Estimating the Power of International Carbon Markets to Increase Global Climate Ambition

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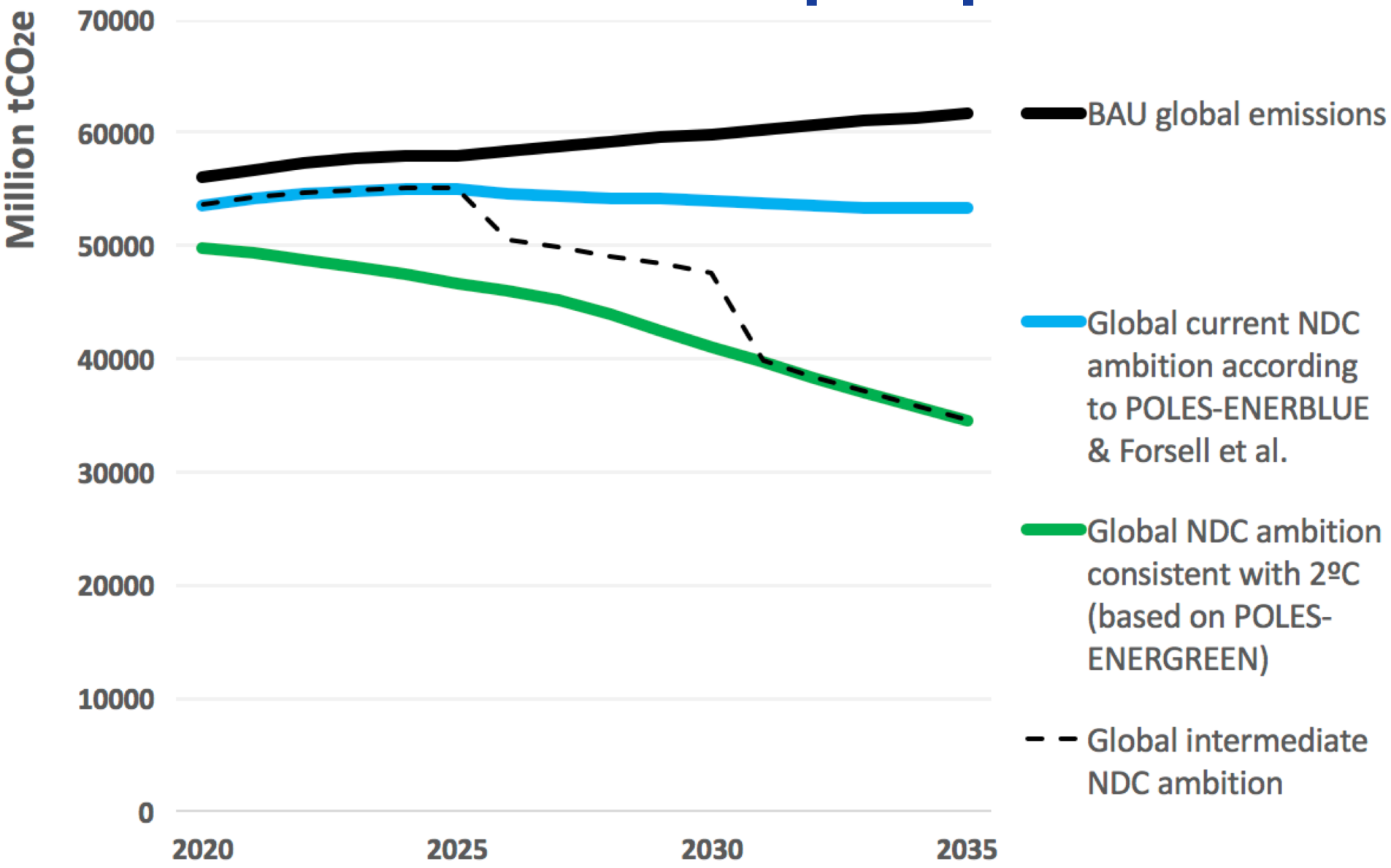
Finding the ways that work

NDC ambition is perspective



Source: EDF based on Enerdata/POLES, IIASA, FAO

Model overview and assumptions

- **Partial equilibrium model** solving for intertemporal equilibrium (with risk premium to account for policy uncertainty); 36 countries/regions, 6 GHGs.

- Trading based on **least-cost approach** based on marginal abatement cost curves (MACCs).

- Nations achieve NDC targets based on an **annual trajectory** that establishes an **absolute limit on emissions** for each sector (and similarly for international aviation).

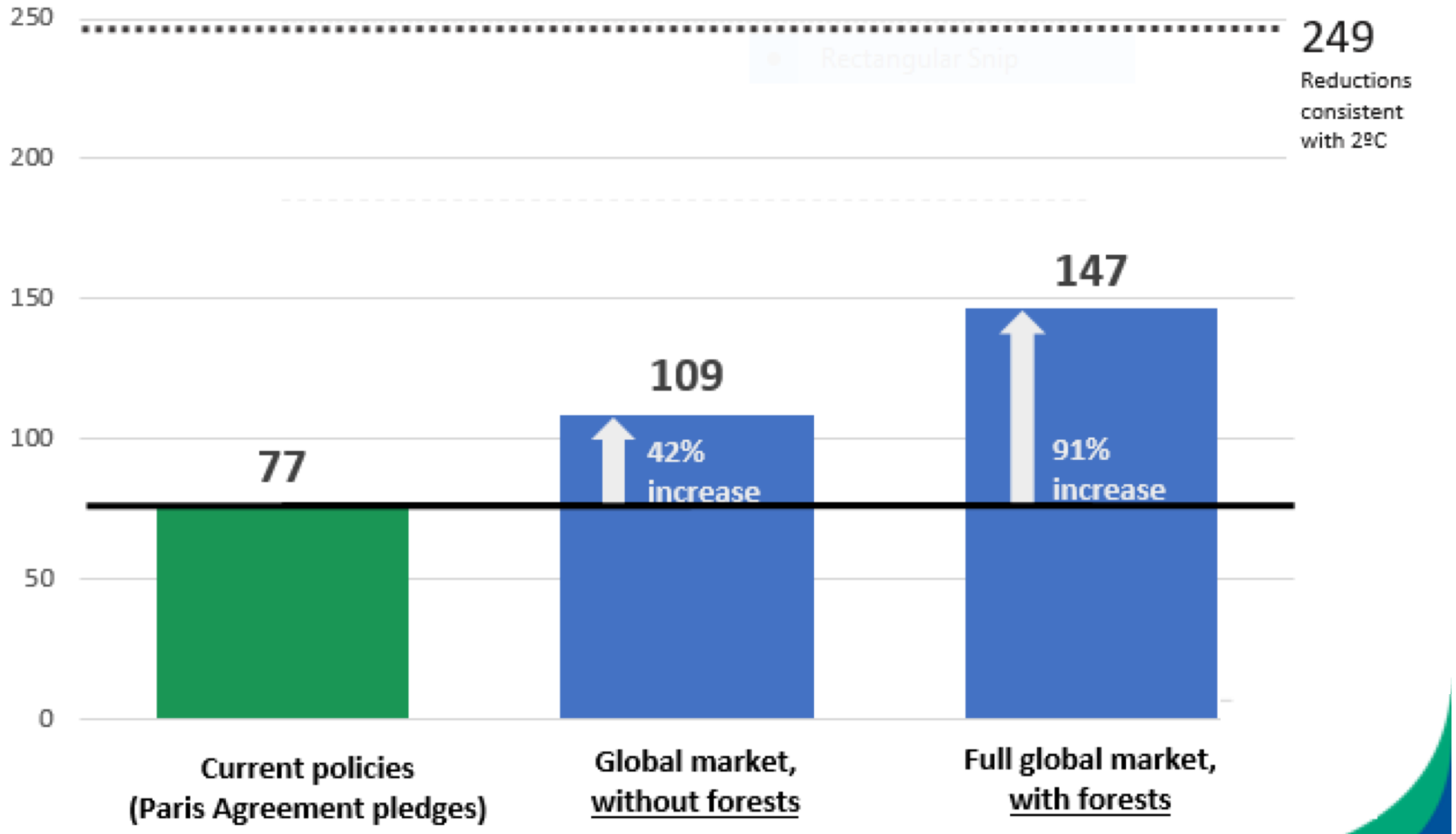
- All traded units represent real mitigation, with **no double counting** of reductions.

- **Banking** (carry forward) of emissions units allowed based on emissions below annualized target trajectory of NDCs.

GLOBAL COVERAGE SCENARIO

Global carbon markets can enable almost double the emissions reductions at the same total cost as current policies

Total emissions reductions from 2020-2035 in billion tonnes CO_2e



Source: EDF

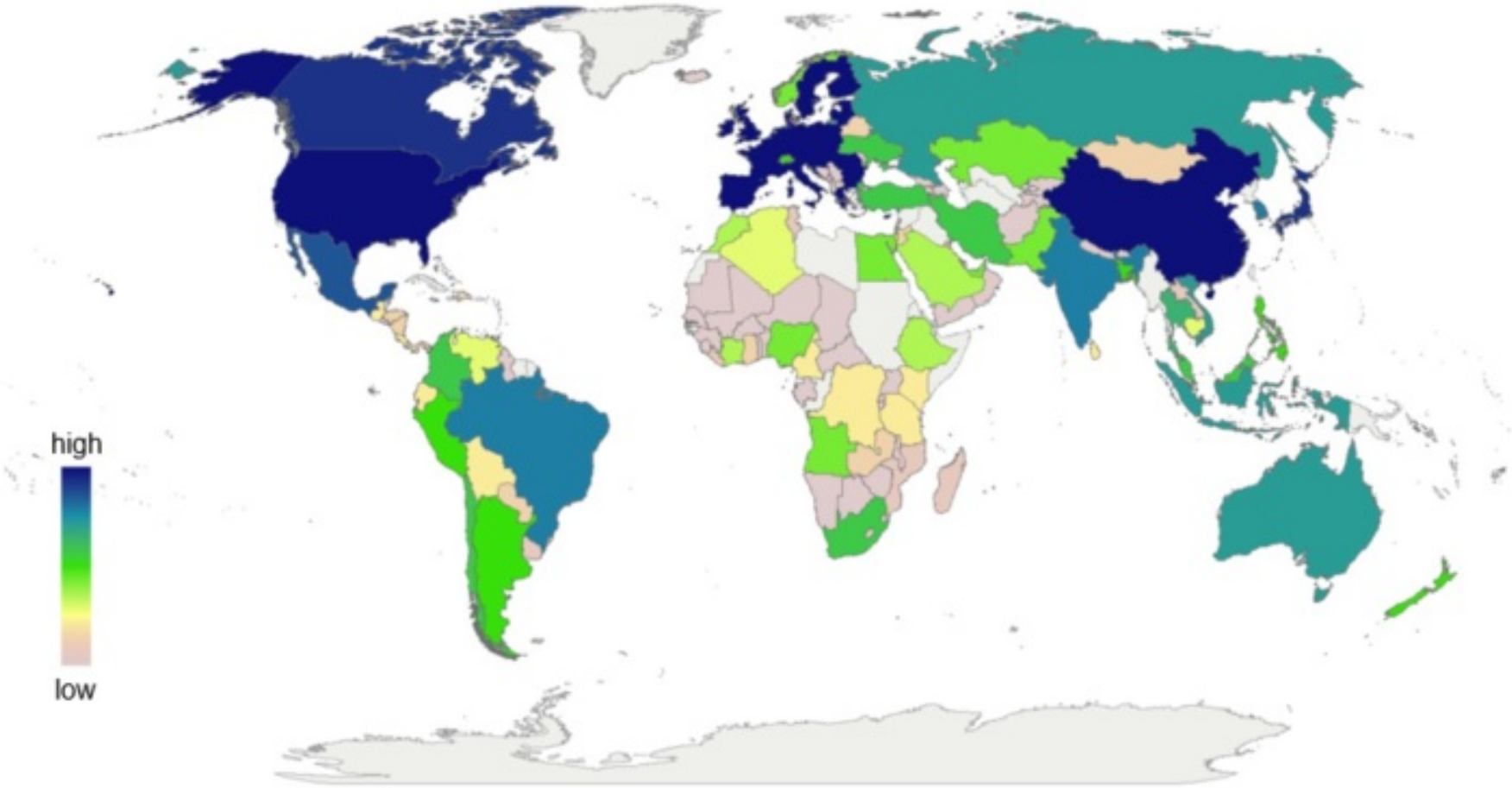
“Co-benefits” of international carbon market cooperation

- Ambition! But also…

- **Environmental and sustainable development benefits**
- **Enhanced trade cooperation in other products and services** of interest to cooperating jurisdictions
- **Strengthened political, economic, and cultural alliances**
- **Synergies with other foreign policy priorities** (food and energy security, innovation, regional air quality, etc.)

PARTIAL COVERAGE BASED ON ‘HEAT MAP’ ANALYSIS

MARKET READINESS AND PRIORITY
"Carbon Markets Heat Map"



Source: EDF

Breaking down Indicators…

GOVERNANCE

Capacity

- Government Effectiveness (WB)
- Political Stability (WB)
- Regulatory Quality (WB)
- Perception of Corruption (TI)
- Control of Corruption (WB)
- Ethics & Corruption (WEF)
- Undue Influence in Government (WEF)
- Rule of Law (WB)
- Public Sector Performance (WEF)
- Security (WEF)
- Average Trust in Institutions * (E)
- Total number of government organizations registered as an observer to the COP
- Total number of government organizations as signatories to the UN Global Compact

Motivation

- Enforcement of Environmental Regulations (WEF)
- Number of Ratified International Treaties (WEF)
- Potential Revenue or Cost from full carbon pricing (WB)
- Adjusted Trade with ETS countries
- Stringency of Environmental Regulations (WEF)
- Trends in Carbon Intensity (Yale)
- Trends in CO2/kWh (Yale)

ENTERPRISE

Capacity

- Macroeconomic Environment (WEF)
- Financial Market Efficiency (WEF)
- Strength in Private Institutions (WEF)
- Business Sophistication (WEF)
- Extent of Corporate Transparency (WB)
- Herfindahl-Hirschmann Index
- Total number of business / private organizations registered as an observer to the COP
- Total number of business/ private organizations as signatories to the UN Global Compact

Motivation

- RECAI Score
- GCII Score
- Carbon Disclosure Project Score
- Innovation Index (WEF)

CIVIL

Capacity

- KPMG Change Readiness Score
- Voice & Accountability (WB)
- Number of Registered Economic Institutions
- Higher Education Index (WEF)
- Graduates in the Environmental Protection Field (OECD only)
- Total number of civil organizations registered as an observer to the COP
- Total number of civil organizations as signatories to the UN Global Compact
- Environmental Democracy Index – Legal Score
- Environmental Democracy Index – Practice Score

Motivation

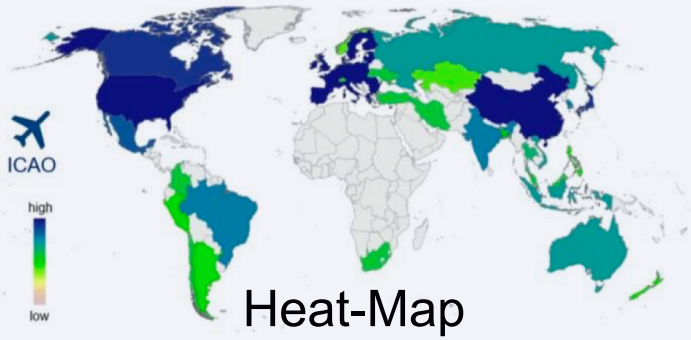
- Public Concern for Climate Change
- Average Exposure – NO_2 Air Pollution (Yale)
- Average Exposure – PM2.5 Air Pollution (Yale)

Carbon market readiness and priority score

Rank	Country	Composite Readiness and Priority Score	Composite Readiness and Priority (Z-Score*)	Societal Readiness		Expressed Interest		Total GHGs		Network Influence	
				Numerical and percentile ranking**							
	European Union	1.0000	6.545	●	1	◑	17	●	3	●	1
	United States	0.9061	5.913	●	2	◔	25	●	2	●	2
	China	0.7964	5.173	●	4	◑	24	●	1	●	3
1	Japan	0.1409	0.757	●	6	●	5	●	8	●	4
2	Canada	0.0885	0.403	●	5	●	10	◕	9	●	5
3	Mexico	0.0679	0.265	◑	26	●	2	◕	10	●	6
4	India	0.0388	0.068	◕	13	◔	28	●	4	◕	11
5	South Korea	0.0309	0.015	◕	12	◑	22	◕	12	●	7
6	Brazil	0.0237	-0.033	◑	22	◕	15	●	6	◕	13
7	Indonesia	0.0143	-0.096	◑	27	◕	13	●	7	◑	17
8	Vietnam	0.0071	-0.145	◔	38	◕	14	◔	22	●	8
9	Russia	0.0055	-0.155	◑	24	○	124	●	5	◑	15
10	Australia	0.0055	-0.155	●	8	○	86	◕	13	◕	9
11	Thailand	0.0048	-0.160	◔	39	◑	19	◑	18	◕	12
12	Iran	0.0020	-0.179	○	62	◔	29	◕	11	◑	20
13	Ukraine	0.0018	-0.181	○	57	●	7	◔	21	◔	24
14	Turkey	0.0018	-0.181	◔	49	◑	21	◑	19	◔	21
15	Chile	0.0015	-0.183	◕	20	●	3	○	45	◑	19
16	Malaysia	0.0014	-0.184	◕	18	○	118	◑	15	◑	14
17	Colombia	0.0013	-0.184	◔	36	●	1	◔	29	○	30
18	South Africa	0.0009	-0.186	◕	19	○	58	◑	17	◔	26
19	Singapore	0.0007	-0.188	●	10	◔	31	○	70	◕	10
20	Argentina	0.0005	-0.189	○	61	○	49	◑	20	○	29
21	Peru	0.0004	-0.190	○	77	◕	16	○	38	○	28
22	New Zealand	0.0004	-0.190	●	9	◕	12	○	50	○	32
23	Philippines	0.0004	-0.190	◑	32	○	88	◔	33	◔	23
24	Bangladesh	0.0003	-0.191	◔	47	◔	37	○	39	◔	25
25	Kazakhstan	0.0003	-0.191	○	58	◑	20	◔	25	○	42

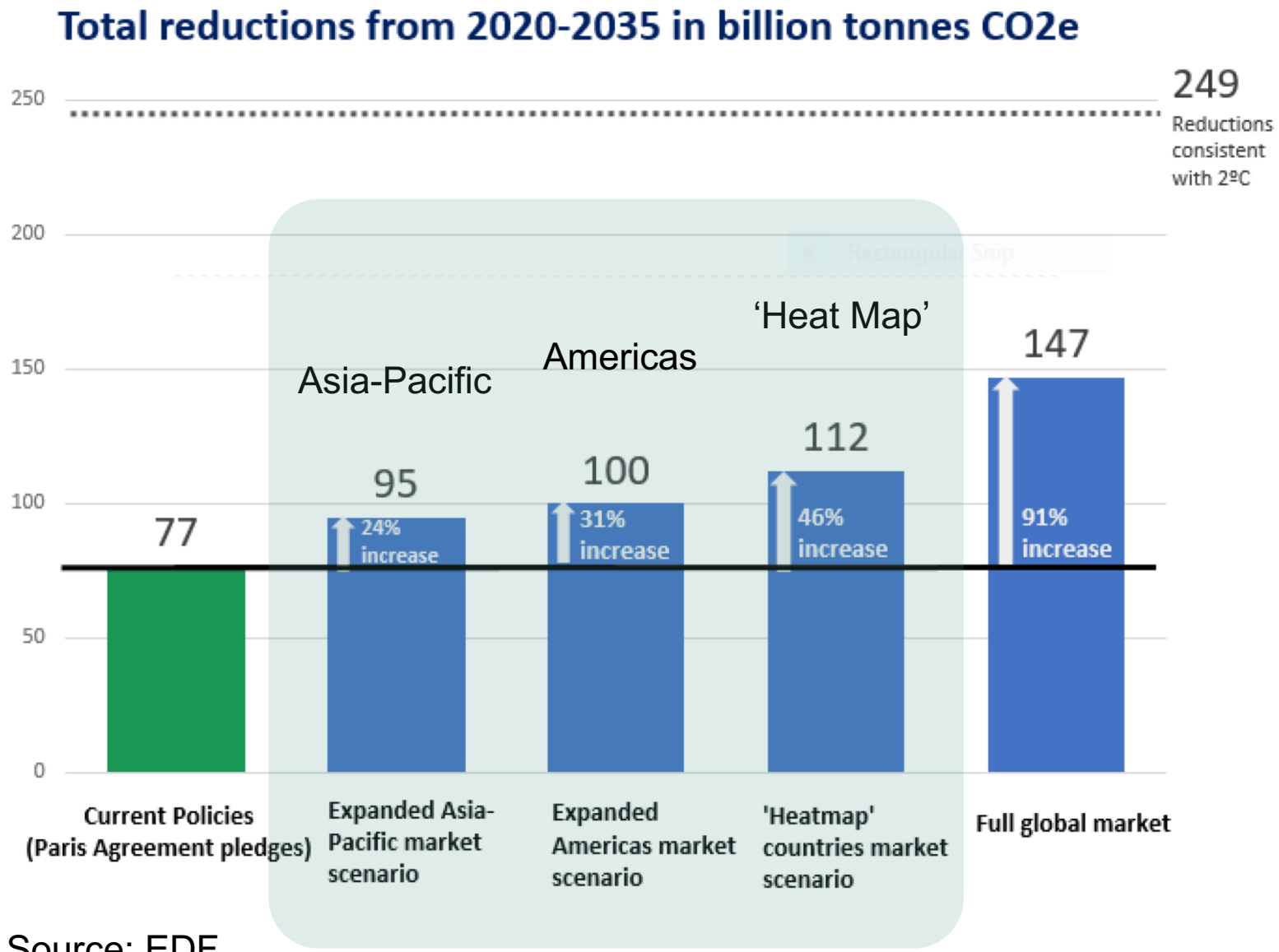
Partial coverage scenarios

- ***'Heat Map' Scenario.***
  - EU, US, China and 25 highest-ranking countries (79% coverage)



- ***Asia-Pacific Scenario.***
  - Current markets plus highest-ranking countries from heat map scenario in Asia-Pacific region (36% coverage).

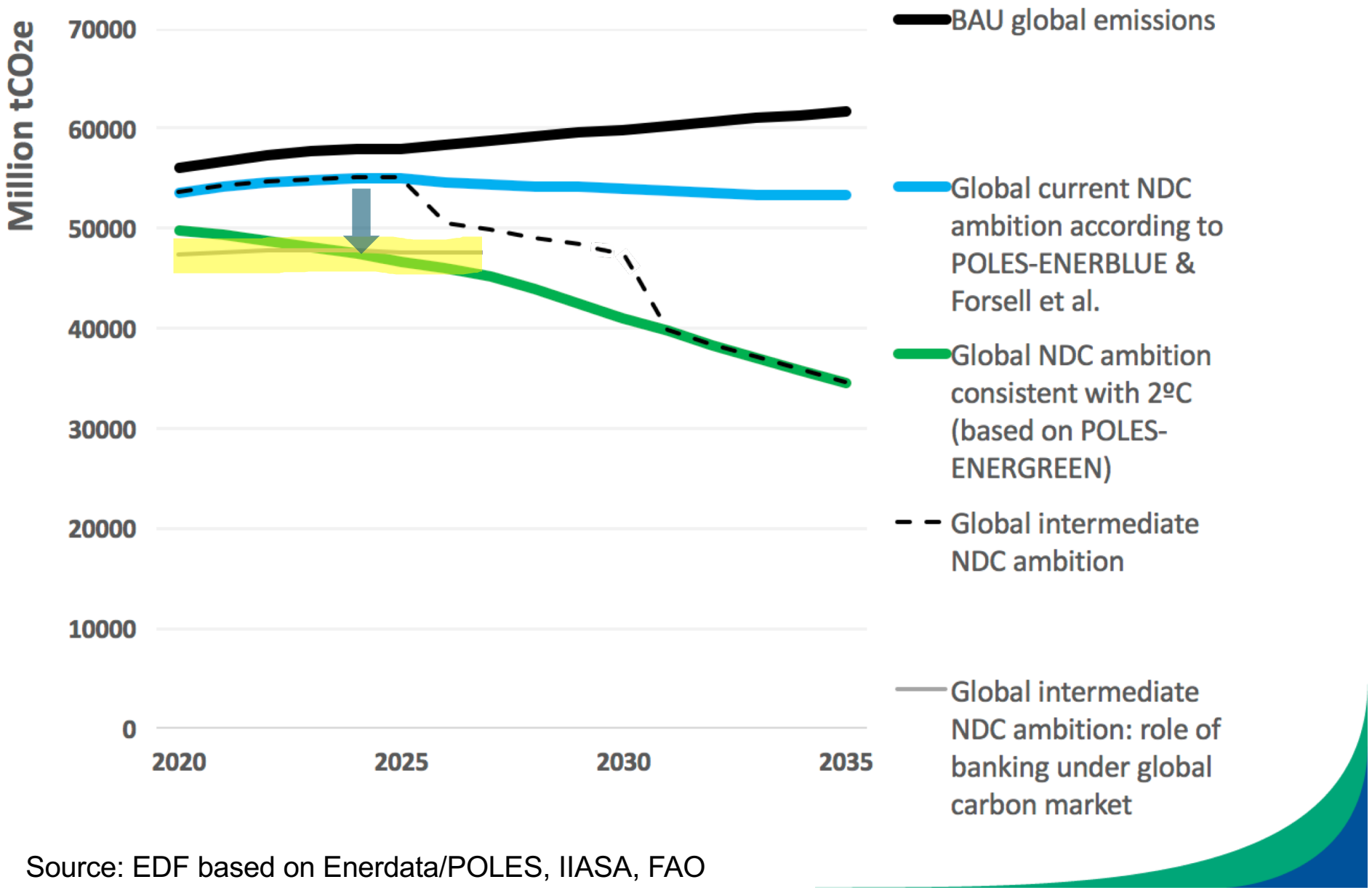
- ***Americas Scenario.***
  - Current markets plus highest-ranking countries from heat map scenario in Americas (42% coverage).



Source: EDF

Significant increases in ambition could still be achieved even with limited international emission trading

The role of banking to keep the 2ºC window open



Source: EDF based on Enerdata/POLES, IIASA, FAO

Key findings

- Global use of carbon markets could allow **nearly double climate ambition** relative to current NDCs at the same total cost.
  - Significant increases in ambition could still be achieved even with limited international emission trading.
- **Reducing deforestation is a key driver** (~1/2) of greater ambition.
- Banking allows keeping the 2ºC window open, under certain conditions.
- **Priority to ensure the development of well-designed, high-integrity international market approaches.**

Thank you!

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Finding the ways that work

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Finding the ways that work

Carbon prices under carbon market scenarios consistent with the Paris Agreement: Implications for the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)

*Analysis conducted by Pedro Piris-Cabezas, Ruben Lubowski and Gabriela Leslie of the Environmental Defense Fund (EDF)**

20 March 2018

Executive Summary

This report analyzes alternative scenarios for the demand for and supply of greenhouse gas emissions units and the resulting carbon price ranges facing the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). The International Civil Aviation Organization (ICAO), the United Nations specialized agency for international air transport, agreed on CORSIA in 2016 as part of a package of policies to help achieve its goal of carbon-neutral growth for international aviation over 2021-2035.[1] The current study explicitly examines emissions unit demand and supply in the context of broader carbon markets expected to emerge as the 2015 Paris Agreement[2] moves forward.

The projected demand for emissions units from the implementation of CORSIA is based on an interactive tool from the Environmental Defense Fund (EDF) that estimates overall coverage and demand from CORSIA in light of current levels of anticipated participation.[3]

We estimate carbon prices by applying EDF's carbon market modeling framework to consider various scenarios for domestic and international emission trading. The EDF carbon market tool balances demand and supply of emissions reductions from multiple sources and sectors in a dynamic framework.

We examine the price of emissions reduction units in CORSIA in a context where airlines will face competing demand for units from other sectors covered under each nation's current Nationally Determined Contributions (NDC) pledges. As demand for emissions units from other sectors is established by the NDC pledges, all units estimated to be available for aviation are analyzed "net of" NDC obligations and therefore not double counted. While beginning to bend absolute emissions downward, the ambition embodied in

[1] ICAO Resolution A39-3: Consolidated statement of continuing ICAO policies and practices related to environmental protection – Global Market-based Measure (MBM) scheme, available at: https://www.icao.int/environmental-protection/Documents/Resolution_A39_3.pdf

[2] Text available at http://unfccc.int/paris_agreement/items/9485.php

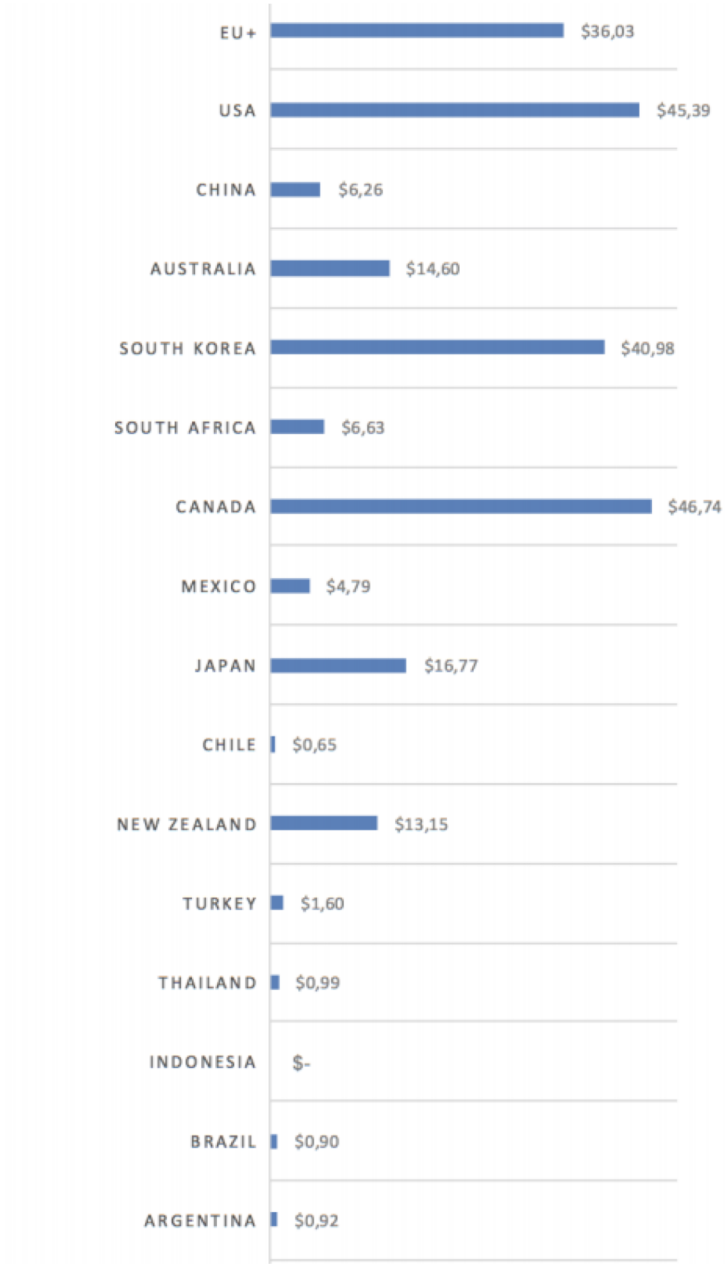
[3] The tool is available at: https://www.edf.org/climate/icaos-market-based-measure. Anticipated participation is at https://www.icao.int/environmental-protection/Pages/market-based-measures.aspx

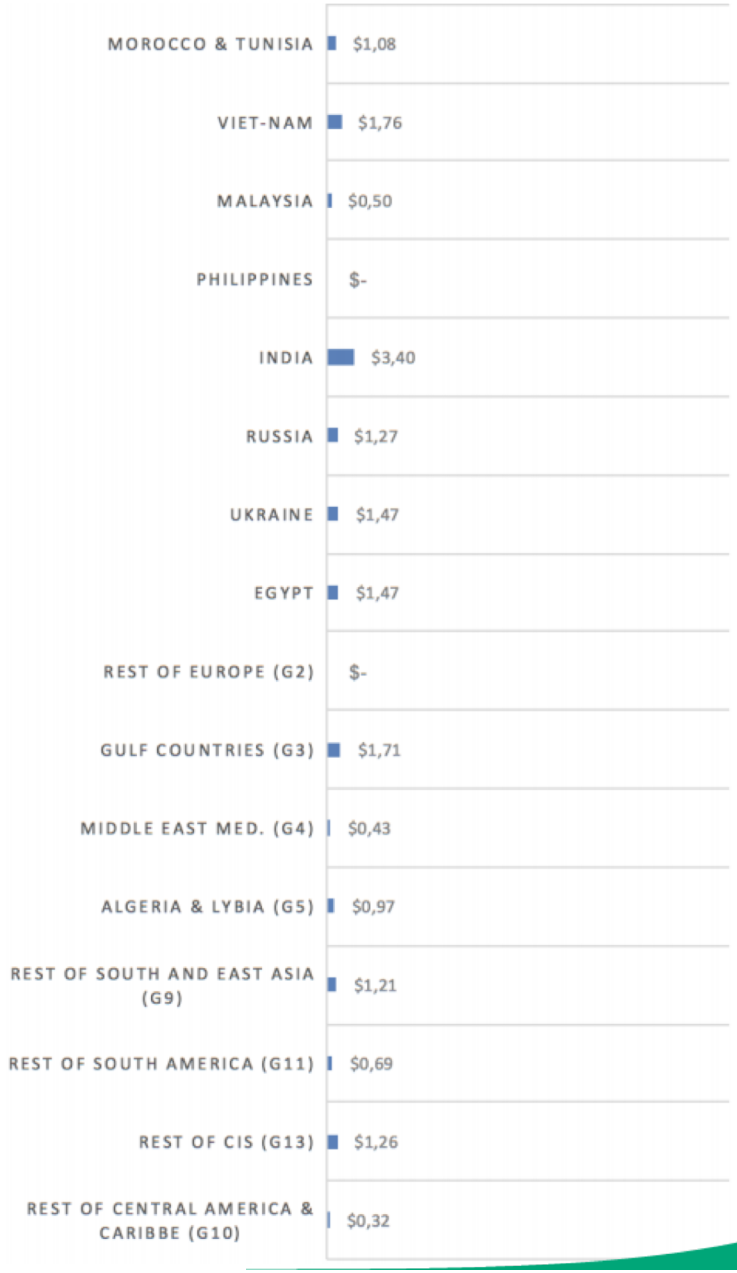
Extensions/caveats

- Politics of resource transfers.
- Considering other economic/co-benefits.
- General equilibrium and trade in goods provides more complex picture.
- Role of ‘bundled” mitigation transferred via trade in biomass/biofuels.
- Uncertainty/shocks will increase gains from linking (Doda, Quemin and Taschini 2018)
- Considering radiative forcing contributions as ultimate target provides further opportunity for cost savings.

Spread in NDC ambition across countries

Estimated carbon price in 2020, assuming domestic trading across energy and industry. ($/tCO2e)





Carbon market model overview

- **Partial equilibrium model** with banking solves for intertemporal equilibrium
  - market clears in each period
  - price rises at the rate of interest (plus risk premium to account for policy uncertainty)
- **Mitigation potentials (MACCs)**
  - Energy, transport and industry sectors (from POLES-Enerdata model)
  - Avoided tropical deforestation and forest degradation (i.e. REDD+) (from IIASA model)
  - Six major GHGs (CO_2, methane, nitrous oxide, SF6, HFC and PFC).
- **36 countries/regions**
- **NDC scenarios**
  - Emissions trajectory consistent with NDC pledges (POLES-Enerblue)
  - Forsell et al. (2016): NDC global goals for land sector.

Net present value of compliance costs for the period 2020-2035 (Billion US$)