Introduction to Environmental Economics

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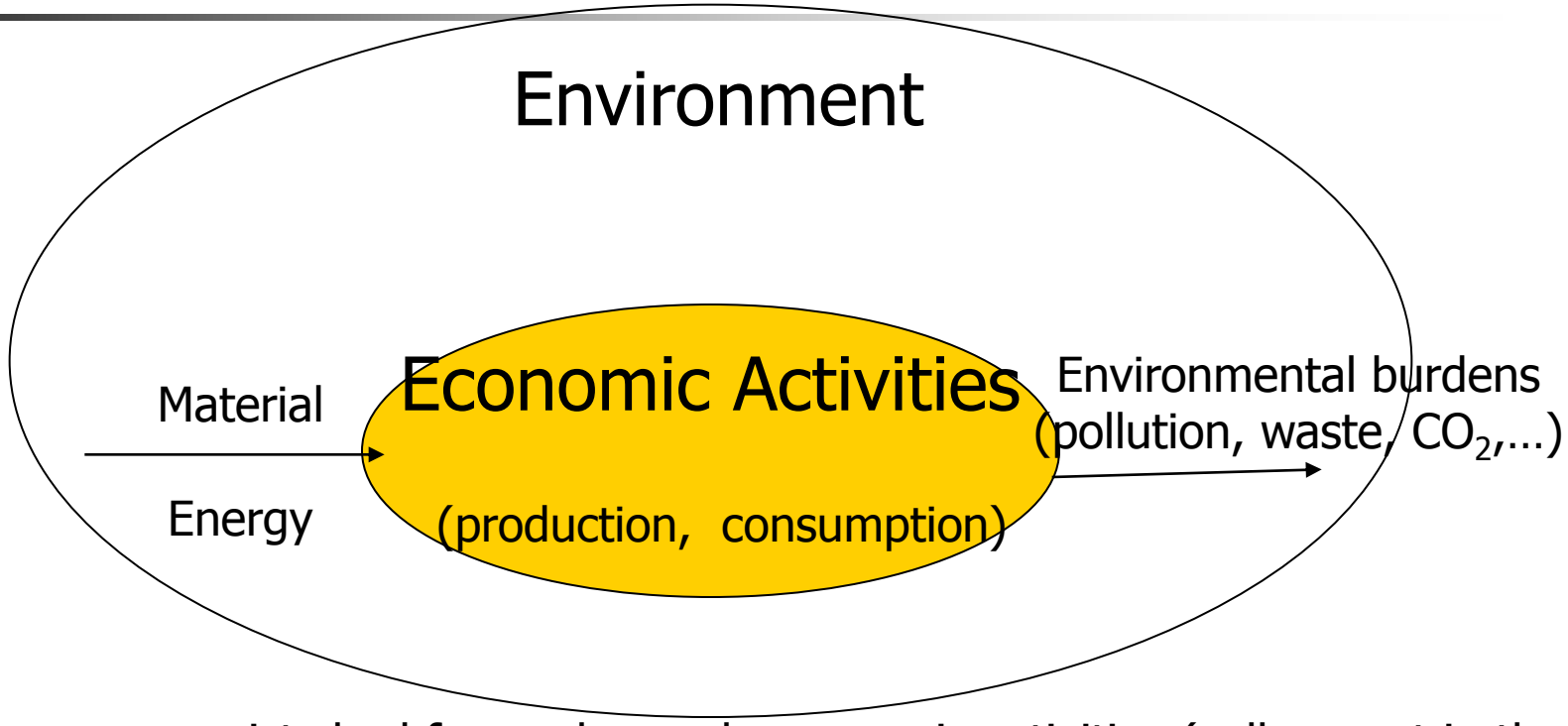
Today's study topics

- Applying economics to environmental issues

  → "environmental economics"

  - Using incentive in policy making
  - Considering both the cost and benefit of a policy

Environmental problems are the result of our pursuit of affluence. Therefore, we have to reconsider the method of pursuing affluence. In other words we have to reconsider the economic activities.



For a long time, economists had focused on only economic activities (yellow part in the figure). However we obtain materials and energy from the environment and inflict burdens on the environment. Therefore, economic activities and the environment are not mutually exclusive. We thus have to consider both the economic activities and the environment.

Environmental economics

- Our economic activities (production and consumption) have an impact on the environment.
- Environmental economics attempts to find the cause of environmental problems and propose policies in terms of economics.

Keyword 1 “incentive”

- Economics regards human beings as “rational” creatures.

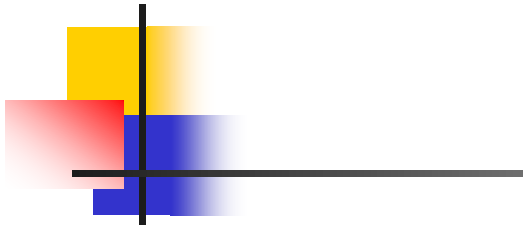
→Most of us do not want to lose money.

→Most of us do not want to engage in troublesome activities.

- To encourage “rational” people to take environmental-friendly action, the government should construct a society where we can save more money by conserving the environment.
- The environmental policies can take into consideration the self-interest of people instead of relying on only moral fiber or the ethical view.

Keyword 2 "cost and benefit"

- Sometimes we have a conflict of opinions on environmental protection.
- Some people emphasize only the cost (disadvantage) of environmental protection saying that stringent environmental regulation worsens the economic situation.
- Some people emphasize only the benefit (advantage) of environmental protection saying that protecting the environment is very, very important.
- We have to take into consideration both the cost and benefit of environmental protection. What we have to decide is to what extent the environment should be protected.



Incentive

An example of environmental policies using incentive

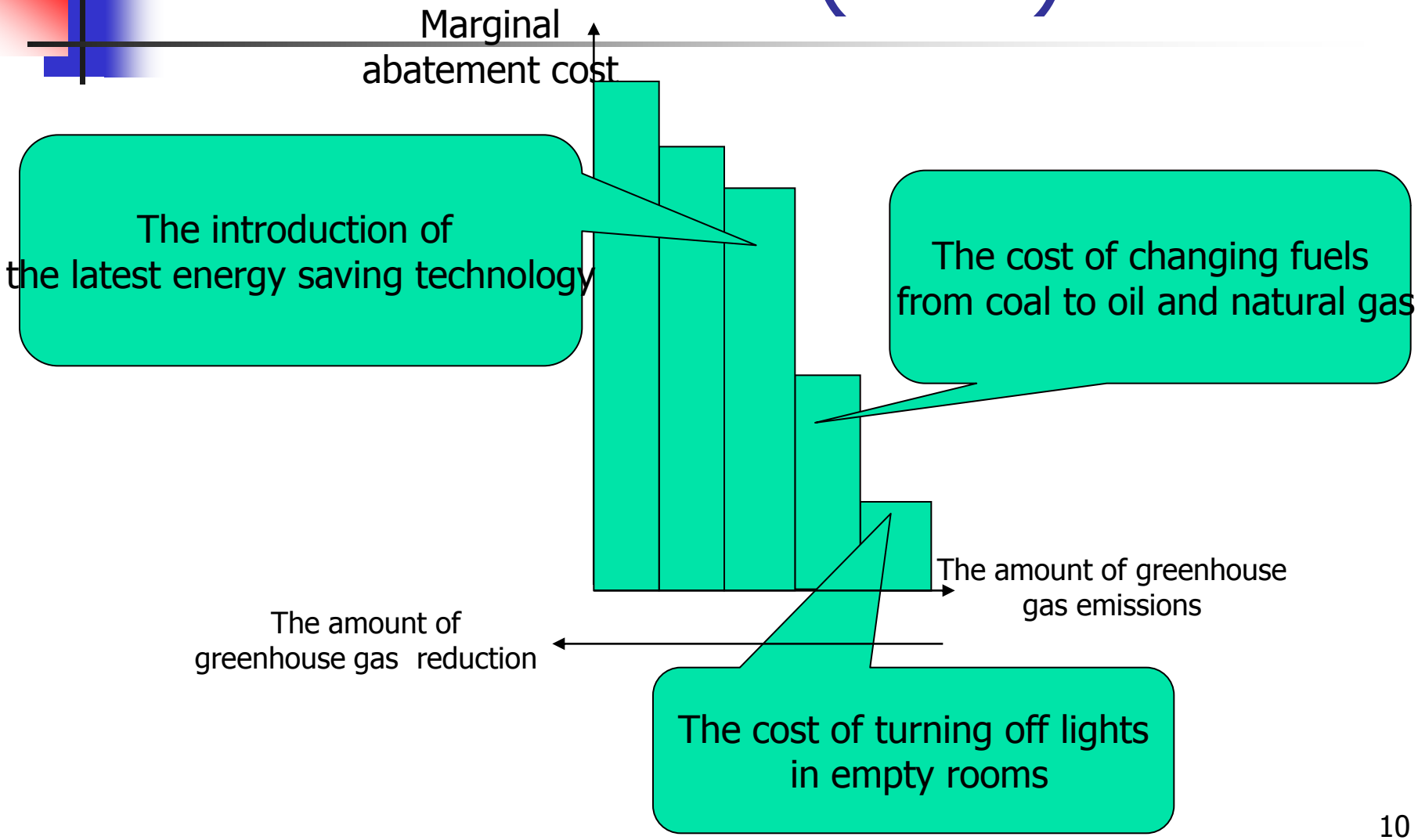
- Carbon tax
  - Levy tax on fossil fuels to reduce their consumption amount

Marginal abatement cost (MAC)

- The cost of reducing an additional one unit of emission.

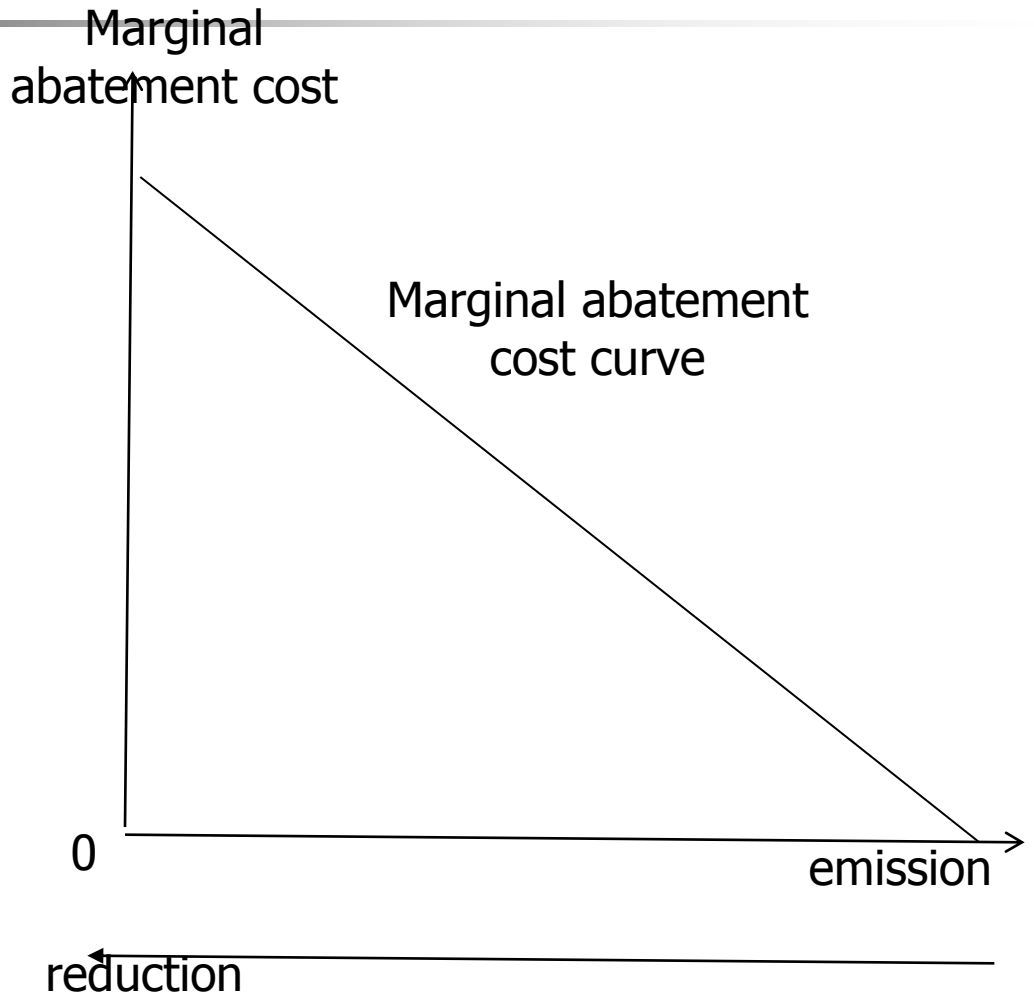
→ MAC increases as the reduction amount increases because a company seems to take the easiest (least cost) environmental measure first. If the company has to reduce more, then the company takes the next step and takes the more costly measure.

Example of marginal abatement cost (MAC)

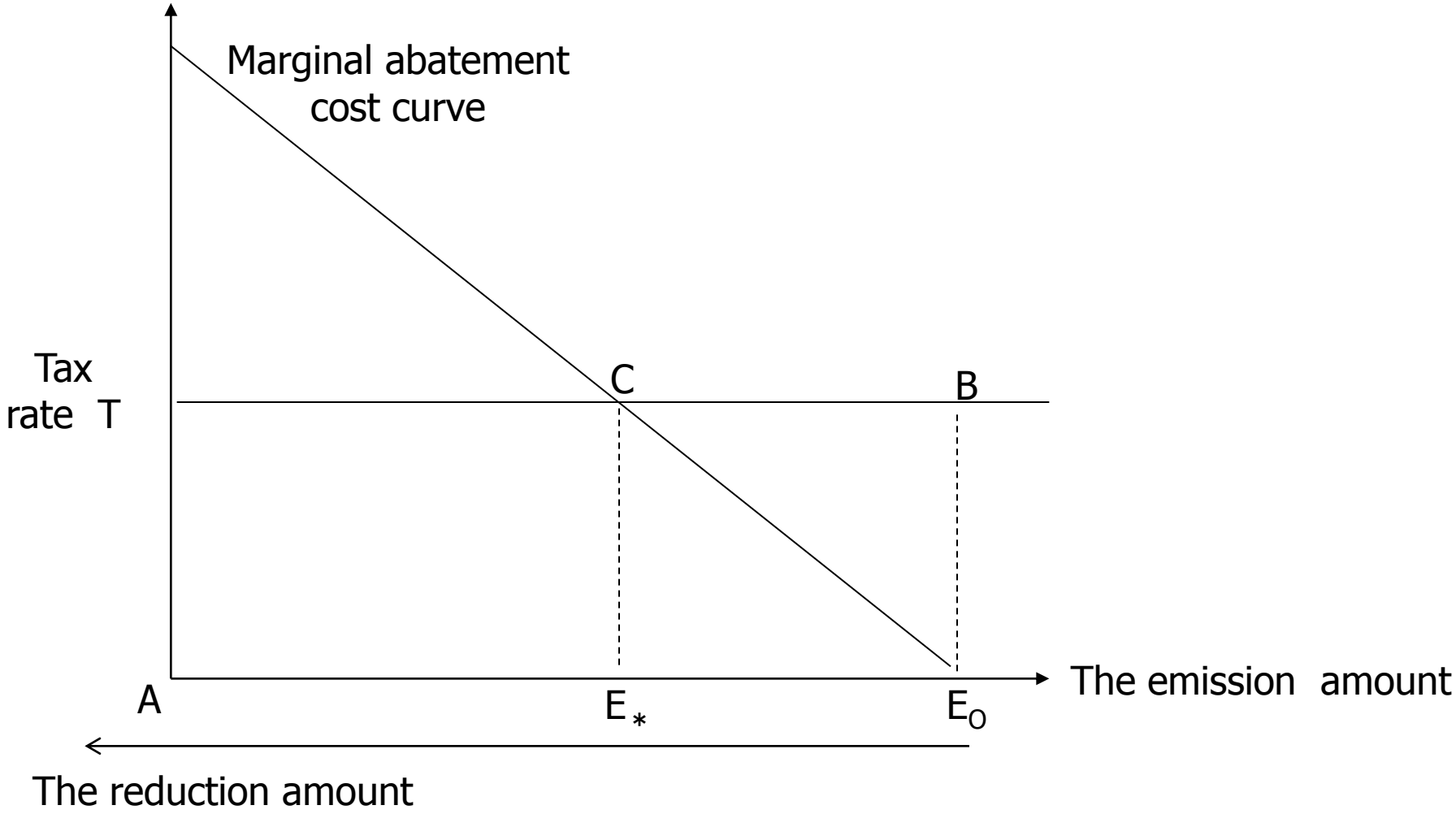


Marginal abatement cost curve

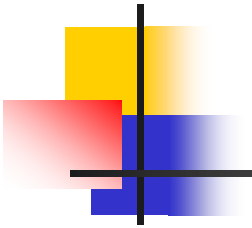
- Connecting the top of each bar (in the figure on Slide 10) with a line gives us the marginal abatement cost curve



Suppose a company has to pay T-amount of yen per unit of emission. How does a company respond to the introduction of the emission tax?



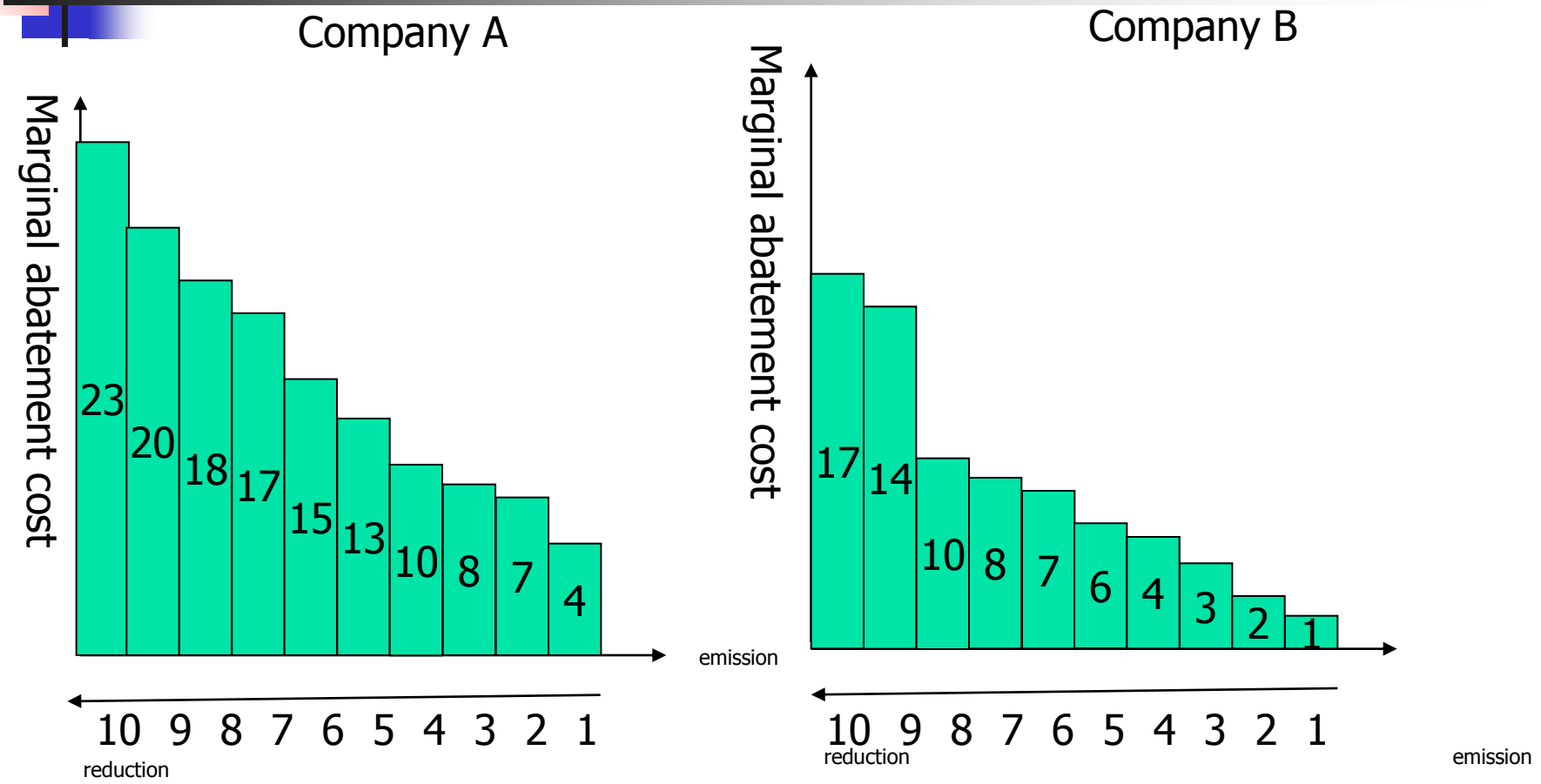
- Case 1 : When no policy is implemented, the company does not reduce the emissions (emit at E_0) and does not pay tax.
- Case 2: However, after the introduction of tax policy, emitting at E_0 results in paying much tax. The amount of tax payment is equal to $\square AE_OBT$.
- Case 3: The company is not happy with the large amount of tax payment and decides to reduce emissions. When the company emits at E*, the amount of tax payment is equal to $\square AE_*CT$. The emission reduction cost is equal to $\triangle E_OE_*C$. The company can save $\triangle$ CBE_O by the reduction compared to Case 2.
- The company does not want to reduce the emission at the lower level of E* because the additional reduction beyond E* takes much reduction cost.
- When the tax policy is implemented, a company decides on the emission amount so that the marginal abatement cost equals the tax rate.



- Suppose that we want to reduce the pollution in the entire country at the smallest cost.
- There are many companies in the country. How do we divide responsibility of reduction among companies to achieve this purpose?

∗ This purpose is sometimes important. Because the resources in society are limited. When we devote some money to environmental protection, we cannot use the money for other purposes.

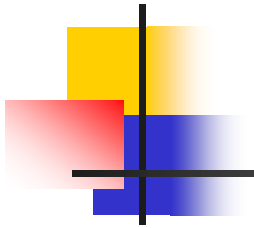
A simple example.
There are only two companies (A and B) in the country. Their marginal abatement cost is shown in the figure.



(The unit of the marginal abatement cost is 1000 yen.)

Case 1: When no policy is implemented…

- The situation of each company
  - Company A
    - [emission 10 units] [reduction 0 units]
    - [total abatement cost 0 yen]
  - Company B
    - [emission 10 units] [reduction 0 units]
    - [total abatement cost 0 yen]
- Sum of the emissions from the two companies equals 20 units.
- Sum of the total abatement cost of the two companies equals 0 yen.



- In Case 1, there are 20 units of emissions in the country.
- Now, suppose the government wants to regulate the emissions to reduce the emissions by 10 units at the smallest cost in the entire country.
- How does the government allocate the reduction responsibility between the companies?

Case 2: Each company is allowed to emit 5 units

- The situation of each company
  - Company A
    - [emission 5 units] [reduction 5 units]
    - [total abatement cost 4+7+8+10+13=42 yen]
  - Company B
    - [emission 5 units] [reduction 5 units]
    - [total abatement cost 1+2+3+4+6=16 yen]
- Sum of the emissions from the two companies equals 10 units.
- Sum of the total abatement cost of the two companies equals 58 yen.

Case 3: Company A is allowed to emit 6 units, while company B is allowed to emit 4 units.

- The situation of each company
  - Company A
    - [emission 6 units] [reduction 4 units]
    - [total abatement cost 4+7+8+10=29 yen]
  - Company B
    - [emission 4 units] [reduction 6 units]
    - [total abatement cost 1+2+3+4+6+7=23 yen]
- Sum of the emissions from the two companies equals 10 units.
- Sum of the total abatement cost of the two companies equals 52 yen.

Case 4: Company A is allowed to emit 7 units, while company B is allowed to emit 3 units.

- The situation of each company
  - Company A
    - [emission 7 units] [reduction 3 units]
    - [total abatement cost 4+7+8=19 yen]
  - Company B
    - [emission 3 units] [reduction 7 units]
    - [total abatement cost 1+2+3+4+6+7+8=31 yen]
- Sum of the emissions from the two companies equals 10 units.
- Sum of the total abatement cost of the two companies equals 50 yen.

Case 5: Company A is allowed to emit 8 units, while company B is allowed to emit 2 units.

- The situation of each company
  - Company A
    - [emission 8 units] [reduction 2 units]
    - [total abatement cost 4+7=11 yen]
  - Company B
    - [emission 2 units] [reduction 8 units]
    - [total abatement cost 1+2+3+4+6+7+8+10=41 yen]
- Sum of the emissions from the two companies equals 10 units.
- Sum of the total abatement cost of the two companies equals 52 yen.

Summary

Case	Sum of the emissions from the two companies	Emissions from Company A and B	Sum of the total abatement cost of the two companies
1	20 units	A 10, B 10	0 yen
2	10 units	A 5, B 5	58 yen
3	10 units	A 6, B 4	52 yen
4	10 units	A 7, B 3	50 yen
5	10 units	A 8, B 2	52 yen

In Case 4, the sum of the total abatement cost of the two companies is the smallest. How much is the marginal abatement cost of each company in Case 4?

- Company A emits 7 units.
  - The marginal abatement cost equals 10 yen.
- Company B emits 3 units.
  - The marginal abatement cost equals 10 yen.
- When the marginal abatement cost of each company is the same, the total abatement cost of the two companies is the smallest.

Comparison of environmental policies
1. Direct regulation

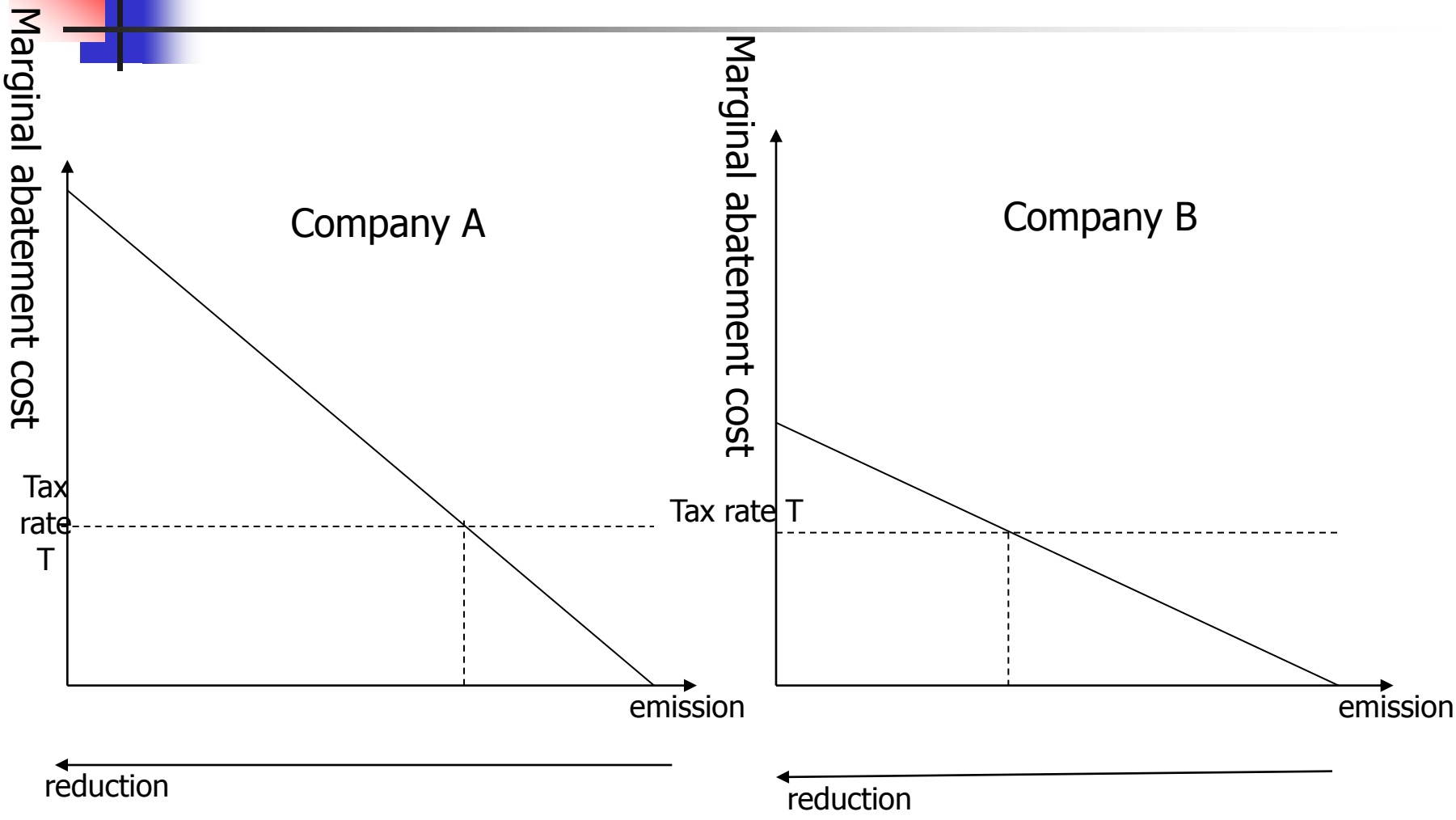
- The government limits the emission amount from each source.
- This type of policy has been used to tackle industrial pollution (air pollution, water pollution…). The advantage of this policy is the immediate effect on the pollution reduction. When what is important is the emission amounts from each source rather than the total amounts in the entire country, this policy should be used.

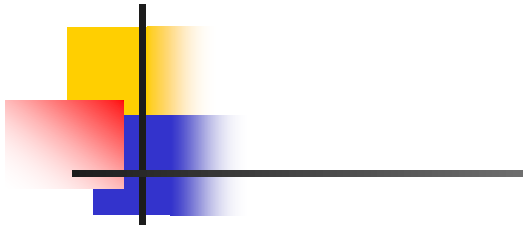
  ※On the other hand, the degree of global warming depends on the total emission amounts in the world.

- From the viewpoint of the equalization of the marginal abatement cost, it is almost impossible for the government to limit the emissions amount for each source to equalize each marginal abatement cost. This is because the information of the marginal abatement cost of each source (such as the figure in slide 15) is not available to the government.
  - In the example above, the information on the slide 15 is not available to the government. Therefore, the government cannot set the limits as in Case 4 (company A is allowed to emit 7 units, and B is allowed to emit 3 units.)

Comparison of environmental policies 2. incentive based policy such as tax

- From the viewpoint of the equalization of the marginal abatement cost, it is possible for the government to equalize the marginal abatement cost of each source.
- Please recall slide 12 and 13. When the tax policy is implemented, a company decides on the emission amount so that the marginal abatement cost equals the tax rate. When the tax rate is the same for each company, the marginal abatement cost of each company becomes the same.
- This means that the total abatement cost of society becomes the smallest.


Marginal abatement cost
Company A
Tax rate T
emission
reduction
Marginal abatement cost
Company B
Tax rate T
emission
reduction



Cost and Benefit

Cost and Benefit

- Any policy involves both the good and the bad.

→When we decide something, we have to take into consideration both its cost and benefit.

An example
A controversy over dam construction

Suppose that there is a plan to construct a dam with deforestation.

Some people want the dam. But some people do not want the dam since they want to protect the forest.

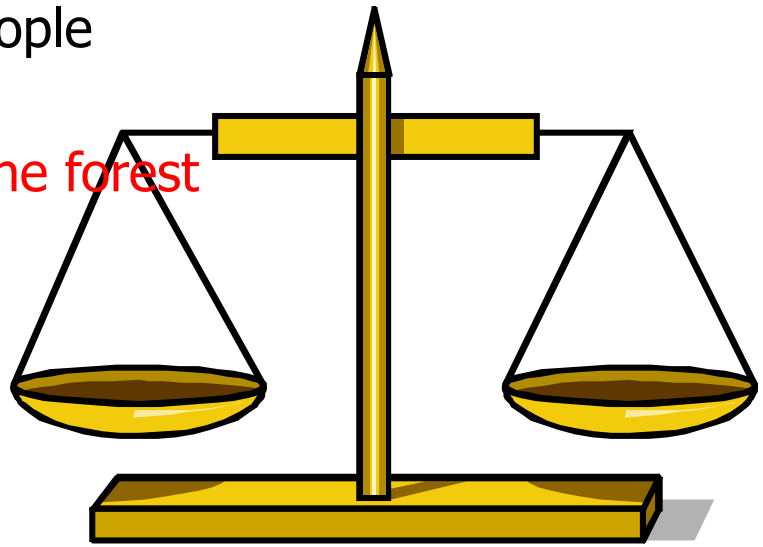
Let's compare the cost and benefit of the dam construction.

cost

- Cost for purchasing the land
- Cost for purchasing the materials
- Cost for hiring people
- ・・・・etc.
- Cost for losing the forest

benefit

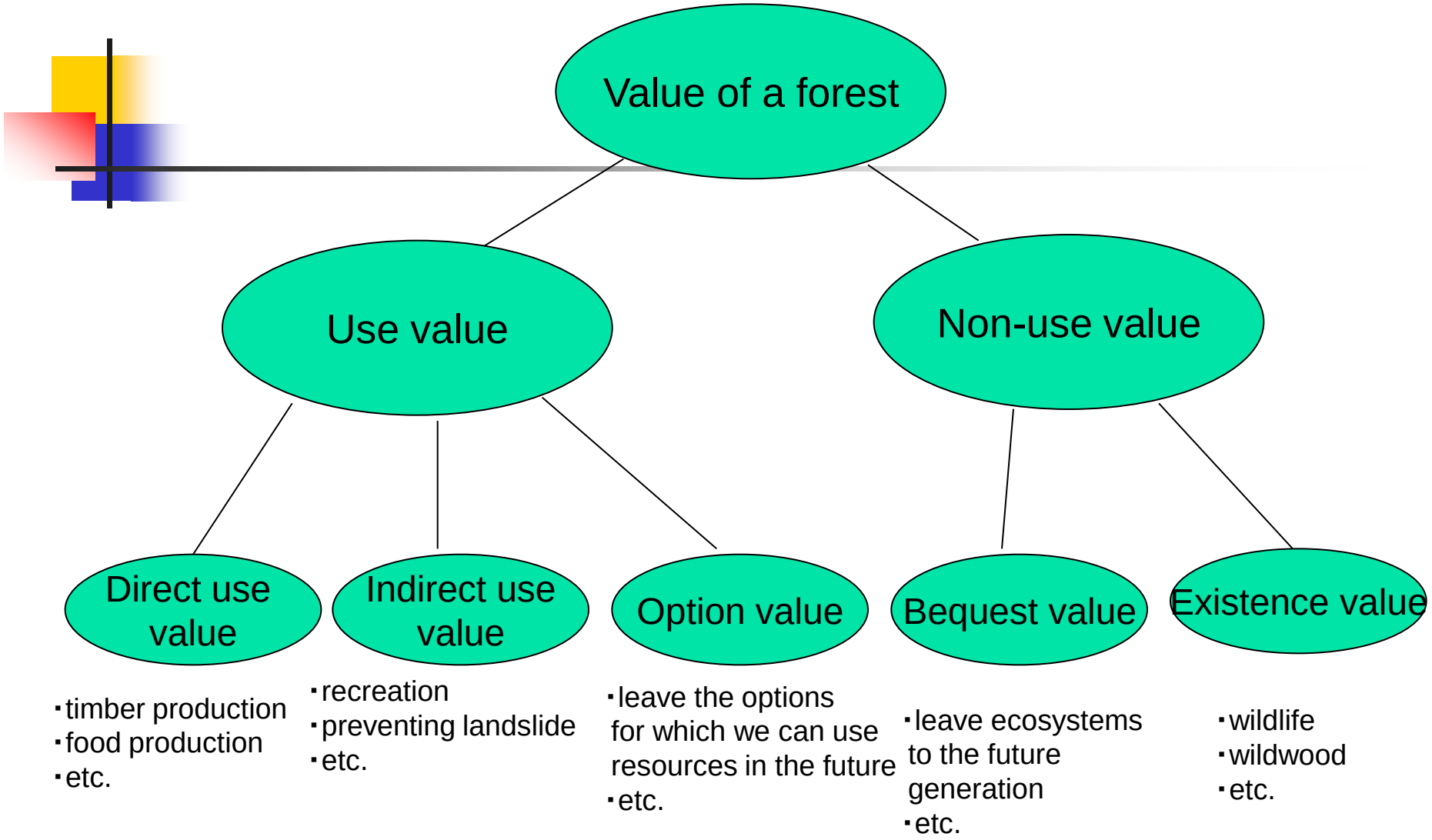
- Benefit of preventing flood
- ・・・・ etc.



This is called the cost benefit analysis

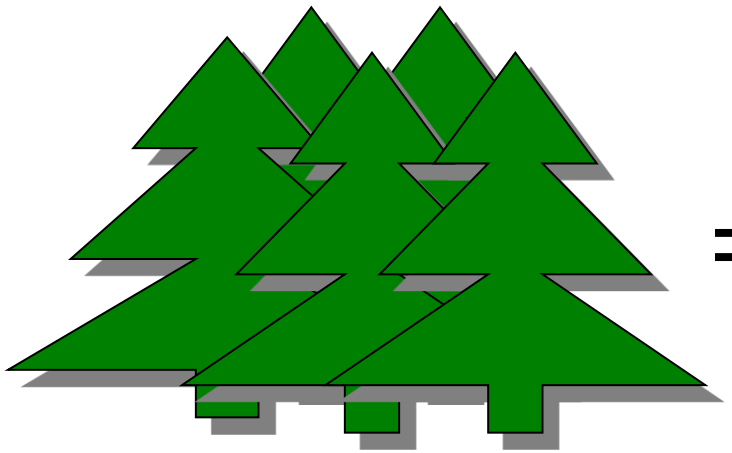
What is the cost for losing the forest?

- While a forest gives people "happiness", certain aspects of it do not have a market price. This is because the aspects are not sold in the market.
  - Example: When we enjoy a beautiful view of the forest, we do not have to pay money unless the forest is part of a park where we have to pay an entrance fee.
- Because of the feature of the no market price, sometimes the aspect is dealt with as if it had no value. This is one of the causes of deforestation.
- Environmental economics tries to measure the value of these aspects and give a monetary value to the environment so that the value can be taken into consideration.
- How can we measure the monetary value of the environment?


Value of a forest
Use value
Non-use value
Direct use value
Indirect use value
Option value
Bequest value
Existence value
・timber production
・food production
・etc.
・recreation
・preventing landslide
・etc.
・leave the options for which we can use resources in the future
・etc.
・leave ecosystems to the future generation
・etc.
・wildlife
・wildwood
・etc.

Example 1:
Giving monetary value to the water-retaining function of the forest.

How much does it cost to construct a dam which has the same amount of water-retaining function as the forest? Suppose the forest can retain 10 times the water that a dam can retain. Then 10 times the cost needed to construct a dam can be assumed to equal the monetary value of the water-retaining function of the forest.



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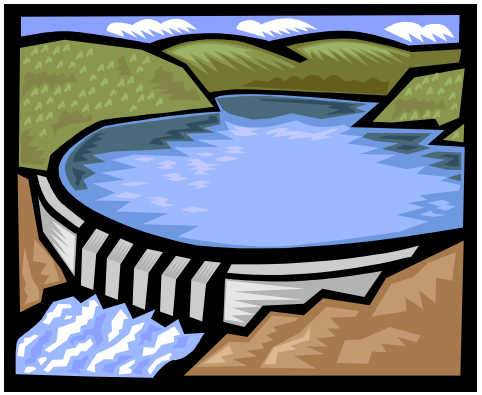
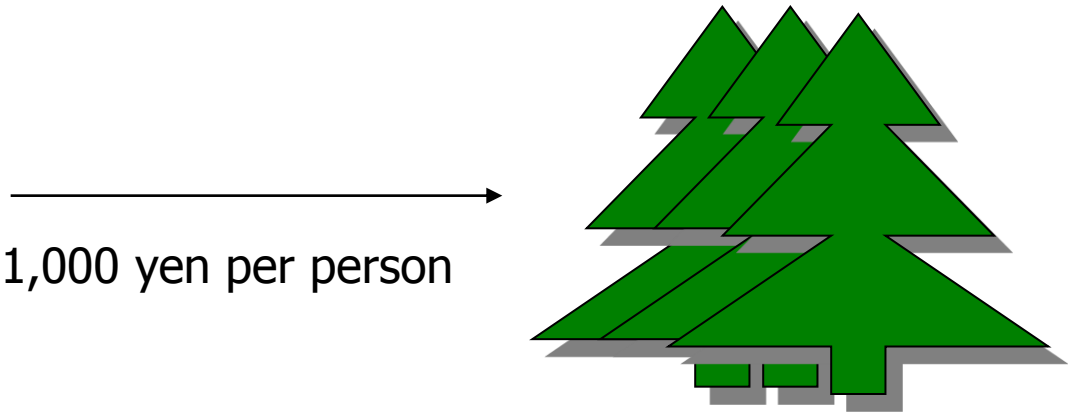


× 10

Example 2:
Giving monetary value to the recreation function of a forest.

How much are people willing to pay as the travel cost to go to the forest ? If they decide to go to the forest, they think that they will evaluate the satisfaction of going to the forest higher than the travel cost.



Example 3:
Giving monetary value to the clean air.

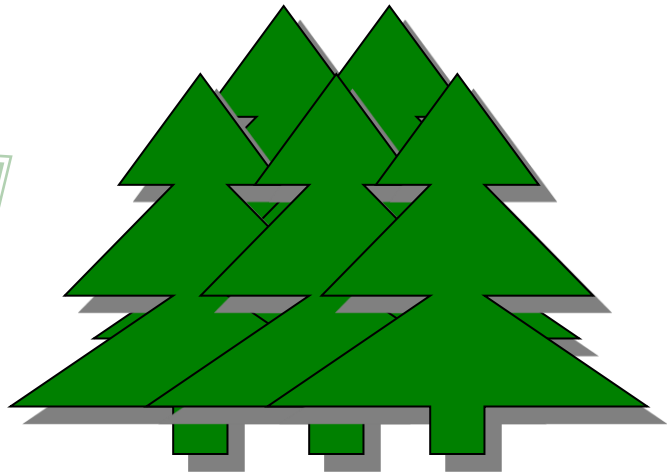
The price of a house is influenced by many factors. One of them is the degree of air pollution in the area. Suppose there are two houses and the characteristics of the houses are the same except for the air pollution. The size, layout, distance to the station, distance to the shops, and so on are the same about the two houses. But the degree of air pollution is different. In this case the difference of the house price can be considered to be the influence of the air pollution.

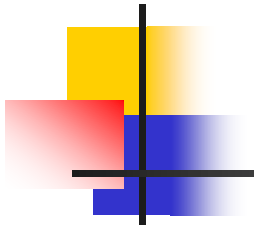
10 million yen

20 million yen

Example 4:
Giving monetary value to the function not related to the human use.

Examples 1, 2 and 3 are all related to human use. However, the forest has the function where it is not used by humans. In the valuation of these functions, price information cannot be used. Suppose an endangered animal lives in the forest. The forest provides food, water and so on to the animal. Humans do not use this habitat function. However, we may think this function is important. How do we give monetary value to the importance? In this case we can use a questionnaire to ask people how much they are willing to pay for the forest preservation for the animal.





- Using these methods, environmental economics tries to give monetary value to the environment so that the values can be taken into consideration.

Summary of today 1 incentive

- In making policies, the government can use the self-interest of people.

Summary of today 2 cost and benefit

- When we decide something, we have to take into consideration both its cost and benefit.
- Although some aspects of the environment do not have a market price, this does not mean the environment has no value.

References

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