Lecture # 5 – Command and Control Policies

I. Command and Control (CAC) Regulation

- Command and control regulation uses the setting of standards.
  - A standard is a mandated level of performance that is enforced in law.
  - A standard simply makes excessive amounts of pollution illegal.
- Setting the standard
  - For any environmental policy, the first question to be addressed is what level of protection is desired.
  - Here, it is important to note that zero pollution is not a reasonable goal. Some pollution will result from daily activities. The question is how much pollution is acceptable.
  - There are several criteria that can be used.
  - Efficiency standard
    - Here, the goal is to maximize economic welfare, accounting for the economic costs of pollution.
    - To do so, the marginal benefits of increased environmental quality should equal the marginal costs of reducing pollution.
    - If done at an aggregate level, distributional issues will be ignored.
  - Health-based
    - Here, the primary goal is protecting human health.
    - Zero-risk
      - Zero-risk requires protecting everyone, no matter how sensitive, from damage.
      - Appropriate for cases in which there is a threshold.
    - Allow "reasonably small" damages
      - Raises the question of how to decide what is reasonable.
      - Should abatement costs be considered?
      - *American Trucking Company v. Browne*r:
        - The Clean Air Act requires the EPA to consider public health, but not economic costs.
        - On February 27, 2001, the U.S. Supreme Court unanimously ruled that the CAA rules were valid.
        - They noted that the Clean Air Act did not give the EPA limitless discretion, but rather instructed the agency to set standards that "allowing an adequate margin of safety, are required to protect the public health."
    - Many U.S. environmental laws use health effects as the criterion for setting environmental standards.
      - The Clean Air Act says that standards should be set to "provide an adequate margin of safety to protect the public…from any known or anticipated adverse effects associated with such air pollutants in the ambient air."
        - But what is an adequate margin of safety?
        - Left to EPA to interpret.

- Ethical standard
    - Here, ethical considerations take precedence.
    - “It is wrong to damage the habitat of an endangered species.”

II. Types of Standards

- Ambient Standards
    - Regulates the amount of pollutant present in the surrounding (ambient) environment.
    - Examples:
        - Parts per million (ppm) of dissolved oxygen in a river
        - Sulfur dioxide (SO_2) in an airshed
        - Ground level ozone levels (ppm)
    - Measures are often an average (e.g. over a 24 hour period, or per year)
        - This is important, as concentrations vary by time of day and by season (e.g. due to changes in weather)
    - Note that the level itself cannot be directly enforced.
        - Rather, the sources of the pollution must be found and regulated to be sure that the ambient standard is met.
        - A good example is the U.S. Clean Air Act.
            - The federal government sets ambient standards for six criteria pollutants in a region.
            - If a region is in violation, they must come up with a plan to attain compliance.
- Emission standards
    - Regulates the level of emissions allowed
    - Examples
        - Emissions rates (pounds of SO_2 per hour)
        - Concentration (ppm of biochemical oxygen demand (BOD) in wastewater)
        - Total quantity of a pollutant
        - Residuals per unit of output (SO_2 per kWh of electricity)
        - Residual content per unit of output (sulfur content of coal)
        - Percentage removal of pollutant (90% of SO_2 scrubbed)
    - Note that emissions standards do not guarantee a specific ambient level of pollution
        - Weather conditions affect the concentrations
        - Human behavior affects pollution levels

- Technology standards
    - Require polluters to use certain technologies, practices, or techniques.
    - Whereas emissions standards require polluters to meet a goal for the level of pollution, but give the polluter freedom to choose the technology used, technology standards require a specific technology.
    - Examples
        - Until 1990, electric utilities were required to install scrubbers with 90% efficiency ratings.
        - U.S. requires catalytic converters in autos
        - The 1972 Water Pollution Control Act Amendments set a goal of zero discharges by 1985.
            - Used technology based effluent standards (TBES)
                - EPA determines the “best practicable technology” and sets standards assuming that firms are using that standard.
            - For enforcement, polluters must have a discharge permit issued by an EPA-backed state permitting program.
    - Often, as in the Clean Air Act, the government mandates that the Best Available Control Technology (BACT) be used.
        - However, BACT is often not clearly defined.
- The article “Marching bans” discusses the implications of technology mandates
    - Examples
        - Phasing out fossil fuel powered vehicles
        - Mandating 10% biofuels in US gasoline
    - Technology mandates reduce consumer choice, and are usually considered less efficient
    - When might they compare favorably to other policies?
        - If the new technology (e.g. EV is an imperfect substitute for the old technology)
            - If it were a perfect substitute, no policy needed
            - If it is a poor substitute, forces consumers to choose a lesser technology
            - In between, the welfare losses can be only slightly worse than pricing mechanisms
        - Can help address other market failures, such as network externalities
            - EV’s need chargers, but chargers aren’t profitable without EV’s
        - May provide signals that encourage more R&D

- The Clean Air Act shows how different types of standards work together
    - Title I uses ambient standards to set overall air quality goals for each airshed
    - State Implementation Plans (SIPs)
        - State governments are responsible for monitoring air quality within the state.
        - Monitoring is done in various Air Quality Control Regions (AQCRs) set up in each state.
            - There are 247 in the U.S.
    - States are required to develop a plan, the SIP, for achieving the national ambient air quality standards by the EPA.
        - Although the EPA has the authority to review a state's SIP, each state was given freedom to choose how it would attain the emissions goals required by the NAAQS.
            - Criteria for review are technology based.
                - Proposals to use new technologies are reviewed by the EPA.
    - Regulations for non-attainment areas:
        - Existing sources must use reasonably available control technology (RACT).
        - New sources must achieve the lowest achievable emissions rate (LAER)
        - To allow new sources in areas violating air quality standards, the EPA established offset trading in 1977.
            - No new emission source can be located in areas where air quality standards are not met unless existing emissions are reduced at least as much.
        - To avoid states simply shifting pollution from non-attainment to attainment areas, AQCR's in compliance were designated as areas targeted for Prevention of Significant Deterioration (PSD).
            - To maintain air quality in these regions, new sources must use BACT.

III. Economic Analysis of Standards

- Incentives matter, as what is regulated affects behavior
    - *Example*: fuel economy regulations lower the cost of driving, leading to more driving (rebound effect)
    - Note how the distinction between cars and trucks in fuel economy regulations led to new types of vehicles (e.g. SUVs, minivans) that qualified as trucks but could be used in the same way as passenger cars.
- Aldy/Pizer (2015) provide an example of how different types of standards provide different incentives. They discuss the implications of different types of targets
- Economists typically assess commitments relative to a no-policy reference case
    - That is, what would have happened without any intervention?
    - Depends on other factors besides the policy, such as the general state of the economy.
    - Goals for a good measure
        - Comprehensive: covers all related policies
        - Measurable: focus on observable characteristics
            - Most emissions from a country are straightforward. Depend on energy consumption.
            - But, some are more challenging:
                - Land-use changes
                - How to account for offsets in international systems (e.g. Clean Development Mechanism)?
        - Replicable: others should be able to recreate the metric
            - Ensures legitimacy
        - Universal: applies to a broad set of countries
- Emission metrics
    - Types of targets
        1. Compare emissions to a historical base year
            - Setting a base year before the regulation eliminates gaming of the system
                - E.g. 1995 Kyoto Protocol set reduction targets relative to 1990 levels
            - But, this still creates issues:
                - Does this punish early actors?
                - Emissions vary for other reasons
                - Russia is the best example
            - Emissions rose 1997-2012, but relative to 1990, emissions are 22% less.
            - Thus, the reductions occurred during restructuring of the economy after the fall of the Soviet Union.

2. Emission intensity
    - Defined as tons of CO_2 per GDP
    - Pros:
        - Compared to a base year target, avoids penalizing economic growth.
        - Straightforward to measure
    - Cons:
        - Emissions will grow unless reduction in emission intensity exceeds growth rate of the economy
        - Business as Usual may be different
            - Countries that are growing often have falling emission intensity simply due to structural changes in the economy (e.g. more services) and better technology
            - Thus, would these emission reductions have happened anyway?
        - Target becomes more stringent if country grows slower than expected
            - Inverse also true, but this could be a particular challenge for a struggling economy
            - Suggests using an index that accounts for deviations from expected economic activity
                - But that requires defining expected activity
    - Measurement challenges
        - To compare across countries, need to convert GDP into a common currency
            - Thus, exchange rate fluctuations affect performance
3. Emission reductions relative to forecasted future emissions
    - Proposed by some large emerging economies
    - Requires subjective judgements about future economic performance
    - May be easier to game the system

- Example: US gasoline content regulations for VOCs & NOX leading to ozone
  - Auffhammer/Kellogg (AER 2011) study the effect of US gasoline content regulations, which differ across states
  - Federal rules limit total evaporation of VOCs from gasoline (called Reid Vapor Pressure regulations, or RVP)
    - New rules introduced in 1989, take full effect in 1991
    - More stringent in summertime
    - Vary across region, from allowing 9.0 psi evaporation to 7.8 psi in non-attainment areas.
      - Some localities even chose a more stringent 7.0 psi limit.
    - They don't consider how much impact each VOC has on ozone
  - Severe non-attainment areas must use reformulated gasoline (RFG), which has stricter limits on benzene and requires at least 2% oxygen from an additive such as MTBE or ethanol
    - Other areas may opt to use RFG as part of their plans to reach attainment
  - California state regulations place strict limits on the specific VOCs found most important for forming ozone
- Research strategy
  - Use regression analysis to compare ozone concentrations in areas treated with one of the regulations above to unregulated control regions
    - Regression controls for other factors, such as weather, that affect ozone
  - General federal rules (labeled RVP in Figure 5a that I showed in class) range from 9.0 psi to 7.8 psi or lower. The 9.0 counties serve as a baseline.
    - Focus on June-August, because ozone peaks then and that is when seasonal regulations are in effect.

- Results
  - More stringent RVP rules had almost no effect.
    - Note in figure 5a that the RVP counties and baseline counties have very similar trends
  - RFG rules in 1995 led to modest reductions in ozone (Figure 5b)
  - More stringent California rules had a larger effect (Figure 5c)
    - Ozone concentrations fell by about 16%
- Why the difference?
  - The federal standards are more flexible. Because they don't target specific VOCs, firms focus those that are easiest to reduce (primarily butane).
    - This lowers compliance costs (just 1-1.5 cents/gallon) but has less environmental benefit. Butane is not highly reactive in forming ozone.
  - The California standard focuses specifically on compounds known to be most problematic for ozone (olefins & aromatic hydrocarbons that are 3-10 times more reactive than butanes)
    - Compliance cost is higher (8-11 cents per gallon), but has larger environmental impact

- Other advantages and disadvantages of standards
    - Advantages of standards
        - Set simple and direct goals.
        - Know final amount with certainty (may be beneficial if a slight mistake is costly).
            - Particularly desirable if optimal level of pollution is near 0.
            - In that case, banning the activity is simpler than collecting fees.
        - Appeals to a sense of fairness
        - May be easier to monitor than fees.
            - Fees require constant monitoring.
            - Regulation could be enforced with random monitoring and large fines.
    - Disadvantages of standards
        - Inefficient if more than one polluter, raising the cost of the policy.
        - To set the efficient level of pollution, need to know each firm's marginal abatement costs. Firms may be reluctant to reveal these costs.
        - May be seen as adversarial
        - Uniform standards may be inefficient
    - Sector-by-sector regulations make achieving cost effectiveness difficult.
    - Recall that costs will be minimized when marginal abatement costs are equal across all polluters. This includes:
        - Individual units have flexibility across different means of reducing pollution
        - Is there flexibility across different units in the same sector?
        - Is there flexibility across sectors?
        - Are households and firms both considered?
            - For example, reducing air pollution may be more difficult if emissions from vehicles are not regulated
    - Rarely are instruments broad enough to minimize costs across all of these
        - Fowlie et al. (2012) estimate marginal abatement costs for NOX reduction from point (power plants) and non-point sources (autos)
            - NO_X emissions at power plants covered by two regional trading programs (Ozone Transport Commission) and NO_X Budget Program
            - Vehicle emissions covered by “Tier 2” command and control standards in the 1990 CAA, which reduced allowable grams per mile of NO_X by 77%
        - Estimate that marginal abatement costs are twice as high for point sources than non-point sources
        - Estimate that inefficiencies raise abatement costs by $1.6 billion
            - This is about six percent of the total costs of compliance with both sets of regulations
        - An efficient policy would raise the cap on NOX emissions in power plants by about 45%, and reduce emissions in autos by about 15%

- Should standards be applied uniformly?
    - Federal standards apply throughout the U.S. Is it appropriate to have uniform standards across regions?
        - Are the needs of rural and urban areas similar?
        - If marginal damages differ across regions, a uniform standard cannot be efficient in both jurisdictions.
            - However, having different standards increases costs to the government.
        - Note in this case the issue is variation in the marginal damage function.
    - Should standards be the same across firms?
        - Efficiency is achieved when MAC is equal across firms, which won't happen with uniform standards unless MAC curves are the same.
            - By efficiency, we mean that any given abatement level is achieved at the lowest cost possible.
        - Note that MAC may even vary across regions, as in the example of arsenic in drinking water.
- Vintage differentiated regulation can help address differences in MAC from command and control. However, it raises additional issues, particularly with dynamic investment decisions.
    - With vintage differentiated regulation (VDR), standards depend on the entry date of each unit.
        - Newer units face more restrictive regulations.
        - Older units are often exempt ("grandfathering")
    - Examples
        - Clean Air Act New Source Review
        - Emissions standards for automobiles
        - Clean Water Act effluent limits for water treatment plants
        - Banning natural gas connections in new homes
    - Why use VDR?
        - Efficiency
            - Costs are lower for newer units
            - Relates to equimarginal principle
                - Holding all plants to the same standard is not cost effective
                - In principle, CAC could mimic an efficient standard if each plant's regulations varied depending on MAC.
                - However, this is hard to observe.
                - If MAC correlates with vintage, using vintage (which is easily observed) to differentiate regulations makes CAC more efficient.
        - Equity: Rules aren't changed in midstream
        - Politics: Easier to pass regulations if don't harm existing firms
            - Potential for economic rent for existing firms if VDR makes entry into the market harder