# Marginal Reduction Cost Approach to Eco-Efficiency

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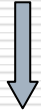
# Obstacles to LCA in helping our decision

- Parameters of environmental burden, such as $CO_2$, NOx, heavy metals etc. cannot be compared with each other.

- Environmental burden cannot directly be compared with economic cost.
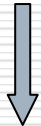
# Cost-Benefit Approach (CBA)

- ☐ Environmental burden
    - ■ $CO_2$, $NOx$, etc.

- ☐ Adverse effects
    - ■ health, ecosystem, etc.

- ☐ Economic benefits
    - ■ WTP for reducing adverse effects

# Difficulties with CBA

- ❑ Difficulties in monetization
  - ◾ Hypothetical nature of CVM or 'stated preference method'
    - Respondents may not...
      - ❑ State their true WTP
      - ❑ Know their WTP
      - ❑ Have their WTP
  - ◾ Environment as a Public good
    - ❑ Voluntariness with WTP vs involuntariness with public goods or bads
    - ❑ Difficulties in making scenarios where respondents obtain a good environment by paying money by themselves
- ❑ Difficulties in relating emissions to environmental qualities

# Cost-Effectiveness Approach (CEA)

- Environmental impacts are measured in physical terms

- Successful in the control of hazardous chemicals

| Policy | CPLYS (million yen) |
|---|---|
| Ban of chlordane | 45 |
| Mercury (caustic soda production) | 570 |
| Mercury (dry batteries) | 22 |
| Benzene control | 230 |
| Dioxin (emergency) | 7.9 |
| Dioxin (long-term) | 150 |
| NOx for automobiles | 86 |

CPLYS: cost per life-year saved

Sources: Oka et al 1997, Nakanishi et al 1998, Nakanishi 1995, Kajihara et al 1999, Kishimoto et al 2001, Oka 1996

# Problems with CEA in applying the choice of products

☐ Multiple pollutants having multiple environmental impacts

- NOx ⇒ human health (respiratory)
- CO2 ⇒ global warming
- Heavy metals ⇒ human health (neurotoxic)

⇒To try to create a common scale of environmental impacts is not hopeful

# Marginal Reduction Cost Approach (MRC Approach)

- ☐ Using marginal abatement costs elsewhere in a society as weights for aggregating the magnitudes of pollutant reduction

- ☐ ARC (avoidable reduction cost)

  $$= \Sigma MRC_i \times Q_i$$

  - ■ MRC$_i$: marginal reduction cost of pollutant i
  - ■ Q$_i$: magnitude of reduction of pollutant i

# Relative efficiency of product in reducing environmental impacts

- ☐ ARC > the cost of introduction of the product in question

  ⬇
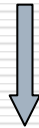
  The product is more efficient in reducing the same amounts of pollutants than other means taken elsewhere in a society

# LCA for alternative pumps

| Pollutant | Emission (kg) | | |
| --- | --- | --- | --- |
| | Conventional | Env friendly | Reduction |
| CO2 | 17900 | 13100 | 4770 |
| NOx | 41.7 | 30.7 | 11.1 |
| SOx | 54.9 | 41.6 | 13.4 |
| TOD | 4.47 | 3.05 | 1.42 |
| SPM | 17.0 | 6.29 | 10.7 |
| DXN | $6.30 \times 10^{-9}$ | $1.25 \times 10^{-8}$ | $-6.20 \times 10^{-9}$ |
| HM | 3.15 | 1.35 | 1.80 |

# Avoidable reduction cost

| Pollutant | Marginal cost (yen/kg) | Marginal cost times emission reduction (yen) |
|---|---|---|
| CO2 | 7.0 | 33400 |
| NOx | 2500 | 27700 |
| SOx | 43 | 575 |
| TOD | 1600 | 2200 |
| SPM | 6700 | 72000 |
| DXN | $1.9 \times 10^{10}$ | -118 |
| HM | 20000 | 36000 |
| ARC | | 170000 |

# Extra cost of introducing the environmentally friendly pump

|  | Conventional pump | Env friendly pump |
|---|---|---|
| Price (yen) | 320,000 | 500,000 |
| Electricity cost (yen) | 675,000 (46,500kWh) | 499,000 (34,300kWh) |
| Total cost (yen) | 995,000 | 999,000 |

# Efficiency of the introduction of the environmentally friendly pump
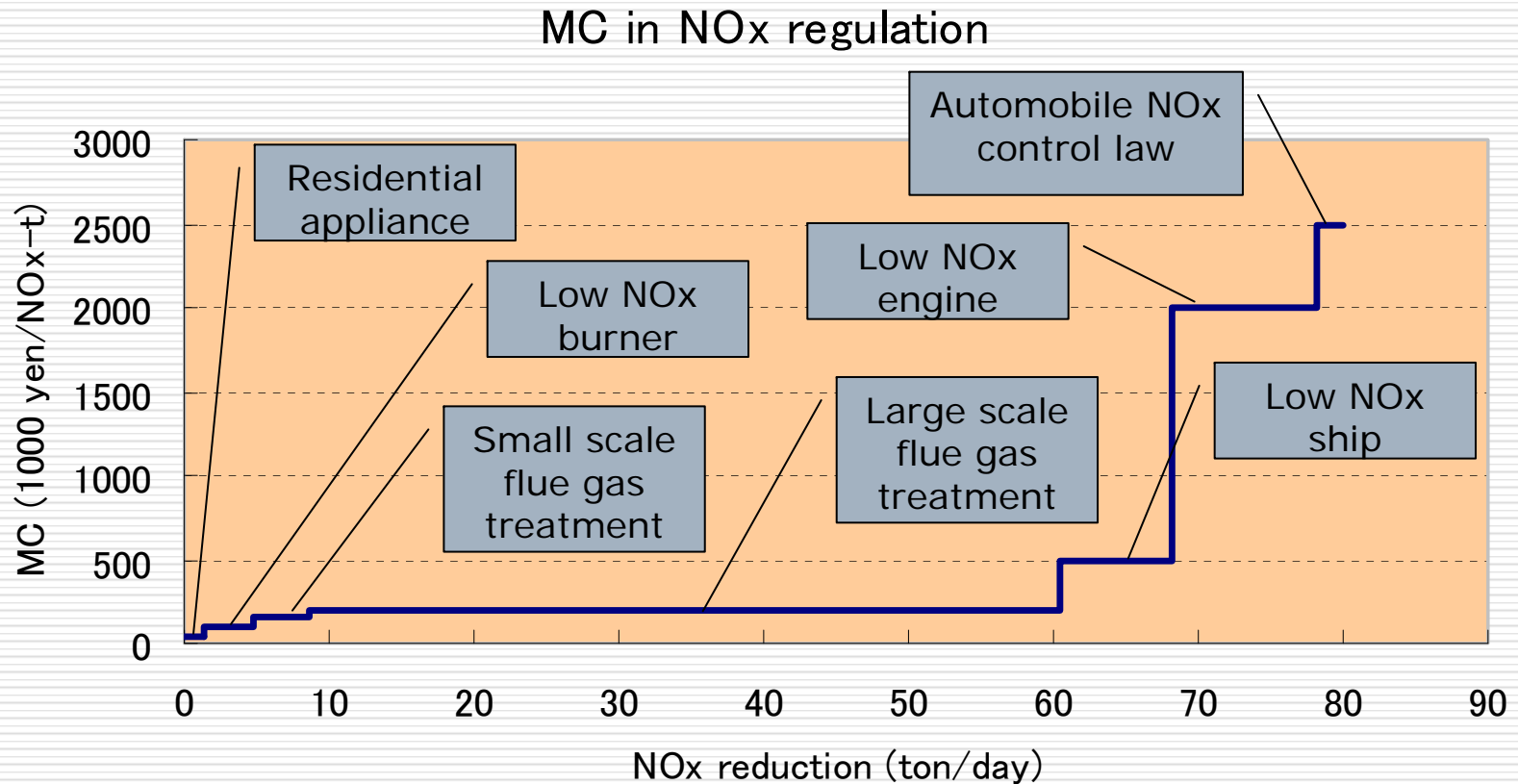
- ☐ ARC (170,000 yen)

  > additional cost of introducing the env. friendly pump (4000 yen)
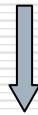
  Introducing the pump is relatively efficient

# MRC is the unit cost of activities having the highest value

MC in NOx regulation

# Marginal reduction cost is not the benefit of pollution reduction

- Only when the activity with the highest unit cost is actually abandoned as the introduction of the product, the marginal reduction cost is regarded as the marginal environmental benefit of the product.

# MRC is a tool to assess the efficiency of products and activities

- ☐ MRC cannot be used to assess new regulations.
    - ■ Introduction of new regulation may change the marginal costs.
- ☐ MRC is a method to assess relative efficiency of particular products or activities.