Carbon market

Shobhakar Dhakal

Type of carbon market

- Kyoto market
- Compliance or regulated carbon market
- Voluntary carbon market
- Corporate offsetting and insetting market
- REDD+ carbon market
- ICAO carbon market

Kyoto Targets

Countries included in Annex B to the Kyoto Protocol and their emissions targets

Country	Target (1990** - 2008/2012)
EU-15*, Bulgaria, Czech Republic, Estonia, Latvia,Liechtenstein, Lithuania, Monaco, Romania,Slovakia,Slovenia, Switzerland	-8%
US***	-7%
Canada, Hungary, Japan, Poland	-6%
Croatia	-5%
New Zealand, Russian Federation, Ukraine	0
Norway	+1%
Australia	+8%
Iceland	+10%

US signed but later not ratified

http://unfccc.int/kyoto_protocol/items/3145.php

The flexible mechanisms- Clean Development Mechanism

- Projects in developing countries can earn certified emission reduction (CER) credits
- What CDM should do?
  - Contribute to sustainable development in developing countries
  - Reduce global emissions
  - Give some flexibility to industrialized countries on meeting their emission reduction targets
- Each CER credits are equivalent to one tonne of CO2
- CER can be used by developed-countries with emission-reduction-commitments to contribute (a part) of their Kyoto Protocol emission reduction targets

The flexible mechanisms- Joint Implementation

- Joint Implementation allows **Annex B country** (with emission reduction commitment in Kyoto Protocol) to earn emission reduction units (ERUs) from emission-reduction/removal project in **another Annex B country**
- I ERU = One tonne of CO2
- This can be used for meeting Kyoto target- thus provide flexible and cost-efficient means of fulfilling a part of their Kyoto commitments

The flexible mechanisms- Emission Trading

- Annex B parties accepted targets are expressed as levels of allowed emissions over the commitment period (2008-12 first period); the allowed emissions are divided into "assigned amount units" **(AAUs)**
- Allows countries with surplus emission units but not "used" - to sell such surplus to countries that are over their targets
- Emission Trading thus creates a new 'commodity' in the form of emission reductions or removals. Carbon and other GHGs are now tracked and traded like any other commodity creating "carbon market"
- The other units which may be transferred under the scheme, each equal to one tonne of CO2, are
  - A removal unit (RMU) on the basis of land use, land-use change and forestry (LULUCF) activities such as reforestation
  - An emission reduction unit (ERU) generated by a joint implementation project
  - A certified emission reduction (CER) generated from CDM project activity
- Transfers and acquisitions of these units are tracked and recorded under the Kyoto Protocol

Expected/Issued CERs by crediting period	2008-12	2013-20
	Million CERs	
Additional amount of CERs expected in the period		**1576**
Total amount of CERs issued for reductions in the period	**1480**	**368**
Share Of Proceeds (SOP) for the Adaptation Fund	29.4	32
Annual amount available		197
Total expected issuance until the end of 2020		**3424**

1.848 bn CERs issued

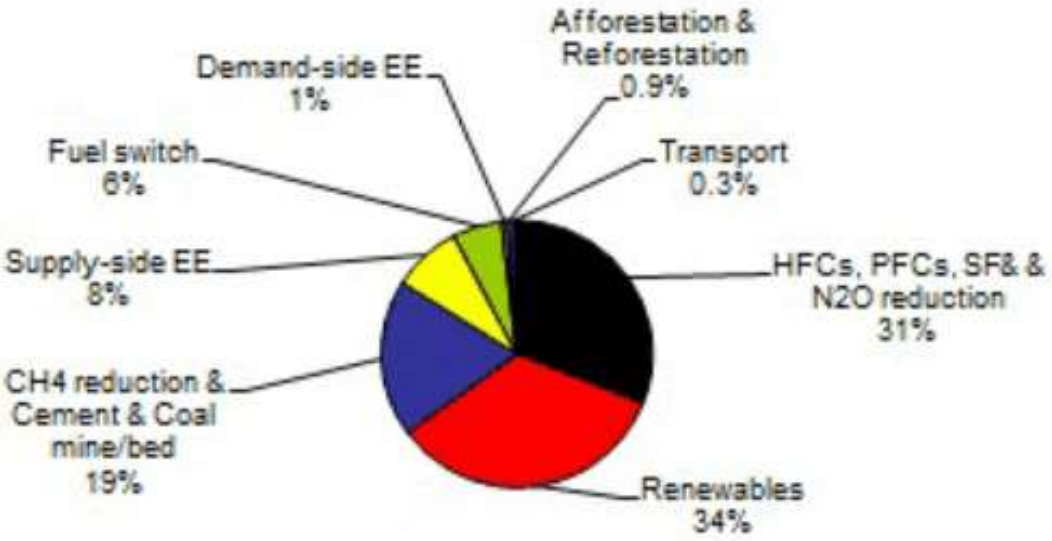
Status of CDM projects in the project cycle	Number
At validation	**654**
Request for registration	4
Request for review	
Correction requested	
Under review	
Total in the process of registration	**4**
Withdrawn	64
Rejected by EB	278
Validation negative by DOE	276
Validation terminated by DOE	2265
Registered, no issuance of CERs	4703
Registered, CER issued	3076
Total registered	**7779**
Total number of different projects	11320
De-registered	2
Replaced PDDs	1085
Total PDDs submitted	12407

http://www.cdmpipeline.org/overview.htm, sept 2017

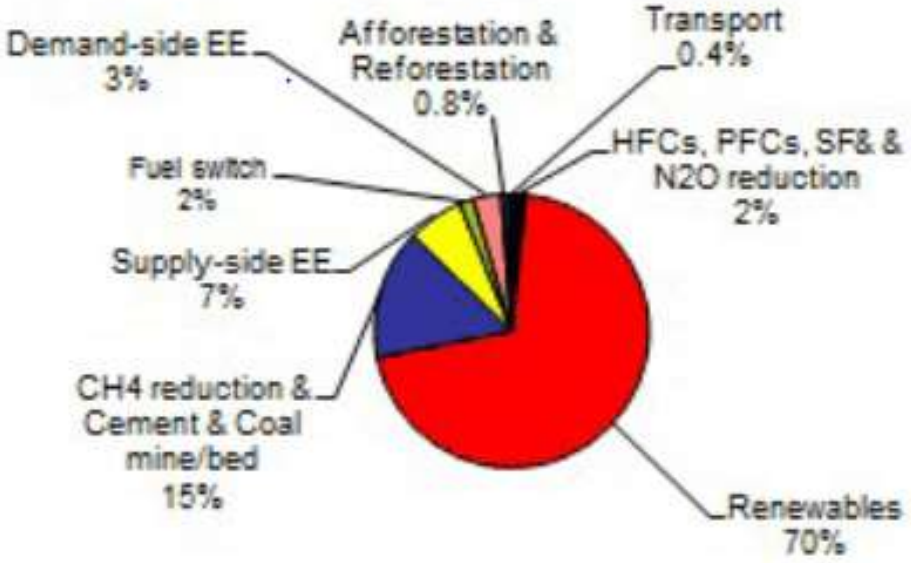
CDM Project history- end of 2012

- 70% of the CDM projects are renewables
- But they take 34% of the CERs
- Energy efficiency takes 9% of the CERs for Supply-side EE and only 1% for Demand-side-EE

Project type in pipeline by CERS by end of 2012

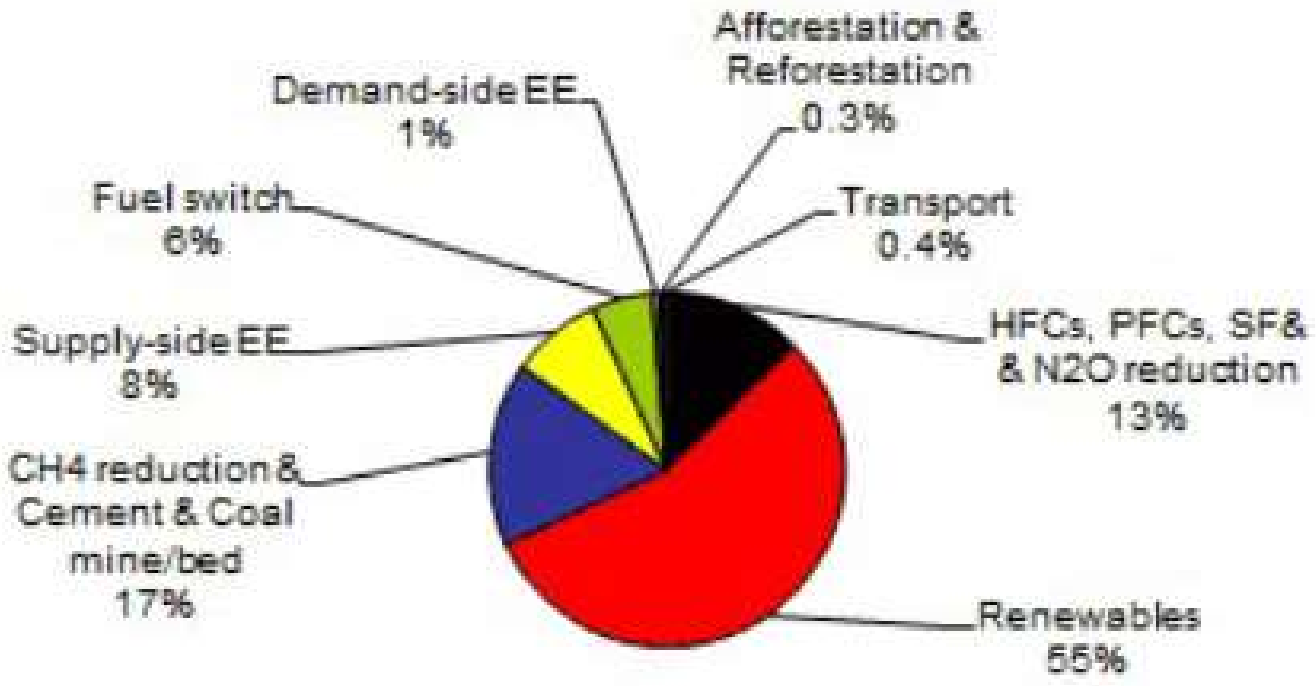


Project type in pipeline by number of projects



UNEP/RISO data, at http://cdmpipeline.org/overview.htm

CERs expected until 2020 in CP2 from CDM projects in each sector



While 71% of the CDM projects are renewables, they take 55% of the CERs in CP2

http://www.cdmpipeline.org/overview.htm, Sept 2017

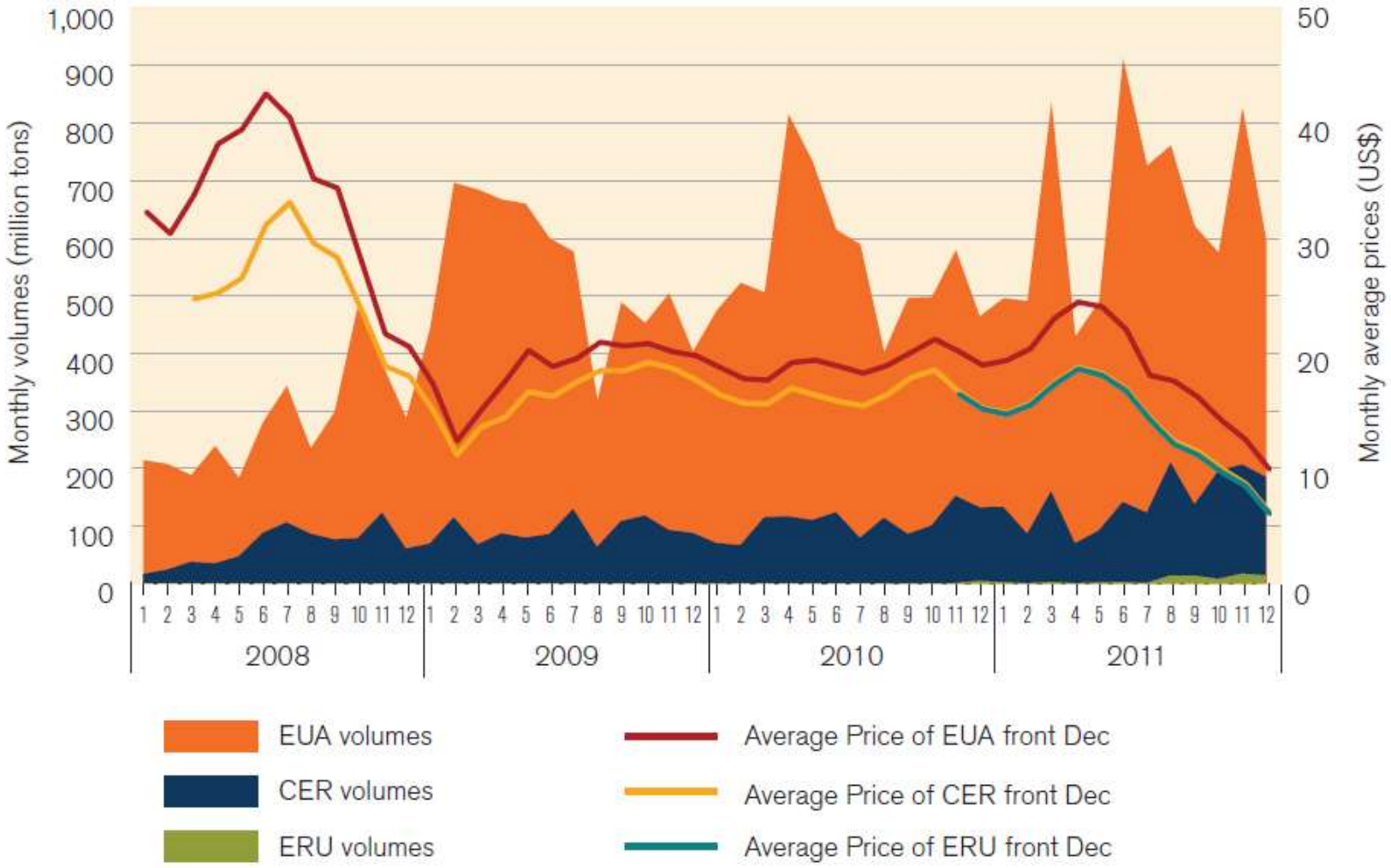
Number of CDM project activities that have issued CERs:	♥CERs issued (KP1)	♦Potential supply of:			
		♣CERs to the end of the 1st KP commitment period (31 Dec. 2012)	CERs to the end of 2017	CERs to the end of 2020	CERs to the end of all current crediting periods
♠3,084	1,850,008,198 (1,478,856,049)	1,481,394,628	3,735,392,493	4,515,786,672	4,838,098,327
♠Adjusted by past rate of issuance			1,864,556,544	2,254,097,664	2,414,982,656

Number of CDM project activities:	♦Potential supply of:			
	♣CERs to the end of the 1st KP commitment period (31 Dec. 2012)	CERs to the end of 2017	CERs to the end of 2020	CERs to the end of all current crediting periods
7,972 of which:	1,625,464,583	5,701,883,242	7,755,134,259	8,851,703,892
7,779 are registered	1,622,995,474	5,611,296,875	7,557,490,411	8,528,359,617
5 are requesting registration	0	3,796	472,277	1,308,901
186 are pending publication	1,382,538	88,689,539	195,150,862	319,875,095
2 are corrections requested	1,086,571	1,893,031	2,020,708	2,160,278
0 are review requested	0	0	0	0

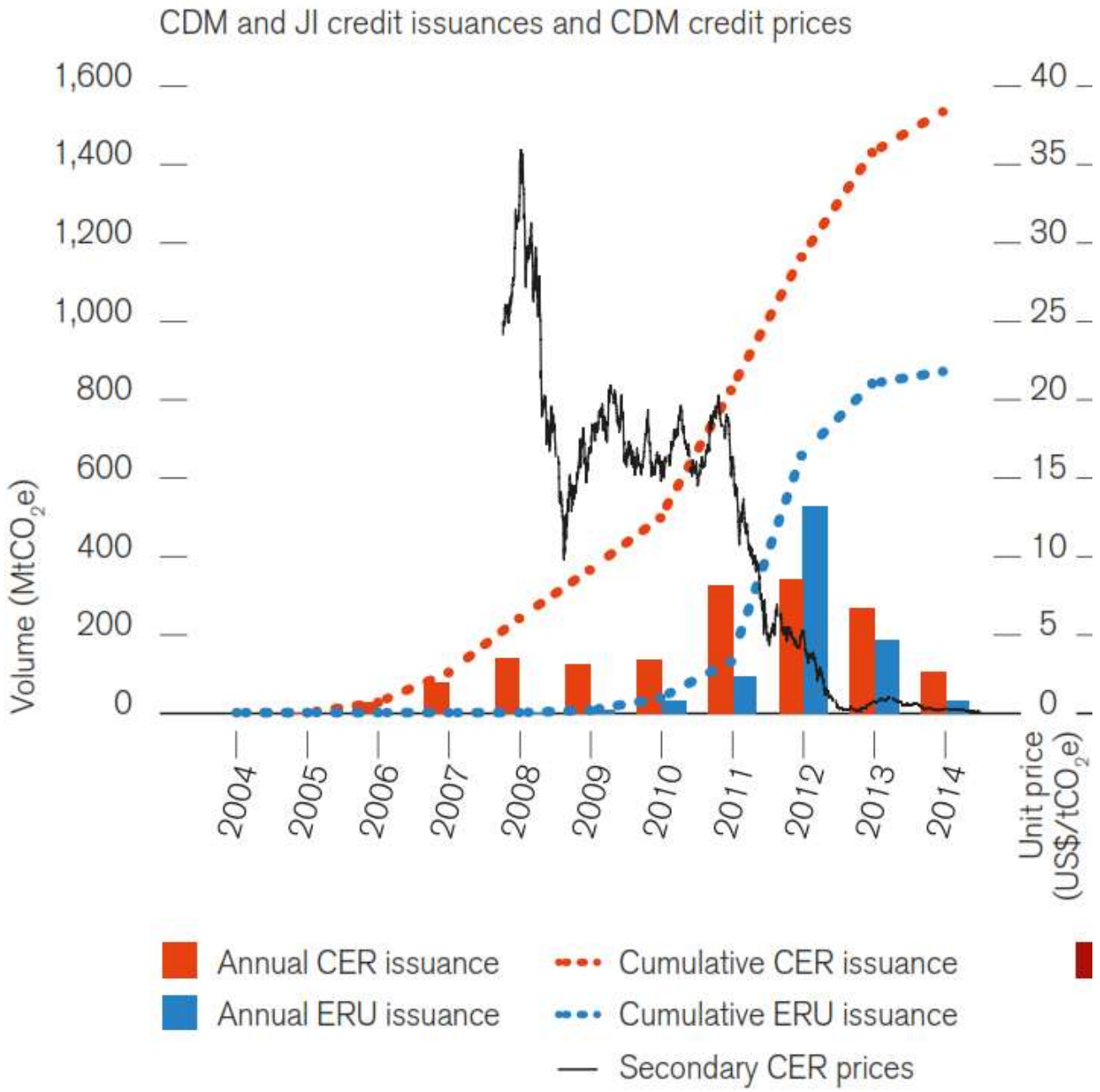
https://cdm.unfccc.int/Statistics/Public/CDMinsights/index.html#iss

Data as of: 31 July 2017

Prices and volumes for EUAs, CERs and ERUs in the secondary market, 2008-2011



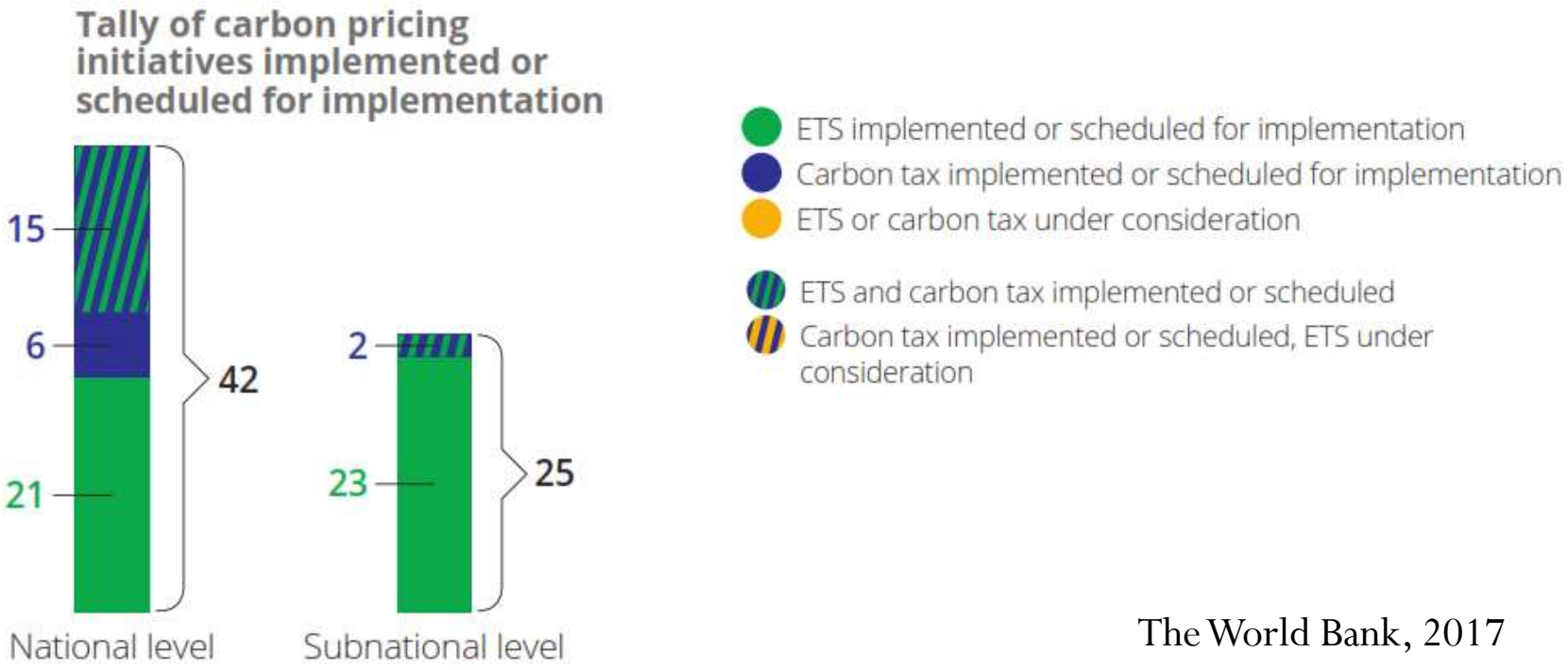
World Bank, 2012



The World Bank, 2015

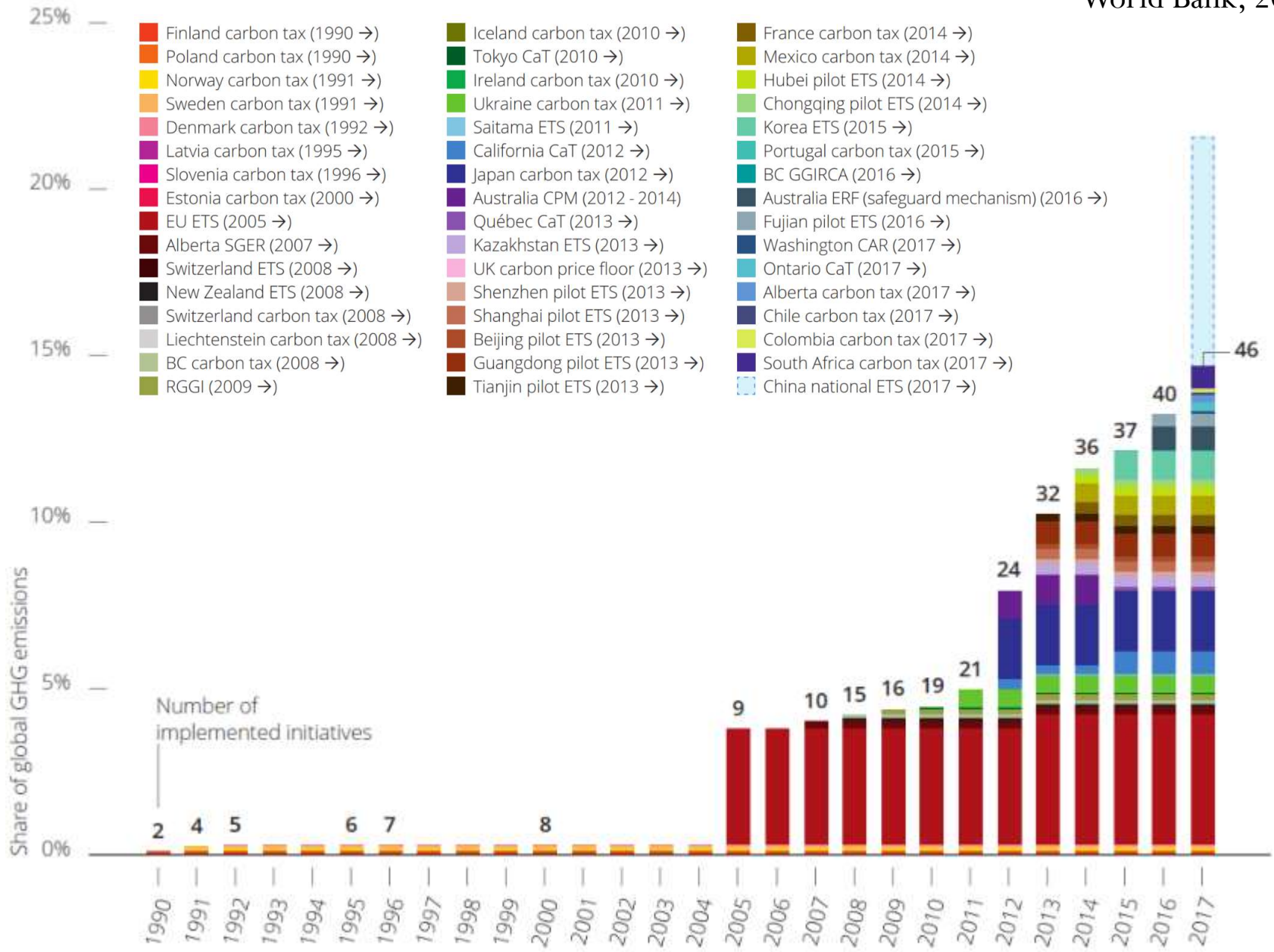
Recent status of carbon pricing

- As of Sept 2017, 42 national jurisdictions and 25 cities, states, and regions are putting a price on carbon (13 more under consideration)
- These 40 national jurisdiction means about 25-26% of global GHG emissions – @ 14.6% of global emissions (8 GtCO2e) are under carbon price (8-9% ETS, 5-6% Carbon Tax)

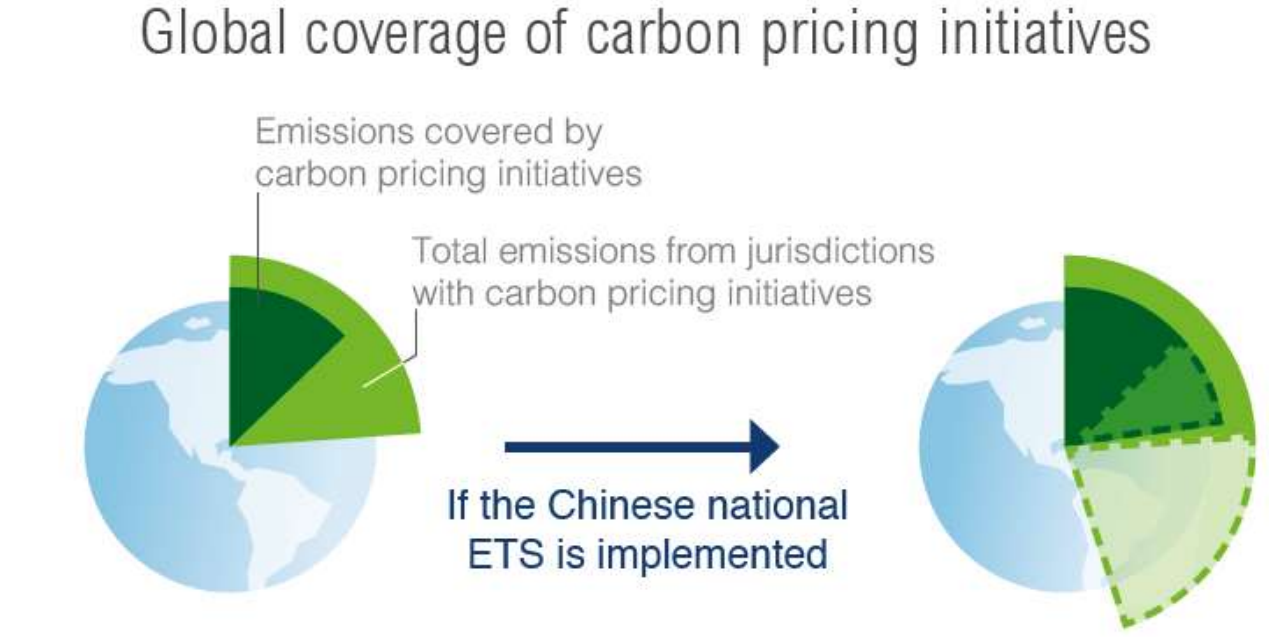


The World Bank, 2017

World Bank, 2017



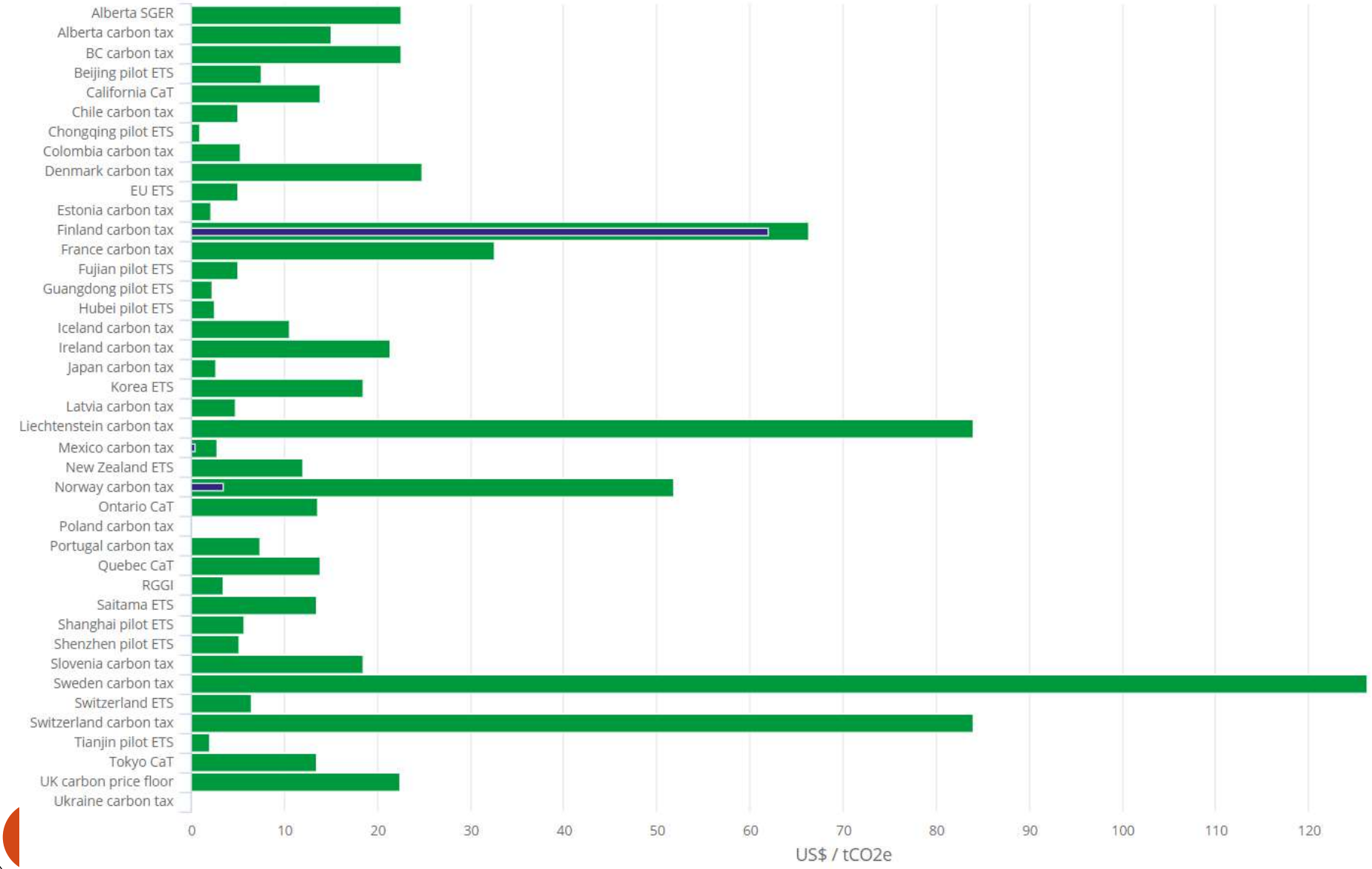
Global coverage and annual value of carbon pricing initiatives



World Bank, 2017

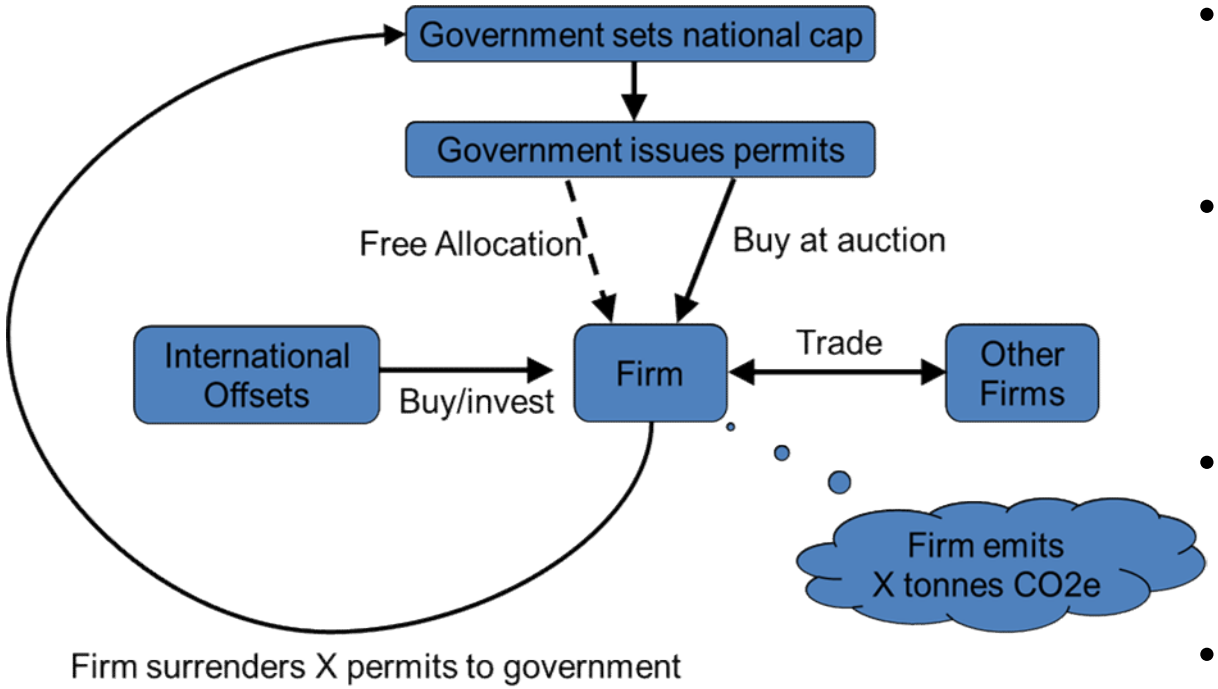
Carbon price, 2017

http://carbonpricingdashboard.worldbank.org
World Bank, 2017



The basic mechanics of carbon trading scheme

http://www.hacaustralia.com/carbonsignal/?p=2216



- **Allocation**: Regulator sets overall caps and allocates to installation under the cap
- **Trading:** Firms buy more permits or sells excess permits to be under permit holdings
- **Monitoring**: Regulator monitors total emission of firms
- **Compliance**: Regulator checks if all installations under cap have enough permits for emissions

Understanding the differences-

- Issuing and allocating allowances
- Surrendering allowances
- Deleting allowances
- Transferring allowances

Design features of ETS market

- Regulator
- Type of cap: absolute vs intensity
- Total cap size and changes in cap over time
- Sector/gases covered
- Allowance allocation rule (how much allocated? Free or auction or hybrid, how allowance revenue used?)
- Compliance period (s)
- Compliant carbon units/commodities

Design features of ETS market

- Trading methods
- Monitoring, reporting and verification (registry and oversight, regulation)
- Banking and borrowing provisions'
- Offsets and flexibilities
- Price containment measures
- Punitive measures for non-compliance
- Allocation rules for new entrants and rules for opt-out
- Linkages with other ETS markets- and other carbon commodity

EU-ETS: General introduction

- EU-ETS Began operation in 2005
- EU28 plus 3 (Liechtenstein, Norway and Iceland); over **11,000 industrial installations** and **airlines** operating between them
- Goal: 21 percent reduction by 2020 from 2005 levels (43% by 2030)
- Covers about half of Europe's CO2 emissions (@ 45% GHG)
- Traded sector of industry:
  - Power and heat generation
  - Energy-intensive industry sectors including oil refineries, steel works and production of iron, aluminium, metals, cement, lime, glass, ceramics, pulp, paper, cardboard, acids and bulk organic chemicals
- Non-traded sector: Others such as transportation sector (except aviation), agricultural sector

Peter Heindl and Andreas Löschel, 2012

http://ec.europa.eu/clima/policies/ets/index_en.htm

EU ETS: Development in phases

2005-2007: 1st trading period constituted a process of 'learning by doing.' EU ETS was successfully established as the world's biggest carbon market. However, the number of allowances, based on estimated needs, turned out to be excessive; consequently the price of first-period allowances fell to zero in 2007.

2008-2012: 2nd trading period. Iceland, Norway and Liechtenstein joined (1.1.2008). The number of allowances was reduced by 6.5% for the period, but the economic downturn depresses emissions, and thus demand, by even more. This led to a surplus of unused allowances and credits which continues to weigh on the carbon price. Aviation was brought into the system (1.1.2012).

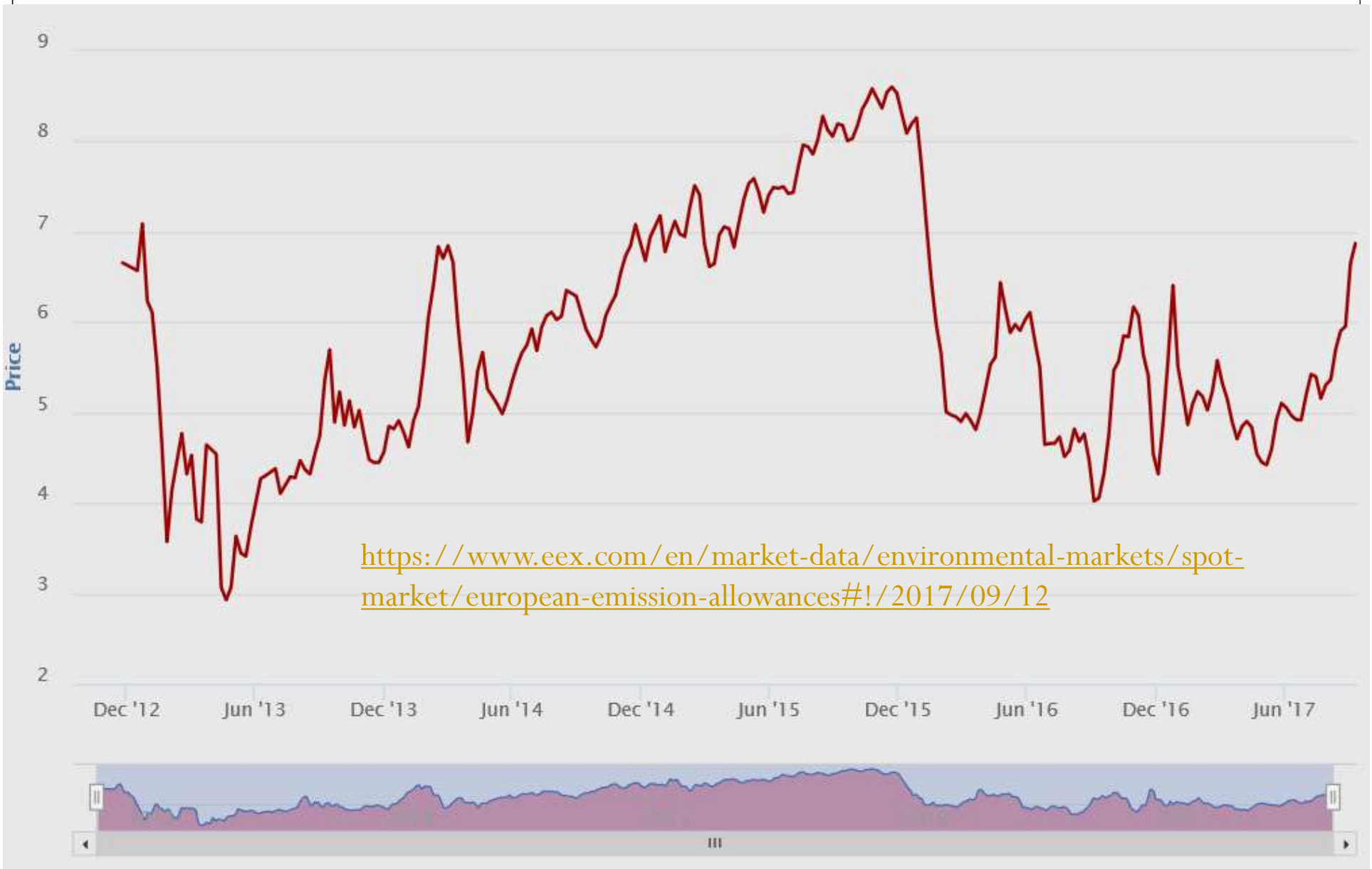
2013-2020: 3rd trading period. Major reform took effect (1.1.2013). The biggest changes have been the introduction of an EU-wide cap on emissions (reduced by 1.74% each year) and a progressive shift towards auctioning of allowances in place of cost-free allocation. Croatia joined the ETS (1.1.2013).

2021-2030: 4th trading period. Legislative proposal for the revision of the EU ETS was presented by the European Commission in July 2015.

https://ec.europa.eu/clima/policies/ets_en

This picture is taken from EU ETS factsheet available at:
https://ec.europa.eu/clima/sites/clima/files/factsheet_ets_en.pdf

EUA prices in secondary spot market- EEX data (Euros)- recent data



https://www.eex.com/en/market-data/environmental-markets/spot-market/european-emission-allowances#!/2017/09/12

Regional Greenhouse Gas Initiative (RGGI)

- Agreed in 2005 and launched in 2009
- US's first and mandatory Cap-and-Trade System for reducing GHG emissions
- 10 North Eastern States of United States
  - Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey (withdrew in 2011), New York, Rhode Island, and Vermont
- Regional cap on CO2 emissions from the power plants located within the RGGI States
- Power plants must possess a tradable CO2 allowance for each ton of CO2 emissions

RGGI: Cap amount, share and sources

First RGGI Control Period (2013-14)			
	The number of CO2 allowances issued by each state	**Each state's share of the regional emissions cap**	**The number of emission sources located in each state**
Connecticut	10,695,036	6.47%	18
Delaware	7,559,787	4.58%	8
Maine	5,948,902	3.60%	6
Maryland	37,503,983	22.70%	16
Massachusetts	26,660,204	16.14%	27
New Hampshire	8,620,460	5.22%	5
New York	64,310,805	38.93%	79
Rhode Island	2,659,239	1.61%	6
Vermont	1,225,830	0.74%	2
TOTAL	**165,184,246**	**100%**	**167**

New Jersey withdrew

Unit is short ton; short ton = 0.907185 metric ton

http://www.rggi.org/design/overview/regulated_sources

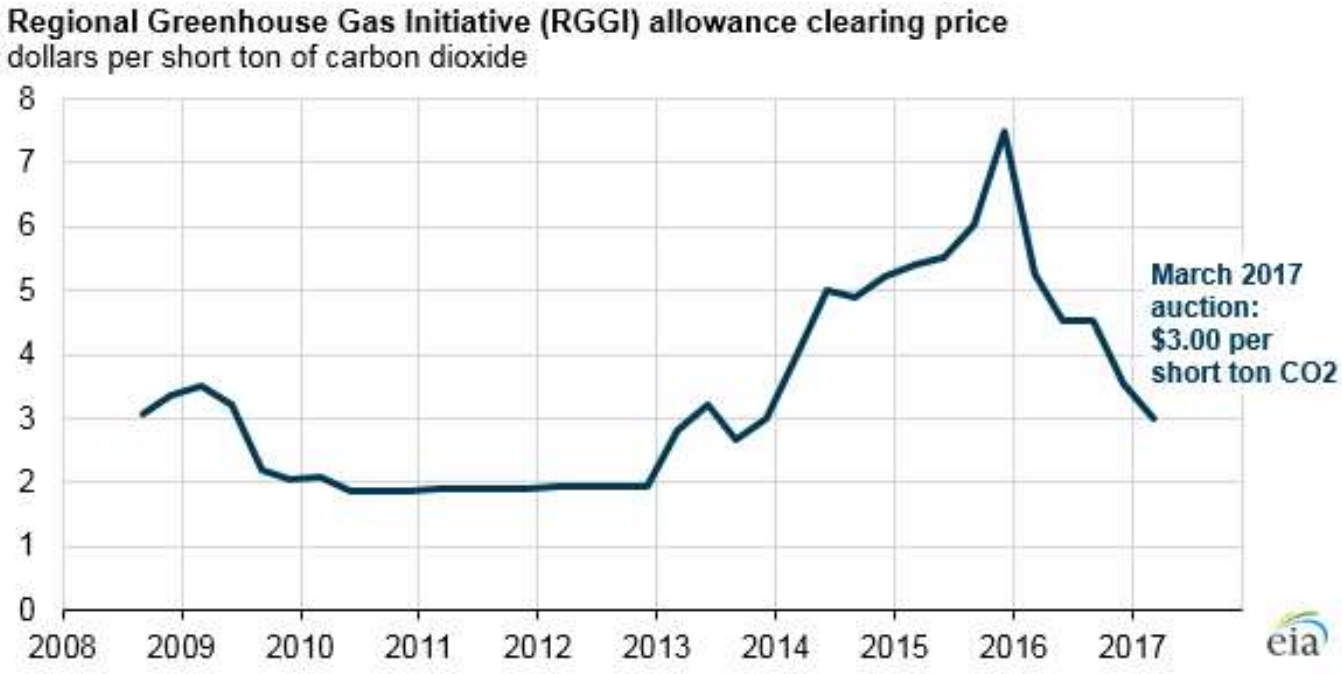
RGGI - outlook

2014: RGGI cap is 91,000,000, RGGI adjusted cap is 82,792,336
2015: RGGI cap is 88,725,000, RGGI adjusted cap is 66,833,592
2016: RGGI cap is 86,506,875, RGGI adjusted cap is 64,615,467
2017: RGGI cap is 84,344,203, RGGI adjusted cap is 62,452,795
2018: RGGI cap is 82,235,598, RGGI adjusted cap is 60,344,190
2019: RGGI cap is 80,179,708, RGGI adjusted cap is 58,288,301
2020: RGGI cap is 78,175,215, RGGI adjusted cap is 56,283,807

https://www.rggi.org/design/overview/cap

- Program review in 2012: updated rule
- In January 2014, the RGGI cap was reduced; 2014 cap of 91 mn short tons (83 mn tCO2) - large % reduction from the previous cap
- 2015 adjusted cap 66.8 million short tons (60.63 mn tCO2)
- The RGGI cap will decline 2.5% each year from 2015 to 2020

World Bank, 2014

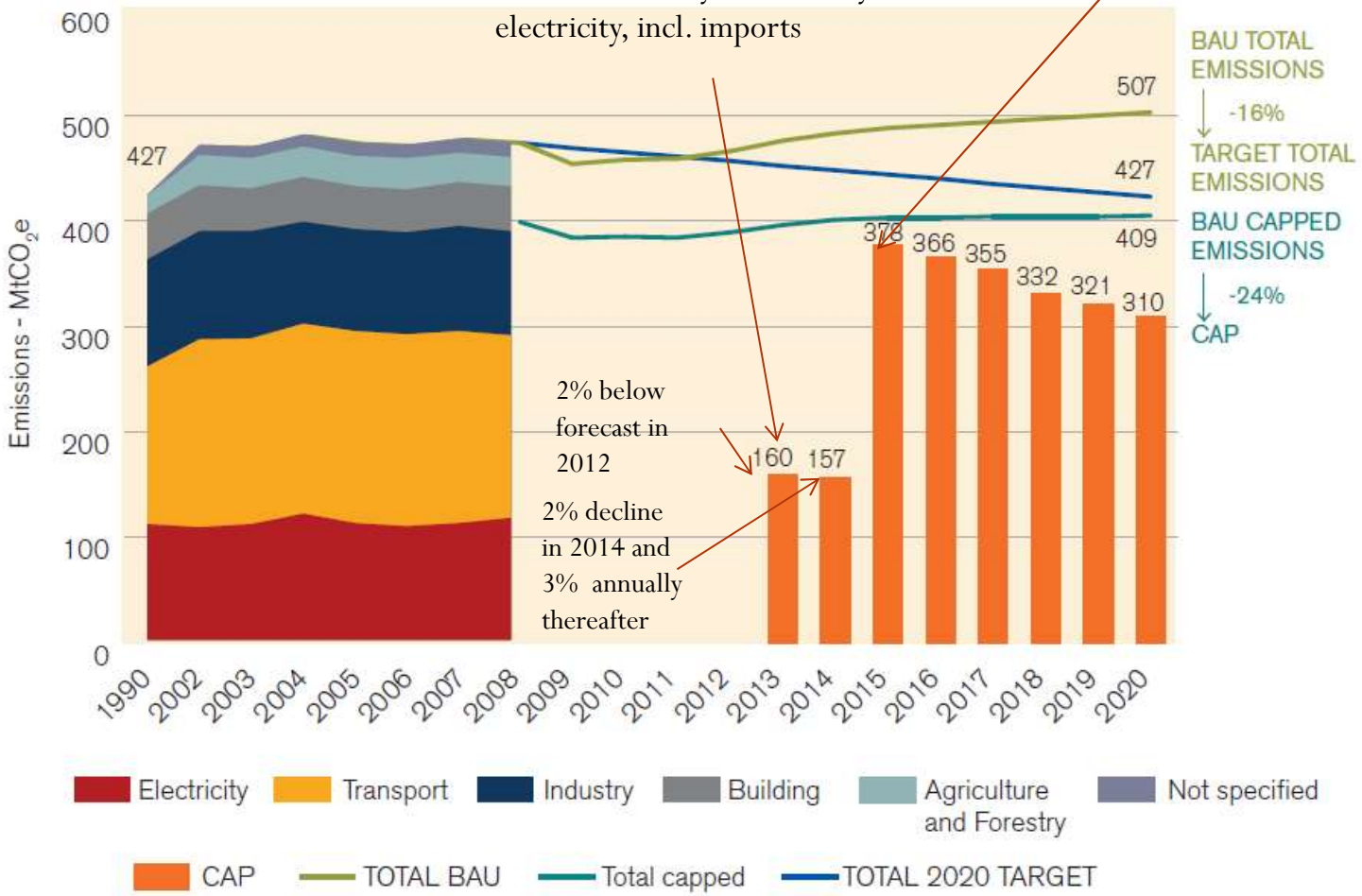


https://www.eia.gov/todayinenergy/detail.php?id=31432

California's GHG emissions, projections, and reduction targets

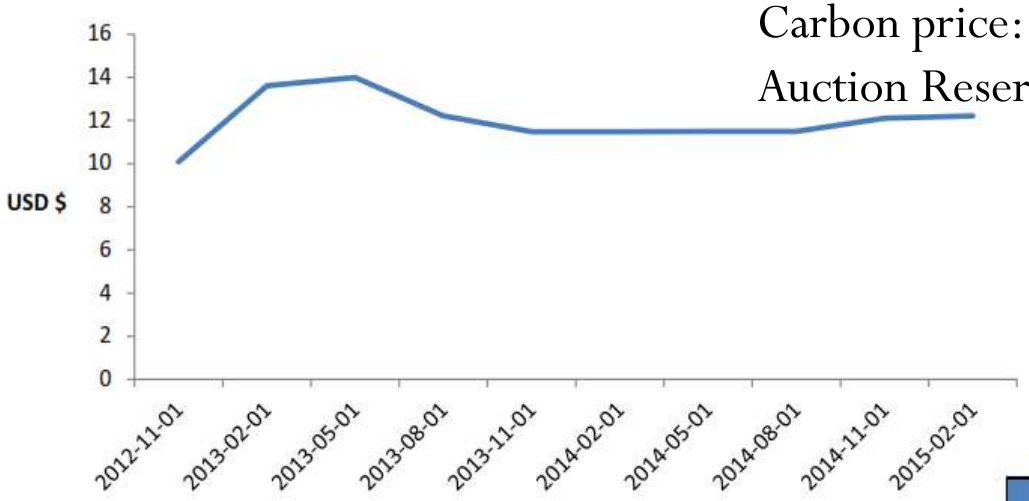
Distributors of transportation, residential, and commercial fuels; @600 covered entities: 3% annually decline

Stationary sources emitting > 25,000 tCO2e/yr in industry and electricity, incl. imports



State of Carbon Market 2012, The World Bank

Auction clearing prices



Carbon price: $11.65 (2014)

Auction Reserve Price: USD 13.57 in 2017

Proceeds from the Sale of State-Owned Allowances (as of February, 2015)

Source: ARB, 2015. Annual Report to the Legislature on Investments of Cap-and-Trade Auction Proceeds (Greenhouse Gas Reduction Fund Monies) March 2015. Available at: arb.ca.gov

Auction	Date	Proceeds ($)
Auction 1	Nov-12	55,760,000
Auction 2	Feb-13	83,923,548
Auction 3	May-13	117 580 484
Auction 4	Aug-13	138,494,503
Auction 5	Nov-13	136,799,446
Auction 6	Feb-13	130,706,470
Auction 7	May-14	71,140,023
Auction 8	Aug-14	98,741,583
Joint Auction 1	Nov-14	135,983,387
joint Auction 2	Feb-15	629,516,452
Total Auction Proceeds		**1,598,646,259**

Tokyo cap-and-trade program

- **Cap coverage**
  - Industrial and commercial sectors account 40% of Tokyo GHGs (2000)
  - Cap to large-scale facilities (buildings/factories) with total consumption of fuels, heating and electricity 1,500 kiloliters/yr (crude oil equivalent) or greater; include office buildings and factories
  - Cover @ 1,400 facilities in Tokyo; almost all major skyscrapers
  - Include many building of the central government, incl Prime Minister's official residence, the Diet Building, the Ministry of the Environment, the Ministry of Economy, Trade and Industry and the Ministry of Foreign Affairs
  - 1,400 facilities' emissions is 13 million tCO2e annually.; @ 40% of all CO2 emitted by industrial and commercial facilities in Tokyo; @ 20% of total CO2 emissions in Tokyo)

TMG, 2010

Tokyo cap-and-trade program

- **Compliance period**
  - First: FY2010-14 (longer than similar other programs)
  - Second: FY2015-19
- **Banking and borrowing**
  - Permitted to bank; borrowing not permitted
- **Gases Covered**
  - CO2 (energy-related CO2 accounts for 95% of the GHG emissions in Tokyo)
- **Cap setting**
  - Absolute cap; 6% reduction in first period; 17% reduction in second period

TMG, 2010

Table 1: Coverage of the Chinese ETS pilots

	Beijing	Shanghai	Guangdong	Shenzhen	Tianjin	Hubei	Chongqing
Emissions reduction target (intensity-based) By 2020	18% over 2010 levels	19% over 2010 levels	19% over 2010 levels	15% over 2010 levels	15% over 2010 levels, with a further goal of less than 1.69 tonne/CO_2 per 10,000 RMB GDP	17% over 2010 levels	20% over 2010 levels
Emissions compliance threshold	+ 5,000 tonnes CO_2 per year as the average from 2009 to 2011	+ 20,000 tonnes CO_2 per year for industrial sectors in 2010 or 2011, above 10,000 tonnes per year for other sectors	+ 20,000 tonnes CO_2 per year from 2010 to 2012	+ 3,000 tonnes CO_2 per year and any building larger than +20,000 sqm	+ 20,000 tonnes CO_2 per year in any year since 2009	+ 60,000 tonnes coal consumption for major sectors in 2010 or 2011	+20,000 tonnes CO_2 per year from 2010 to 2014
Cap coverage	50% of the city's total emissions: Around 1000 companies from heat supply, power generation, cement, petrochemical, car manufacturing, and public buildings	57% of the city's total emissions: 191 entities are listed (steel, petrochemical, chemical, non-ferrous metal, power, building materials, textile, paper, rubber, and the chemical fibre industry)	42% of the province's total energy consumption: 242 firms are listed (power, cement, steel, ceramics, petrochemical, non-ferrous, plastics, and paper)	635 entities listed from 26 sectors which cover various forms of industry in addition to power, gas, and water supply. Participation is open to any financial institution, 197 public-use buildings	60% of the city's total emissions: 114 entities including iron and steel, chemicals, electricity, heat, petrochemical, oil and gas mining, and civil construction	35% of the province's total carbon emissions: 138 entities are listed (steel, chemical, cement, automobile manufacturing, power generation, non-ferrous metals, glass, paper, etc.)	125 million allowances were issued to 242 companies in the electricity, aluminium, iron and steel, cement, and other industrial sectors
Baseline years	2009 to 2011	2009 to 2011	2011, 2012	2009 to 2011	2009 to 2013	2010, 2011	2010 to 2014

Information from this table stems from a policy briefing the author wrote for the International Emissions Trading Association's member companies (IETA).

http://www.ieta.org/resources/China/Chinas_National_ETS_Implications_for_Carbon_Markets_and_Trade_ICTSD_March2016_Jeff_Swartz.pdf

Difference between compliance and voluntary carbon markets

- **Compliance (regulated) carbon market**
  - Compliance requirement for entities are imposed by government regulation- Set up from the top-down
  - Need to surrender emissions permits or allowances or equivalent allowed offsets in order to meet predetermined regulatory targets
  - Commoditized carbon as a tradable good; price and quality standardization
  - Design feature area place-specific set by regulator
  - MRV set up my regulators
- **Voluntary (unregulated) carbon market**
  - Operates in parallel with compliance market
  - Based on voluntary activities by firms and individuals - Voluntary-buyers and willing-sellers are not obliged to trade or meet any target by any law or regulation
  - Represent demand for mitigation by citizens- potential to drive society towards a low-carbon pathways from bottom-up
  - MRV set up by trustable entities

Why firms and individual engaged in voluntary market?

17 Oct

- Global good- Philanthropy
- Green image/branding through off-sets of their own emissions- corporate social responsibility, ethics, reputation, supply chain risk
- Risk management (preemptive strategies)- so that they will not be subjected to stringent compliance market
- As a preparation for entering into regulatory market formally (pre-compliance)

Standards

- **Verified Carbon Standards**
  - Founded in 2005 to address needs for quality assurance in voluntary carbon markets
  - Registered more than 1,300 carbon reduction projects = more than 200 million tons of CO2 equivalent
- **Climate, Community & Biodiversity (CCB) Program**
  - Projects must improve livelihoods, create employment, protect traditional cultures and endangered species, and help secure tenure to lands and resources together with making a key contribution to combating climate change
- **VCS California Offset Project Registry** (OPR)
- **VCS Jurisdictional and Nested REDD+** (JNR) Framework

http://www.v-c-s.org/

Standards

- **Gold Standard**
  - Established in 2003 by WWF and other international NGOs as a best practice benchmark for energy projects developed under the UN's Clean Development Mechanism (CDM)
  - Endorsed by 80+ NGOs
  - Over 1400 projects certified in 80 countries – 60 million TCO2e saved (as of Oct 2017)

http://www.goldstandard.org/our-work/our-principles-process

Historical Market-Wide Voluntary Offset Transaction Volumes

CCX volume represents transactions from US-based projects by US buyers anticipating regulation. At the time, buyers were acting voluntarily in anticipation of cap-and-trade in the United States. After the legislation failed to pass in 2009, CCX tonnes continued to be traded on a voluntary basis, "off-exchange." Additional precompliance volumes were documented in the lead-up to California cap-and-trade and Australia's (now repealed) carbon tax.

Historical Market-Wide Voluntary Offset Transaction Values

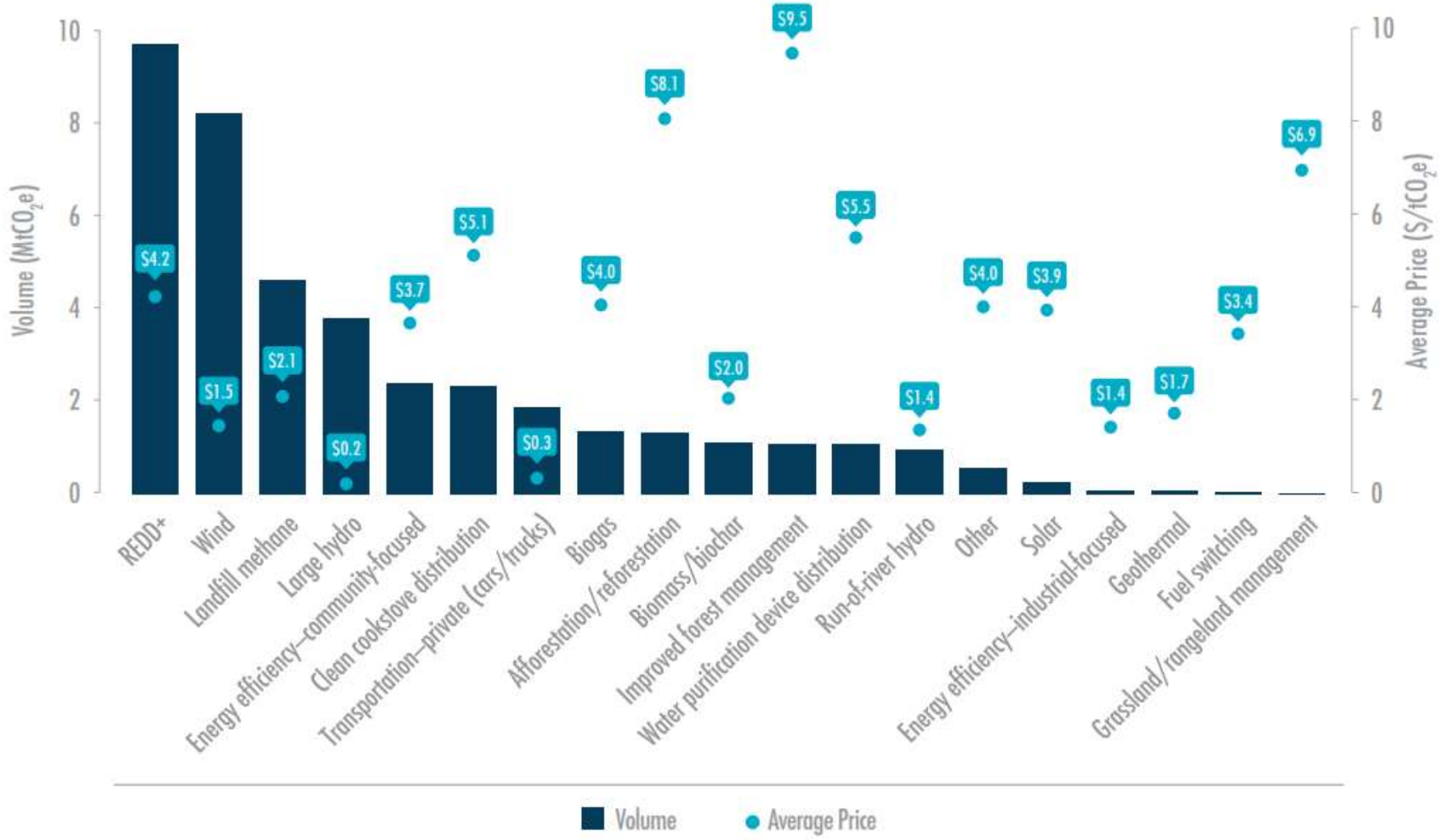
Historical Market-Wide Average Price

$3.0 in 2016

Notes: Based on 931.2 $MtCO_2e$ in transacted volume over time.

Source: Forest Trends' Ecosystem Marketplace. *State of the Voluntary Carbon Markets 2015.*

Transacted Volume, Average Price, and Price Range by Project Type, 2016



Microsoft carbon tax

- Goal: To achieve zero net direct GHG emissions
- Microsoft's global operations have been 100 percent carbon neutral since June 2012
- 2014 emission: 85 th (Direct), 310 th (Indirect- air travel), 1.5 mn (Indirect – primarily electricity) - https://www.statista.com/statistics/579993/greenhouse-gas-emissions-of-microsoft-by-type/ (not authentic)
- Reduce 9.5 mn tCO2 since June 2012
- The carbon fee is charged quarterly to business units based on actual GHG emissions
- Carbon Neutral Fee fund- purchase carbon offsets and achieve carbon neutrality
- Carbon price is based on cost of their offsets and carbon emissions - FY2013: $6-7 per ton of CO2

Microsoft.com

Joint Crediting Mechanism (JCM/BOCM) Japan

Mongolia	Bangladesh	Ethiopia	Kenya	Maldives	Viet Nam
Laos	Indonesia	Costa Rica	Palau	Cambodia	Mexico
Saudi Arabia	Chile	Myanmar	Thailand	Philippines	

- Compliments CDM as Japan is out from 2nd Kyoto period
- Japan invests/provides low-carbon technology/products/service etc in emissions reduction projects/programs and get GHG offsets credits (similar to CDM)
- Started as non-tradable credits but with trading possibilities
- Signed bilateral document with 17 countries (Thailand Nov 2015, Philippines Jan 2017)

https://www.jcm.go.jp/

https://www.jcm.go.jp/

http://www.mmechanisms.org/e/initiatives/index.html; Ministry of Environment Japan

New voluntary climate commitments

- The Science-Based Targets initiative, which launched in September 2014, aimed to get 100 companies to set emissions reductions targets- 157 companies, from Coca-Cola to Sony, have signed up to date
- The World Bank's Carbon Pricing Leadership Coalition, launched at the Paris climate talks- 74 countries and more than 1,000 companies support carbon pricing
- Aviation's potential new market: International Civil Aviation. and ICAO is starting to craft its own offsetting scheme, known as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). → which offsets (such as particular standards or project types) will be allowed in this market yet not clear
- Paris Agreement's market prospects

Carbon pricing in Paris Agreement and ICAO

- **Article 6 of the Paris Agreement**: Parties can voluntarily cooperate on the implementation of their NDCs to facilitate higher ambition in mitigation and adaptation actions.
  - Article 6.2: Recognizes that a robust accounting framework for internationally transferred mitigation outcomes (ITMOs) needs to be developed
  - The operationalization of the mechanisms under Article 6 is key for enabling carbon pricing
- **Carbon Offsetting and Reduction Scheme for International Aviation**: At the 39th Assembly (Oct 2016) of the International Civil Aviation Organization (ICAO) adopted (66 states representing 87% of international aviation activities) the CORSIA
  - Stabilize net emissions from international aviation at 2020 levels
  - Pilot phase (2021-2023), phase 1 (2024-2026) and phase 2 (2027-2035)
  - CORSIA has the potential to generate demand for around 2.5 gigatons of CO2e offset between 2021 and 2035

World Bank 2017