**General Model of Pollution Control**

Environmental damage lowers people’s well-being

Economics estimates dollar value of change in well-being caused by emissions

Reducing emissions employs scarce resources that could have been used elsewhere

Tradeoff:

1. We can increase 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 utility for people

**Damage Function**

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

**Figure A**

MD

damage $

$15

$12

e2

e0

e1

pounds emissions/time period

**Figure A**

Initial release of emission does not affect well being

Marginal damage up to roughly e0 is nonexistent

At e1 if emissions increased marginally, the damage to society would roughly equal $12

$12 is the dollar value of the lost well-being to some people resulting from marginal increase in 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 B**

damage $

MD

pounds emissions/time period

**Figure B**

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

Marginal damage increases with emissions

Possible examples:

A. Highly toxic substance

B. Radioactive waste

**Figure C**

damage $

MD

 e1 pounds emissions/time period

**Figure C**

Total damage to society increases at a constant rate with emissions

Pollutant appears immediately toxic but marginal damage does not increase with emissions

Example?

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

 Suppose MD in figure C is $10

What is total damage at e1=1000?

Are damages reversible?

Consider damage as increased incidence of asthma attacks.

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 of cost of marginally reducing emissions

 $

MAC

a

15

b

10

e1

e2

e3

pounds emissions/time period

If firm ignored social cost of emissions, would emit e3 pounds

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

Firm finds it more and more difficult to decrease pollution

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

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

Interpret:

MAC - inverse relationship with emissions

MD - positive relationship with emissions

$

MAC

MD

**g=$10**

**f=$5**

A

B

e\* e1 emissions/pound/period

Socially efficient pollution level:

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 the cost of eliminating (some of) it (B) and the social damage resulting from pollution that remains (A)

There is no emission level where total cost to society is less than the A+B found at e\*

e1 level of emissions would be considered inefficient

 society could gain net benefits by decreasing emissions below e1

 the benefit to society of marginally decreasing emission below e1 is $10 (damage would fall by $10)

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

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The two costs A and B do not have to equal

If opportunity cost to society of reducing emissions rises dramatically with pollution reduction, B will likely be smaller than A at the efficient solution

If damage of emissions to society rises dramatically with emissions increase, A will likely be smaller than B at the efficient solution

In above figure B<A

 marginal cost of reducing emissions rise quickly

efficient emissions at the point where most of society’s cost of emissions is in the form of societal damage from emissions (A) than in form of costs of abating pollution (B)

Scenario:

1. B>A less costly (relatively) to eliminate emissions compared to damage caused by emissions
2. Efficient solution is zero emissions