**General Model of Pollution Control**

Environmental damage lowers people’s well-being

Reducing or eliminating damage carries opportunity cost

Tradeoff:

1. We can increase social well-being by reducing environmental damage of emissions

2. Reducing emissions has an opportunity cost in form of forgoing other output that could have generated well-being for people

Marginal Damage function (MD) - marginal relationship between lost well-being and quantity of emissions

**Figure A**

damage $

MD

 e1 e2 pounds emissions/time period

**Figure A**

Total damage to society increases at a constant rate with emissions

Pollutant appears immediately affect society but marginal damage does not increase with emissions

Is the total damage to society greater at e2 than at e1?

Total damage to society of given amount of pollution represented by area under MD curve

 Suppose MD in figure C is $10 interpret

What is total social damage if e1=100 e2=130

**Figure B**

MD

damage $

$15

$12

e0

e1

e2

pounds emissions/time period

**Figure B**

Initial release of emission does not affect well being

Social damage up to roughly e0 is nonexistent

At e1 a small change in emissions causes $12 in social damage

$12 is the dollar value of the lost well-being to some people

May be measured by willingness to pay to avoid additional pollution

The twelve dollars does not represent total damage up to e1 pollution

At e2 marginal damage is $15

Specific damage function:

1. Has threshold below which flow of pollution does not affect well-being

2. Total damage to society increases at an increasing rate

marginal damage increases as pollution increases

**Figure C**

damage $

MD

pounds emissions/time period

**Figure C**

Marginal damage is greater than zero for even the first unit of emission

Marginal damage increases with emissions

Possible examples:

A. Highly toxic substance

B. Radioactive waste

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Are damages reversible?

Consider damage as increased incidence of stinging eyes.

Consider damage as increased incidence of lung cancer.

**Abatement cost**

Cost of reducing emissions

Example: equipment costs (example: precipitators, catalytic convertors etc), changes in production process, recycling, changes in inputs used to produce output, changes in output

Marginal Abatement Cost Function (MAC)

Illustrates opportunity cost of marginally reducing emissions

 $

MAC

15

a

b

10

e3

e1

e2

pounds emissions/time period

If firm makes no effort to control emissions, would emit e3 pounds

Slope of line implies marginal cost of decreasing emissions increases as abatement increases

Firm finds it more and more difficult to decrease emissions

suppose e1=30, e2=45, e3=100

[Precipitators](https://en.wikipedia.org/wiki/Electrostatic_precipitator)

interpret point b: cost approximately $10 to eliminate the 55th pound

interpret point a: cost approximately $15 to eliminate the 70th pound

total cost of reducing emission is area under MAC curve from right to left

Interpret:

MAC - inverse relationship with emissions

MD - positive relationship with emissions

Socially efficient pollution level:

$

MD

MAC

g=$10

f=$5

B

A

e1

e\*

emissions/pound/period

Point where MD=MAC at e\* emissions

Areas under curves illustrate the total damage, opportunity cost of pollution

B – total cost of abating polluting down to the efficient level of e\*

A – total damage to society in the form of lost well being generated by e\* emissions

The optimal pollution level is not zero in this case

A+B equals the **total social cost** of e\* emissions per time period

Social cost of emissions is split between

 1. the cost of reducing pollution (B)

 2. the social damage from pollution that remains (A)

The emissions level e\* minimizes A+B – **total social cost**

e1 level of emissions is not efficient point

 the benefit to society of marginally decreasing emission below e1 is $10

 the cost to society of eliminating the next pound of emissions below e1 is $5

 society benefits in net terms

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The two costs A and B do not have to equal

Depending on shapes of MD, MAC curves, efficient solution may be zero emissions