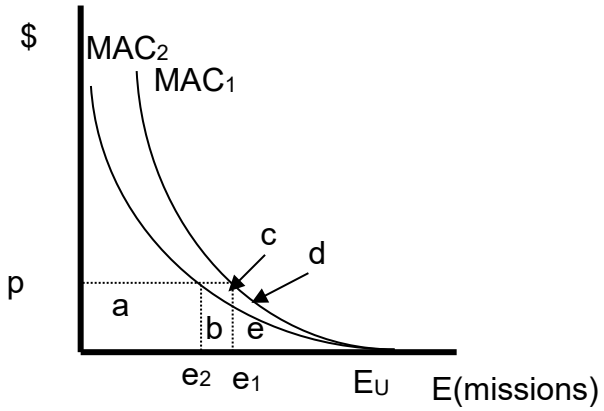
Lecture # 9 – Permit Trading in Practice

I. Implementation Issues (continued)

- Interaction with other policies
  - Because there is a hard cap, other policies that affect emissions may lower permit prices
    - E.g. in the EU-ETS, if an individual country adds additional regulations (e.g. UK carbon tax), demand for permits falls
    - Because supply is fixed, the price falls, but emissions do not change
  - This is known as the "waterbed" effect
  - Can address the waterbed effect by adding a price floor
    - If prices cannot fall below the price floor, so emissions fall instead. Some permits go unused.
- Geographic considerations:
  - For some types of pollution (e.g. CO_2), where it is emitted doesn't matter.
  - For others, (e.g. carbon monoxide in a city), location does matter.
  - A tax system would deal with this by charging higher fees in areas where pollution is a bigger concern.
  - Ways for permit system to deal with geographic concerns:
    - Ambient-based permit system: permits needed for pollution as measured at each receptor.
      - E.g. a firm downwind might need to buy two permits from a firm upwind to be able to emit one unit of pollution.
    - Limit trading to within regions
      - Limits trades to areas where the emissions have the same effect.
        - For example, New York State has tried to prohibit NY power plants from selling SO_2 permits to plants in neighboring states.
        - The EPA divides the country into two regions (East and West) for NO_X trading
      - However, such rules may prohibit some beneficial trades.
      - Also, this limits competition, which might keep the market from working correctly.

- Incentives for innovation
  - The incentives for innovation are the same as with an emissions fee
  - Here, the opportunity cost of polluting is using a permit, which sells for price p.



  - Consider two cases:
    i. A firm has enough permits to cover its pollution.
       - The opportunity cost of polluting is that it cannot sell a permit.
       - Thus, innovation not only lowers marginal abatement costs, but allows the firm to sell more permits.
    ii. A firm does not have enough permits to cover its pollution.
       - The opportunity cost of polluting is that the firm must buy a permit.
       - Thus, innovation not only lowers marginal abatement costs, but saves the firm from the need to buy additional permits.
  - In either case, the opportunity cost includes the value of permits either purchased or used instead of being sold:
    - With MAC_1, e_1 is the level of emissions.
      - Abatement costs = d + e
      - Cost of permits = a + b + c
        - Total cost to firm: a + b + c + d + e
    - With MAC_2, e_2 is the level of emissions
      - Abatement costs = b + e
      - Cost of permits: a
    - Savings: c + d
    - This the is the same result we had with emission fees

II. Examples of Permit Trading

- Sulfur dioxide (SO_2) permits and the 1990 Clean Air act
    - Before the 1990 CAA, SO_2 and NO_x were only regulated as local pollutants.
    - Therefore, utilities could meet regulations by building tall smokestacks that carried pollution away.
    - Moreover, command and control regulation required new plants use best available scrubber technology
        - As a result, firms had incentives to extend lives of units.
        - By 1985, 83% of SO_2 emissions came from plants that didn't meet 1971 standards for new units.
            - Heterogeneity among plants made a market solution useful.
    - The 1990 CAA established a permit market for sulfur dioxide (SO_2).
        - Goal by 2010:
            - Reduce SO_2 emissions by 10 million tons.
    - How the market was implemented.
        - Plants given permits (1 ton SO2 per permit) based on current emissions.
            - Phase I (1995-1999): starts with dirtiest 263 units.
                - 8.7 million tons of permits were allocated in 1995.
                - By 1999, this was reduced to 6.9 million tons.
            - Phase II (2000): tightens limits and includes more firms.
        - Most permits freely allocated to maximize political support
            - Since most plants were under cost-of-service regulation, cost savings expected to be passed on to consumers
        - 2.8% not allocated – held back and auctioned off to stimulate market activity.
        - Firms can make investments to reduce emissions, sell excess permits, or buy permits to emit more.
        - Permits can be banked.
        - Initially a $2,000 per ton fine for exceeding permits.
            - The fine is indexed for inflation.

- Results
    - Emissions fell by 36 percent from 1990-2004, while electricity generation from coal plants increased 25%
        - Simulations suggest costs were 15-90% lower than under command and control
    - The market operated efficiently
        - When permits first sold in 1993, there was a 10-20% difference between the top bids and the average bids.
        - By 1997, 3.4% difference.
        - Firms learned about the market.
    - Costs have been reduced
        - Why did costs fall?
            - Low sulfur coal cheaper than expected because of rail deregulation.
                - Fuel switching has accounted for 45% of emissions reductions.
            - Cheaper technologies available.
    - History of prices
        - Projected price of permits: $250-$350 for phase I, $500-$750 for phase II
        - Actual price around $100-150 in phase I
        - Changing regulations led to price spikes and eventual market collapse
            - 2005: Clean Air Interstate Rule (CAIR) proposed lowering SO2 emission cap 70%
                - Because of banking, permit prices peaked over $1,200/ton
            - 2008: Circuit Court of Appeals invalidates CAIR and unlimited interstate trading
                - Concern was that unlimited trading could push some states into non-attainment, due to hotspots
                - Prices fell from $315/ton to $115/ton in a single day
            - 2010: Clean Air Transport Rule (CATR) sets state-specific caps
                - Put limits on interstate trading
            - 2012 permit prices are below $1/ton
        - Key lesson: What the government creates can be taken away
            - Policy uncertainty becomes a concern!

- European Union Emissions Trading System (EU-ETS)
    - The EU-ETS is the world's largest carbon market. Accounts for nearly 90% of the value of global carbon markets.
    - Helps Europe meet its emission reduction goals.
        - Started to help the EU meet its commitments from the Kyoto Protocol
        - In July 2021, the European commission devised plans to achieve carbon neutrality by 2050, including a 55% net reduction in GHG emissions by 2030.
    - The EU sets a national CO2 emissions limit for each country
        - From this, the EU has specified the industries that will participate in trading
            - Initially, four industries could trade:
                - iron and steal
                - some mineral industries (e.g. cement)
                - energy production
                - pulp and paper
        - Other industries face emissions limits, but not be able to trade permits.
        - Aviation emissions included beginning in 2012
    - Each country gets allowances based on its national cap in Kyoto. It faces two allocation decisions:
        - Total allowances are spread between the trading & non-trading sector
        - Permits in the trading sector must be allocated among individual firms.
    - Issues:
        - Difficult to make projects about price, because supply of permits was not known until countries made allocations between the trading and non-trading sectors.
            - Also makes it hard for an individual country to control emissions from its trading sector, because market prices will be determined by the allocation decisions of all countries.
        - However, it allows countries to distribute permits based on differences between MACs of traded and non-traded sectors in their country.
        - Countries have incentives to give more allowances to industries that trade goods, so that they do not have a competitive disadvantage with firms from other countries.
            - Thus, likely to require more reductions from industries like electric utilities.
            - In general, countries have given more allowances to the trading sector than expected, which has kept prices low.
        - Key lesson: trading rules matter, and complex rules can affect the market.

- There have been four phases:
  - Phase I: 2005-2007, after which adjustments may be made
  - Phase II: 2008-2012
  - Phase III: 2013-2020
    - Included more industries and a lower cap
    - Requires more permits to be auctioned, rather than freely allocated
      - All electric utility permits to be auctioned beginning in 2013, over concerns of utilities capturing windfall profits
      - Auctioning to be phased in on other sectors by 2027
    - EU returns the auction revenues to individual member states using a formula related to per-capita income
  - Phase IV: 2021+
- Other provisions
  - Free allowances initially made available for new entrants, and allowances of exiting facilities retired.
    - About 3% of initial permit allocation was set aside for new entrants.
      - Varies by country.
      - Typically allocated on a first-come, first-served basis.
    - Distorts market, but was done so that countries weren't penalized when trying to attract new investment.
  - Now most allowances are sold at auction
- Phase 4 begins in 2021. New rules announced in 2018. Key changes:
  - Cap falls by 2.2% per year. Goal is to reduce emissions 43% compared to 2005 levels
  - Most allowances (57%) now sold at auction, rather than being given to firms for free.
  - Market Stability Reserve (MSR)
    - If too many allowances banked for future use, some allowances withheld from the next year's auction
      - Placed in MSR, which cannot be bought or sold
    - If bank of unused allowances falls below a threshold, some allowances taken out of MSR and put back into circulation
    - Addresses "waterbed effect"
      - With a firm cap, other reductions simply reduce permit prices
      - MSR reduces, but does not eliminate waterbed effect

- Use of offsets
    - Allowed use of Clean Development Mechanism (CDM) projects
        - Disallowed certain project types
        - Supervision by CDM Executive Board
    - As a result, offsets widely used
        - Allowed to cover 11% of emissions
        - CDM credits were even cheaper than ETS allowances
- What happened
    - As expected, the electric utility industry did not have enough permits, but other sectors did.
    - Overall, emissions were down about 3.4% in 2005, compared to a BAU baseline.
    - Permit prices
        - 2005
            - When EU ETS began on January 1, 2005, price was €8.38.
            - By end of 2005, price was €21.10.
            - Generally, traded between €20-€30.
        - 2006
            - In 2006, data for 2005 revealed that emission reductions were greater than necessary.
            - As such, permit price s fell
            - Bottomed-out at €8.45 on November 13.
        - Prices rose to €20 in 2008 before falling during recession
        - Phase III, which begin in 2013, includes more industries and a lower cap
            - But didn't lead to higher prices
        - In December 2013, the European Parliament approved a rescue plan for EU-ETS
            - Would delay allocation of a third of new permits scheduled for 2014-16
            - Hoped to drive up price, but little immediate impact as markets anticipated the change
            - Prices finally began to rise in early 2018
        - Prices rising after phase 4: €85 in February 2026

- By 2025, 28% of global emissions covered by carbon pricing
    - Most often through cap-and-trade
    - We'll end class discussing when these markets are most successful. Some key points to consider:
        - How does the stringency of the cap affect prices?
        - How does how reductions are measured matter?
            - Consider, for example China's use of rate-based measurements (e.g. emissions per unit of electricity output)
            - How do they set benchmarks for different sectors?
        - How does the breadth of coverage affect overall compliance costs.
            - The EU-ETS has expanded coverage over time.
            - In contrast, RGGI just covers electric utilities.
            - Transportation is rarely covered, which protects consumers from higher costs but reduces mitigation options.
        - How has concerns over International competition affected policy?

For those of you interested in more details on these markets, below are additional notes on the markets in China, RGGI, and California.

- China's emissions trading market began February 1, 2021.
    - Initially, it only covers the electric power sector
    - Ultimate goal is to cover at least 70% of China's GHG emissions.
    - Trading will be rate-based (e.g. emissions per unit of electricity output)
        - Thus, allows for future economic growth
    - Firms only need to pay for 20% of the emissions that exceed their cap, and fines are low.
    - Benchmarks are based on the type of fuel
        - Based on the average carbon intensity of each sector
        - Thus, rewards better than average performance within sectors, but doesn't encourage fuel switching
    - Allowance price has been $5-15/ton)
    - Challenges
        - Many energy companies are state-owned
            - Prices often set by administrators, rather than the market
                - Higher prices from abatement might not be passed on to consumers
            - Dispatch of power determined by planners, rather than by costs
                - Lowest cost power not necessarily chosen first
        - Need accurate monitoring of emission for enforcement
            - This has been a problem with earlier environmental policies in China
            - China proposed third-party verification of emissions to address
        - Penalties for enforcement left to provinces
            - National environmental agency does not have authority to issue penalties for non-compliance

- The Regional Greenhouse Gas Initiative (RGGI) includes 10 northeastern states that have committed to reducing CO_2 emissions from power plants, with a goal of capping emissions at current levels in 2009, and reducing emissions 10% by 2019.
    - The states are the 6 New England states, plus NY, MD, NJ, and DE.
        - NJ left but rejoined in January 2018; VA joined in 2020, pulled out in 2023
        - Goal of capping emissions at current levels in 2009, and reducing emissions 10% by 2019.
            - Initially allowed emissions were 188 million tons CO2 annually through 2014
            - This then fell 2.5% per year through 2018
            - Announced plans for extending RGGI in 2017
        - Because of recession, initial cap appeared unlikely to be binding
            - Thus, after a 2012 review, the states agreed to a lower cap beginning in 2014
            - 20264 cap 78.5 million short tons
    - How it works
        - States are apportioned their share of allowances from the overall cap.
            - States set limits for carbon dioxide emissions, and can decide how many to auction versus freely allocate.
                - Must auction at least 25%
            - Most states auction nearly all permits.
            - Delaware auctions the fewest, starting at 60% in 2009. This percentage increased 8% per year until 100% in 2014.
            - New York auctions 100%.
        - Utilities bid for allowances, which can sold later.
            - Covers power plants of 25 MW or more burning at least 50% fossil fuels.
            - Auctions are held quarterly.
            - Proceeds from permit auction will be used for energy-saving and renewable energy programs in each state.
            - Sources may choose to reduce their emissions early and bank their excess allowances for future use.
        - Compared to EU, RGGI is more restrictive about the number of outside credits plants can use to offset emissions. Only 3.3% of a plant's emissions, or about half of their obliged reductions, can be met using offsets.

    - RGGI prices
        - Includes a price cap and price floor
            - Extra permits held in reserve and released if price hits the cap ($18.22 in 2026 – increases each year)
            - The minimum reserve price is the lowest allowable bid ($8.41 in 2026)
        - Unsold allowances retired after three years, which tightens the cap if there is an unexpected surplus.
        - Price history
            - Two “pre-compliance” auctions were held
                - 9/25 price: $3.07/ton CO2
                - 12/17 price: $3.38/ton CO2
            - Prices fell to a low of $1.86/ton in 2010
            - Prices are low because emissions cap overestimated current CO2 output, which fell between 2005 & 2006
                - Estimated 2007 emissions were 172.4 million tons CO2, although cap for 2009 is 188 million tons CO2
            - With more stringent cap, rose to $5.50/ton in 2015
        - Last clearing price: $26.73/ton in December 2025
- California AB-32 Cap and Trade
    - Established in 2006 to reduce California GHG emissions to 1990 level by 2020
        - The law includes several components, including energy efficiency standards and a renewable portfolio standard. Cap and trade is just one part of it.
    - Cap and trade market began in 2013
        - By 2015, covered 85% of state emissions
    - Most permits initially allocated freely
    - Banking allowed
    - Has a ceiling and price floor
    - Allows offset projects for up to 49% of reductions
    - 2017: California’s new target reduces emissions by 40% by 2030
        - Up to now, other policies have had a bigger effect on emissions than cap-and-trade
            - But, most easy things have been done
        - Cap-and-trade expected to account for up to ¼ of emission reductions
        - Most permits will be auctioned, creating revenue
            - Free allocation to industries that may relocate
        - Maintains a ceiling on permit prices
        - Prices have risen since lowering the cap
    - 2025: Re-authorization extends “cap-and-invest” to 2045
        - Goals for covered sectors:
            - Reduce emissions 40% below 1990 levels by 2030
            - Net zero emissions by 2045