Climate change and fossil fuels

Filip Černoch
cernoch@mail.muni.cz

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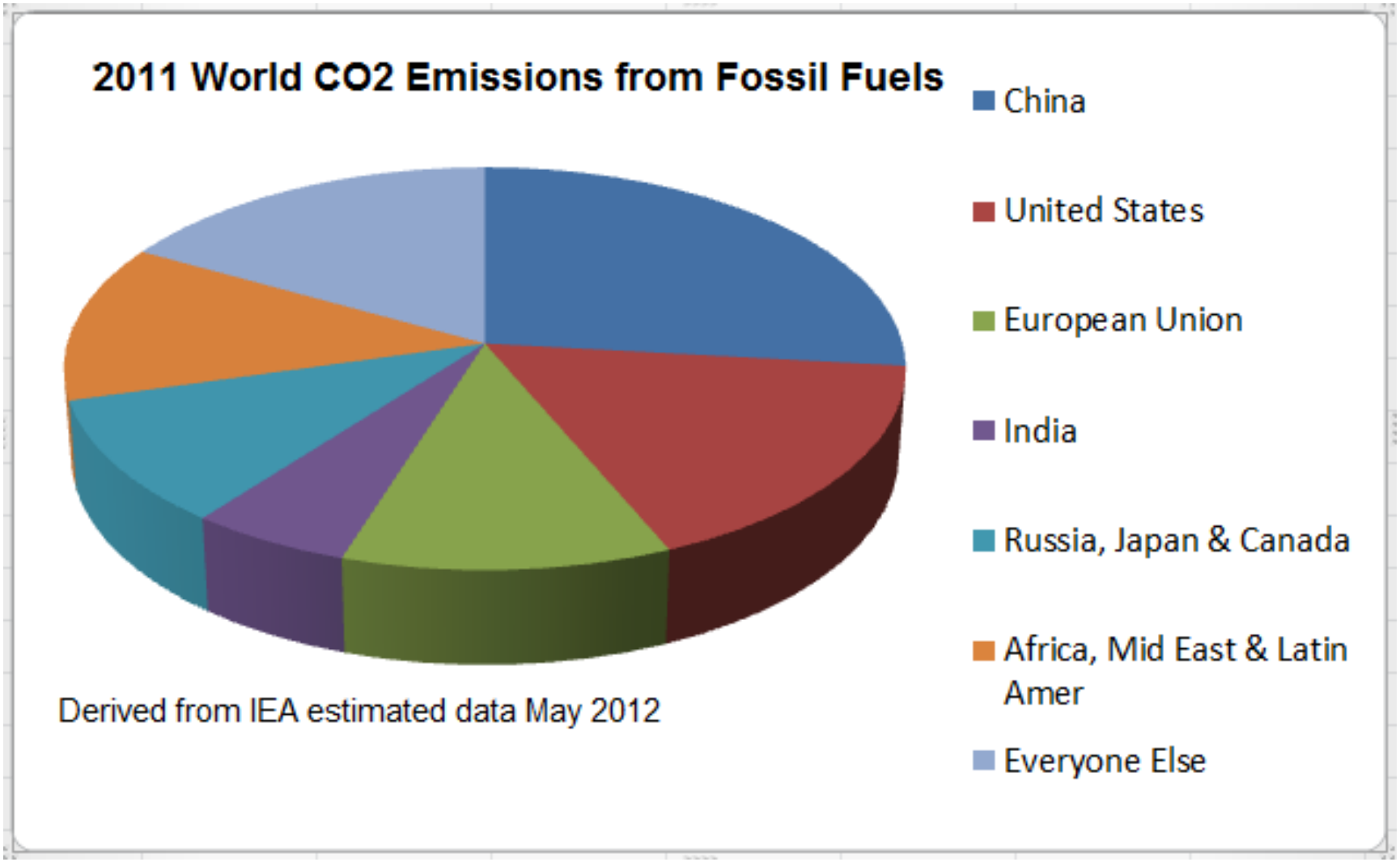
Climate change as a public policy problem

- Is uniquely global
  - Environmental problems usually regional (Beijing´s smog, waste from EU´s industry)
  - In the case of climate change, impacts may be regional, but phenomenon is global
  - The global nature of climate change also complicates any sensible climate policy. It is tough to get voters to enact pollution limits on themselves, when those limits benefit them and only them, but it is tougher to get voters to enact pollution limits on themselves if the costs are felt domestically, but the benefits are global = a planetary free riding problem
  - Impact of climate change is not evenly distributed among regions and countries. Different vulnerability.



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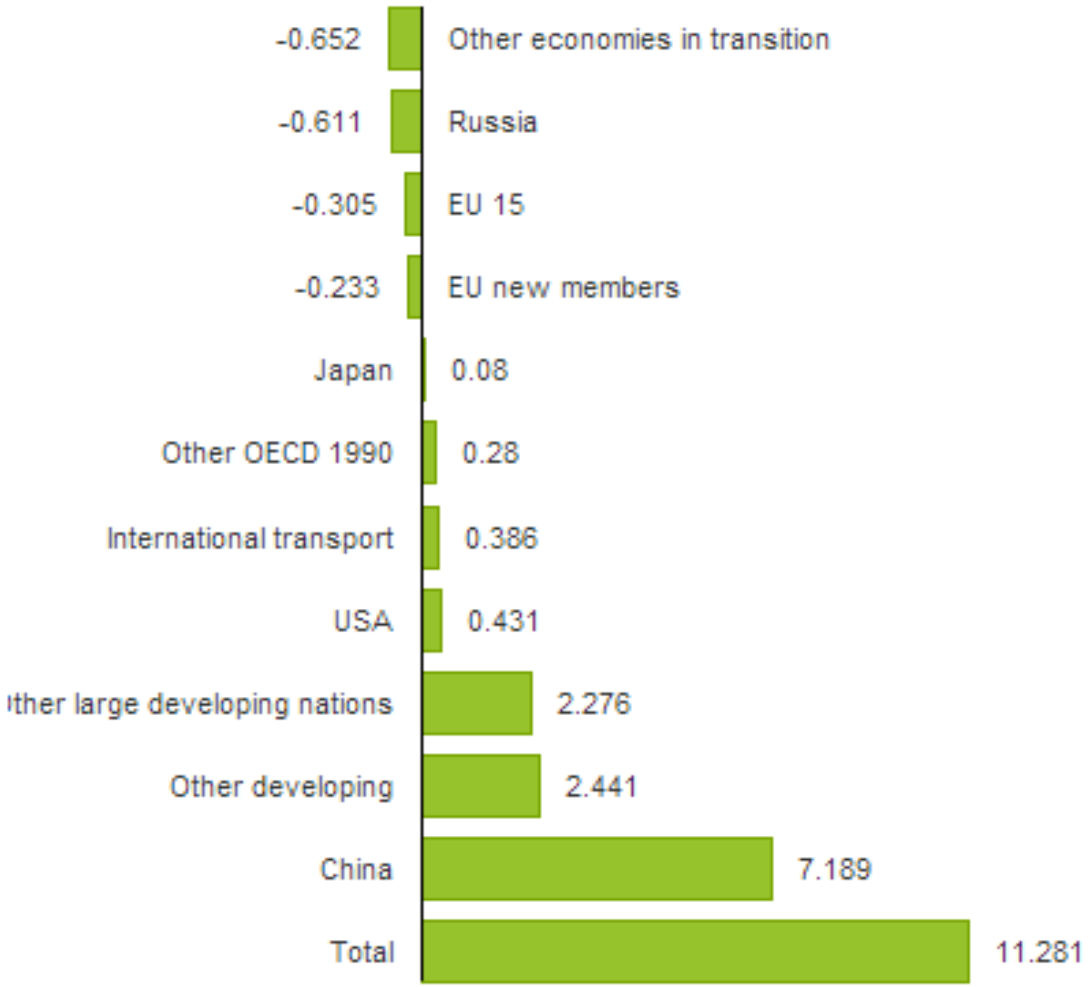
Change in CO2 emissions (GT), 1990 to 2011



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Climate change as a public policy problem

- Is uniquely long-term
  - The past decade was the warmest in human history. The one before was the second-warmest. The one before was the third-warmest
  - Changes are evident. Arctic sea ice has lost half of its mass, three-quaters of this volume in only the past thirty years
  - But the most of the worst consequences of climate change are still remote, often caged in global, long-term averages. The worst effects are still far off – but avoiding these predictions would entail acting now

Climate change as a public policy problem

- Is uniquely irreversible
  - Stopping emitting carbon now we still would have decades of warming and centuries of sea-level rise locked in. Full melting of large West Antarctic ice sheets may be unstoppable
  - Over 2/3 of the excess CO2 in the atmosphere that wasn´t there when humans started burning fossil fuels will still be present a hundred years from now. Over 1/3 will be there in 1000 years

Climate change as a public policy problem

- Is uniquely uncertain.
- „Everything we know that we don´t know, and perhaps more importantly, what we don´t yet know we don´t know“ (Wagner, Weitzman).
- Last time concentration of carbon dioxide were as high as they are today, at 400 ppm, at Pliocene. That was over three million years ago, when average temperatures were around 1-2,5°C warmer than today, sea levels were up to 20 meters higher, and camels lived in Canada.
- We wouldn´t expect any of these dramatic changes today. The greenhouse effect needs decades to centuries to come into full force, ice sheets need decades to centuries to melt, global sea levels take decades to centuries to adjust accordingly. CO2 concentrations may have been at 400 ppm 3 million years ago, whereas rising sea levels lagged decades or centuries behind

Costs of climate change

- Around current climates masive investments and industrial infrastructures is build, that makes temperature increases costly
- The current models estimates that warming of 1°C will cost 0,5% of global GDP, 2°C around 1% GDP, 4°C around 4% GDP
- We could think about damages as a percentage of output in any given year. At a 3 percent annual growth rate, global economic output will increase almost twenty-fold in a hudred years
- Or lets assume that damages affect output growth rates faster than output levels. Climate change clearly affects labor productivity, esp. in already hot countries. Then the cumulative effects of damages could be much worse over time

Summary

- Climate change is unlike any other public policy problem. It´s almost uniquely global, long-term, irreversible, uncertain. These factors are what make climate change so difficult to solve

International regime to fight climate change

- Who is responsible?
- Who is affected
- Who should act?
- What is to be done?

International regime to fight climate change

- Who is responsible? (population growt + increasing consumption)
- Who is affected (common but differentiated vulnerabilities)
- Who should act? (divergence between the countries most responsible and countries most affected)
- What is to be done?

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International regime to fight climate change

- Intergovernmental Panel on Climate Change – 1988.

  Rio Summit on Earth – 1992 (UN conference on environment and development) → UNFCCC
- Kyoto Protocol
- 1997, in force 2005

  = Existence of a generally accepted consensus on the climate change as well as the contribution of human activities to this change

Kyoto Protocol (KP)

- 4 GHG (carbon dioxide, methane, nitrous oxide, sulphur hexafluoride) + hydrofluorocarbons and pefluorocarbons
- Annex I. countries (37 industrialized countries + EU15), Non-annex I. parties
- Reducing of GHG emissions by 5,2 % for the first commitment period of 2008-2012. (4,2 % after USA left). Base year 1990
- Reduction of emissions from fossil fuel combustion; reduction emission in other sectors (land-use or direct industrial emissions); flexible mechanisms – Emission trading, CDM, JI
- Common but differenciated responsibility

Kyoto Protocol (KP)

- In 2012, CO2 emissions from fuel combustion across all Parties with KP targets were 14% below 1990 levels
- Emissions in the EU-15 were 8% bellow 1990 levels
- Some industrialised countries have seen significant increases (Australia +48%), New Zealand (+44%), Spain (+30%)
- Despite extensive participation of 192 countries the KP is limited in its potential – U.S. remains outside, developing countries do not have emission targets
- The KP implies action on less than one-quarter of global CO2 emissions
- Through its flexibility mechanisms the KP has made CO2 a tradable commodity, and has been a driver for the development of national emission trading schemes

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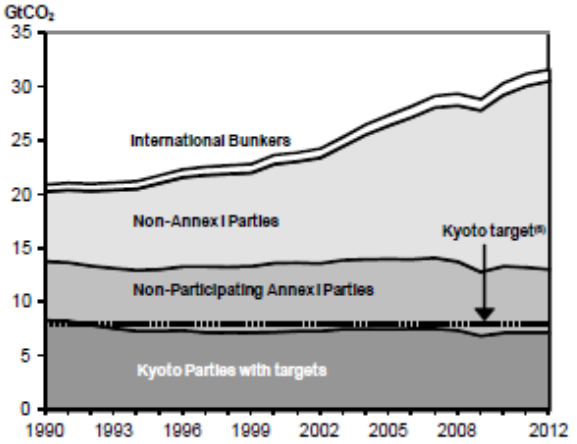
World CO_2 emissions from fuel combustion and Kyoto Protocol targets

	1990 $MtCO_2$	2012 $MtCO_2$	% change 90-12	Kyoto Target
KYOTO PARTIES WITH TARGETS [1]	**8,339.6**	**7,157.0**	**-14.2%**	**-4.6%** [2]
Europe	*3,154.5*	*2,906.4*	*-7.9%*	
Austria	56.4	64.7	14.8%	-13%
Belgium	107.9	104.6	-3.1%	-7.5%
Denmark	50.6	37.1	-26.7%	-21%
Finland	54.4	49.4	-9.1%	0%
France [3]	352.8	333.9	-5.4%	0%
Germany	949.7	755.3	-20.5%	-21%
Greece	70.1	77.5	10.5%	+25%
Iceland	1.9	1.8	-2.5%	+10%
Ireland	30.6	35.5	16.3%	+13%
Italy	397.4	374.8	-5.7%	-6.5%
Luxembourg	10.4	10.2	-1.3%	-28%
Netherlands	155.8	173.8	11.5%	-6%
Norway	28.3	36.2	27.9%	+1%
Portugal	39.4	45.9	16.4%	+27%
Spain	205.2	266.6	29.9%	+15%
Sweden	52.8	40.4	-23.4%	+4%
Switzerland	41.6	41.3	-0.8%	-8%
United Kingdom	549.3	457.5	-16.7%	-12.5%
European Union - 15	3,082.7	2,827.1	-8.3%	-8%
Asia Oceania	*1,339.5*	*1,641.7*	*22.6%*	
Australia	260.5	386.3	48.3%	+8%
Japan	1,056.7	1,223.3	15.8%	-6%
New Zealand	22.3	32.1	44.0%	0%
Economies in Transition	*3,845.6*	*2,608.8*	*-32.2%*	
Bulgaria	74.9	44.3	-40.9%	-8%
Croatia	21.5	17.2	-20.1%	-5%
Czech Republic	148.8	107.8	-27.6%	-8%
Estonia	35.8	16.3	-54.3%	-8%
Hungary	66.4	43.6	-34.4%	-6%
Latvia	18.6	7.0	-62.4%	-8%
Lithuania	33.1	13.3	-59.8%	-8%
Poland	342.1	293.8	-14.1%	-6%
Romania	167.5	79.0	-52.9%	-8%
Russian Federation	2,178.8	1,659.0	-23.9%	0%
Slovak Republic	56.7	31.9	-43.8%	-8%
Slovenia	13.3	14.6	9.6%	-8%
Ukraine	687.9	281.1	-59.1%	0%

	1990 $MtCO_2$	2012 $MtCO_2$	% change 90-12	Kyoto Target
OTHER COUNTRIES	**12,014.7**	**23,497.4**	**95.6%**	
Non-participating Annex I Parties	*5,550.9*	*5,983.9*	*7.8%*	
Belarus	124.8	71.1	-43.0%	-8%
Canada [1]	428.2	533.7	24.6%	-6%
Malta	2.3	2.5	10.4%	none
Turkey	126.9	302.4	138.3%	none
United States	4,868.7	5,074.1	4.2%	-7%
Other Regions	*6,352.7*	*17,334.0*	*172.9%*	none
Africa	545.0	1,032.4	89.4%	none
Middle East	549.9	1,647.1	199.5%	none
N-OECD Eur. & Eurasia [4]	630.0	528.8	-16.1%	none
Latin America [4]	842.5	1,583.3	87.9%	none
Asia (excl. China) [4]	1,507.5	4,291.4	184.7%	none
China	2,277.7	8,250.8	262.2%	none
INTL. MARINE BUNKERS	**363.2**	**602.2**	**65.8%**	
INTL. AVIATION BUNKERS	**256.3**	**477.8**	**86.4%**	
WORLD	**20,973.9**	**31,734.3**	**51.3%**	



(1) On 15 December 2011, Canada withdrew from the Kyoto Protocol. This action became effective for Canada on 15 December 2012.

(2) The actual country targets apply to a basket of six greenhouse gases and allow sinks and international credits to be used for compliance. The overall "Kyoto target" is estimated for this publication by applying the country targets to IEA data for CO_2 emissions from fuel combustion, and is only shown as an indication. The overall target for the combined EU-15 under the Protocol is -8%, but the member countries have agreed on a burden-sharing arrangement as listed.

(3) Emissions from Monaco are included with France.

(4) Composition of regions differs from elsewhere in this publication to take into account countries that are not Kyoto Parties.

(5) The Kyoto target is calculated as percentage of the 1990 CO_2 emissions from fuel combustion only, therefore it does not represent the total target for the six-gas basket. This assumes that the reduction targets are spread equally across all gases.

Post-Kyoto system

- Second commitment period of KP for 2013--2020 concluded in 2012 (COP 18 in Doha). Belarus, Canada, Japan, New Zealand, Russia, USA and Ukraine missing. Others reduction commitments covering 13% of global GHG emissions at 2010 levels
- To limit global temperature increase to less than 2°C above pre-industrial level, countries are negotiating a new climate agreement (partialy finalised at COP21 in Paris 2015)
- It builds on the voluntary emission reduction goals for 2020 that were made at COP15 in Cobenhagen
- Developed and developing countries with these aims account for over 80% of global emissions. (goals nevertheless not sufficient to fulfill 2°C limit)

Paris agreement (COP21)

- Legally binding treaty with reduction commitments from 187 countries starting in 2020. It will enter the force once 55 countries covering 55% of global emissions are in.
  - Aim of limiting global warming to less than 2 °C
  - Intended Nationally Determined Contribution – to be reviewed every 5 years (should reduce warming from estimated 4-5 °C by 2100 to 2,7 °C
  - No detailed timetable or country-specific goals for emission in the Paris Agreement, no enforcement mechanism (name and shame mechanism)

Post-Kyoto system

- While obligations are to start from 2020, emissions from the energy sector need to peak by 2020 if there is to be a reasonable chance of limiting temperature rise to below 2°C
- Complementary initiatives outside the UNFCCC are needed

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A wide range of energy and climate policies reduce greenhouse gas emissions

Policy Type	Policy options
Price-based instruments	Taxes on CO_2 directly Taxes/charges on inputs or outputs of process (*e.g.* fuel and vehicle taxes) Subsidies for emissions-reducing activities Emissions trading systems (cap and trade or baseline and credit)
Command and control regulations	Technology standards (*e.g.* biofuel blend mandate, minimum energy performance standards) Performance standards (*e.g.* fleet average CO_2 vehicle efficiency) Prohibition or mandating of certain products or practices Reporting requirements Requirements for operating certification (*e.g.* HFC handling certification) Land use planning, zoning
Technology support policies	Public and private RD&D funding Public procurement Green certificates (renewable portfolio standard or clean energy standard) Feed-in tariffs Public investment in underpinning infrastructure for new technologies Policies to remove financial barriers to acquiring green technology (loans, revolving funds)
Information and voluntary approaches	Rating and labelling programmes Public information campaigns Education and training Product certification and labelling Award schemes

Source: Hood (2011), based on de Serres, Murtin and Nicolleti (2010).

Emission reduction policies – GHG reduction is a primary goal

- Comand-and-control methods (regulations), where CO2 producers are limited by their govt in how much they can emit
- Subsidy for emissions-reducing activities
- Policies to develop CCS
- Carbon pricing

Regulation of GHG emissions

- Regulatory controls of the GHGs emitted by new/existing fossil fuel infrastructure. May have an important role to play in driving the retirement of existing old, high-emissions infrastructure
- UK, Canada (new construction to be no more emissions-intensive than natural gas)
- In 2013 EPA published regulations to limit emissions of newly-constructed power plants requiring CCS for any new coal-fired generation

Subsidies for GHG reduction activities

- Subsidies (or credits) for emissions-reducing activities
  - Since they do not (directly) raise energy prices could be politically easier to implement. But:
  - Subsidies rely on govt budgets, so they are vulnerable to cuts in difficult economic circumstances (instability)
  - The price signals are effective only for individual projects or narrow sectors of the economy – not suffucient to drive the long term decarbonisation transition

Carbon pricing

- To decrease demand we need to raise its cost. If the price of fossil fuels is increased the amount of emission will decrease. Trying to find the balance of the costs and benefits of carbon production, not to reducing it entirely. To internalize the externalities
- Instruments that reach throughout the economy, influencing all production and consumption decisions
- 1)figuring out how much carbon we want to put into the environment. 2) Then a cost must be applied
  - Applying tax on it (Pigouvian tax)
  - Cap-and-trading
- Both these systems raise some revenue that could be used to offset the negative macroeconomic impacts of energy price rises

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Carbon taxes

- Norway – CO2 tax introduced in 1991. Applied to oil products, emissions from oil and gas production and gas used for heating and transport. Sectors covered by EU ETS exempted from carbon tax, with exeption of the offshore oil and gas sector. From 2013 the tax level has been increased to offset the falling EUA price
- Japan – introduced in 2012 to raise revenue for energy efficiency and RES programmes, not as a direct price incentive
- Switzerland – CO2 levy intended as an incentive for energy efficiency and for shifting toward cleaner heating and proces fuels (not to raise revenue). In place since 2008. Increased from 12 CHF/tCO2 to 120 CHF/tCO2

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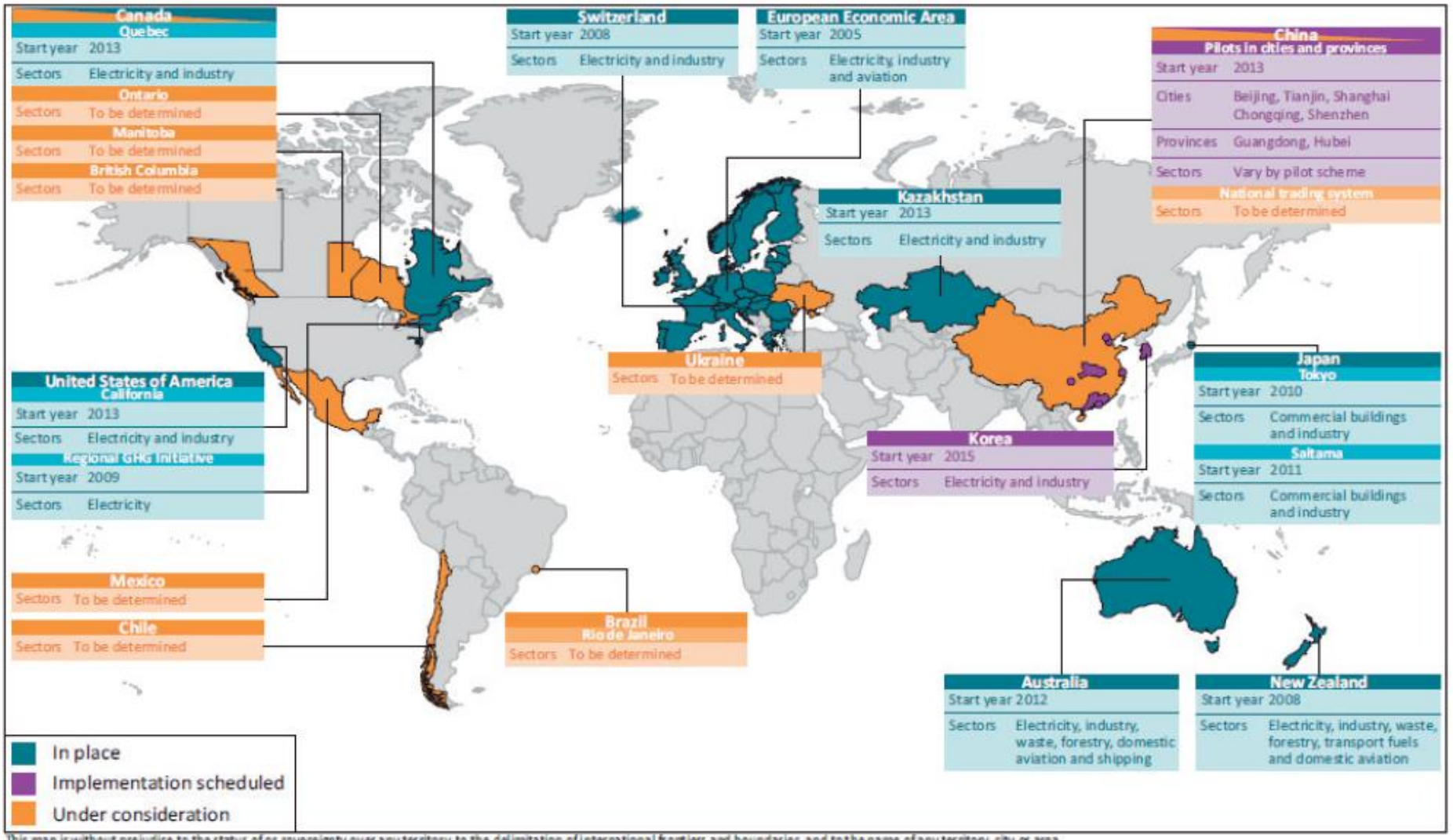
Cap and trade systems

- A govt assigns to itself the right to put emissions into the environment
- It defines what it believes to be the socially optimal quantity of emissions
- The govt generates a number of permits equal to the amount of allowable emissions
- These permits are allocated to emitters to trade with them – market is created
- = economically efficient, provides incentives for efectivity of the system. To develop technology that would allow one to reduce emissions at a cost lower than that of buying a permit, that spurs innovation and technological development

Current and proposed emissions trading systems



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

Source: IEA (2013a)

GHGs related policies

- Energy policies – implemented primarily for other reasons with emissions reductions one of a number of their benefits
  - Energy efficiency programmes to overcome barriers to cost-effective investment in energy-savings
  - Technology deployment policies (incl. RES support) which drive the deployment of cleaner energy options
  - Energy taxes and subsidies, which change the prices of fuels, impacting production and consumption choices
  - Regulation of conventional pollutants from fossil-fueled power stations to improve air quality

Energy policies that affect emissions

- Energy taxes and subsidies
  - Non-climate objectives (funding of infrastructure, revenue rasing), can shift the average and relative prices of fuels, therefore act as a significant carbon price. (and vice versa)
- Energy efficiency
  - The primary motivation for energy efficiency policies is cost savings to consumers and society, improved energy security. Emissions savings a positive by-product
  - Performance standards, information and labelling, energy provider obligations in lightning, equipment and buildings
- Development and deployment of low-carbon supply
  - Technology support policies – research development to demonstration projects to support for deployment

Sources

- Wagner, G.; Weitzman, M.L.(2015: Climate Shock: The Economic Consequences of a Hotter Planet
- Figueres, Ch.-Ivanova, H.M.: Climate Change: National Interests or a Global Regime?
- IEA: CO_2 Emission from Fuel Combustion

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