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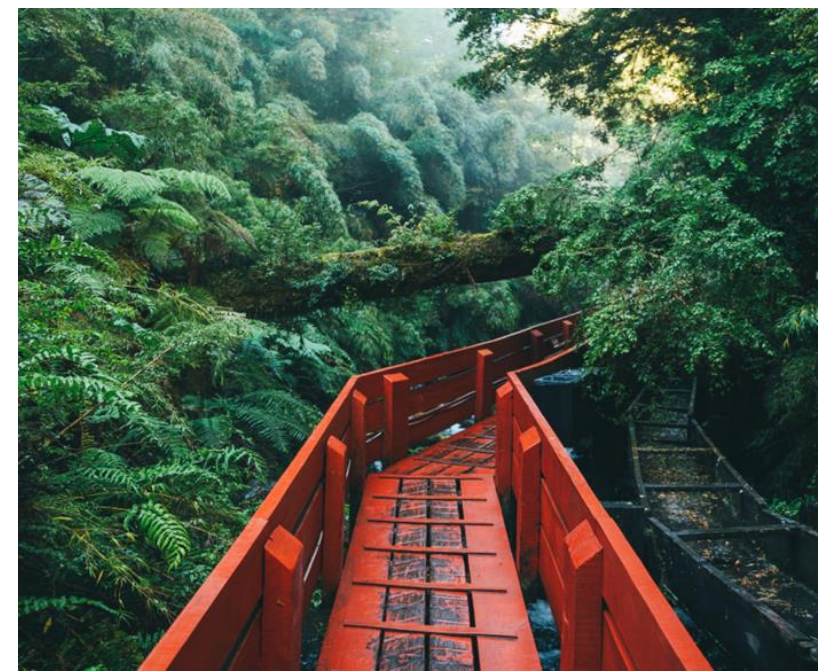
<sup>6</sup>Chemical &  
<sup>15</sup>Physical  
<sup>16</sup>Society

# Applying Science & Finance To Stop Climate Change

Professor Michael Mainelli  
Chairman, Z/En Group  
22 September 2022

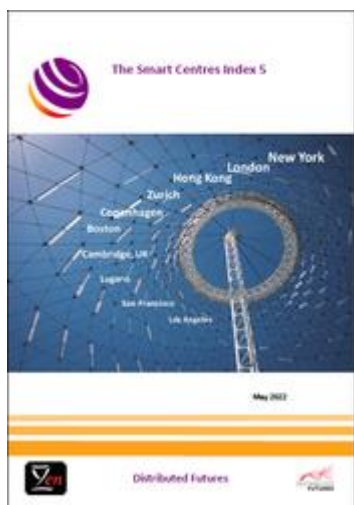
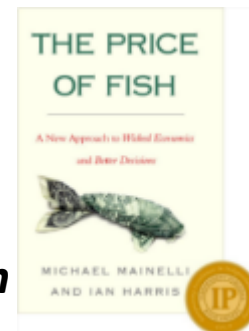


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# City Of London's Leading Commercial Think-Tank

- ◆ Services – projects, strategy, expertise on demand, coaching, research, analytics, modern systems
- ◆ Sectors – technology, finance, voluntary, professional services, outsourcing
  - *Sunday Times* Book of the Week, **Clean Business Cuisine**
  - Independent Publisher Book Awards Finance, Investment & Economics Gold Prize for **The Price of Fish**
  - British Computer Society **IT Director of the Year 2004** for PropheZy and VizZy
  - DTI **Smart Award 2003** for PropheZy
  - £1.9M **Foresight Challenge Award** for Financial Laboratory visualising financial risk 1997
- ◆ Innovation – policy performance bonds, prediction markets, medical imaging, support vector machines, low-loss electric cables, risk visualisation, smart ledgers, etc.



# Agenda

- The 'City' Story So Far
- Multiple views on climate change & economics
- Pricing & policy risk
  - carbon pricing
  - policy performance bonds
- Q&A discussion



**"Get a detailed grip on the big picture."  
Chao Li Ning**



# The 'City' Story So Far

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City of London Corporation passes local Clean Air directive in 1953 leading to Clean Air Act of 1956.

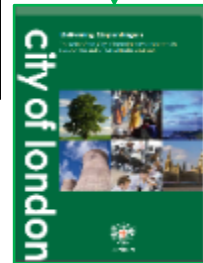


["The London Principles: The Role Of The UK Financial Services In Sustainable Development"](#), Johannesburg Earth Summit.

2002



2007



2009

London Accord – Sharing Investment Research For The Sake Of The Planet

Policy Performance Bonds



2017



2019



1991



World Business Council for Sustainable Development

1992



2000

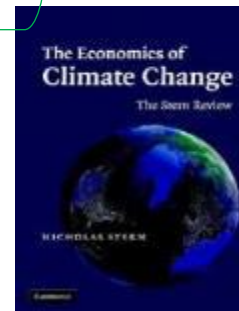
2005



2007



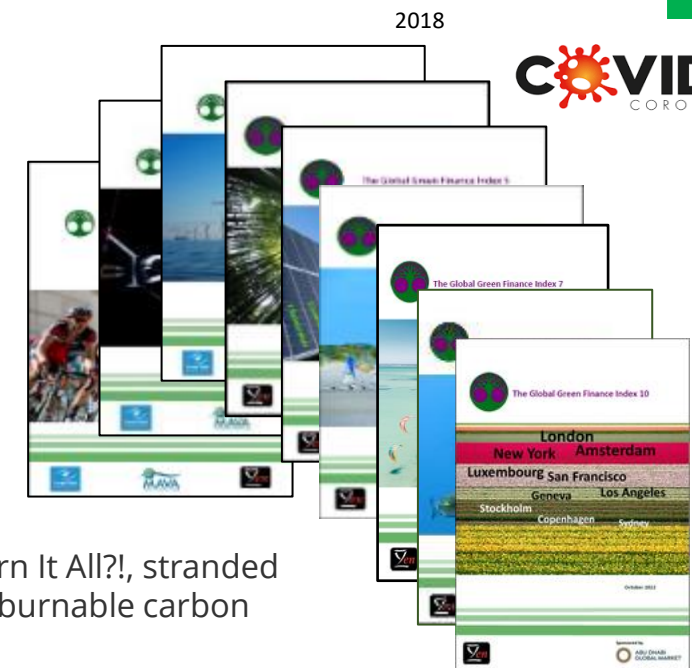
2008



2006

Following COP3 Kyoto (1997), City of London Corporation publishes – ["Trading Emission Permits – A Business Opportunity For The City?"](#) (January 1999). COLC sets up shadow trading scheme, works with DTI, EU Emissions Trading System (ETS) adopts UK framework, launches April 2005.

Carbon - Burn It All?!, stranded assets, unburnable carbon



2018



2020



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# The Environment – A Luxury Good?

More than climate change...

- 1960's – *Silent Spring* (1962), WWF
- 1970's – Earth Day (1970), United States Environmental Protection Agency, Greenpeace, Three Mile Island

## 1973 oil crisis

- 1980's – IUCN & World Conservation Monitoring Centre, Antarctic ozone hole, Chernobyl, Exxon Valdez

## Early 1980's recession

- 1990's – BS7750 to ISO14000, US SO2 cap-and-trade, Earth Summit, Kyoto COP, IPCC assessment reports

## 1992 downturn, 2000 dot.bomb

- 2000's – EU Emissions Trading System, London Accord

## 2010 financial crises

- 2010's – Paris COP, solar equivalence, rise (again) of ESG

## Covid-19?

- 2020's – Net-zero 'targets', Chinese ETS



# Winning Portfolios In 2007

Successful model portfolios exist – though **concentrated** at \$30 to \$60 per tonne, and based upon IPCC/UNFCCC data

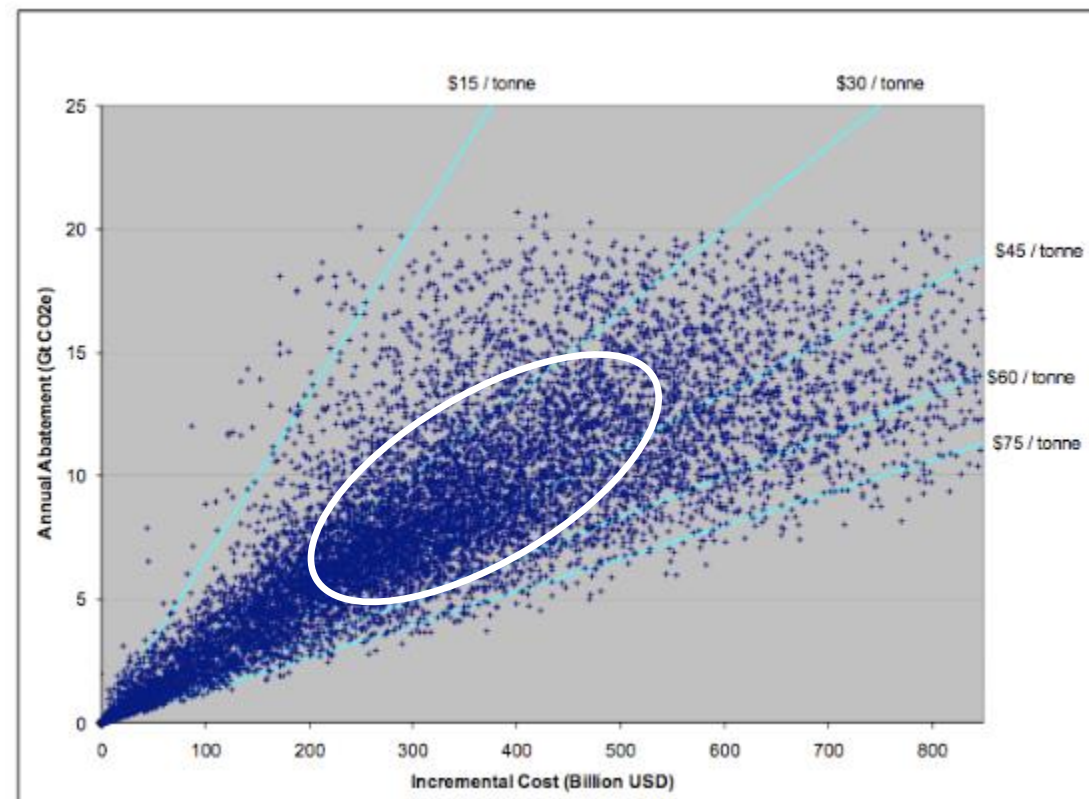
**Focus on the carbon market** - business investment follows the carbon price

**Avoid carbon-dumping wars** – duties on carbon ‘at the borders’ could be worse than anti-dumping trade wars



A **mix** of sectors and technologies is essential; no single technology suffices

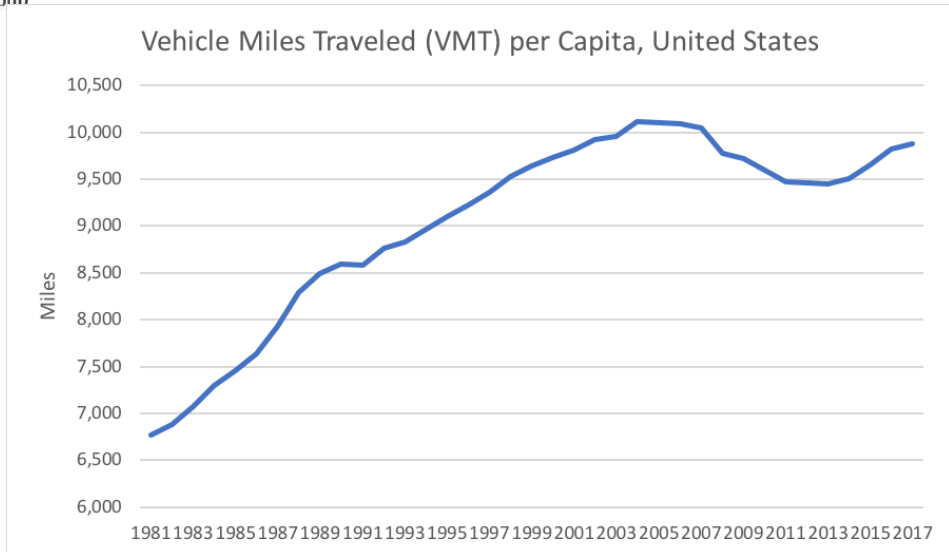
**Abatement** potential up to about 15 Gt is available



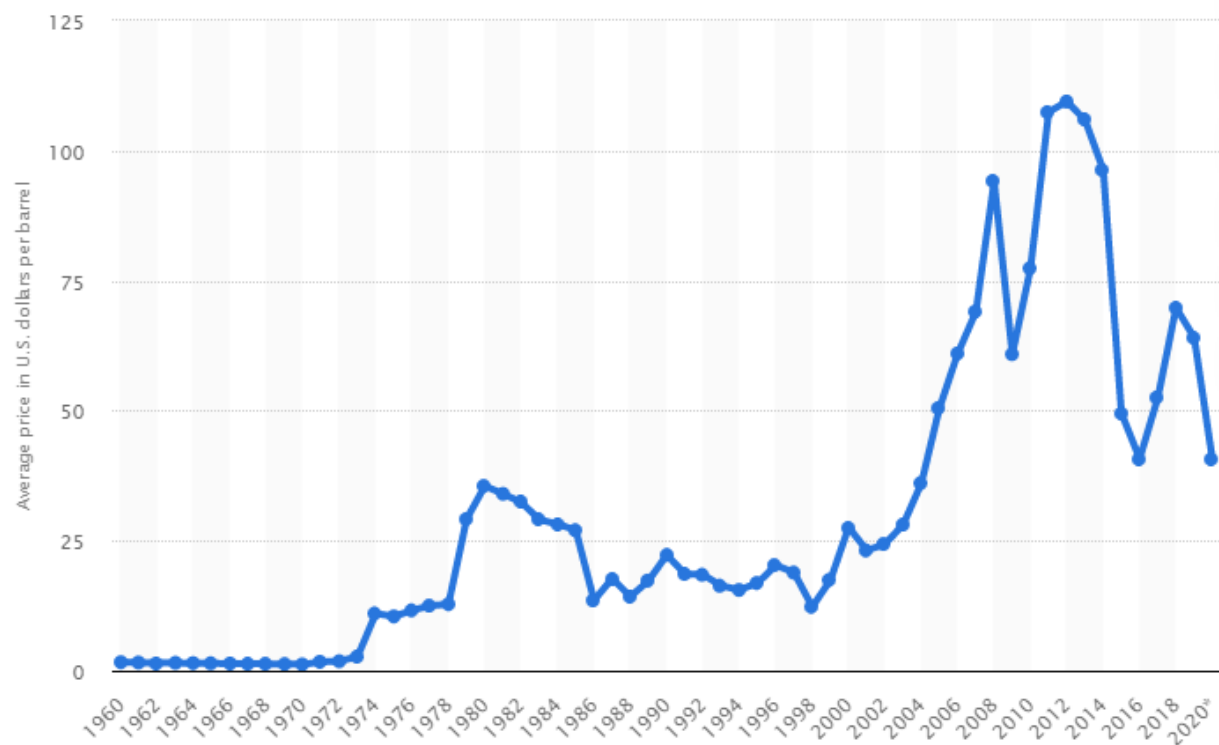


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# Awareness Works?

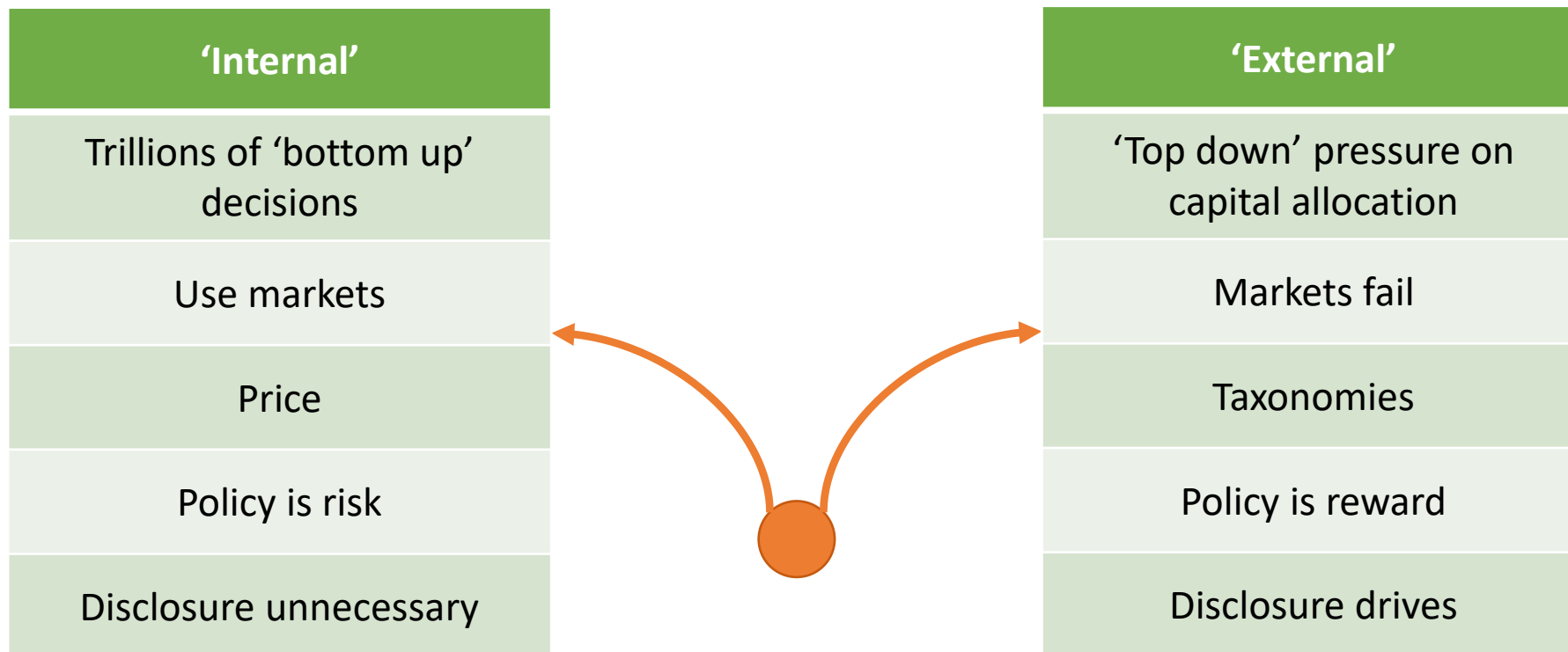


- Covid-19? 6% temporarily
- Miles driven in America dropped 4% in 2011 due to a 32% increase in oil prices, not due to an outbreak of environmental awareness



# After 'Awareness' What Next?

## *Need Economics - Plandemics Are Insufficient*





## ESG Works?

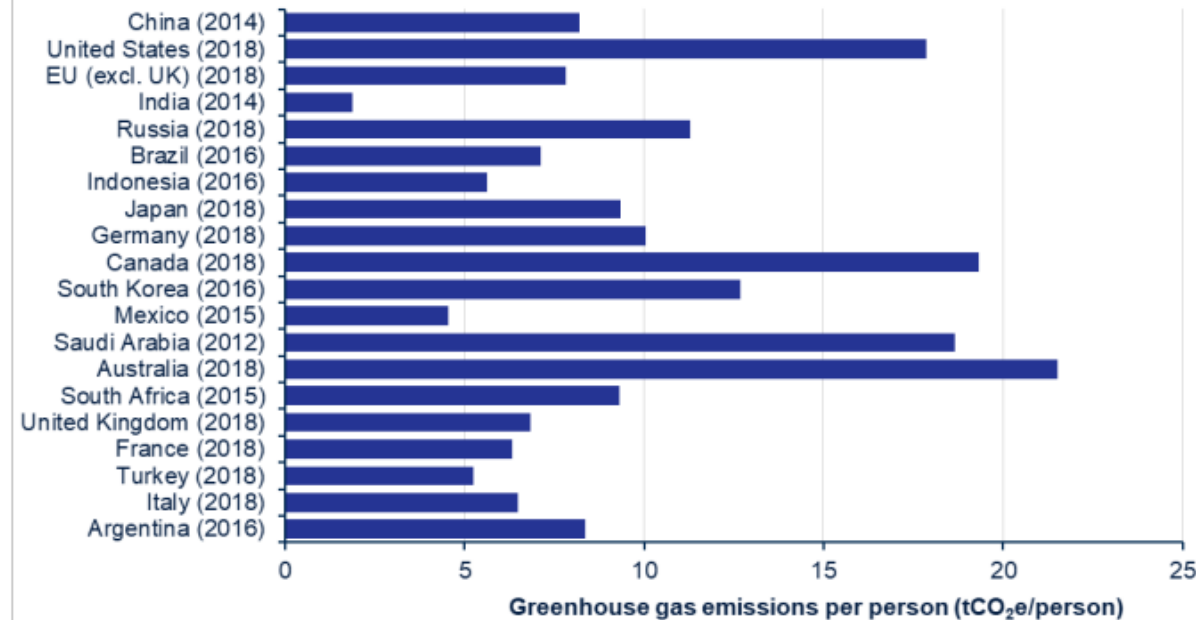
- ESG has had 25 years+ already
- MIT 'Aggregate Confusion' project found companies could be in the top 5% on one ESG rating algorithm and the bottom 20% on another - reputable firms like Shell find their ratings to be A from one rating agency and C+ from another
- 'Alphabet' soup of ESG models may be an irresolvable problem
- Creating separate 'currency'
- Out of time



# Meet The Numbers, Price x Quantity or Macro-economics

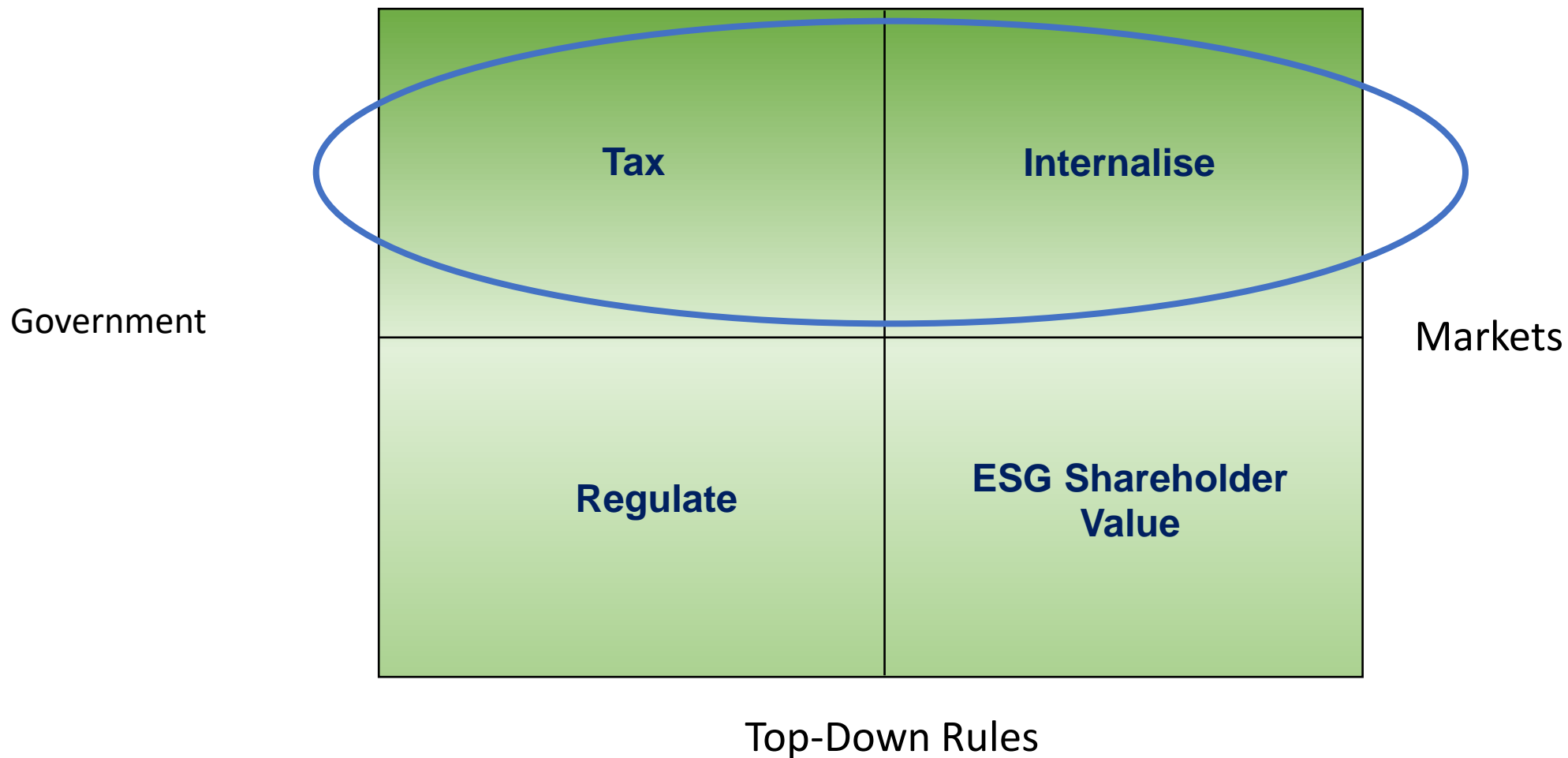
- UK CO<sub>2</sub>e emissions = 7 tonnes/UK citizen, or 12.7 tonnes ‘carbon footprint’ – say 10 tonnes:
  - US\$50 tonne/UK citizen = US\$500/year
  - US\$100/tonne/UK citizen = US\$1,000/year
- Stern Review (2006):
  - 1%, then 2% of GDP
  - = US\$403 to US\$806/UK citizen

Figure 17: Territorial greenhouse gas emissions per person: G20 countries (tCO<sub>2</sub>e)



# Policies Need Pricing

## In 1997 (COP3), 2007 (London Accord), Or 2021 (COP26)



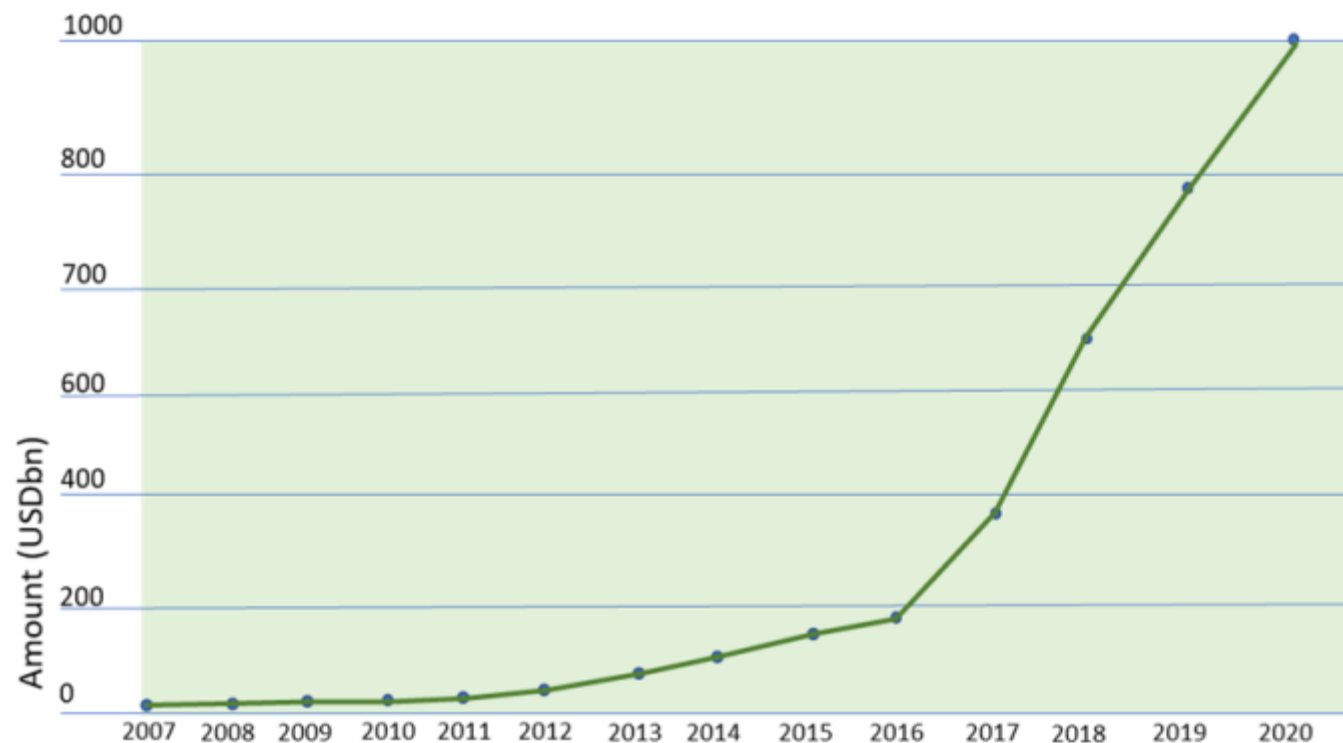
Need Economics - Plandemics Are Insufficient



## Green – ESG ‘Use Of Proceeds’ - Bonds

- Green Bonds have been the ‘gateway drug’ that has got the markets hooked on green finance.
- Debut in 2007 with AAA-rated issuance from the European Investment Bank.
- December 2020 saw the cumulative issuance of green bonds, worldwide, reach \$1 trillion.
- It’s forecast that Green bond investment in a single year is set to double and reach \$1 trillion for the first time by the end of Q4 2022.

Exponential Growth Of The Green Bonds Market



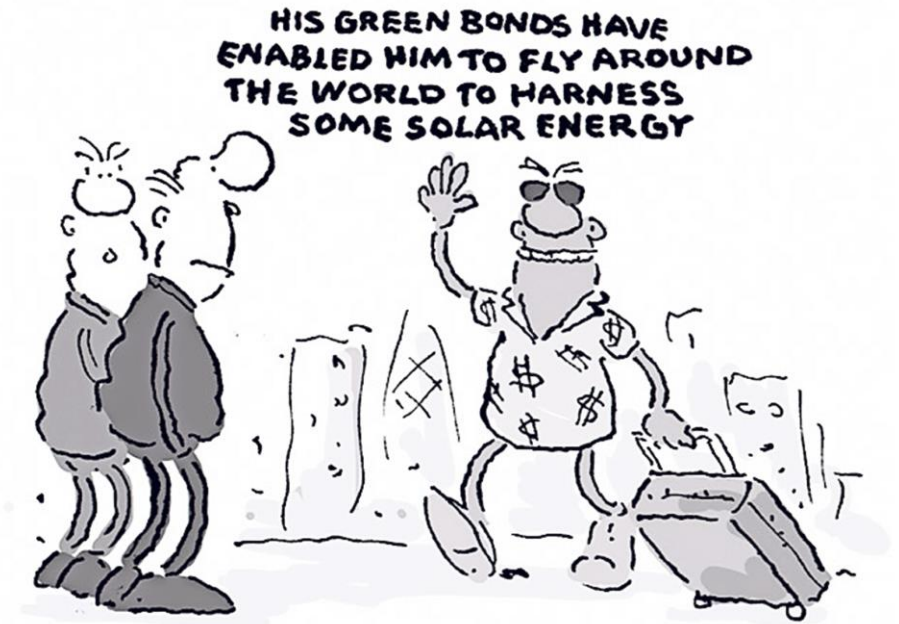
# Some Prejudices

Green debt instruments hold a triple advantage:

- They enhance company (country) reputation and underscore sustainability commitments.
- Green bonds are suitable for long term projects (such as renewables) and the disclosure requirements associated with them place sustainability performance on companies' balance sheets.
- Green bonds are a highly effective way to diversify debt and raise funds – especially for emerging economies.

However:

- No commonly agreed definitions or frameworks (Choose from Climate Bonds Standard, Green Bond Principles, ASEAN Green Bond Standards, Sustainability Linked Bond Standards or no standards at all – see MIT [Aggregate Confusion](#) project and reports).
- Accusations of greenwashing (issuing a bond, labelled or unlabelled, that supports unsustainable activity).
- Green bonds are project specific, **'use of proceeds'** rather than **'rewarded on outcomes'**.



# Politicians' Promises

Politicians promise all sorts of things, sometimes they even mean them ... at the time



# Policy Risk

Governments claim commitment to ending climate change, but long term existential risks are trumped by short term issues. Result? Policy U-turns.

For investors in a low-carbon future, uncertainty about government commitment manifests itself in three specific risks:

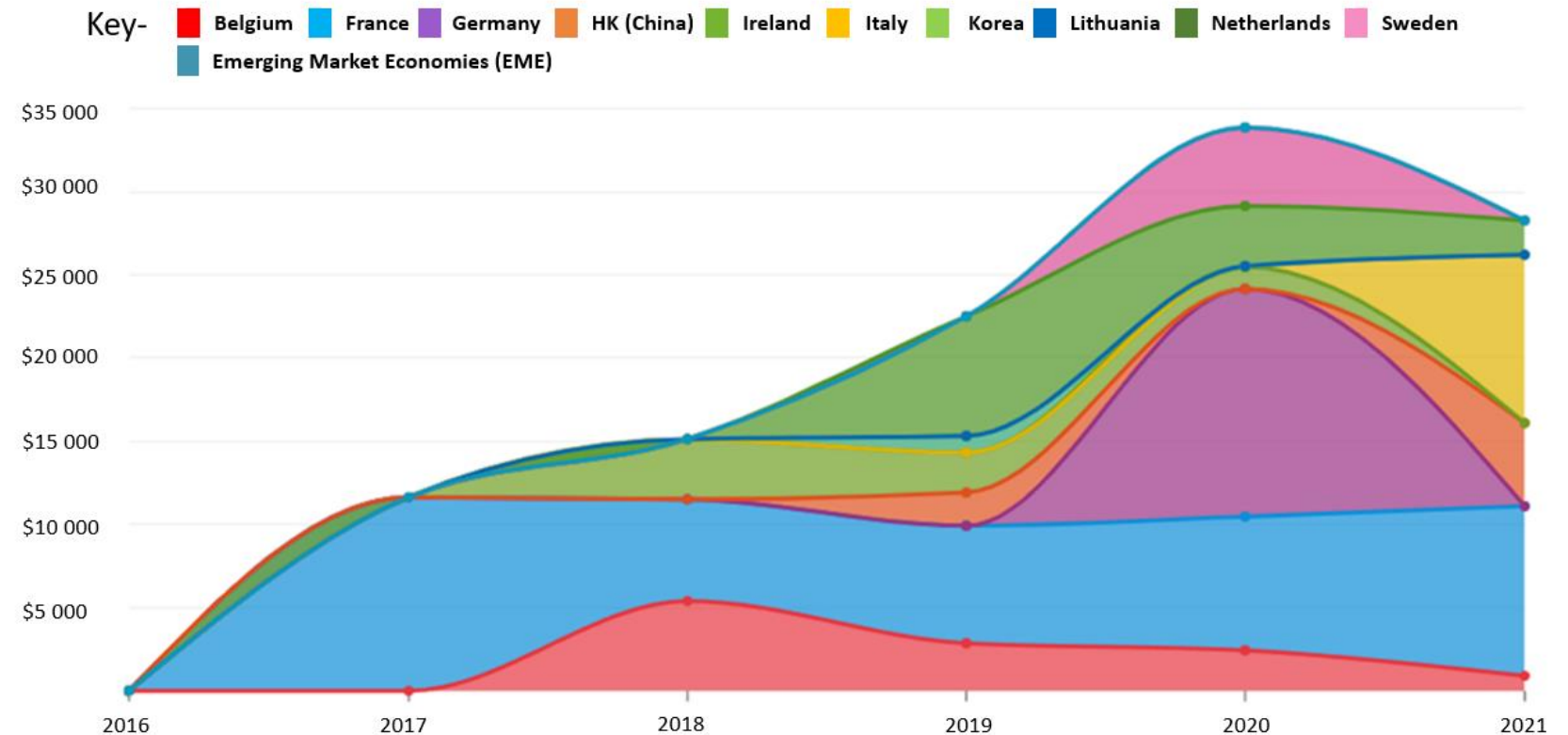
- government carbon emission targets being missed
- fossil fuel prices remaining low
- carbon (emissions) prices remaining low

Conclusion? Hedge using fossil fuel investments.



# Sovereign Green Bonds

- Nations were a little slow to join the party.
- Poland pipped France to the post to issue the first sovereign green bond in 2016.
- UK did not issue a green bond until 2021.



Note: Data as at March 2021, EME include Chile (2019-21), Egypt (2020), Fiji (2017), Hungary (2020), Indonesia (2018-20), Nigeria (2017,2019), Poland (2016,2018-19), Seychelles (2018) and Thailand (2020).  
Source: OECD (2020) OECD Business and Finance Outlook 2021



# History Lesson

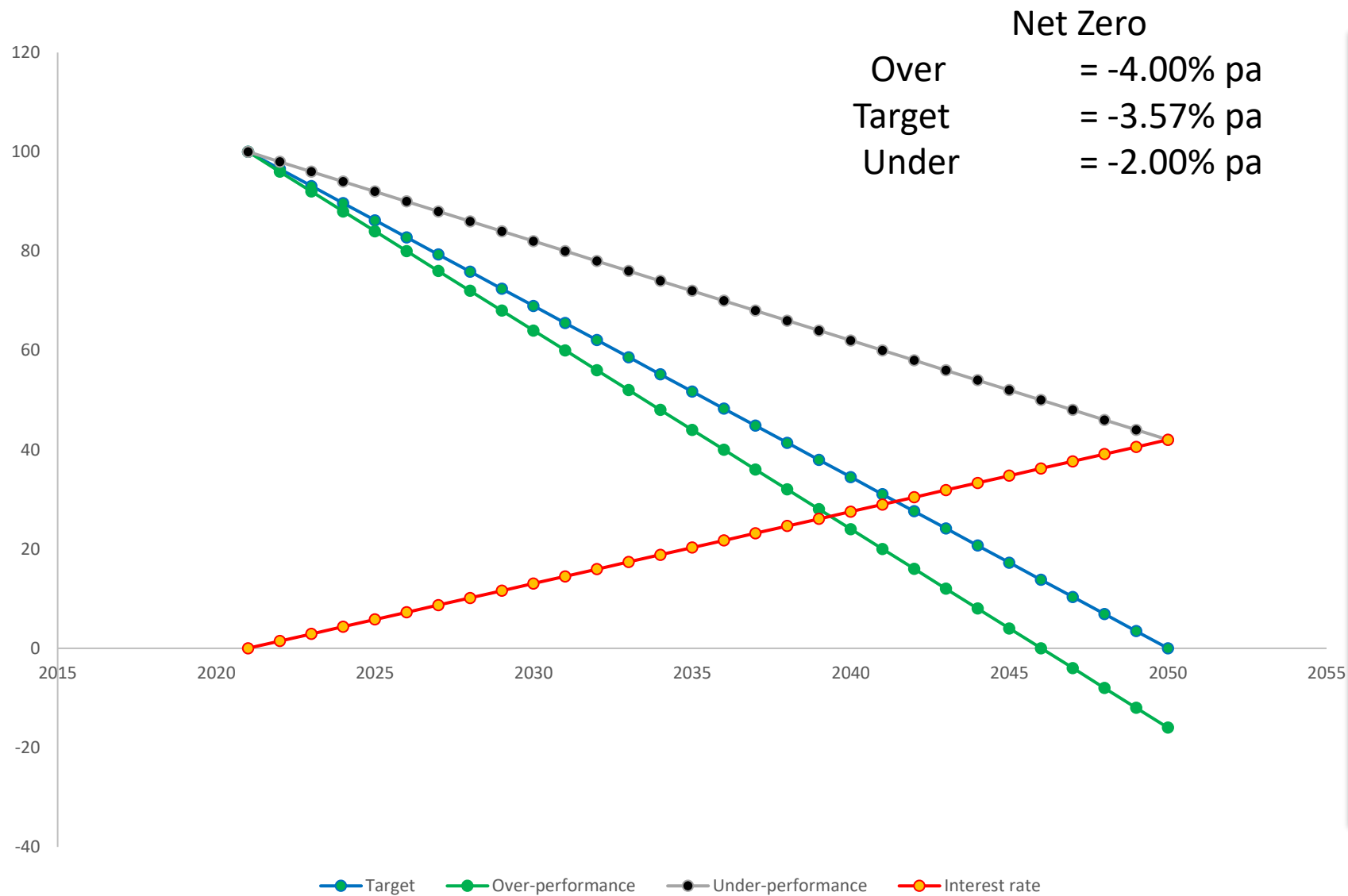
- In 2005, Long Finance's London Accord observed that the world's first known inflation-indexed bonds were issued by the Massachusetts Bay Company in 1780, invented to deal with severe wartime inflation and with discontent among soldiers. The bonds were a promise that the Commonwealth of Massachusetts would **pursue a policy to tackle inflation**, backed by financial penalties should it fail to do so.
- Why couldn't this concept be applied to climate change? The idea was formally presented by Z/en at the World Bank Government Borrowers' Forum in Ljubljana in May 2009, was included in the City of London's submission to COP15 in Copenhagen, was promoted by the French government in the run-up to COP21 in 2015 and has been the subject of many papers and journal articles.





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# Policy Performance Bonds



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Les Obligations à Impact Environnemental

Abdeldjelil Bouzidi  
Michael Mainelli

**RB**  
EDMOND

# Policy 'Bond-Cuffs'

[Policy performance bonds](#) - (aka 'ESG linked', 'sustainability linked', 'performance incentive')

Education:

2017 - Khazanah

Sustainability:

2018 – Danone, Wilmar

2019 - Louis Dreyfus, Nokia, Enel, Bunge, MásMóvil, COFCO

2020 – WSP, Schneider Electric

2021 – TRIG (UK), Bank of China

Sustainability market:

2020 - \$11bn

2021 - \$110bn





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## Summary - Policy Performance Bonds



- Policy Performance Bonds (PPBs) or Sustainability-Linked Bonds (SLBs) are issued with specific sustainability performance targets (SPTs), which contain key performance indicators (KPIs), for example: “A 10% reduction in scope 1 and 2 emissions by 2032”.
- If the SPT is missed the bond is subject to a ‘step-up’ clause, meaning the bond interest increases.
- This type of financial instrument provides a hedge against the issuer not delivering on commitments or targets - if the low-carbon future fails to arrive, due to changes in policy (such as subsidies or tax breaks) the government bears some of the direct costs by having to pay higher interest rates on government debt.
- Policy performance bonds can be issued against a range of social or environmental issues which are policy dependent, including education, deforestation, and housing.
- Major advantage of SLBs is that they are tied to **outcomes** rather than **application** – this means that an organisation or country can use a wide range of means to achieve outcome – such as education and training, the recruitment of specialist staff, or grants and subsidies.



4 Mar, 2022

**IN THIS LIST**

**World's 1st sovereign sustainability linked bond issued by Chile**

**PODCAST**

Street Talk | Episode 90: Banks should not wait on the Fed to put cash to work

**BLOG**

Expand Your Perspective: Data & Distribution Q&A

**PODCAST**

Street Talk | Episode 89: Big bank cuts to overdraft fees could trickle down to small banks, spur M&A

**CASE STUDY**

A Large Bank Deepens and Automates its Analysis of

## World's 1st sovereign sustainability linked bond issued by Chile

Chile issued the world's first sovereign sustainability linked bond this week, the finance ministry said.

The \$2 billion sustainability-linked bond was issued March 2, carrying a 4.346% rate or 200 basis points above 20-year U.S. Treasury notes. Demand for the bond reached more than \$8 billion, or 4.1 times the original placed amount, spread across investors in Europe, Asia and the Americas. Finance Minister Rodrigo Cerda noted this was a sign of confidence in the Chilean economy.

The bond adheres to the Paris Agreement on climate change, including that the country emit no more than 95 metric tons of carbon dioxide and equivalent by 2030 and that 60% of electricity production be derived from renewable energy by 2032.



# Chile Breaks The Mould

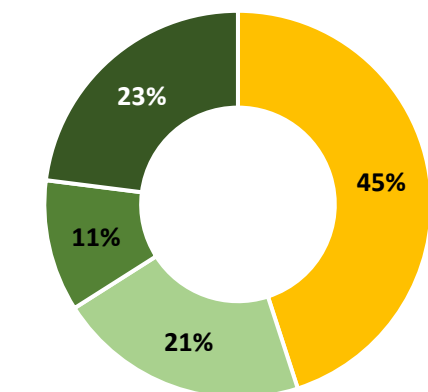
- In March 2022, the Republic of Chile priced the first-ever Sovereign Sustainability-Linked Bond (SSLB).
- This \$2 billion 20 year SSLB has generated a strong appetite from more than 230 investors, more than four times oversubscribed.
- The sustainability performance targets were pretty stringent
  - an absolute reduction in greenhouse gas emissions (from 112.3mt/pa in 2018 to 95mt/pa) by 2030
  - an increase in renewable energy generation (from 43% to 60% renewables by 2032)
- Because the SSLB is not tied to a specific project, Chile is free to use any means it can to achieve them



# Sustainability-Linked Bonds

- On February, 2022 Chile published its SLB Framework, which sets the guidelines for the issuance of SLB.
- SLB Framework aligned with the SLB Principles of ICMA.
- Through this Chile seeks to expand its ESG instruments, including instruments whose financial cost of depends on sustainability performance targets. In short: efforts are aligned to meet goals; if not, there will be a penalty.**
- In its SLB Framework, Chile established targets (SPTs) based on:
  - Achieve annual GHG emissions of 95 MtCO<sub>2</sub>e by 2030 (SPT1a)
  - Achieve a maximum GHG budget of 1,100 MtCO<sub>2</sub>e between 2020 and 2030 (SPT1b)
  - Achieve 60% electricity generation derived from non-conventional renewable sources by 2032 (SPT2)
- On March, 2022 Chile issued its first SLB, US\$2 billion dollar denominated with maturity on 2042 (20yrs).**
- Coupon Step-Up: 12.5 or 25 bps if one or two SPTs are not satisfied, respectively (8yrs fully accrued payment; equivalent to potential total penalty of 200 bps)
- IPTs: T+240bp area; Final Spread: T+200bp; New Issue Concession: 15bp; Final Orderbook: \$5.75bn

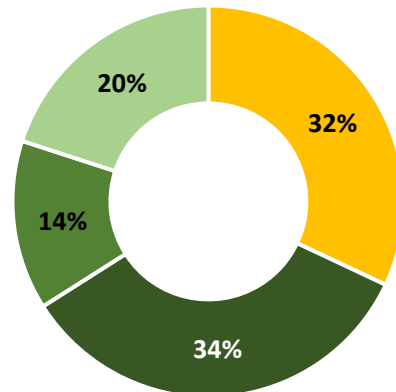
**SRI Investors Density by Number of Accounts**



■ Not SRI ■ Dark ■ Medium ■ Light

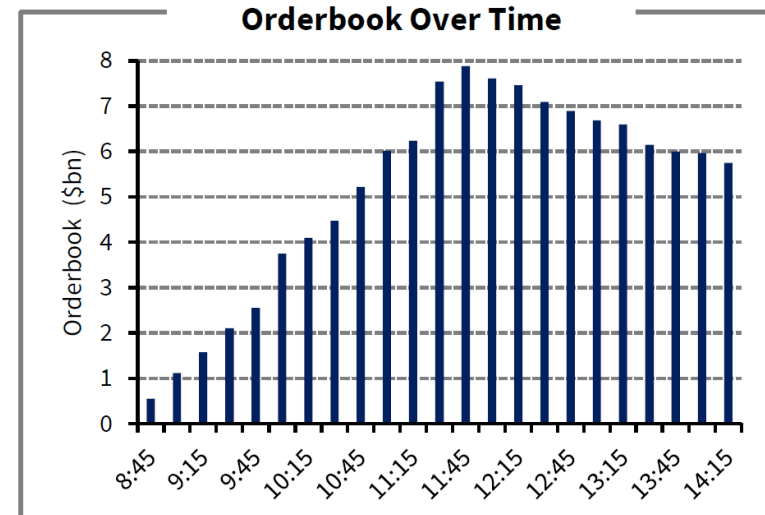
- 55% of accounts where SRI investors
- 68% of allocation went to SRI investors

**SRI Investors Density of Allocation**



■ Not SRI ■ Dark ■ Medium ■ Light

**Orderbook Over Time**



# Challenges To Countries Issuing SSLBs

**Political Handcuffs** - Sovereign SLBs mature across multiple electoral cycles -new parties taking charge may have different policy priorities – but they are still tied to the commitments embedded in the SSLB.

**Shorting The Government’s ESG Performance** - Some investors do not want to ‘short’ the sustainability performance of a government and are worried to make the situation of a potentially vulnerable issuer harder and more complex if a target is missed.

**ESG data availability and transparency** - For SSLBs to be successful, investors need to trust the data used for the KPIs’ and SPTs’ computation and progression monitoring. Second Party Opinion firms, external auditors, and national statistics authorities should be used to establish a strong Monitoring, Reporting, and Verification framework regarding SPTs.

**Private Sector Responsibility For Meeting Targets** - Some sustainability performance targets rely, in large part, on private sector cooperation. Less than 100 companies are responsible for 71% of world GHG emissions according to a Carbon Disclosure Project report. As a result, some Debt Management Offices do not feel comfortable with a target that is not fully controlled by government.





# Roadmaps Differ

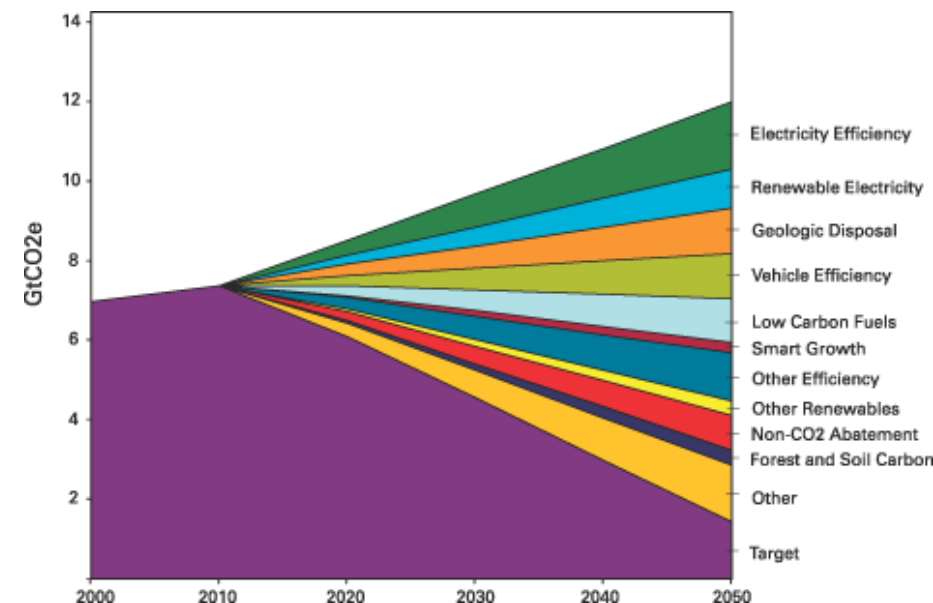
## Top 10 solutions to climate change

Total gigatons of CO<sub>2</sub>-equivalent emissions that could be reduced by 2050

SOLUTION		PLAUSIBLE SCENARIO		DRAWDOWN SCENARIO		OPTIMUM SCENARIO
Refrigerant Management	1	89.74	2	96.49	3	96.49
Wind Turbines (Onshore)	2	84.60	1	146.50	1	139.31
Reduced Food Waste	3	70.53	4	83.03	4	92.89
Plant-Rich Diet	4	66.11	5	78.65	5	87.86
Tropical Forests	5	61.23	3	89.00	2	105.60
Educating Girls	6	59.60	7	59.60	8	59.60
Family Planning	7	59.60	8	59.60	9	59.60
Solar Farms	8	36.90	6	64.60	7	60.48
Silvopasture	9	31.19	9	47.50	6	63.81
Rooftop Solar	10	24.60	10	43.10	13	40.34

Source: Project Drawdown

Vox



# The SDGs

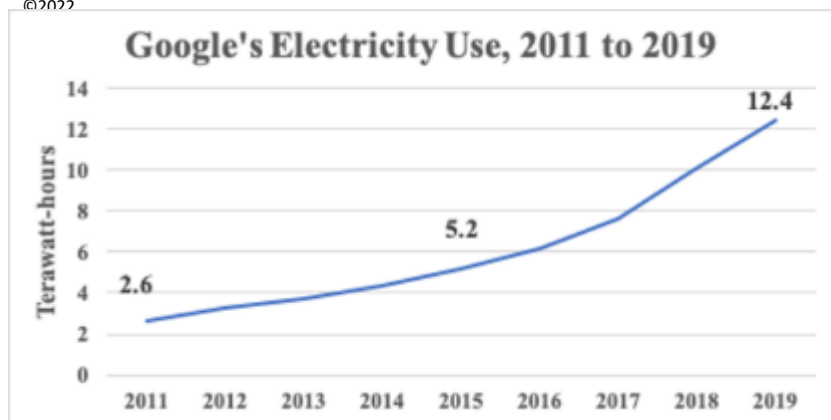
## Financial Services Threats And Opportunities To The Sustainable Development Goals



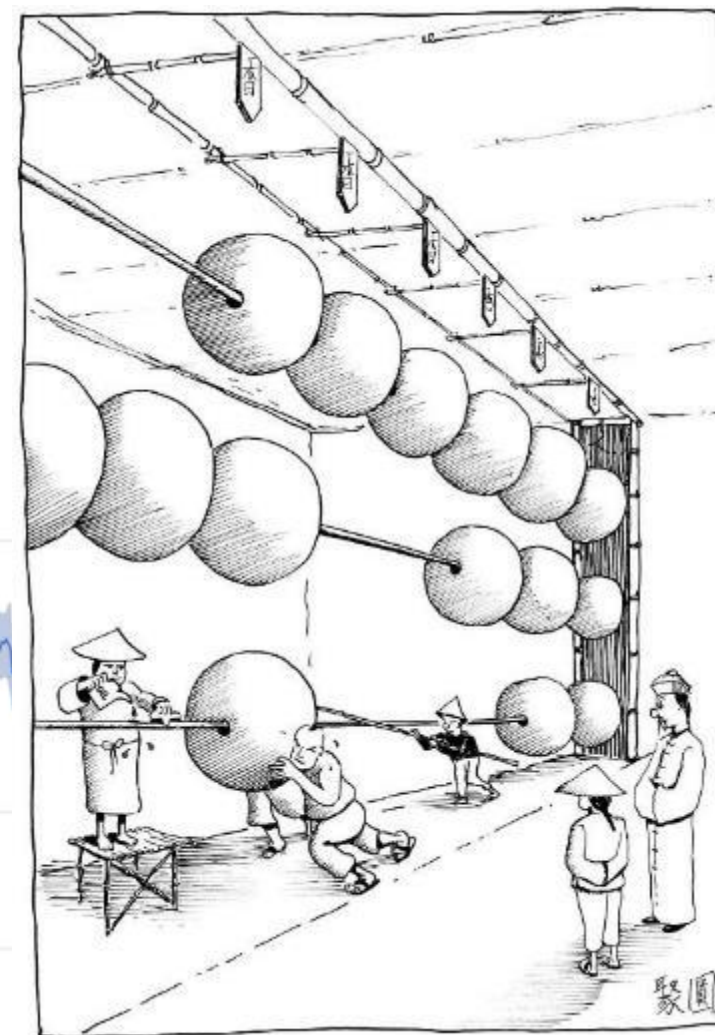
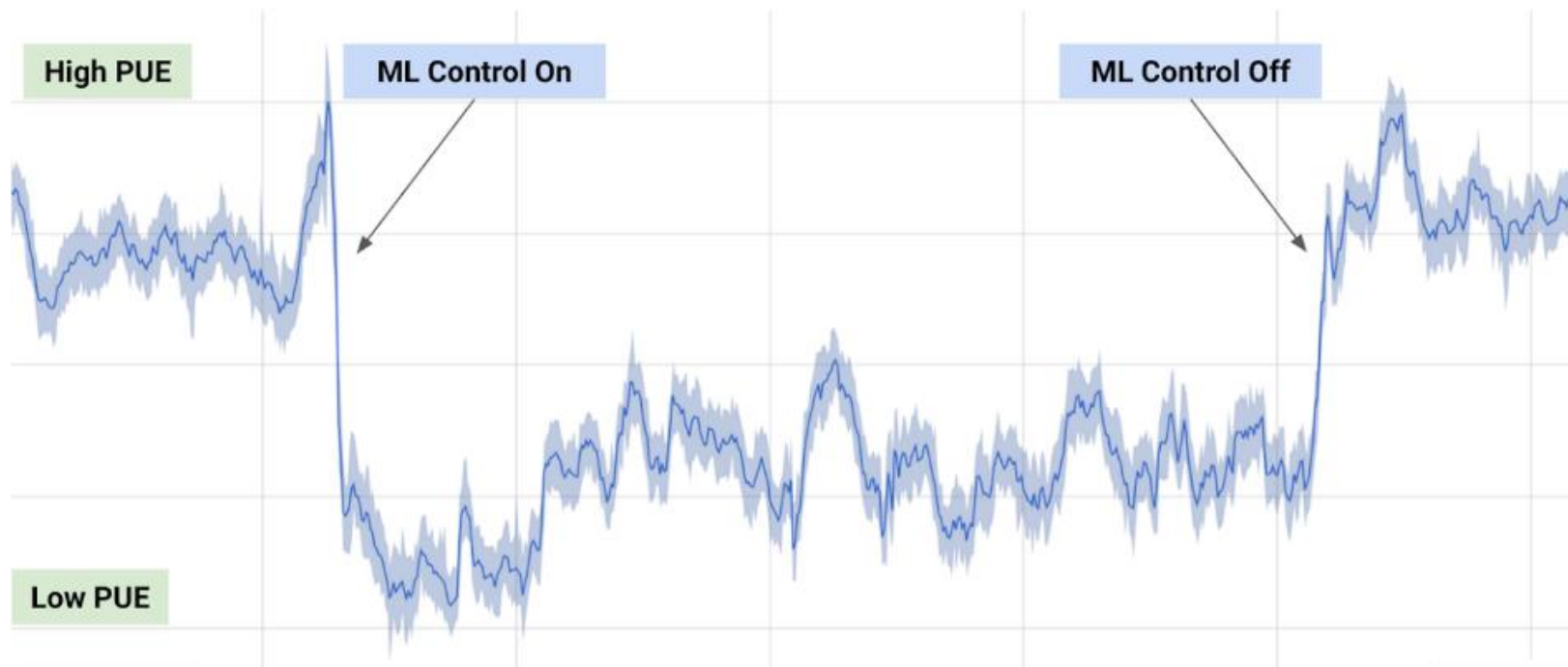


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# Trillions Of Tiny Financial Decisions



“DeepMind AI Reduces Google Data Centre Cooling Bill by 40%”



“Get a big picture grip on the details.”  
*Chao Kli Ning*



# What Will Financial Services Do In The Climate Wars?

**Economy**

time reduction	fewer geographical sites or travel	fewer steps	less material or time
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**Efficiency**

greater throughput per period	load balancing geographically	load balancing between functions	more output for given inputs
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**Effectiveness**

on time for customer	right place	correctly performed	most appropriate
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**Innovation**

radical time change	unexpected location	elimination or automation	elimination
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**Time**

**Place**

**Function**

**Consumption**

Big opportunities for Dynamic Anomaly & Pattern Recognition (DAPR) & finance, in:

- Carbon markets
- Energy storage markets
- Smart transport and logistics markets
- Smart energy markets and grids
- Smart land use management
- Smart cities, urban planning & design

# We've Known The Answer Since Cop3 – Time To Learn To Like It

- Market measures essential - competition, open data, better regulation, and voluntary standards markets
- We should lobby for:
  - costed carbon and extensive coverage
  - policy performance bonds - financial handcuffs on government policy

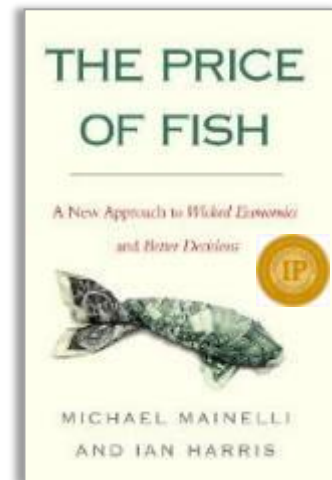


**"Get a detailed grip on the big picture."  
Chao Kli Ning**

# When Would We Know Our Commerce Is Working?



**“Get a big picture grip on the details.”**  
*Chao Kli Ning*



**Thank you!**

[www.youtube.com/zyengroup](http://www.youtube.com/zyengroup)

