CHAPTER 10

EMISSION TRADINGS AND BUBBLE POLICY: THE EXPERIENCE OF USEPA&EUROP

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目錄

Part I. The USA

Reference: www.epa.gov/airmarkets

•10-0. The Air Market History

- Clean Air Markets Programs have delivered substantial emission reductions and air quality improvements since the first nationwide program.

➢ the Acid Rain Program, which began in 1995.

➢ With the addition of the Ozone Transport Commission NO_x Budget Program (1999 - 2002), the NO_X Budget Trading Program (2003-2008), the Clean Air Interstate Rule (CAIR) (2009-2014), the Cross-State Air Pollution Rule (CSAPR) (2015-present) and CSAPR Update, which was implemented in 2017 to further reduce seasonal NO_X emissions and help state attain ozone NAAQS.

- The reduction in **ozone and fine particulates ($PM_{2.5}$)** formation resulting from CAIR and CSAPR has provided health benefits as well as improved visibility in national parks and improvements in fresh water ecosystems in the eastern United States.

•10-0. The Air Market History

Retired Program:

- The Ozone Transport Commission NO_x Budget Program began in 1999 in the northeastern United States, and was intended to reduce summertime NO_x emissions. It was effectively replaced by the NO_x Budget Trading Program under the NO_x SIP Call in 2003.
- The NO_x Budget Trading Program was created under the NO_x SIP Call. Beginning in 2003, it was designed to reduce the transport of ground-level ozone in the eastern United States and was effectively replaced by the CAIR (Clean Air Interstate Rule) Ozone Season NO_x program in 2009. Learn more about the NO_x SIP Call.
- The Clean Air Interstate Rule (CAIR) began in 2009 and capped emissions of SO_2 and NO_x in the eastern United States. This program ended January 1, 2015 and it was replaced by the Cross-State Air Pollution Rule

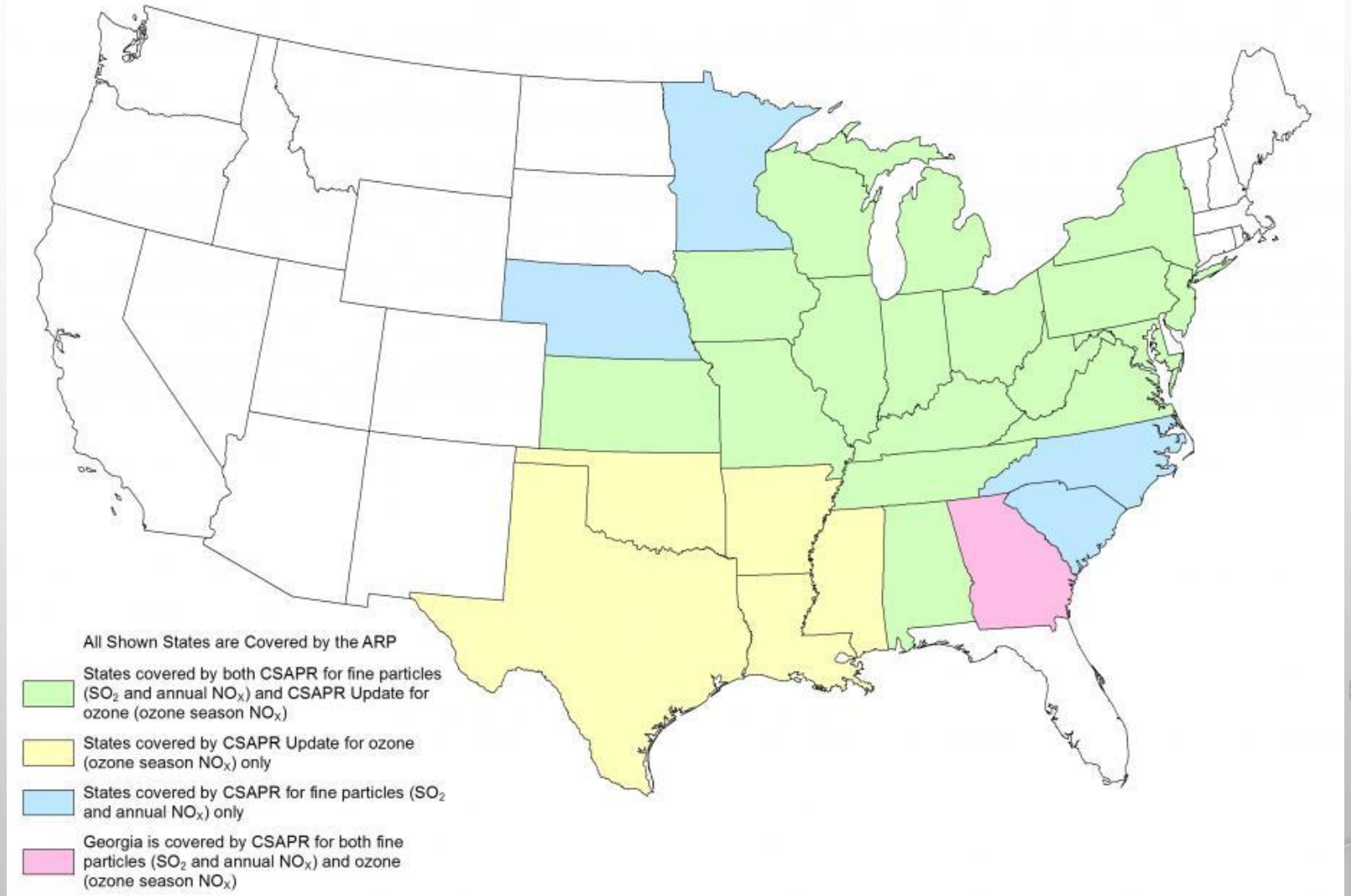
•10-0. The Air Market History

Current Program:

- The Acid Rain Program began in 1995 and required reductions in emissions of SO_2 and NO_x (the primary causes of acid rain) from power plants.
- The Cross-State Air Pollution Rule requires 28 states to reduce power plant emissions that contribute to ozone and/or fine particle pollution in other states. This rule was intended to replace the Clean Air Interstate Rule.
- EPA finalized an update to the CSAPR (Cross-State Air Pollution Rule) ozone season program for the 2008 ozone NAAQS

•10-0. The Air Market History

States Covered by EPA's Acid Rain Program, Cross-State Air Pollution Rule, and/or CSAPR Update



•10-1. The Acid Rain Program

- The overall goal of the Acid Rain Program: to achieve significant environmental and public health benefits through reductions in emissions of sulfur dioxide (SO2) and nitrogen oxides (NOx), the primary causes of acid rain.
- To achieve this goal at the lowest cost to society, the program employs both traditional and innovative, market-based approaches for controlling air pollution.
- In addition, the program encourages energy efficiency and pollution prevention.

•10-1. The Acid Rain Program

- Title IV of the Clean Air Act set a goal of reducing annual SO2 emissions by 10 million tons below 1980 levels.
- The law required a two-phase tightening of the restrictions placed on fossil fuel-fired power plants:
  - Phase I began in 1995 and affected 263 units at 110 mostly coal-burning electric utility plants located in 21 eastern and midwestern states. An additional 182 units joined Phase I of the program as substitution or compensating units, bringing the total of Phase I affected units to 445. Emissions data indicate that 1995 SO2 emissions at these units nationwide were **reduced by almost 40% below their required level**.

•10-1. The Acid Rain Program

- Phase II, which began in the year 2000, tightened the annual emissions limits imposed on these large, higher emitting plants and also set restrictions on smaller, cleaner plants fired by coal, oil, and gas, encompassing over 2,000 units in all. The program affects existing utility units serving generators with an output capacity of greater than 25 megawatts and all new utility units.

- The Act also called for a 2 million ton reduction in NOx emissions by the year 2000. A significant portion of this reduction has been achieved by coal-fired utility boilers that will be required to install low NOx burner technologies and to meet new emissions standards.

•10-1. The Acid Rain Program

- **Allowance (排放權; 排放限額) System**

➢ The Acid Rain Program introduces an allowance trading system that harnesses the incentives of the free market to reduce pollution.

➢ Under this system, affected utility units are allocated allowances based on their historic fuel consumption and a specific emissions rate.

➢ Each allowance permits a unit to emit 1 ton of SO2 during or after a specified year. For each ton of SO2 emitted in a given year, one allowance is retired, that is, it can no longer be used.

•10-1. The Acid Rain Program

- Allowances may be bought, sold, or banked. Anyone may acquire allowances and participate in the trading system.
- However, regardless of the number of allowances a source holds, it may not emit at levels that would violate federal or state limits set under Title I of the Clean Air Act to protect public health.
- The program was phased in, with the final 2010 SO2 cap set at 8.95 million tons, a level of about one-half of the emissions from the power sector in 1980.

10-2. Ozone Transport Commission (OTC) NOx Budget Program

- The **Ozone Transport Commission (OTC)** comprises the states of Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Maryland, Delaware, the northern counties of Virginia, and the District of Columbia.
- In September 1994, the OTC adopted a memorandum of understanding (**MOU**) to achieve regional emission reductions of nitrogen oxides (NOx). (Virginia did not sign the MOU.)
- These reductions are in addition to previous state efforts to control NOx emissions, which included the installation of **reasonably available control technology**.
- In signing the MOU, states have committed to developing and adopting regulations that would reduce region-wide NOx emissions in 1999 and further reduce emissions in 2003.
- The **NOx Budget Program** represents the Northeast's effort to control NOx emissions in order to make progress towards attainment of the **ozone** health standard.

10-2. Ozone Transport Commission (OTC) NOx Budget Program

- The NOx Budget Program is to reduce summertime NOx emissions, which cause ozone formation, in the northeast United States.
- The program caps summertime NOx emissions at 219,000 tons in 1999 and 143,000 tons in 2003, less than half of the 1990 baseline emission level of 490,000 tons.
- The NOx Budget Program uses an allowance trading system which harnesses free market forces to reduce pollution.
- Each allowance permits a source to emit one ton of NOx during the control period (May through September) for which it is allocated or any later control period.

10-2. Ozone Transport Commission (OTC) NOx Budget Program

Who's affected?

- Generally, the program affects electric utilities and large industrial boilers.
- Specifically, the program affects all fossil fuel fired boilers or indirect heat exchangers with a maximum rated heat input capacity of 250 MMBtu/hour or more; and all electric generating facilities with a rated output of 15 MW or more.
- Other stationary sources of NOx emissions have the option of voluntarily complying with the program (i.e., opt-in) on an individual basis.

10-2. Ozone Transport Commission (OTC) NOx Budget Program

- In order to demonstrate compliance, budget sources must monitor and report their actual emissions. Sources with large NOx emissions must monitor using continuous emissions monitoring systems (CEMS). Sources with lower NOx emissions may use simpler estimation methods. Regardless of the method used to determine emissions, the data used to support these determinations must be reported electronically to EPA.
- The NOx Budget Program is separate and distinct from the Acid Rain "Phase I and II" NOx reduction requirements. Sources affected by these programs are responsible for demonstrating compliance with the requirements of both programs.

10-3. Allowance Trading

The emissions trading approaches used by EPA's Clean Air Market Programs is called "allowance trading" or "cap and trade" and has the following key features:

1. An emissions "cap": a limit on the total amount of pollution that can be emitted (released) from all regulated sources (e.g., power plants); the cap is set lower than historical emissions to cause reductions in emissions

2.Allowances: an allowance is an authorization to emit a fixed amount of a pollutant

3.Measurement: accurate tracking of all emissions (e.g. CEMS)

4.Flexibility: sources can choose how to reduce emissions, including where to buy additional allowances from other sources that reduce emissions

5.Allowance trading: sources can buy or sell allowances on the open market

6.Compliance: at the end of each compliance period, each source must own at least as many allowances as its emissions

10-3. Allowance Trading

- This approach is best used when:
  - ✓ the problem occurs over a relatively large area
  - ✓ there are a significant number of sources responsible for the problem
  - ✓ the cost of controls varies from source to source, and
  - ✓ emissions can be consistently and accurately measured.
- The regulating agency (e.g., EPA) must:
  - ✓ be able to receive the large amount of emissions and allowance transfer data and quality assure those data
  - ✓ be able to determine compliance fairly and accurately
  - ✓ strongly and consistently enforce the rule

10-4 Allowance Data - Allowance Tracking Fact Sheet

Frequently Asked Questions About the Allowance System

- What Is Allowance Trading?
- What Is A General Account?
- Who May Participate in Allowance Trading?
- How Are Allowances Allocated?
- How Else Can Allowances Be Obtained?
- How Are Allowance Transfers Submitted?
- How Does EPA Keep Track of Allowances?
- How Are Allowances Used for Compliance?

10-4 Allowance Data - Allowance Tracking Fact Sheet

What Is Allowance Trading?

- Allowance trading allows sources in cap and trade programs to adopt the most cost-effective strategy to reduce emissions.
- Affected sources are required to install systems that continuously monitor emissions of SO_2, NO_x, and other related pollutants in order to track progress and ensure compliance.
- Sources that reduce their emissions below the number of allowances they hold may trade allowances with other sources in their system, sell them to other sources on the open market or through EPA auctions, or bank them to cover emissions in future years.

10-4 Allowance Data - Allowance Tracking Fact Sheet

What Is A Unit Account and A General Account?

- The ATS contains two types of accounts: unit accounts and general accounts.
- EPA creates unit accounts for all regulated sources under each trading program. These accounts receive allocated allowances and EPA removes allowances as part of compliance.
- General accounts can be created by anyone to hold or trade allowances. Any individual or group, including a utility, can open a general account by submitting the appropriate form. General accounts are not tied to specific plants, and are not considered compliance accounts.
- In addition to the compliance accounts established for them by the EPA, members of the regulated community may also open general accounts to hold or transfer allowances.

10-4 Allowance Data - Allowance Tracking Fact Sheet

General accounts can be used for a variety of purposes:

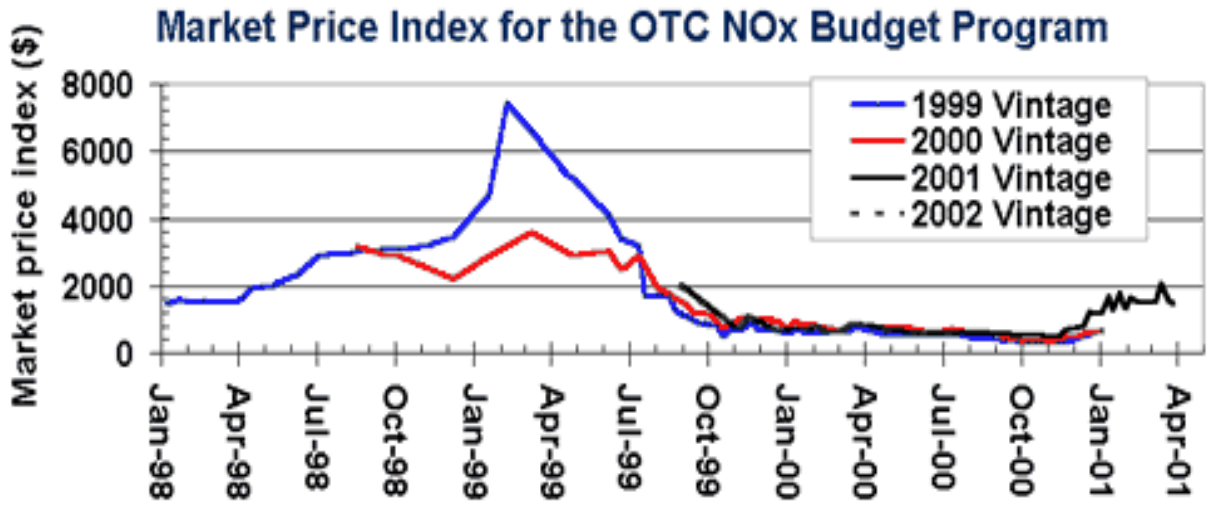
- Utilities may pool their emission allowances in general accounts.
- Brokers may use general accounts to hold allowances that they buy or sell for customers.
- Investors may use general accounts to hold allowances they have acquired for eventual resale.
- Public interest groups wishing to remove a portion of the available allowances from the market may purchase allowances and place them in general accounts.

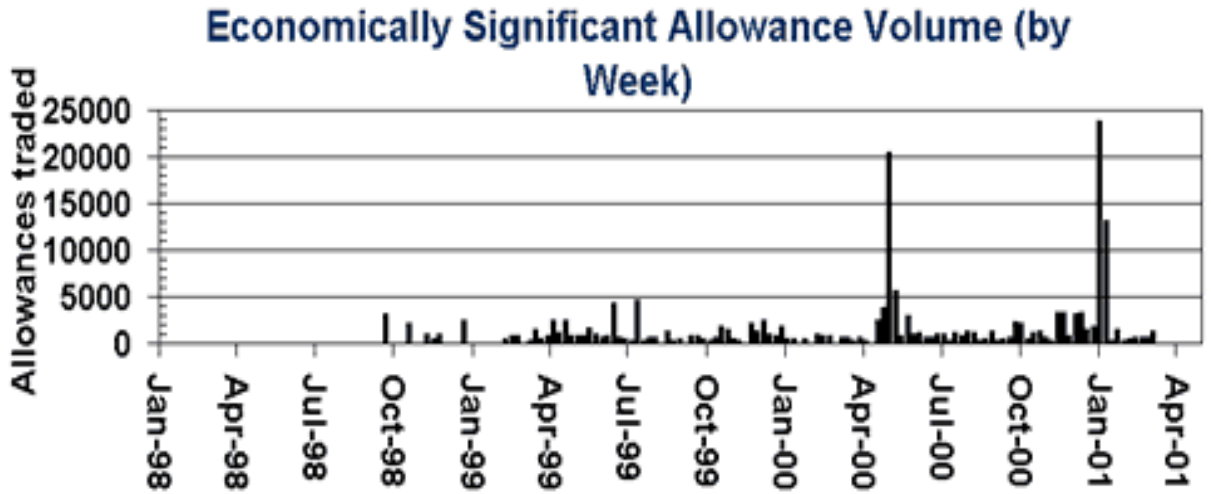
10-4 Allowance Data - Allowance Tracking Fact Sheet

How Are Allowances Used for Compliance?

- Under the Acid Rain Program, one allowance is equivalent to 1 ton of SO_2 during a given year or any subsequent year.
- Under CAIR and CSAPR, there are annual NO_x and SO_2 allowances, as well as seasonal NO_x allowances.
- At the end of each year or ozone season, the source must hold an amount of allowances at least equal to its emissions for that time period.
- For example, a source that emits 5,000 tons of SO_2 must hold at least 5,000 allowances that are usable in that year. Regardless of how many allowances a source holds, however, it is never entitled to exceed the limits set under Title I of the Act to protect public health.

10-5. The Market Prices: NOx





Once the OTC NOx Budget Program established itself by the end of 1999, allowance prices have ranged between $600 and $1,700 per ton and have generally been less than $1,000 per ton.

(Source: USEPA website; further detail see https://www.epa.gov/sites/production/files/2015-08/documents/otcreport.pdf)

10.6 The Clean Air Interstate Rule (CAIR)

- On March 10, **2005**, EPA issued the Clean Air Interstate Rule (CAIR)
- In 2015, CAIR will provide health and environmental benefits valued at more than 25 times the cost of compliance.
- CAIR achieves large reductions of SO2 and/or NOx emissions across 28 eastern states and the District of Columbia.
- When fully implemented, CAIR will reduce SO2 emissions in these states by over 70 percent and NOx emissions by over 60 percent from 2003 levels.
- A closely related action is the EPA Clean Air Mercury Rule, the first ever federally-mandated requirements that coal-fired electric utilities reduce their emissions of mercury. Together the Clean Air Mercury Rule and the Clean Air Interstate Rule create a multi-pollutant strategy to reduce emissions throughout the United States.

10.6 The Clean Air Interstate Rule (CAIR)

為何加州LA的臭氧這麼嚴重，卻不在CAIR中?

California : The final Clean Air Interstate Rule covers 28 eastern states and the District of Columbia. Air emissions in these states contribute to unhealthy levels of ground-level ozone, fine particles or both in downwind states. Several states are not included in the CAIR region because they do not contribute to down wind nonattainment. California is one of the state not regulated by CAIR.

10.6 The Clean Air Interstate Rule (CAIR)

Ohio:

- By 2015, CAIR will help Ohio sources reduce emissions of sulfur dioxide (SO2) by **968,000 tons** or **82%**

SO2 Emissions (thousand tons)	2003	2010	2015
Ohio SO2 emissions without CAIR	1,176	1,373	1,064
Ohio SO2 emissions with CAIR	N/A	298	208

- By 2015 CAIR will help Ohio sources reduce emissions of nitrogen oxides (NOx) by **272,000 tons** or **77%**

NOx Emissions (thousand tons)	2003	2009	2015
Ohio NOx emissions without CAIR	355	264	274
Ohio NOx emissions with CAIR	N/A	93	83

10-6.Cross-State Air Pollution Rule (CSAPR)

- **CSAPR Phase 1 implementation was scheduled for 2015, with Phase 2 beginning in 2017.**
- **This rule replaces EPA's 2005 Clean Air Interstate Rule (CAIR).**
- Starting in May 2017, this rule will reduce summertime (May - September) nitrogen oxides (NOX) emissions from power plants in **22 states in the eastern U.S., providing up to $880 million in benefits** and reducing ground-level ozone exposure for millions of Americans.
- The rule will reduce air quality impacts of ozone pollution that crosses state lines and will help downwind areas meet and maintain the 2008 ozone air quality standard.

Sources: https://www.epa.gov/csapr
https://www.epa.gov/airmarkets/final-cross-state-air-pollution-rule-update

10-6. Cross-State Air Pollution Rule (CSAPR)

2016 ARP and CSAPR at a Glance:

- **Annual SO_2 emissions:**
  CSAPR - 1.2 million tons (87 percent below 2005)
  ARP - 1.5 million tons (91 percent below 1990)
- **Annual NO_x emissions**
  CSAPR - 0.8 million tons (69 percent below 2005)
  ARP - 1.2 million tons (81 percent below 1990)
- CSAPR **ozone season** NO_x emissions: 420,000 tons (53 percent below 2005)
- Compliance: 100 percent compliance for power plants in the ARP and CSAPR programs.

Note: ARP: Acid Rain Program; CSAPR: Cross-State Air Pollution Rule
Source: https://www3.epa.gov/airmarkets/progress/reports/index.html

10-6. Cross-State Air Pollution Rule (CSAPR)

2016 ARP and CSAPR at a Glance:

- **Ambient particulate sulfate concentrations:** The eastern United States has shown substantial improvement, decreasing 71 to 75 percent between 1989–1991 and 2014–2016.
- **Ozone NAAQS attainment:** Based on 2014-2016 data, all 92 areas in the East originally designated as nonattainment for the 1997 ozone NAAQS are now meeting the standard.
- **$PM_{2.5}$ NAAQS attainment:** Based on 2014-2016 data, 34 of the 39 areas in the East originally designated as nonattainment for the 1997 $PM_{2.5}$ NAAQS are now meeting the standard (two areas have incomplete data).
- **Wet sulfate deposition:** All areas of the eastern United States have shown significant improvement with an overall 66 percent reduction in wet sulfate deposition from 1989–1991 to 2014–2016.
- **Levels of acid neutralizing capacity (ANC):** This indicator of recovery improved (i.e., increased) significantly from 1990 levels at lake and stream monitoring sites in the Adirondack region, New England and the Catskill mountains.

Note: ARP: Acid Rain Program; CSAPR: Cross-State Air Pollution Rule
Source: https://www3.epa.gov/airmarkets/progress/reports/index.html

Part II. The EUROP

https://ec.europa.eu/clima/index_en

http://www.ieta.org/emissions-trading-101-library

溫室氣體排放交易市場與法規制度(Evolution of GHG Markets and Regulatory Framework)

Part II. The EUROP

- 歐盟的ETS系統是目前世界最大的碳交易系統，其為強制性交易。
- 從2005年1月開始進行溫室氣體排放交易，在第一階段中（2005-2007年），每年歐盟總共分配量約20億公噸二氧化碳當量，而以各年之碳價格(2006年4/19最高曾達29.75歐元/噸CO_2)換算，其市場交易價值在2005年約為79億美元，2006年為244億美元，2007年則為501億美元(IETA State and Trends of the Carbon Market, 2008, p.7)。
- 但在2006結算報告查證期間，顯示許多國家出現配額剩餘的現象，市場價格為之崩跌，2007年的排放權每噸不到 0.1 歐元。但是其2008年期貨交易，也就是第二階段（2008~2012年）之交易期，仍然維持在15~20歐元，顯示市場預計第二階段之總量分配方案應該會較嚴格。

Part II. The EUROP

- 歐盟在2008-2012年進入第二階段的排放交易制度，並逐步擴大其他部門的參與及包含其他非CO2溫室氣體。2013-2020年則進入第三階段，增加更多之參與sectors及氣體種類。
- 目前參與ETS EU的國家共有**31國**，除了28 EU的國家外，還有 Iceland, Liechtenstein (列支敦斯登) and Norway。
- 其限制了**11,000個**重大能源使用端(電廠、大型工業)之溫室氣體排放，所涵蓋之**溫室氣體排放量**大約為全歐盟的**45%**。

註:列支敦斯登為位於瑞士和奧地利之間的一個小國家，總面積160km2, 人口<40,000, GDP世界排序第二位。

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

Part II. The EUROP

- In **2020**, emissions from sectors covered by the system will be **21% lower than in 2005**.
- In **2030**, under the revised system they will be **43% lower**.
- Member States have generated nearly € 15.8 billion from the auctioning of EU ETS allowances over the period 2013-2016.

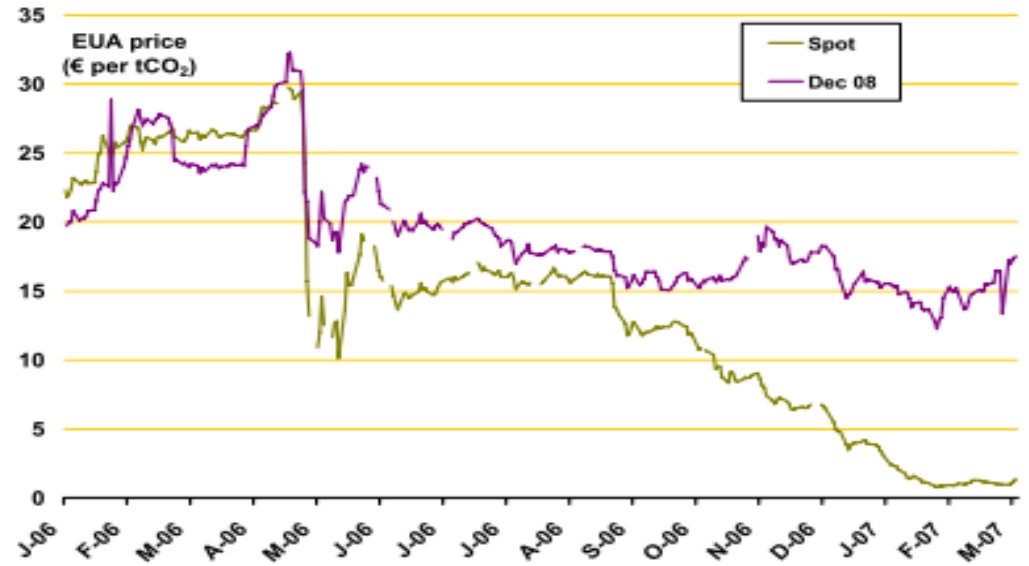
註1: Source: https://ec.europa.eu/clima/policies/ets_en

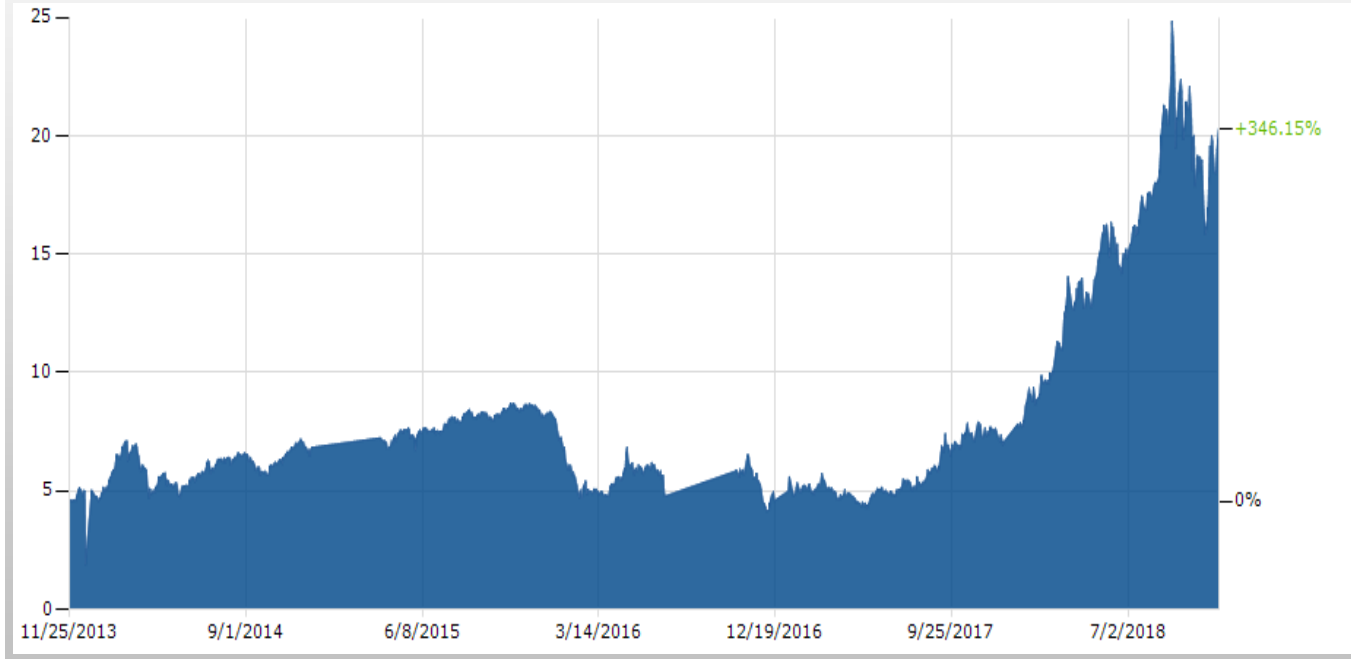
註2: 我國溫室氣體長期減量目標-於2050年溫室氣體排放量降為2005年溫室氣體排放量50%以下，及2030年溫室氣體排放量為BAU (business as usual)減量50%（214百萬公噸二氧化碳當量）之中程願景，此一減量目標相當於溫室氣體排放量降為2005年溫室氣體排放量20%以下。

Part II. The EUROP

歐盟 ETS 碳交易價格: 左圖為2006-2007; 右圖為最近五年(2013-2018)

Figure 1: Spot and Dec'08 Prices for EUAs 2006-Q1'07 (Source: Powernext, ECX)





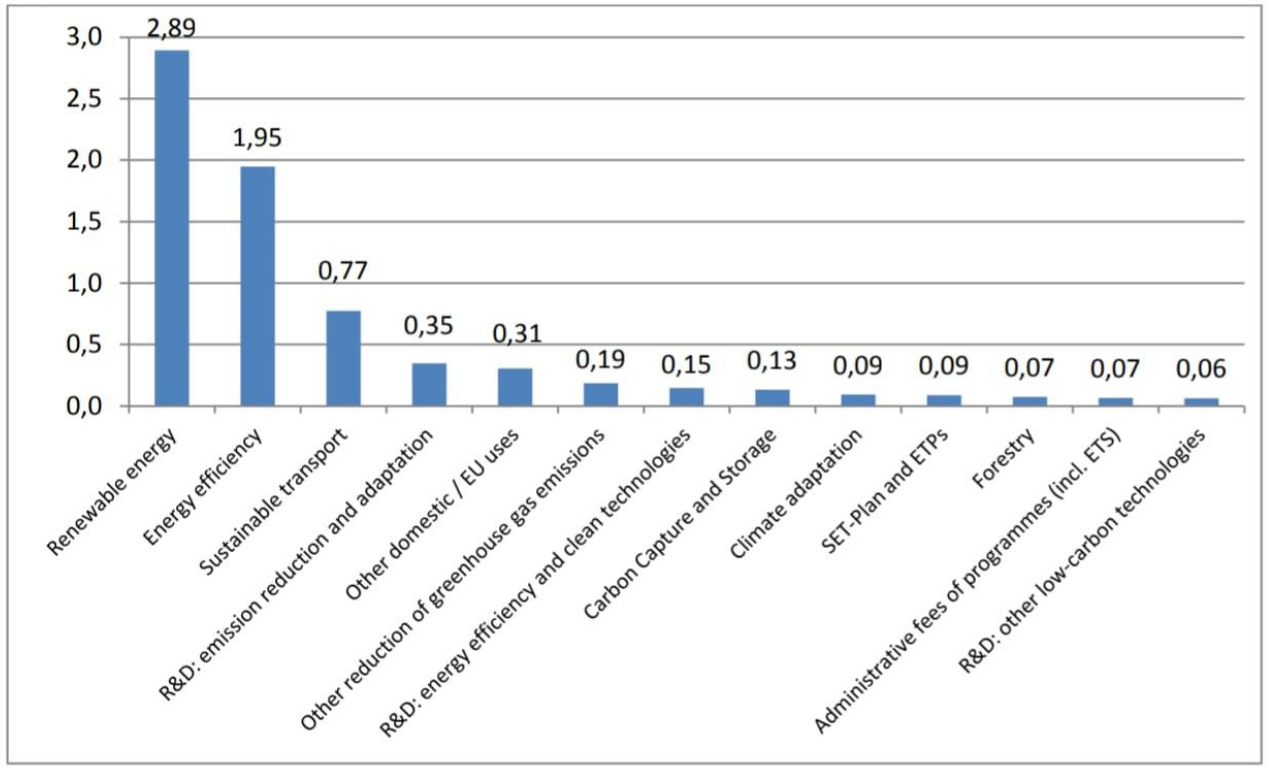
資料來源:
左圖: World Bank/IETA, "STATE AND TRENDS OF THE CARBON MARKET 2007". http://www.setatwork.eu/trends2007.htm
右圖: https://markets.businessinsider.com/commodities/co2-emissionsrechte

Part II. The EUROP

歐盟 ETS 碳交易的收入用來做甚麼?

資料來源:https://ec.europa.eu/clima/sites/clima/files/ets/auctioning/docs/auction_revenues_report_2017_en.pdf

Figure 3: Use of auctioning revenues by category of domestic and EU spending between 2013-2015 (bn EUR)[20]



The most important revenue use categories are renewable energy (2.89 billion EUR, or 40.6% of total revenue use) and energy efficiency related spending (1.95 billion euros, or 27.4%), followed by sustainable transport (774 million EUR, or 10.9%).

Part II. The EUROP: Other countries

2015 China' carbon price:

For other countries, please refer to: http://www.ieta.org/worldscarbonmarkets

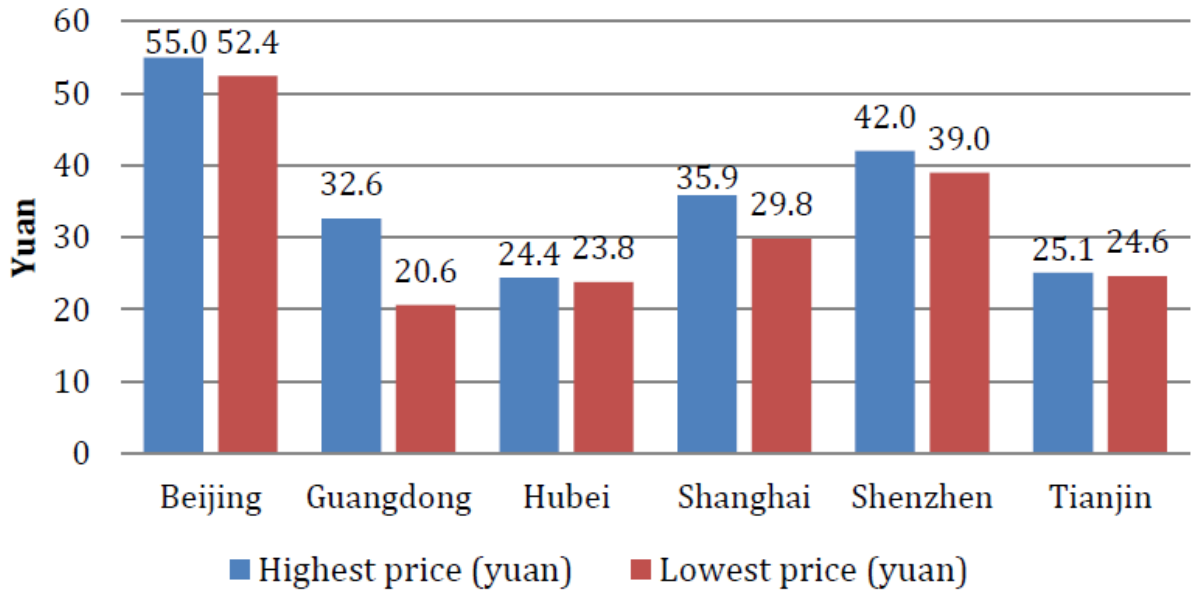


Figure 3 – Carbon price for each ETS pilot in January 2015

Source: *China carbon, http://chinacarbon.net.cn/wp-content/uploads/2015/02/China-Carbon-Market-Review_January-2015.pdf, January 2015*

- In 2014-2017, the European Commission in close cooperation with China carried out a 3-year project to support the design and the implementation of emissions trading in China.
- The Korean emissions trading system (KETS), launched in 2015, covers around 66% of Korea's total greenhouse gas emissions.

Thanks for your participation