

Environmental Regulation

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What is an Externality?

- ▶ A cost or benefit to an agent not involved in a transaction.
- ▶ Please note:
 - ▶ It could be because of production (Example: The colored glass factories in Portland)
 - ▶ Or because of consumption (Example: Cigarette butts)

It means that we are missing a property right or that the right is hard to enforce.

The Missing Market

- ▶ We often frame externalities as a missing market or property right.
 - ▶ The right to quiet after 10pm
 - ▶ The right to dump CO_{2e} into the air
- ▶ We then analyze the goods market with the externality internalized and not.
- ▶ And the hypothetical market with the externality.
 - ▶ What would it look like with property rights
 - ▶ What does it look like without.

Externalities Cause Over and Underproduction

When you analyze the goods market:

- ▶ You include Supply and Demand but only the *private* costs and benefits
- ▶ You also show the externality cost/benefit as a shift to supply or demand
 - ▶ You can model it either way
 - ▶ Supply decrease with an additional, privatized cost, is more common.

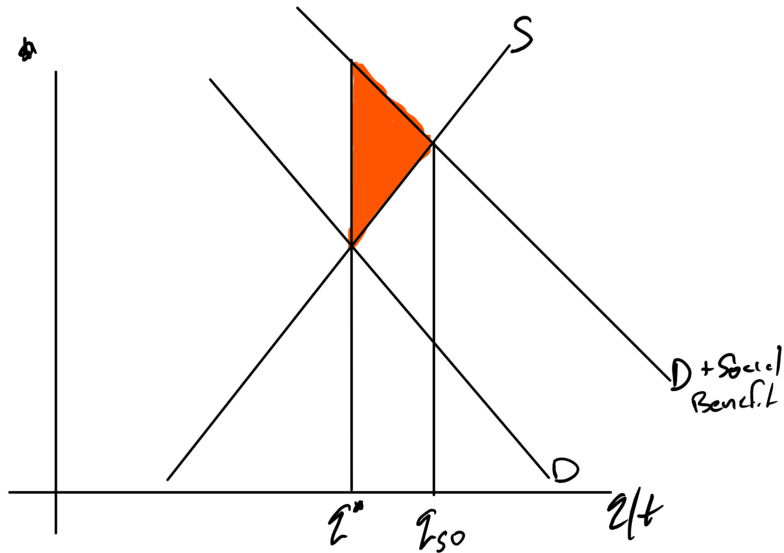
A Positive Externality

This is intended to be a positive effect on others that the buyer or seller can not capture.

In this case:

- ▶ We model it as a benefit caused by the consumption of others.
- ▶ Consumption causes a benefit to others that the individual can not capture.
- ▶ Having a nice yard is an example. It helps surrounding property values.

Welfare Effects of Positive Externalities



Summary

- ▶ If you could capture the benefits to others – demand would be higher.
- ▶ Socially optimal consumption is higher than when you can't capture the benefits.
- ▶ There is a social loss.

Negative Externality

This is a cost imposed by others that the buyer or seller does not have to pay for.

In this case:

- ▶ We model it as a cost, caused by the production, that is imposed on others.
- ▶ Production causes a cost to others that the firm avoids.
- ▶ Remember those glass factories with the heavy metals.

Welfare Effects of Negative Externalities

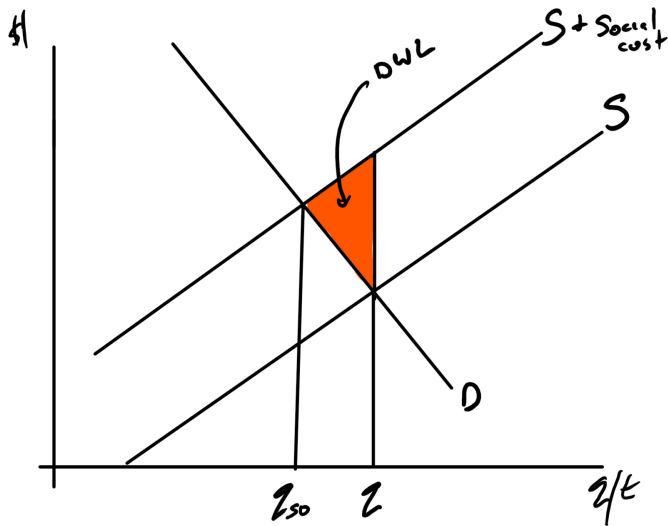


Figure 2:

Summary

- ▶ If someone could charge for the cost – supply would be lower.
- ▶ Socially optimal consumption is lower than when you can't charge for the costs.
- ▶ There is a social loss.

Yes, somethings should not be produced but are ...

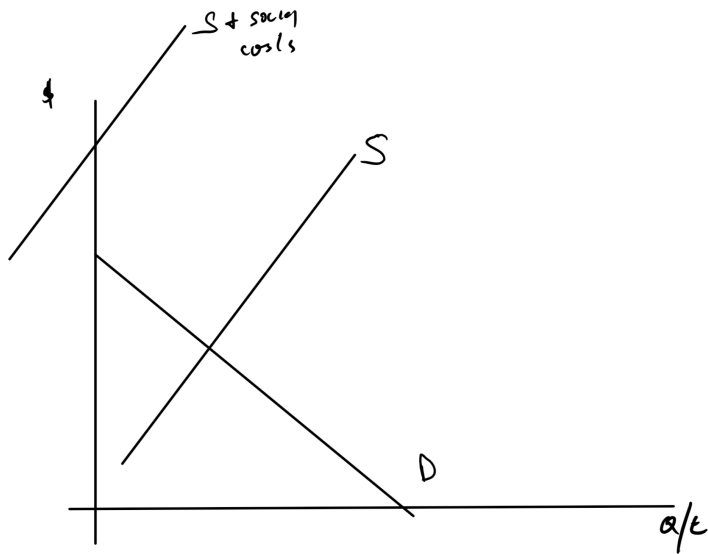


Figure 3:

You can also look at the Externality Market

This is a theoretical market where a price exists for the externality

- ▶ It often assumes a property right.
- ▶ There is a socially optimal level of the externality
 - ▶ Yes, even pollution
 - ▶ If nature can process some of the toxins over time, then yes
- ▶ The current law price of the externality is often zero.

When There are No Property Rights

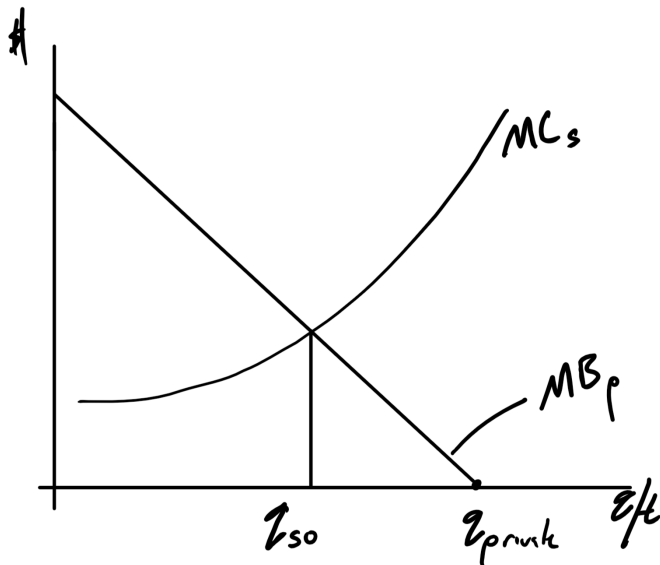


Figure 4:

The Major Approaches

- ▶ Command and Control
 - ▶ In equipment
 - ▶ In levels
- ▶ Pigouvian Taxes
- ▶ Cap and Trade

There are also hybrids, cap and trade with price ceilings and floors.

A word on costs

There are a few interesting issues about costs

- ▶ Value of a statistical life
 - ▶ \$9.1 million (Environmental Protection Agency, 2010)[14]
 - ▶ \$7.9 million (Food and Drug Administration, 2010)[14]
 - ▶ \$9.6 million (Department of Transportation, Aug. 2016)
- ▶ Perceived vs Actual risk
 - ▶ The driving vs flying phenomena
- ▶ Different Costs
 - ▶ Damage Cost – What happens if you don't clean it up
 - ▶ Abatement Cost – What it costs to clean up
 - ▶ Prevention Cost – What it cost to not put it out.

Command and Control

- ▶ Two cases, required equipment and individual limits
- ▶ Required equipment
 - ▶ This often slows down innovation
 - ▶ No advantage to do anything different
 - ▶ No advantage to develop new control strategies
- ▶ Individual limitations
 - ▶ Usually the most expensive way to achieve a reduction
 - ▶ Different firms have different cost to reduce externalities
 - ▶ Those that find it cheap to reduce should do more

Individual Limits

- ▶ Everyone has the same limit
- ▶ Different costs to reduce the externality
- ▶ We can get to the same level cheaper by:
 - ▶ Having the high cost firm do less and the low cost firm do more.
 - ▶ Transfer money from one to the other.

CC Graph

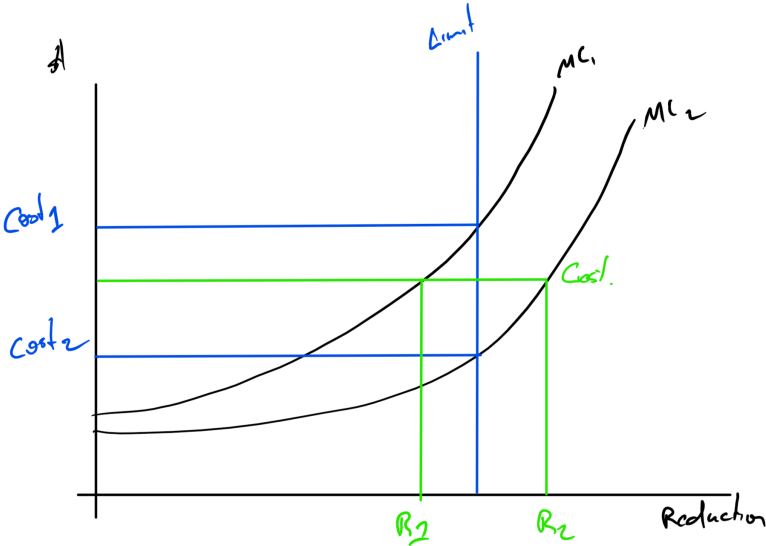


Figure 5:

Tax It

Another classic solution is the Pigovian tax/subsidy.

- ▶ Figure out the cost of the externality
- ▶ Set up a measuring system
- ▶ Charge per usual

But, which cost and what to do with the money

Chose the cost, decide the action

- ▶ Firms will chose the lease cost method to avoid or reduce the tax.
- ▶ Which cost is higher determines, what action, prevention, clean up, or payoffs will take place.

The Cost Cases (Incomplete)

- ▶ $\text{Damage} < \text{Abatement} < \text{Prevention}$
 - ▶ Damage – Makes no sense to prevent or clean up. You give the money to those harmed.
 - ▶ Abatement – Makes no sense to prevent. You spend the money on cleaning up the damage
 - ▶ Prevention – No harm to others. Firms spend money to prevent rather than produce.
- ▶ $\text{Abatement} < \text{Damage} < \text{Prevention}$
 - ▶ Damage – Makes no sense to prevent. You spend the money on cleaning up the damage (Private or Public).
 - ▶ Abatement – Makes no sense to prevent. You spend the money on cleaning up the damage (Private or Public).
 - ▶ Prevention – No harm to others. You spend the money on cleaning up the damage (Private or Public).

Tax It Diagram

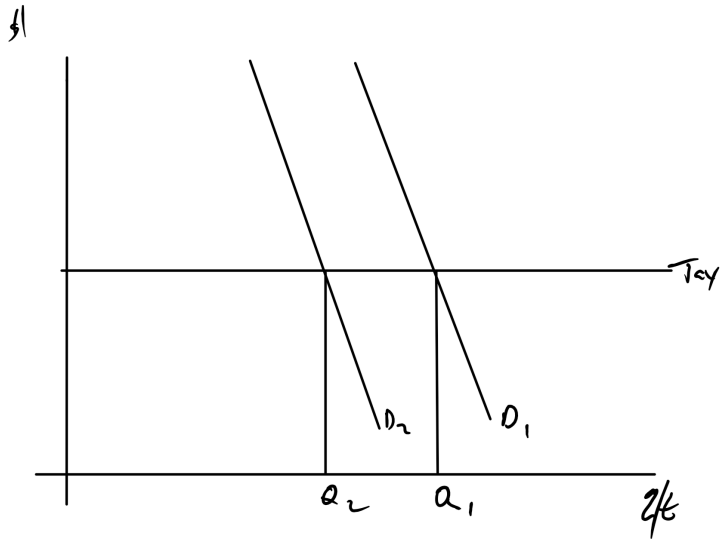


Figure 6:

Comments on Carbon Tax

- ▶ Really hard to estimate the right number
- ▶ Harder to get it implemented (It is almost always, “too expensive” or “costs jobs”)
- ▶ Price is very stable – business likes
- ▶ Quantity is highly variable – environmentalists hate
- ▶ What WA tried to get in 2018

Cap and Trade

Another classic solution is cap and trade.

- ▶ Allocate the rights to pollute, called *allowances*
 - ▶ Gov't takes all or gives away often doesn't matter.
- ▶ Create a market
 - ▶ Those with low cost to reduce or low need to pollute, sell.
 - ▶ Those with high cost to reduce or high need to pollute, buy.

Wait, it doesn't matter

- ▶ If you can establish property rights on an externality (like cap and trade)
- ▶ If transaction costs are small
- ▶ The allocation of the rights don't matter, you will get an efficient, Pareto optimal, allocation.

Pareto optimal means no one can be made better off without making someone else worse off.

Quick example

Values:

- ▶ Alice values quiet \$5
- ▶ Bob values throwing a party \$8 (Parties are loud)

Note that social welfare is maximized by throwing a party (\$8 gain to society vs \$5 gain for no party)

There is a right to Quiet

- ▶ Bob still wants a party.
- ▶ Bob offers Alice money, up to \$8, to be able to throw a party.
- ▶ Alice accepts, \$5.

Summary:

- ▶ Alice does not get quiet but gets \$5 for a net of \$0
- ▶ Bob gets a party and gets benefits of \$8 for the party less the \$5 to Alice or \$3.

Note: Party is socially optimal.

There is a right to Party

- ▶ Alice offers Bob \$5 to not have a party.
- ▶ Bob does not accept and throws a party.

Summary:

- ▶ Alice does not get quiet and has net welfare of \$0.
- ▶ Bob gets a party and has net welfare of \$8.

Note: Party is socially optimal.

Summary

- ▶ The allocation of property rights (Party or Quiet) does not matter for what happens – a party is thrown.
- ▶ What matters is the allocation of the benefits.
 - ▶ Right to quiet: Alice \$0, Bob \$3, Party
 - ▶ Right to party: Alice \$0, Bob \$8, Party
- ▶ If trade is not allowed:
 - ▶ Right to quiet: Alice \$5, Bob \$0, No party
 - ▶ Right to party: Alice \$0, Bob \$8, Party

Back to Classic Cap and Trade

- ▶ Create a market
- ▶ Those with low cost to reduce or low need to pollute, sell.
- ▶ Those with high cost to reduce or high need to pollute, buy.

Cap and Trade Diagram

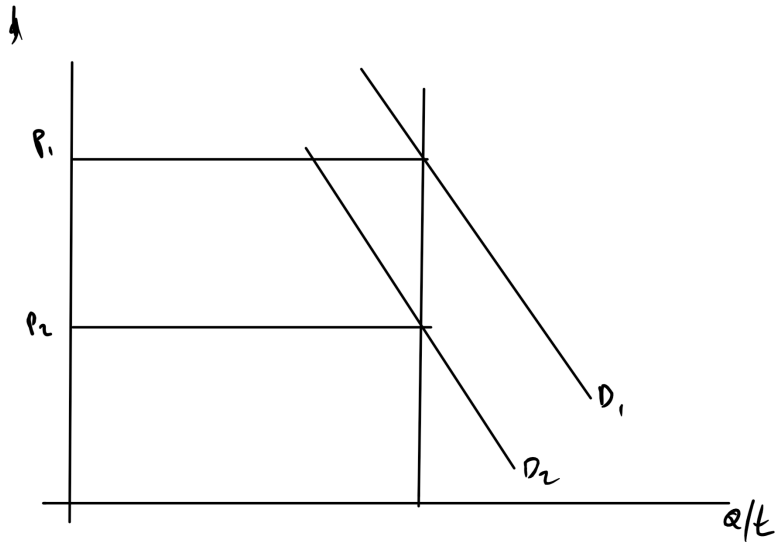


Figure 7:

Comments Cap and Trade

- ▶ Slightly easier to get the right number
- ▶ Often not everyone is 'covered' since sometimes hard to measure
 - ▶ Land use and agriculture often excluded in CO_{2e} cap and trade.
- ▶ Price is very unstable – business hates
 - ▶ Mostly because off very inelastic supply and demand
- ▶ Quantity is very stable – environmentalists like
- ▶ What OR tried to get in 2018.

Compromise

- ▶ Have cap and trade but put a max and min on the price
- ▶ Better than a tax for environmentalists
- ▶ Better than pure cap and trade for business
- ▶ Diagram has a few features
 - ▶ Supply is not vertical – allow some offsets and banking
 - ▶ Banking – save allowances for later and use or sell
 - ▶ Offsets – make extra reductions in uncovered areas, like Ag, and sell those on the market.

Cap and Trade with Ceilings and Floors

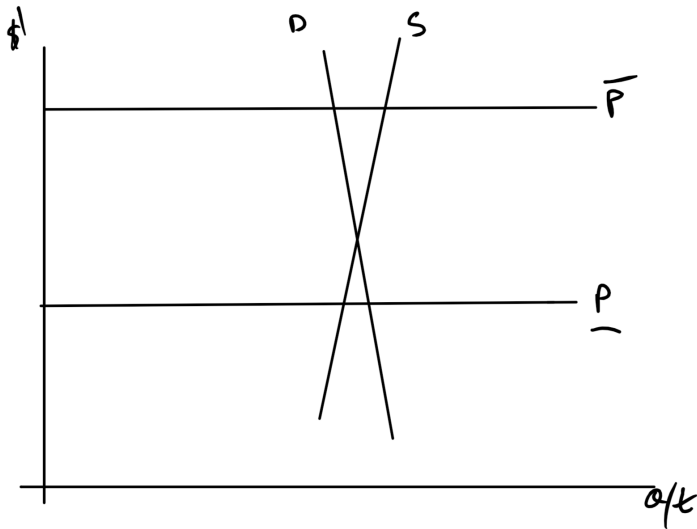


Figure 8:

Complications

- ▶ How do you impose the floors and ceilings?
- ▶ Can I save the allowance from one year to the next
- ▶ What about those offsets?

Shortage and Surplusses

- ▶ At the ceiling, people want more allocations than exist.
- ▶ At the floor, people want fewer allocations than are for sale.

You need a mechanism to allocate when you can't use price. BTW, the slow increase in the price floor makes this much less prominent.

Ignore it

Just ignore it:

- ▶ At the ceiling, some people will be able to buy allowances and others will not.
- ▶ At the floor, some people will be able to sell and others will not.

The floor is rough if you counted on selling the allowances for revenue. The ceiling is rough if you need an allowance and can't buy.

Market Maker Approach

Someone (Government) stands ready to buy and sell allocations at all times:

- ▶ They buy when prices hit the floor
 - ▶ Hope you don't run out of money before you get to sell.
- ▶ They sell when the prices hit the ceiling.
 - ▶ Hope you bought enough when you were at the floor.

No guarantee of revenue neutrality. History shows that these spend a lot of time at the floor value.

Why so much time on the floor?

- ▶ Plenty of direct regulation, e.g., RPS, coal bans, to reduce GHG emissions.
- ▶ The annual limitations, supply, must make sense given the price floor.
- ▶ The annual allocations have been far too large given the floors.

Allocation prices on the floor are not evidence that direct regulation is all we need, it indicates we picked the wrong floor/annual allocation combination.

Why being on the floor is bad

Besides allowances there are also “offsets”

Offsets are new reductions in GHG:

- ▶ Geologic sequestration of existing.
- ▶ Methane capture
- ▶ Agricultural land management that reduces emissions.

If the price is low, you don't invest to make these reductions.

Changes from Year-to-year

- ▶ With a carbon tax, this would be a slow increase in the tax from year to year.
- ▶ For cap and trade with a collar.
 - ▶ Annual reduction in allocations
 - ▶ Annual increase in both the ceiling and floor.

Banking and Floors

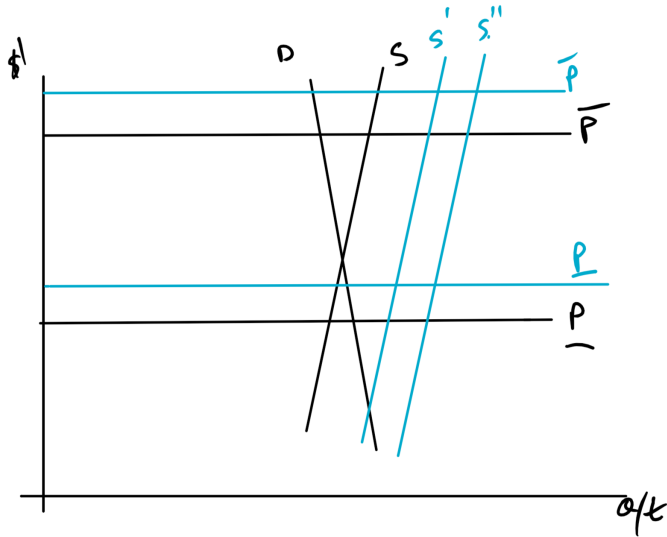


Figure 9:

Comments on the Banking Effects

- ▶ Way harder to chose the right level of allowances from year to year
 - ▶ Mistakes, almost always too many allowances, are carried forward.
 - ▶

Futures Markets

Market Power

In Oregon:

- ▶ 6 firms will be required to purchase 49.8% of the allowances.
- ▶ top 10 firms will be purchasing 72% of the allowances.

Oregon Complications

We are trying to do cap and trade with a collar but there are complications:

- ▶ OR constitution says gas taxes have to be spent on highways.
- ▶ “Revenue bills” have to pass legislature with 3/5 majority
 - ▶ Recent court decision is redefining revenue bills.
 - ▶ There is still room for appeal.
 - ▶ Still room to punt – “send it to the voters”
- ▶ Reasonable resources for transition
 - ▶ Somehow raise money from the sale of allocations.
 - ▶ Consignment
 - ▶ Free allocations
 - ▶ Direct sale
 - ▶ An investment plan

Oregon Complications (Con't)

- ▶ “Leakage” firms leaving the because of a price on carbon
- ▶ Complex rules that could make some people pay twice for GHG and other pay not at all.
- ▶ Interaction between:
 - ▶ Global Warming Commission
 - ▶ Public Utilities Commission
 - ▶ Department of Transportation
 - ▶ Oregon Business Development Department
 - ▶ Department of Environmental Quality

Current State of Affairs

- ▶ Started as a placeholder bill from the 2017 session SB 1070 “Cap and Invest” (<https://olis.leg.state.or.us/liz/2017R1/Measures/Overview/SB1070>)
- ▶ They held work groups to explore the ideas and get feedback (<https://www.oregonlegislature.gov/helm/Pages/clean-energy.aspx>)
 - ▶ Meeting material and video online.
 - ▶ If you have the time watch the videos
 - ▶ “Steakholder” group with a few experts thrown in
 - ▶ Sen Beyer used to be on PUC and was the executive director.
 - ▶ Carl Fink is very good
- ▶ 2018, HB 4001 Bill Failed (<https://olis.leg.state.or.us/liz/2018R1/Measures/Overview/HB4001>)
 - ▶ Clause for referral to Oregon Supreme Court about the “revenue bill” decision.
 - ▶ No R support
 - ▶ No majority D. – Roblan (Coos Bay) was a notable holdout.

Degree of Magnitude Costs

Assuming \$10/T CO_2

- ▶ \$0.10 per gallon of gasoline
 - ▶ Cost ~\$2.70/Gal
 - ▶ Person 50 gal per month
 - ▶ ~ \$5 month
- ▶ \$0.007 per kWh
 - ▶ Cost ~\$0.098 per kWh
 - ▶ HH ~1,000 kWh per month
 - ▶ ~ \$7 month
- ▶ \$0.05 per therm
 - ▶ Cost ~\$0.05 per therm
 - ▶ HH ~ 50 therms per month
 - ▶ ~ \$2.50 month

Major Questions

- ▶ What goes in legislation and what is rule making?

Involved Agencies

- ▶ Global Warming Commission
 - ▶ Establish limits
 - ▶ “Coordinate”
- ▶ Public Utilities Commission
 - ▶ Decide how to treat the allowances and offsets
 - ▶ Electricity G/T/D
 - ▶ Natural Gas
- ▶ Department of Transportation
 - ▶ How to spend the motor vehicle fuel part
- ▶ Oregon Business Development Department
 - ▶ How to help people transition
- ▶ Department of Environmental Quality
 - ▶ Establish a market for CO_2

What is covered.

The intent is to require allowances for:

- ▶ Natural Gas
- ▶ Electricity
- ▶ Motor Vehicle Fuel
- ▶ Point sources more than 20kT CO_2

Note that agriculture and Forestry are not connected to this system.

A firm level list is on p. 69

(<http://www.oregon.gov/deq/FilterDocs/ghgmarketstudy.pdf>)

Point of Regulation

“Point of Regulation” where do you put the meter and who pays.

Key Needs:

- ▶ Easy to meter at that point.
- ▶ Hard to avoid
- ▶ Makes sure nobody pays twice.

Point of Regulation: Electricity

- ▶ Must cover in-state merchant generators
- ▶ Must cover out of purchases
- ▶ Must cover in-state IOU generation

Complications:

- ▶ Some generation is gas fired (Avoid double counting)
- ▶ Out of state purchases must not run afoul of the commerce clause (Interstate trade is Federal)
- ▶ Co-gen?
- ▶ Bonneville Power Administration (Federal) is a balancing authority
- ▶ Wheeling (Generated out of state, passing through but to elsewhere.)

Point of Regulation: Natural Gas

- ▶ Interstate pipelines
- ▶ LNG terminals
- ▶ Marketers

Complications:

- ▶ Ontario has seen marketers split to avoid 20kT limit.
- ▶ Mix of inter and intra state pipelines

Point of Regulation: Motor Fuel

- ▶ Pipelines (<https://www.eia.gov/state/maps.php?v=Petroleum>)
- ▶ Trucking – We move a lot of motor fuel by truck.

Complications:

- ▶ Dyed (untaxed diesel)
- ▶ Oregon Constitution requires use of “Fuel taxes” on highways.

Point of Regulation Other

Mish mash of:

- ▶ Concrete
- ▶ Chemicals
- ▶ Landfill

This is hard

Leakage

Compound concept

- ▶ Businesses leaving regulated area to produce same GHG emissions outside cap and trade area.
- ▶ Shifting contracts so lower carbon is counted in Oregon and higher carbon is counted elsewhere.
- ▶ Washing the source of emissions.

Business Leaving (Emissions-Intensive Trade-Exposed (EITE))

- ▶ Note: emissions not energy.
- ▶ Compete with firms that do not face GHG allowance requirements.

Complications:

- ▶ GHG allowances are one price, we could be low on others.
- ▶ Current thought is to do this based on NAICS codes
- ▶ Or, individuals but renormed/assessed periodically

Problem goes away with greater coverage of cap and trade across states.

Lets be Clear

We have some pretty cheap power (https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a)

Shifting Contracts (Mostly Electricity)

Remember that electricity comes from everywhere. Electrons are not 'green' and 'brown', but contracts are.

Example:

- ▶ Merchant generator sells green and brown power, 1/2 to ID and 1/2 OR IOUs.
- ▶ OR IOU now only wants green
 - ▶ All Brown power goes to ID
 - ▶ All Green power goes to OR
- ▶ No change in net CO_2

Source Washing

Obscure the source of power through a chain of contracts.

Example:

- ▶ Buy coal power from A.
- ▶ Avoid buying directly from A
 - ▶ A sells to B.
 - ▶ B sells to C
 - ▶ ...
 - ▶ Z sells to IOU. We don't know if the power is green or brown so assume Natural Gas

Interaction with PUC

- ▶ The Public Utilities Commission (PUC):
 - ▶ Regulates retail prices for electricity and gas.
 - ▶ Defines allowable expenditures that are then passed on to the consumers in rates
- ▶ They must figure out how:
 - ▶ They will allow the LDC will treat allowances.
 - ▶ How existing coal phase-out interacts
 - ▶ How the existing renewable portfolio standards (RPS) interacts

How PUC treats Costs

- ▶ $\text{Revenue Requirement} = \text{Expenses} + (\text{Rate of Return})\text{Rate Base}$
- ▶ *Expenses* are generally on the income statement, but there are a few things that start on the balance sheet and move over to income statement.
- ▶ *Rate Base* is generally on the balance sheet, but there are a few things that move back and forth between balance and income.

To be clear, the cost of the allowances will be passed on to the consumer but how?

- ▶ Allow only current allowances – Expenses.
- ▶ Allow them to bank them (if rules allow banking) – Rate base

The Rate Base Complication

- ▶ *If they can hold on to the allowances*, utilities will earn a 'fair rate of return'
- ▶ *If the purchase assets at the floor price*, the value goes up by at least the floor price.

$$(1 + \text{Rate of Return})(1 + \text{Price Increase}) - 1 = \text{Utility Return}$$

Can be big

$$(1 + .06)(1 + .05) - 1 = 11.3\%$$

Note that this is risk free.

Coal Phase-out and RPS

- ▶ Both are expensive
 - ▶ IOUs have purchased new generation and long-term contracts
 - ▶ These costs are already embedded in utility rates.

Would you have committed to natural gas if you knew cap and trade was on the way?

Coal Phase-out and RPS Options

- ▶ Keep them separate:
 - ▶ Add those costs and the allowance costs into the revenue requirement.
 - ▶ Easy
- ▶ Give them credit for reductions:
 - ▶ Give them an allowance credit – every year – for the the difference between coal generation and natural gas.
 - ▶ Give them allowance credit – every year – for the avoided CO_2 emissions.
 - ▶ Real coal phase-out and RPS.
 - ▶ Similar to how going beyond RPS is treated now.

Two Phrases you missed: “Give Allowances”, “Banking”

- ▶ Banking
 - ▶ Ability to save allowances from one year and apply to another.
- ▶ How to distribute allowances is not guided by microeconomics theory
 - ▶ Theory says it doesn't matter for price, with some caveats.
 - ▶ How they are allocated determines who gets the benefits.
 - ▶ State sells all – State gains
 - ▶ Given to utility – utility shareholders/consumers gain.
 - ▶ Can mix

Banking Allocations

- ▶ To bank or not:
 - ▶ Industry likes to bank. It allows stability
 - ▶ Hard to change ex post: European markets collapsed in 2007 when they tried to remove it.
- ▶ Options:
 - ▶ Limited banking. Three year is common suggested number.
 - ▶ 2018 allowances can be used till 2021.
 - ▶ Not PUC can be stricter than that if they wish.
 - ▶ Degrading
 - ▶ 10% less every year.
 - ▶ 1 T 2018 allowance is worth .9 T in 2019, .81 in 2020 ,...

Consignment, Free Allocations, Direct Expenditures

There are a few ways to allocate ownership of “allocations” (Sorry about allocate being used two ways)

- ▶ Free allocations: Given to those intended to use the proceeds for their self interest.
 - ▶ Current intent is for EITE industries
- ▶ Sale by the state: Used to generate revenue for the state
 - ▶ Current for majority of allowances.
- ▶ Consignment: Given to a party so that the proceeds of the sale can be used to benefit others.
 - ▶ Current for IOUs and LDCs for the benefit of low-income household transition.

Could there be a problem with market power?

- ▶ Is there a problem with giving allowances to large emitters?
- ▶ Is there a problem with consignment?

Answer: It depends.

Key question: Can those that receive a lot of free allowances leverage market power in either the product or allowance market, to produce market power in the other?

Keep in mind, this is why CA wanted to make sure they connected to other states – they were afraid of the exercise of market power.

There are regulatory policies that can help

- ▶ Anti-fraud and manipulation requirements: 17 CFR 36.6 has regs that can help.
- ▶ Full access to trades
- ▶ Frequent, daily, reporting of transactions prices and volumes
- ▶ Connecting to the Chicago Climate Futures Exchange like CA will also put trades under greater scrutiny.
- ▶ Regularly reporting emissions.

JUST PUT IT IN THE RULES: No colluding.

What the Markets Look Like

- ▶ Western Climate Initiative
(<http://www.westernclimateinitiative.org>)
 - ▶ Multi-state/province set of rules
 - ▶ Trading platform
 - ▶ Oregon has an on and off relationship with this.
- ▶ California (<http://calcarbondash.org/>)
- ▶ Futures Market (<https://www.theice.com/products/31687042/California-Carbon-Allowance-Vintage-2017-Future/specs>)
 - ▶ California is big enough.
 - ▶ Futures markets are where most price discovery takes place
 - ▶ Way more transactions.

Market Power Considerations

- ▶ Similarities with SO₂ markets
- ▶ Use to maintain market power

Offsets

- ▶ Offsets protocols <https://www.arb.ca.gov/cc/capandtrade/offsets/offsets.htm#protocols>
- ▶ Offset verification (<https://www.arb.ca.gov/cc/capandtrade/offsets/verification/verification.htm>)

CA limited this.

8% total now 4% with 2% in state.

Little action because the price of allowances are not high. On the floor.

California's Offset Reduction

- ▶ Allowance allocation
- ▶ Risk diminishes with more online and should be removed.
- ▶ JW we need to focus on the effect on relative energy prices.
- ▶ What about trade patterns changing?