20arc%20furnaces%2C%20which%20use,study%20by%20Global%20Energy%20Monitor.

From $1.5 Trillion to around $4 Trillion

Can We Scale Low Carbon Investments 3 Times?

Focus on policy expectations

- **Optimized portfolio allocations today are very sensitive to expected future returns**

Use financial engineering to create credibility

- **Consider TIPS – Treasury Inflation Protected Securities**

Start by defining a carbon price

- **Incentives come in many forms**

DATA AGGREGATION

Computation of the Carbon Barometer

Country-specific Policy Documents

Policy Databases

Policy-specific Carbon Pricing

Energy Use & Economic Data

Emissions Inventory Databases

Emissions & Sector Contribution

Country-level time series of carbon pricing

- Reactive to underlying changes in current policies, or new policies under similar themes
- Standardized by contribution to total carbon emissions
- Consistent data ingestion and normalization

DATA AGGREGATION

Overview of Seven Main Policies

Policy	Direction	Description
Carbon Tax	Tariff	Carbon taxes are an explicit form of carbon pricing that impose a fixed fee on every ton of CO2 emission from regulated entities.
Emissions Trading System (ETS)	Tariff	ETS are an explicit form of carbon pricing that cap the overall carbon emissions from regulated polluters & issue tradable allowances. When allowances are auctioned, allowance price provides marginal incentive to reduce CO2 emissions.
Fossil Fuel Tax	Tariff	Governments impose taxes on transportation fuel at the pump, which provides a marginal incentive to reduce transportation carbon emissions. Covers taxes levied on energy use from fossil fuels for transportation, industry, agriculture, residential and commercial units, and utilities.
Fossil Fuel Subsidy	Subsidy	Fossil fuel subsidies are effectively negative carbon prices. They are expenditures by the government that support fossil fuels and are still ubiquitous around the world, especially in developing countries.
Feed-in Tariffs	Tariff	FITs offer a price premium for renewable energy provided to the grid. This price premium is set by the government and paid to renewable energy producers by consumers. The price premium is typically an absolute amount, denoted in dollars per MWh.
Renewable Portfolio Standards	Tariff	RPS require electricity providers to supply a certain percentage of their electricity with renewable sources. Tradable renewable energy credits (RECs) can be purchased by suppliers who fail to achieve this percentage requirement.
Low-Carbon Fuel Standards	Tariff	LCFS impose a limit on carbon intensity for fuels. Suppliers below the rate receive credits denoted in metric tons of carbon dioxide. Suppliers above the rate incur deficits to rectify either through abatement or purchase of credits.

Carbon Barometer

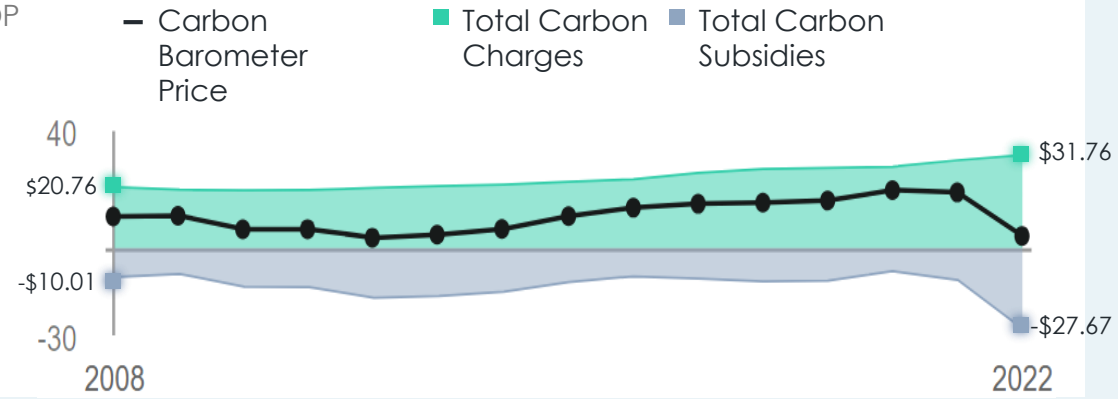
Evolution of Global Carbon Price

The Global Carbon Barometer price has increased steadily over the past decade, until 2022.

Policy Overview, Global

Country	Carbon Barometer Price $USD/MTCO$_2$	Total Emissions M MTCO$_2$	Emissions Intensity of GDP kg CO$_2$/$USD	Net Carbon Charges as % of GDP
Global	$4.08	28713	0.34	0.14%

Policy Evolution



DATA AGGREGATION

Carbon Barometer Visualization

Carbon Barometer Price
$USD/MTCO$_2$

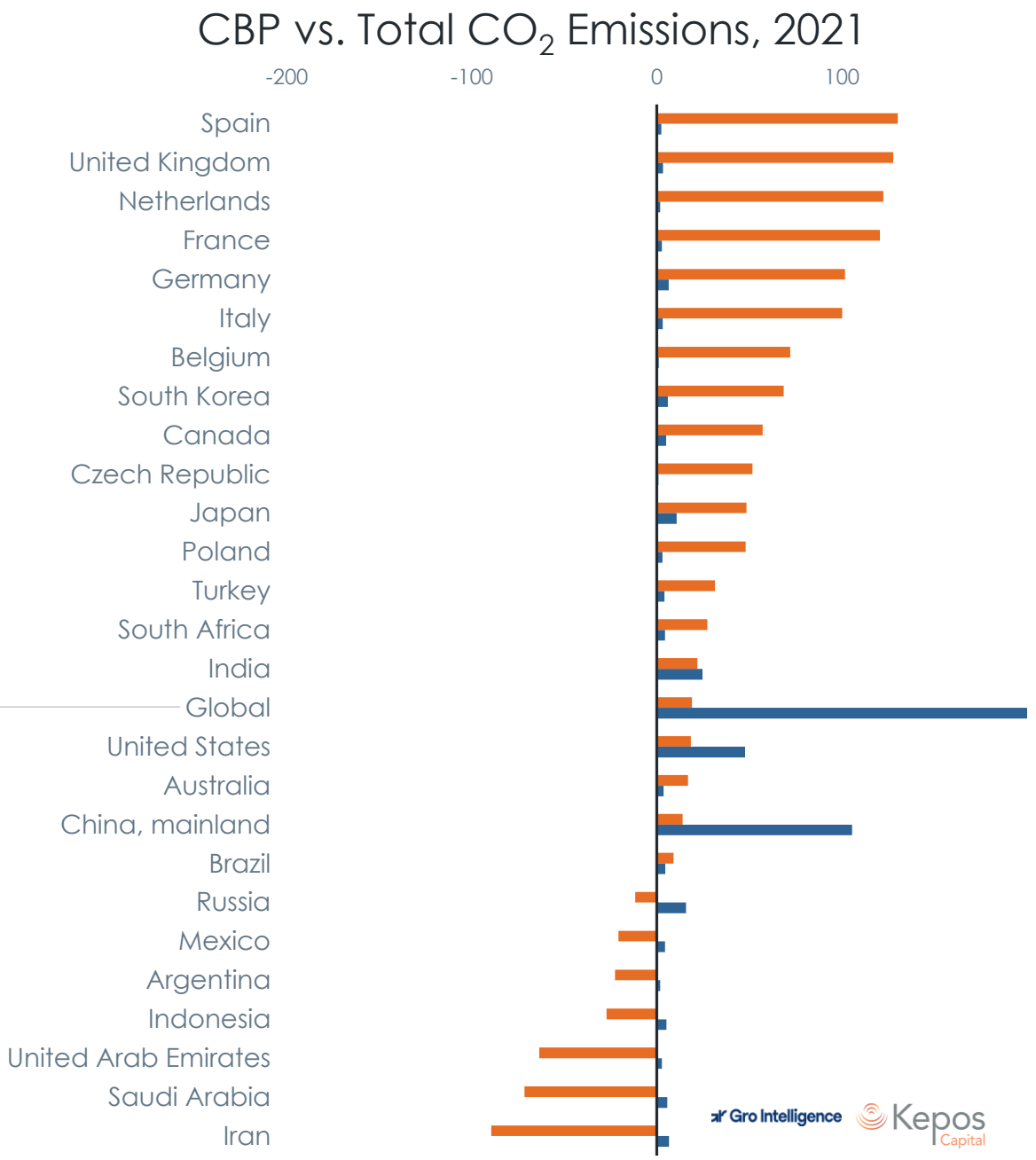
$18.97

Additional views

Country-level policy data and evolution over time of Carbon Barometer price

Disaggregated seven policies and contribution to overall Carbon Barometer calculation

- Carbon Barometer Price $USD/MTCO$_2$
- Total Carbon Dioxide Emissions



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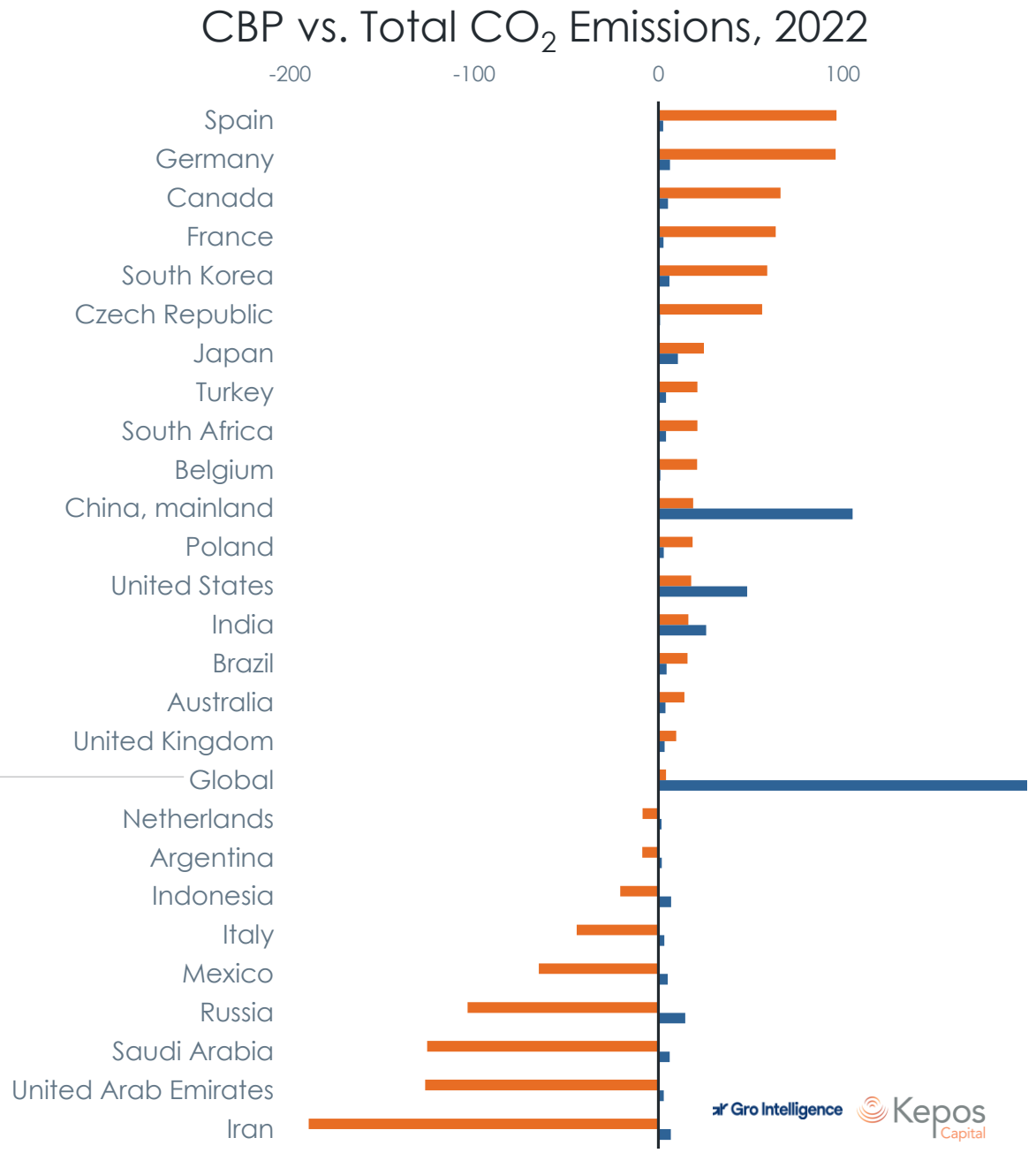
Carbon Barometer Visualization

Carbon Barometer Price
Down 78% from 2021

$4.08

- Carbon Barometer Price $USD/MTCO$_2$
- Total Carbon Dioxide Emissions



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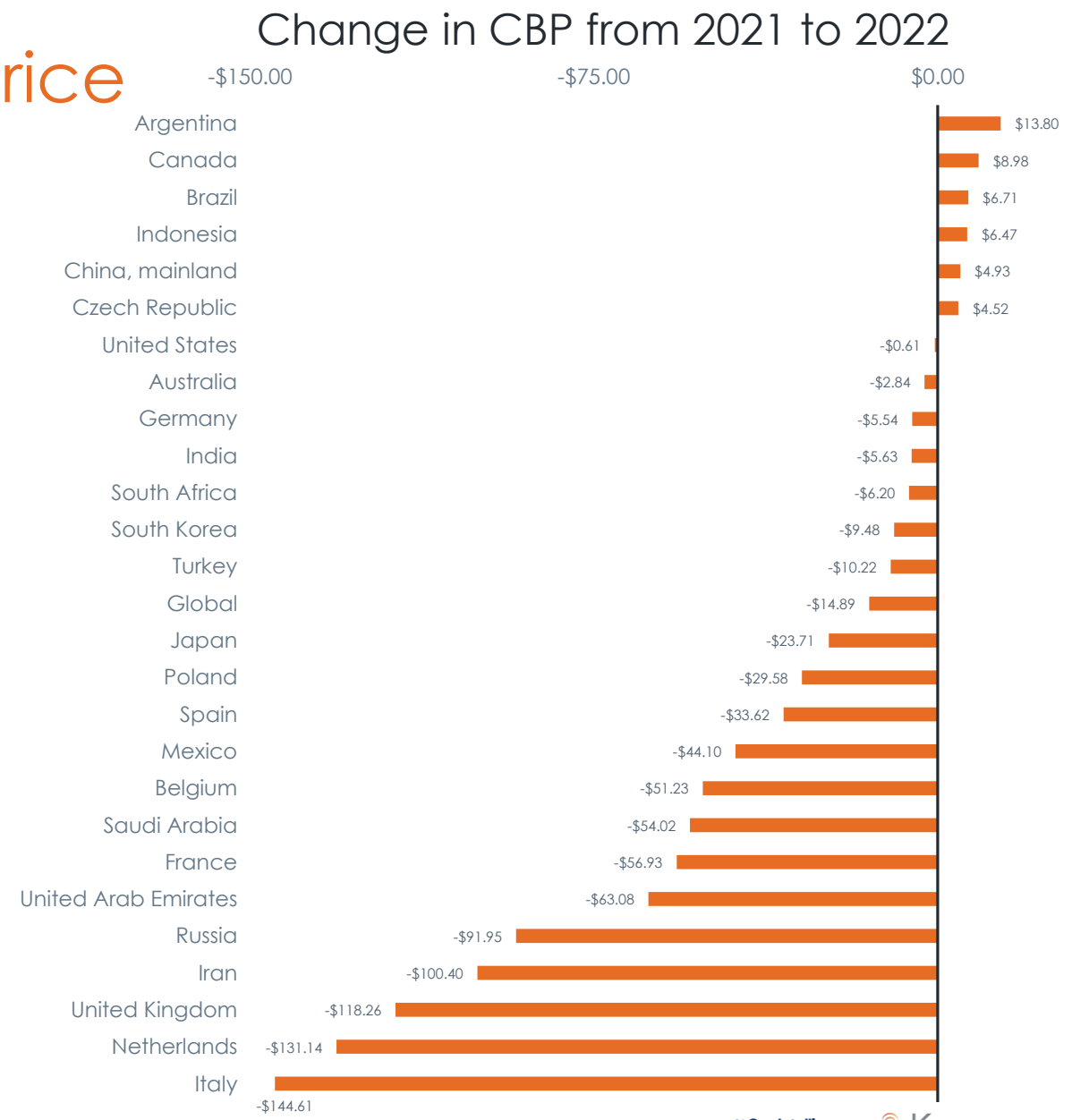
Change in Carbon Barometer Price

Country	2021 Price	2022 Price
Argentina	-$22.50	-$8.71
Canada	$57.33	$66.31
Brazil	$9.06	$15.77
Indonesia	-$27.13	-$20.66
China, mainland	$13.93	$18.87
Czech Republic	$51.80	$56.32
United States	$18.47	$17.85
Australia	$16.90	$14.06
Germany	$101.85	$96.31
India	$21.93	$16.29
South Africa	$27.39	$21.20
South Korea	$68.61	$59.13
Turkey	$31.42	$21.21
Global	$18.97	$4.08
Japan	$48.47	$24.76
Poland	$48.11	$18.53
Spain	$130.28	$96.67
Mexico	-$20.78	-$64.88
Belgium	$72.19	$20.96
Saudi Arabia	-$71.61	-$125.63
France	$120.64	$63.71
United Arab Emirates	-$63.51	-$126.59
Russia	-$11.62	-$103.57
Iran	-$89.47	-$189.87
United Kingdom	$127.94	$9.68
Netherlands	$122.58	-$8.56
Italy	$100.18	-$44.42



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Carbon Barometer

Policy Contributions

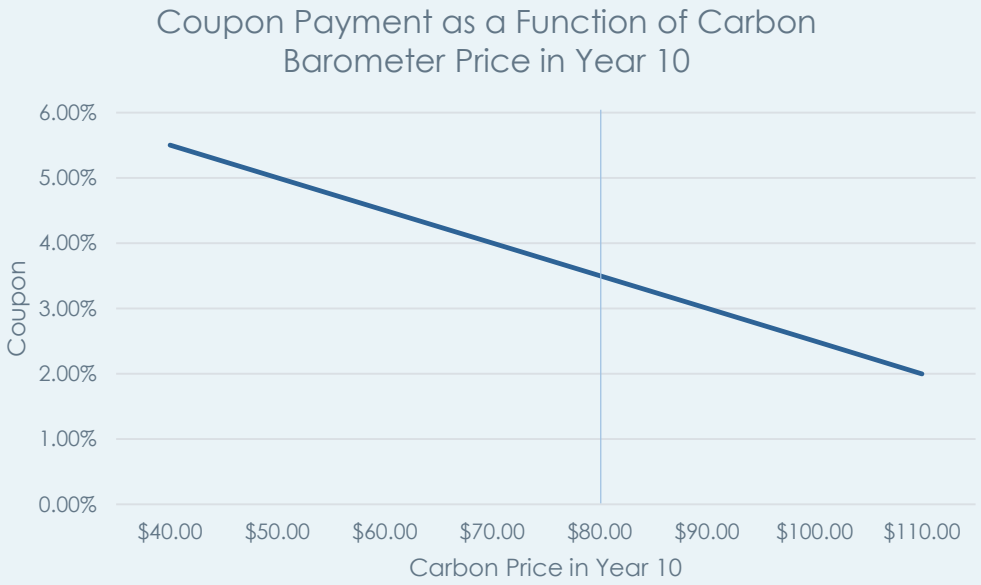
The Carbon Barometer framework allows users to clearly understand the relative contribution of various policies to a country-level Carbon Price

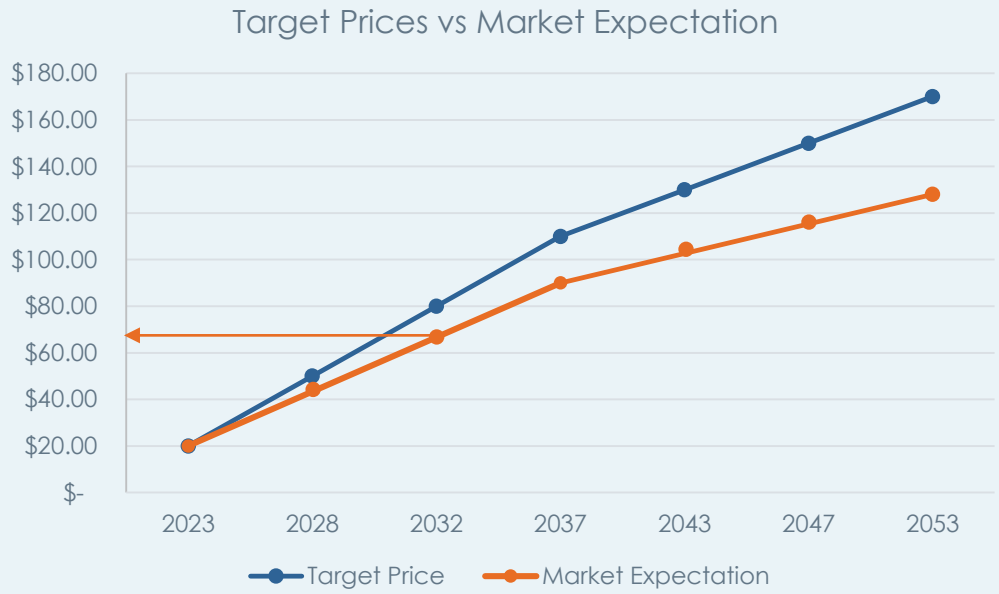
Individual Policy Contribution to Carbon Barometer Price

Country	Carbon Barometer Price	Fossil Fuel Subsidies	Carbon Tax	Emissions Trading Systems	Carbon Barometer Price	Fossil Fuel Subsidies	Carbon Tax	Emissions Trading Systems
	$USD/MTCO$_2$	$USD/MTCO$_2$	$USD/MTCO$_2$	$USD/MTCO$_2$	$USD/MTCO$_2$	$USD/MTCO$_2$	$USD/MTCO$_2$	$USD/MTCO$_2$
	2021				2022			
Global	$18.97	-$11.07	$1.03	$3.09	$4.08	-$27.67	$1.12	$6.00
France	$120.64	-$34.85	$26.69	$19.91	$63.71	-$110.32	$25.55	$34.61
United States	$18.47	-$1.99	$0.00	$1.21	$17.85	-$2.91	$0.00	$2.03
China	$13.93	-$2.38	$0.00	$0.35	$18.87	-$2.37	$0.00	$4.55

Deriving a Product from the Carbon Barometer

Carbon-Linked Bonds Reveal Forward Expectations





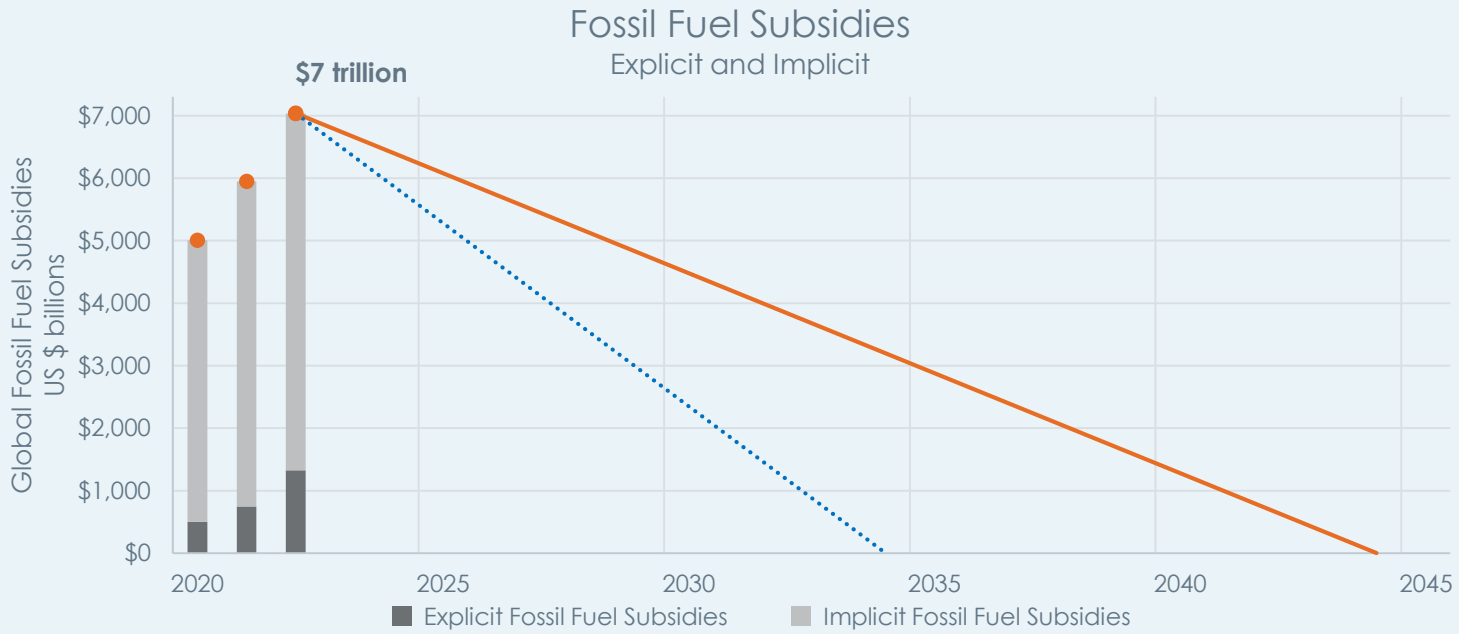
Coupon and principal are tied to the Carbon Price

The forward curve for carbon prices

1. Forward dates have targeted carbon prices
2. A lower borrowing cost as a commitment device – missing target costs the issuer
3. Weak policy increases return to investors, and
4. Carbon forward curve allows hedging, reveals expectations, and accelerates investment in low-emissions capital

Global Harmonization of Incentives to Reduce Emissions

Highlight the Path to Elimination of Carbon Subsidies



Charting a Path to End Fossil Fuel Subsidies

1. Fossil fuel subsidies promote inefficient allocation of an economy's resources and encourage pollution
2. Raising fuel prices to their fully efficient levels reduces projected global fossil fuel CO_2 emissions by 43% below baseline levels in 2030, raises revenues worth 3.6% of global GDP and prevent 1.6 million local air pollution deaths per year [1]
3. Reducing subsidies saves money for taxpayers and redistributes investments towards sustainable and equitable outcomes

[1] Source: International Monetary Fund, Fossil Fuel Subsidies