



# **Eco-Efficiency Indicators:**

## **Measuring Ecological Efficiency of Economic Performance**

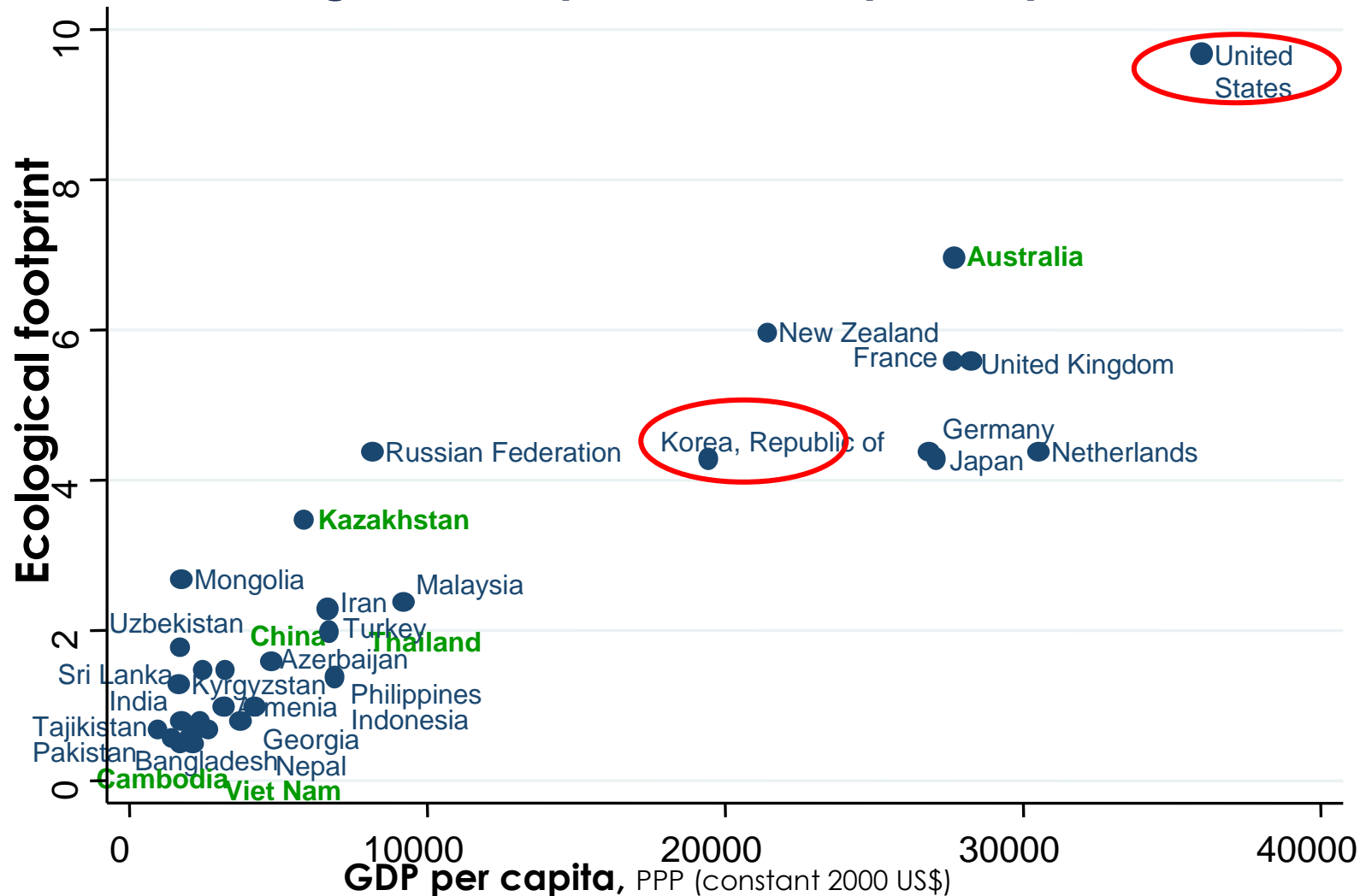
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# Eco-efficiency: conceptual framework

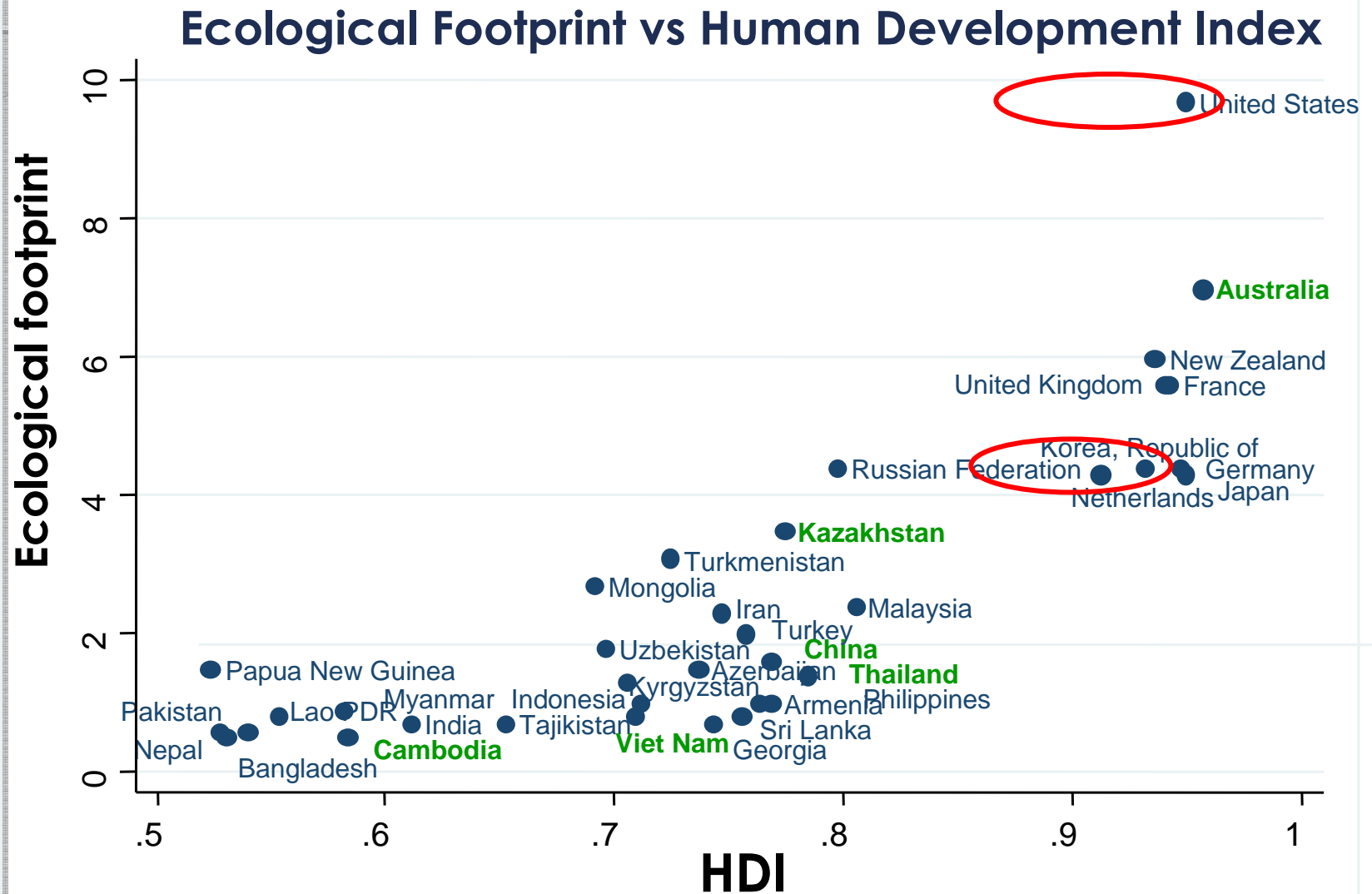


# Economic growth: patterns matter

## Ecological Footprint vs GDP per capita\_PPP



# Economic growth: patterns matter





# Eco-Efficiency

- “Eco-efficiency is achieved by the delivery of competitively-priced goods and services that satisfy human needs and bring quality of life, while progressively **reducing ecological impacts and resource intensity** throughout the life-cycle to a level at least in line with the earth’s estimated carrying capacity”

(WBCSD)

- Seeks to **maximize the productivity of energy and material** inputs in order to reduce resource consumption and pollution/waste per unit of output, and to generate cost savings and competitive advantage.

*(Sustainable Consumption and Production, OECD, 1997)*

- Simply defined as “**creating more economic value with less environmental impact**”



# Relevant Concepts (I)

## Factor 4

Wealth  $\times 2$  and resource use  $\times \frac{1}{2} \rightarrow$  factor 4

It addresses both consumption and production

## Factor 10

- Focuses more on the reduction of resource consumption in economy as whole
- Concept moves beyond Factor Four suggesting that developed countries need to reduce resource use  $10\times$  in order to truly be sustainable.



## Relevant Concepts (2)

- **Resource Efficiency:**

*Useful material output / material input*

This concept is also consistent with the economic concept of efficiency

- **Resource Intensity:**

The amounts of resources used for per unit of GDP





# Elements for Eco-efficiency in the Business Sector

- Reducing material requirements for goods & services
- Reducing energy intensity of goods & services
- Reducing toxic dispersion
- Enhancing material recyclability
- Maximizing sustainable use of renewable resources
- Extending product durability
- Increasing the service intensity of goods and services

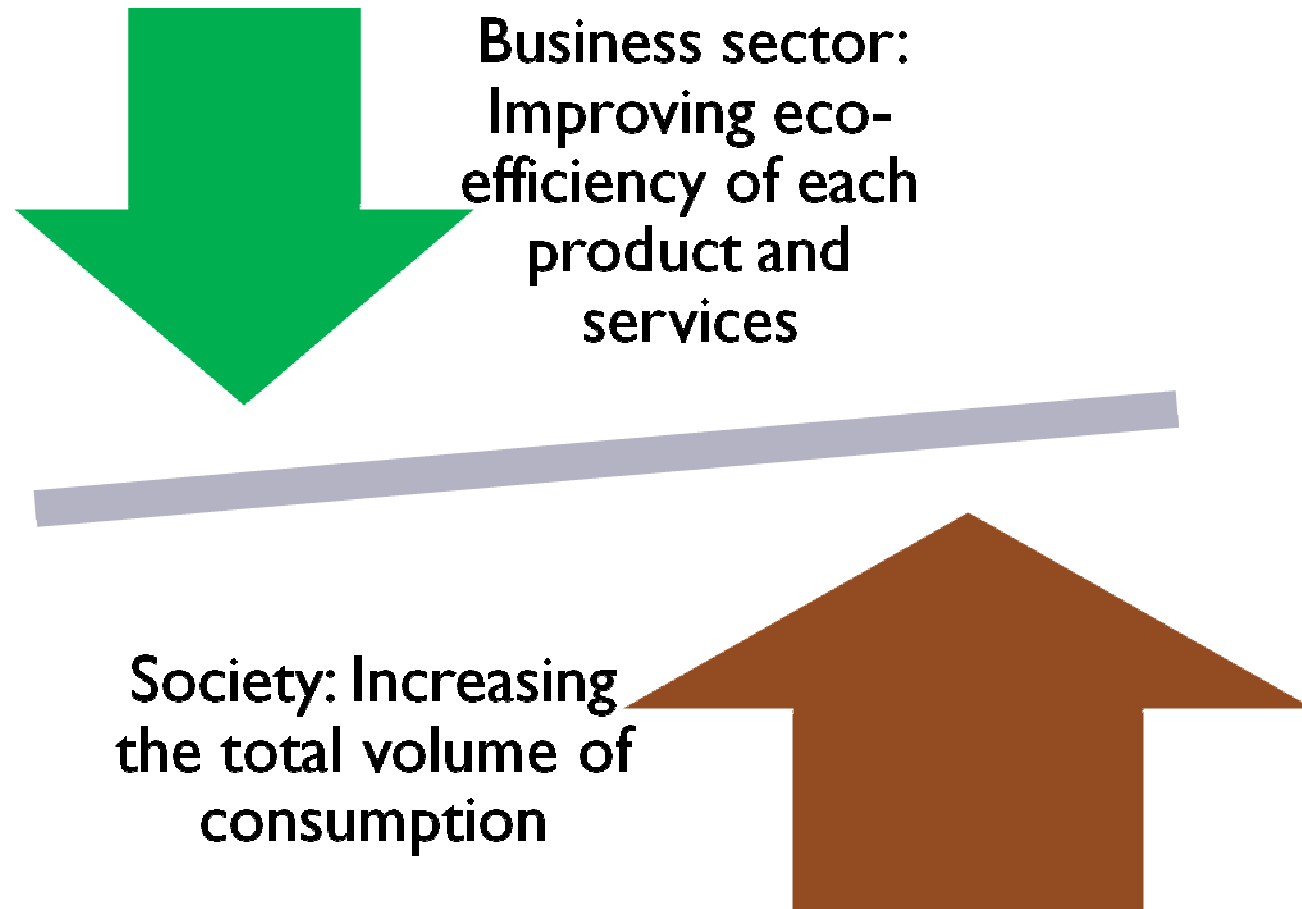




# Eco-efficiency for the Economy as a Whole

- Improvement of eco-efficiency in the business sector contributes to environmental sustainability
- However, it is imperative to address the **rebound effect**, implying the progress obtained from production process of individual products are easily outstripped by the absolute increase of the social demand for goods and resources
- Thus, it is important to apply the EE concept to macro-level and economy-wide level

# Rebound Effect

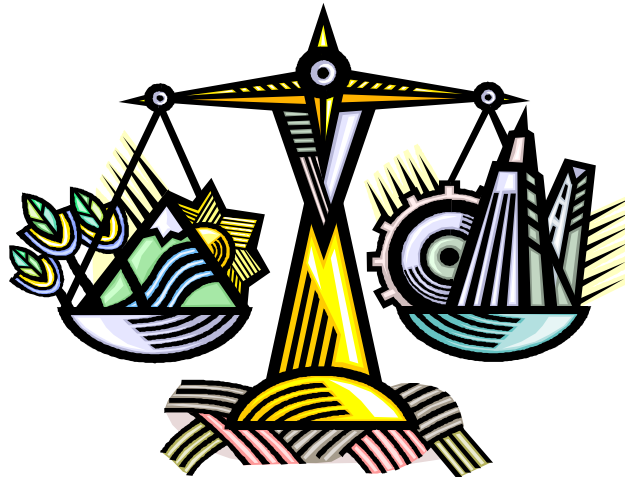




# Eco-efficiency for the Economy as a Whole

- **Micro-level:** Current cases in the business sector, full use of eco-efficiency concept to reduce the environmental impacts
- **Macro-level:** Implementing policy measures to motivate and enable society and key sectors (transport, energy, industry, etc) to move towards eco-efficient practices
- **Regional/global level:** Building a common view on EE, sharing knowledge and experience, promoting capacity of stakeholders, etc

# Eco-efficiency Indicators: measuring resource-efficiency and environmental impacts of economy



# Measuring the Performance: Eco-efficiency Indicators

The application of eco-efficiency indicators in the business sectors: the ratio of product or service value/ environmental impact

Most indicators focus on the consumption of energy, materials and waters and the emission of greenhouse gases

$$\text{Eco-efficiency} = \frac{\text{Value of a product}}{\text{Environmental impact of a product}}$$

↑ Enhancing the quality  
↓ Reducing the impacts

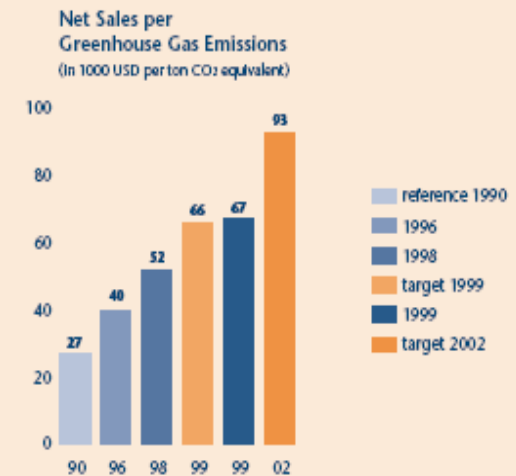
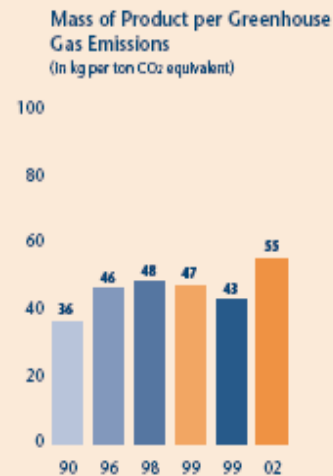
## Eco-efficiency Ratios

### Mass of product sold per:

Energy consumption = 6.0 kg per gigajoule  
Material consumption = 66.7 kg per ton  
GHG emissions = 42.9 kg per ton CO<sub>2</sub> equiv.

### Net sales per:

Energy consumption = 9,400 USD per gigajoule  
Material consumption = 104,000 USD per ton  
GHG emissions = 67,100 USD per ton CO<sub>2</sub> equiv.

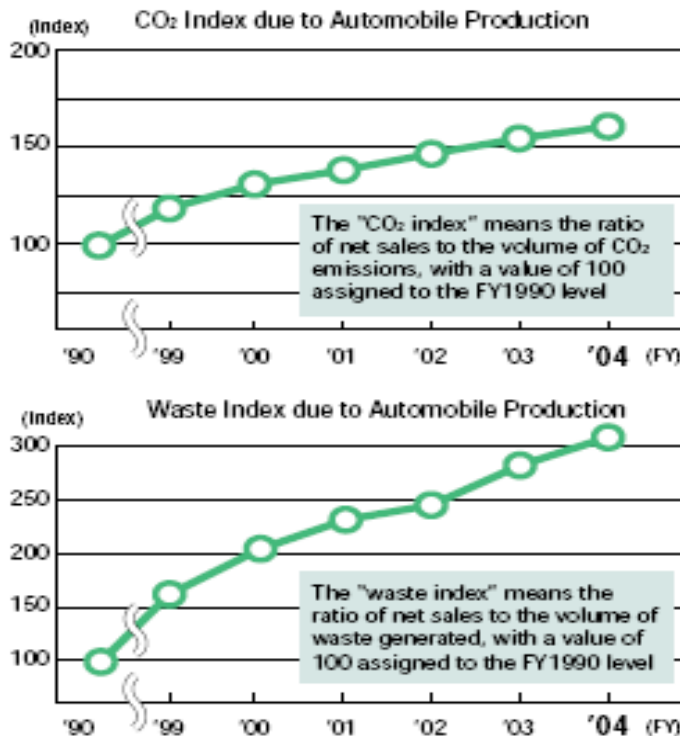


# EEl for the Business Sector: Cases of Toyota and Toshiba

## Eco-efficiency Formula

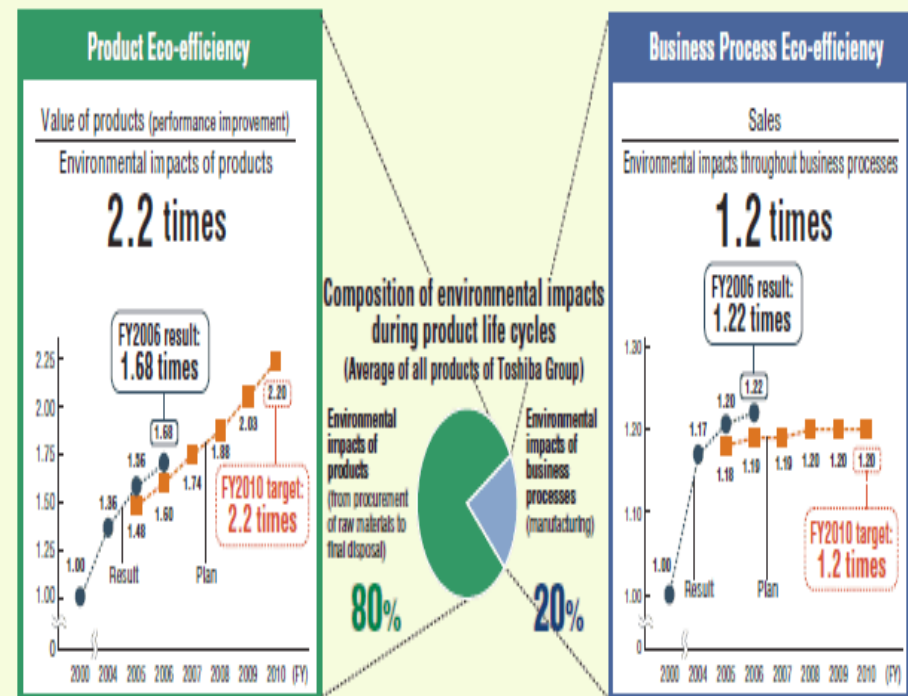
$$\text{Eco-efficiency} = \frac{\text{Net sales}}{\text{Environmental impact}}$$

## Trend in Eco-efficiency



## Environmental Vision 2010 Double Overall Eco-efficiency

(FY2010/FY2000)







# Measuring Economy-wide Eco-efficiency

- Need to present an easy tool clearly showing the direction for economic growth with less resource consumption and pollution, a key ingredient and prerequisite of sustainable development.
- Need to provide a yardstick to measure the progress in attaining both economic and ecological goals.



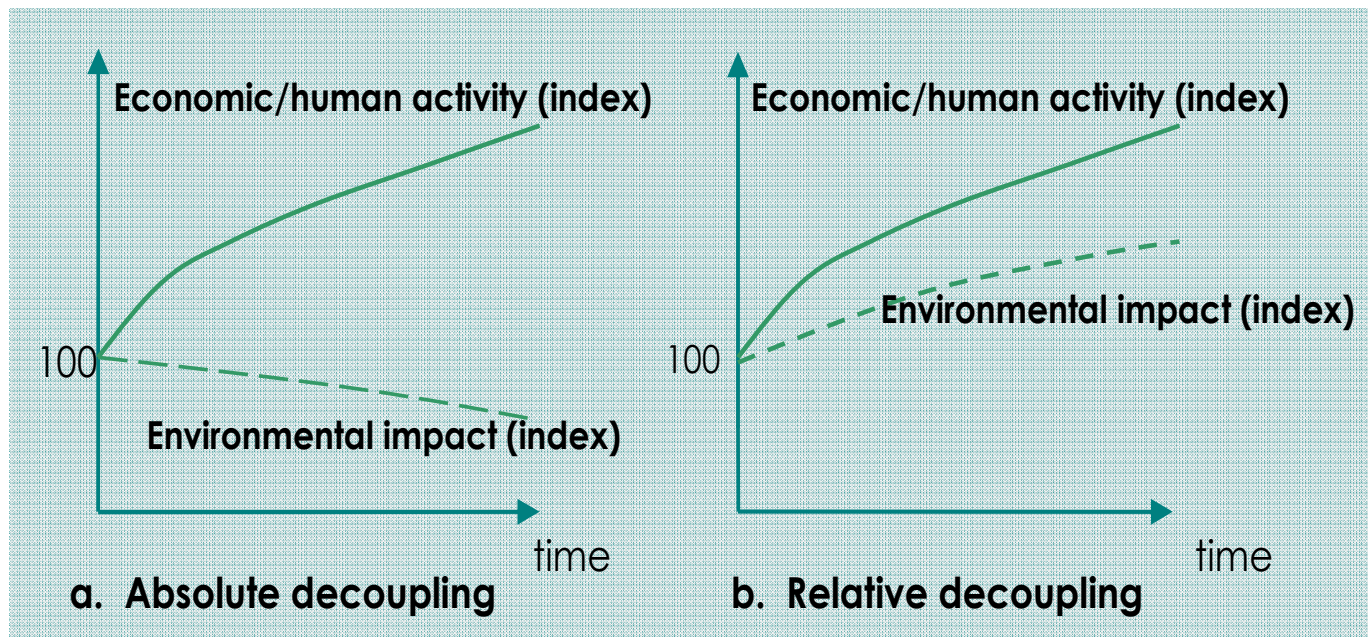


# Sustainability Indices

- Living Planet Index (LPI)
- Ecological Footprint (EF)
- City Development Index (CDI)
- Human Development Index (HDI)
- Environmental Sustainability Index (ESI)
- Environmental Performance Index (EPI)
- Environmental Vulnerability Index (EVI)
- Index of Sustainable Economic Welfare (ISEW)
- Well Being Index (WBI)
- Genuine Savings Index (GS)
- Environmental Adjusted Domestic Product (EDP)

# Economy-wide approach: decoupling

- **Absolute decoupling:** the environmental pressure does not change or decreases while the driving force increases
- **Relative decoupling:** the growth rate of environmental pressure is positive but less than the rate of growth of human activity



# Economy-wide EEI

**Environmental costs**

**Economic output**

**Environmental costs** can be:

- Pollution emissions ( $\text{CO}_2$ ,  $\text{SO}_x$  emissions, BOD, etc)
- Resource used (energy or water used)

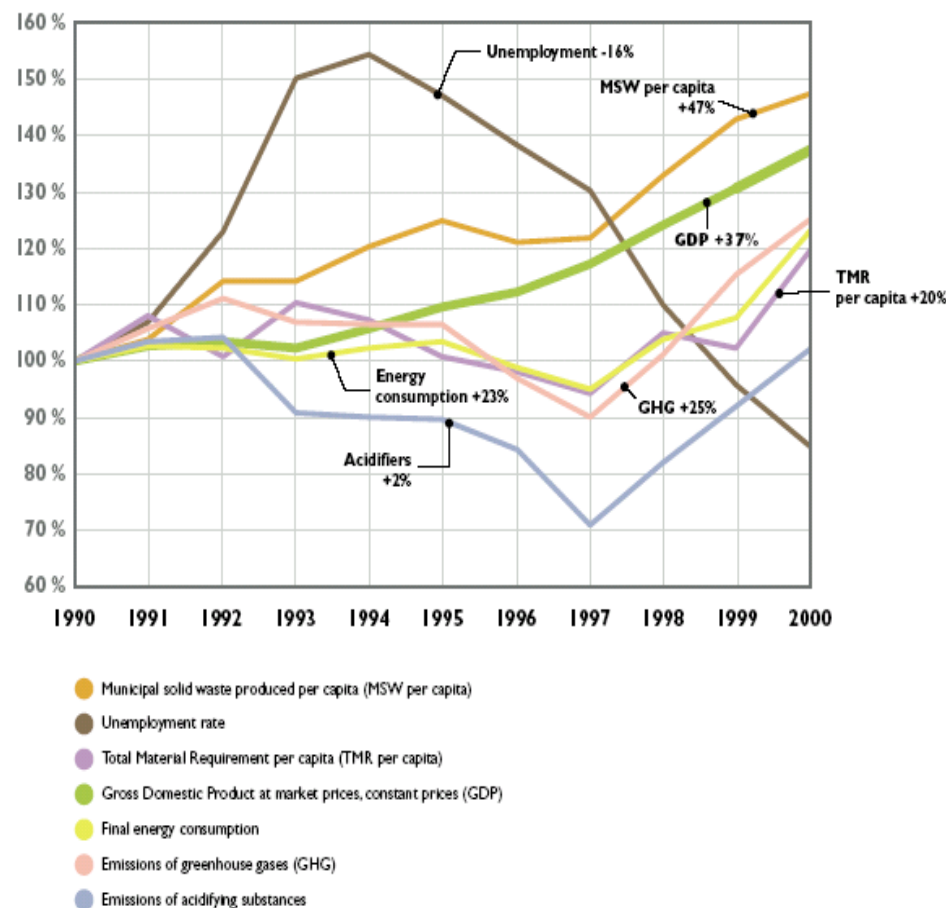
**Economic output** can be:

- Value added or benefit (GPD per capita)
- Unit of product or service (per km, per  $\text{m}^2$ )

# Applications of EEI for Macro-level: Case of Basque in Spain

## Ecoefficiency in the Economy of the Basque Country

INDEX 1990 = 100



Source: drawn up in-house using data from Basque Government Department of Land Use and the Environment, IHOBE, EVE and EUSTAT.

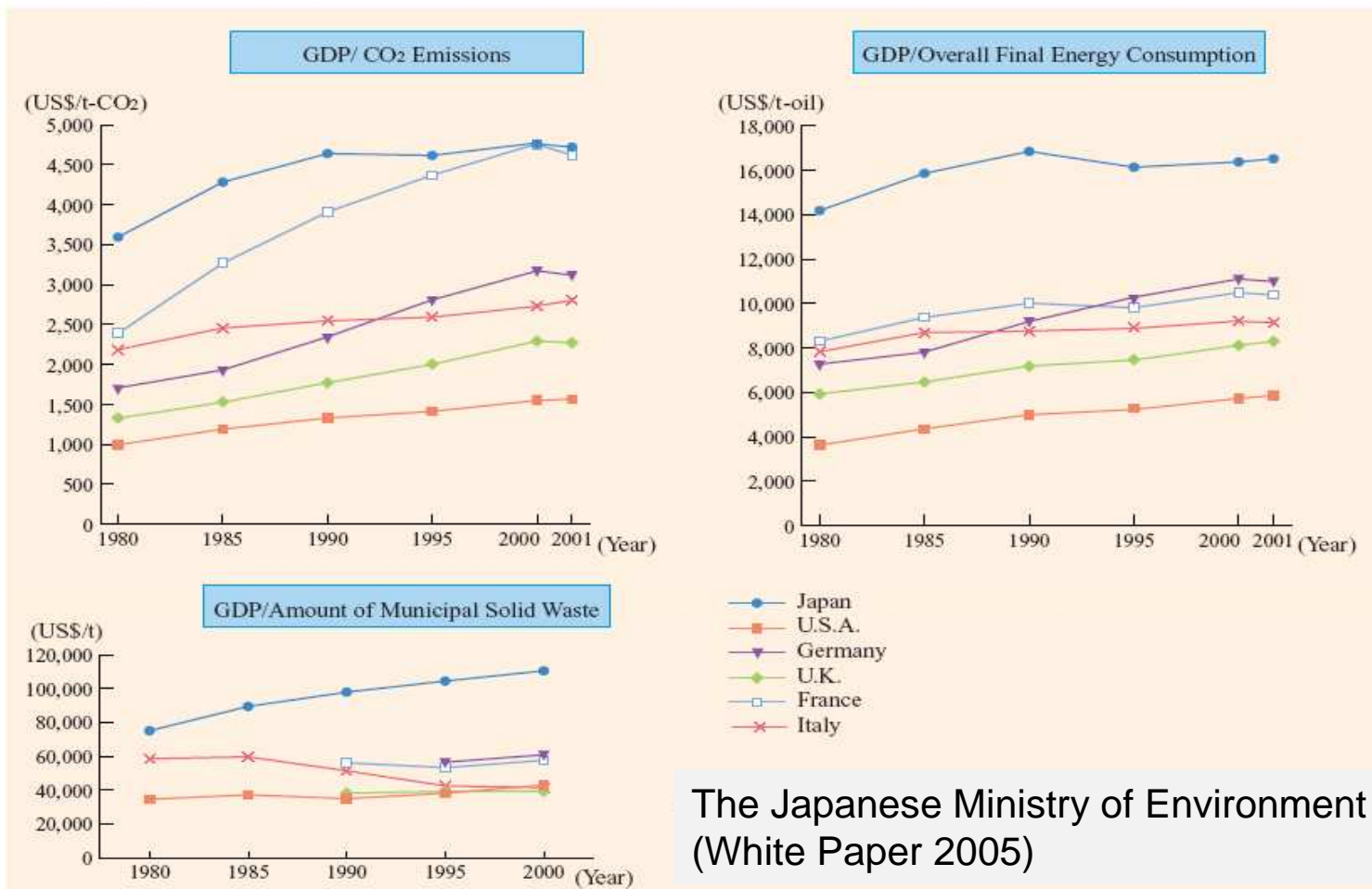
Basque Country in Spain  
(2003)

*“ To analyze the extent to which the economy has been de-linked from the environment... and to show changes in the pressure exerted on the environment by different economic activities”*

The application focused on the eco-efficiency of the economy and four sectors (transport, industry, energy and residential sectors)

# Applications of EEI for Macro-level: Case of Japan

International Comparison of Changes in Eco-efficiency



The Japanese Ministry of Environment  
(White Paper 2005)





# ESCAP Eco-Efficiency Indicators Project: Key Approaches

- Assess the macro-level eco-efficiency of society to enhance regional efforts for improving eco-efficiency
- Provide governments with a practical tool to measure their performance and outcome in the context of eco-efficiency
- Develop a conceptual and methodological framework, and a complete set of indicators representing the progress and state of economy-wide eco-efficiency.
- Undertake a pilot work of inter-country comparisons using a number of selected indicators based on the availability of reliable data



# Groups of Eco-efficiency Indicators

## (1) Scope-wise Indicators

- **Economy-wide Indicators:** Indicators that represent the macro-level eco-efficiency of society or economic growth.
- **Sector-specific Indicators:** Sectors include Energy, Manufacturing, Transport, Household consumption, Resource use related Policy, etc

## (2) Subject-wise Indicators

- **Intensity or Productivity of Resource Use:** indicators for energy supply and consumption, non-renewable resource use, renewable resource use, land use for built environment, etc.
- **Intensity of Environmental Pressure:** Indicators of GHG emissions, waste generation, air and water pollutions, etc.
- **Intensity of Socio-environmental Costs:** Not necessarily immediate indicators representing the scale of environmental pressure or the state of environmental quality, but are sufficient to reveal the socio-environmental costs. (e.g. traffic congestion costs, environmental health costs, environmental restoration costs, etc.)





# Framework and set of EEI: Economy-wide indicators

Resource use intensity	Environmental impact intensity
Water intensity [m <sup>3</sup> /GDP] Energy intensity [J/GDP] Land use intensity [km <sup>2</sup> /GDP] Material intensity [DMI/GDP]	Emission to water intensities [t/GDP] Emission to air intensities [t/GDP] GHG emissions intensities [t/GDP]

# Framework and set of EEI: Sector-specific indicators

	Resource use intensity	Environmental impact intensity
Agriculture	Water intensity [m3/GDP] Energy intensity [J/GDP] Land use intensity [km2/GDP]	CO2 intensity [t/GDP] CH4 intensity [t/GDP]
Industry	Energy intensity [J/GDP] Water intensity [m3/GDP] Material intensity [DMI/GDP]	CO2 intensity [t/GDP] Solid waste intensity [t/GDP]
Manufacturing	Energy intensity [J/GDP] Water intensity [m3/GDP] Material intensity [DMI/GDP]	CO2 intensity [t/GDP] BOD intensity [t/GDP] Solid waste intensity [t/GDP]
Public & services sector Private ownership, but open or accessible to public (commercial, schools)	Energy intensity [J/GDP] Water intensity [m3/GDP] Land use intensity [km2/GDP]	CO2 intensity [t/GDP] Wastewater intensity [m3/GDP] Municipal solid waste intensity [t/GDP]
Transport sector (use of vehicles only, not manufacturing of vehicles)	Fuel intensity [J/GDP]	CO2 intensity [t/GDP]

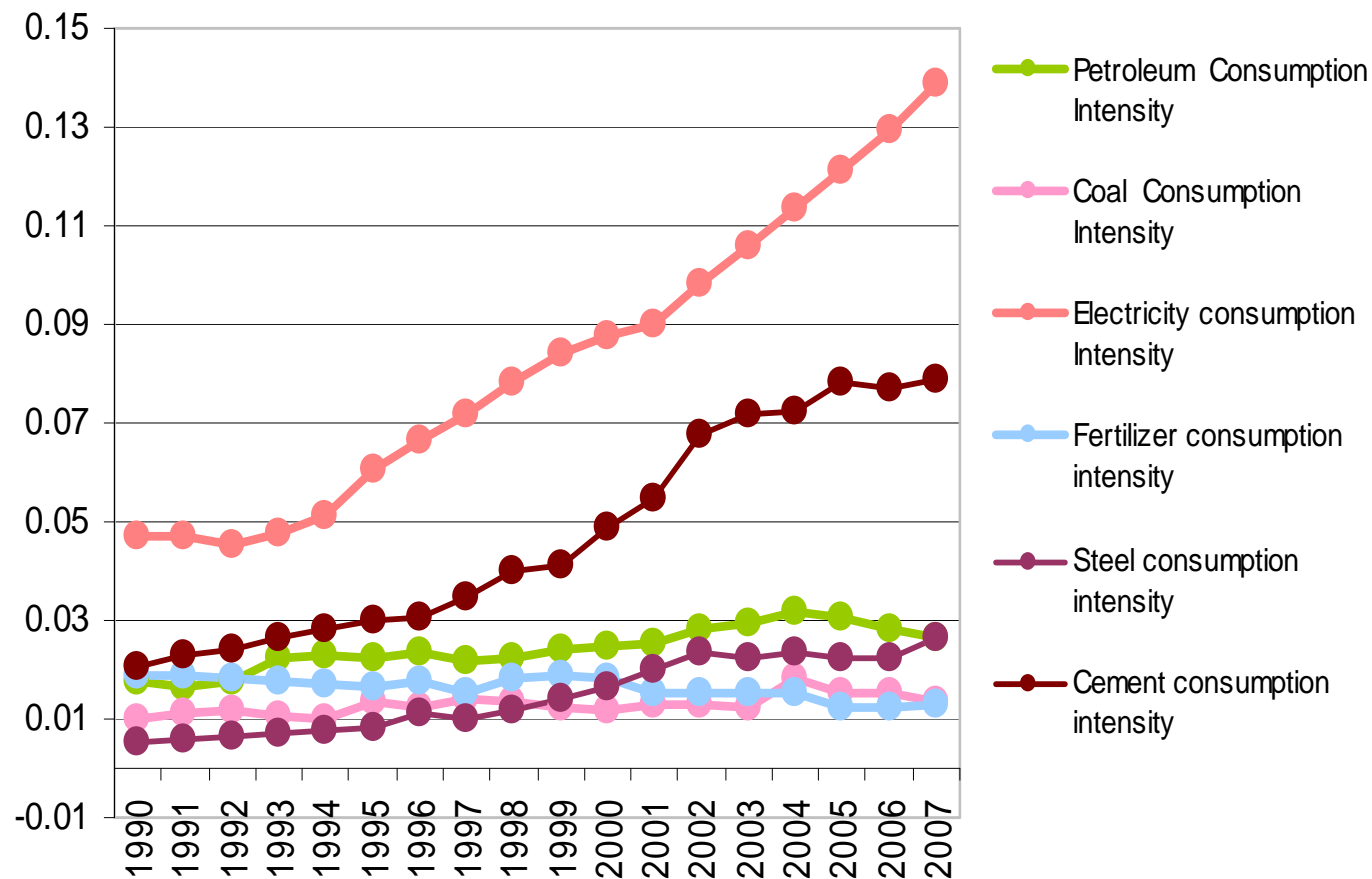


# Principles and concepts associated with selecting EEI

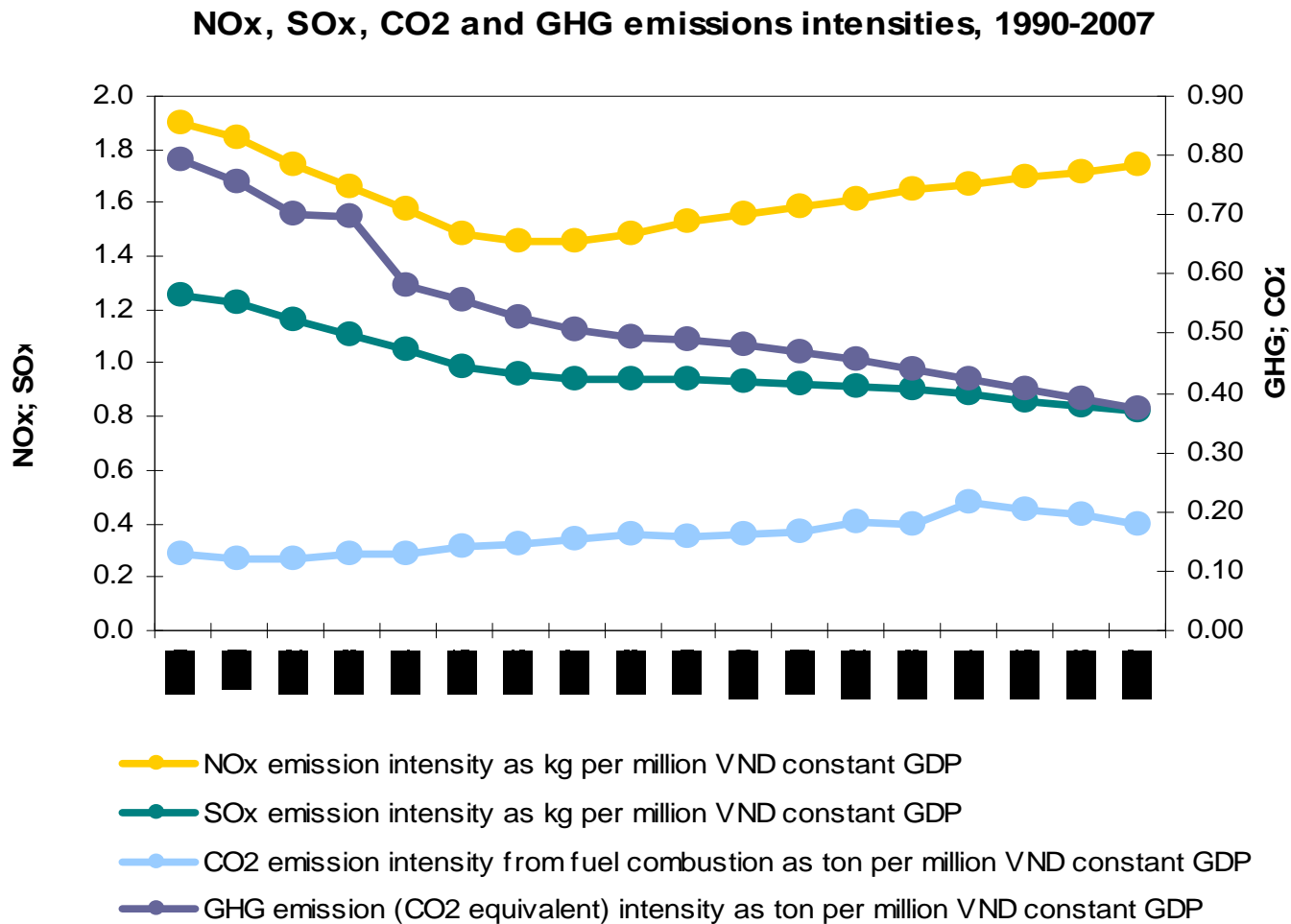
- Guided by sustainability principles
- Taking the structure of the economy into account
- Considered data availability and methodological
- Attuned to the national sustainable development strategies

# ESCAP EEI: Case of Viet Nam

Material use intensities, 1990-2007

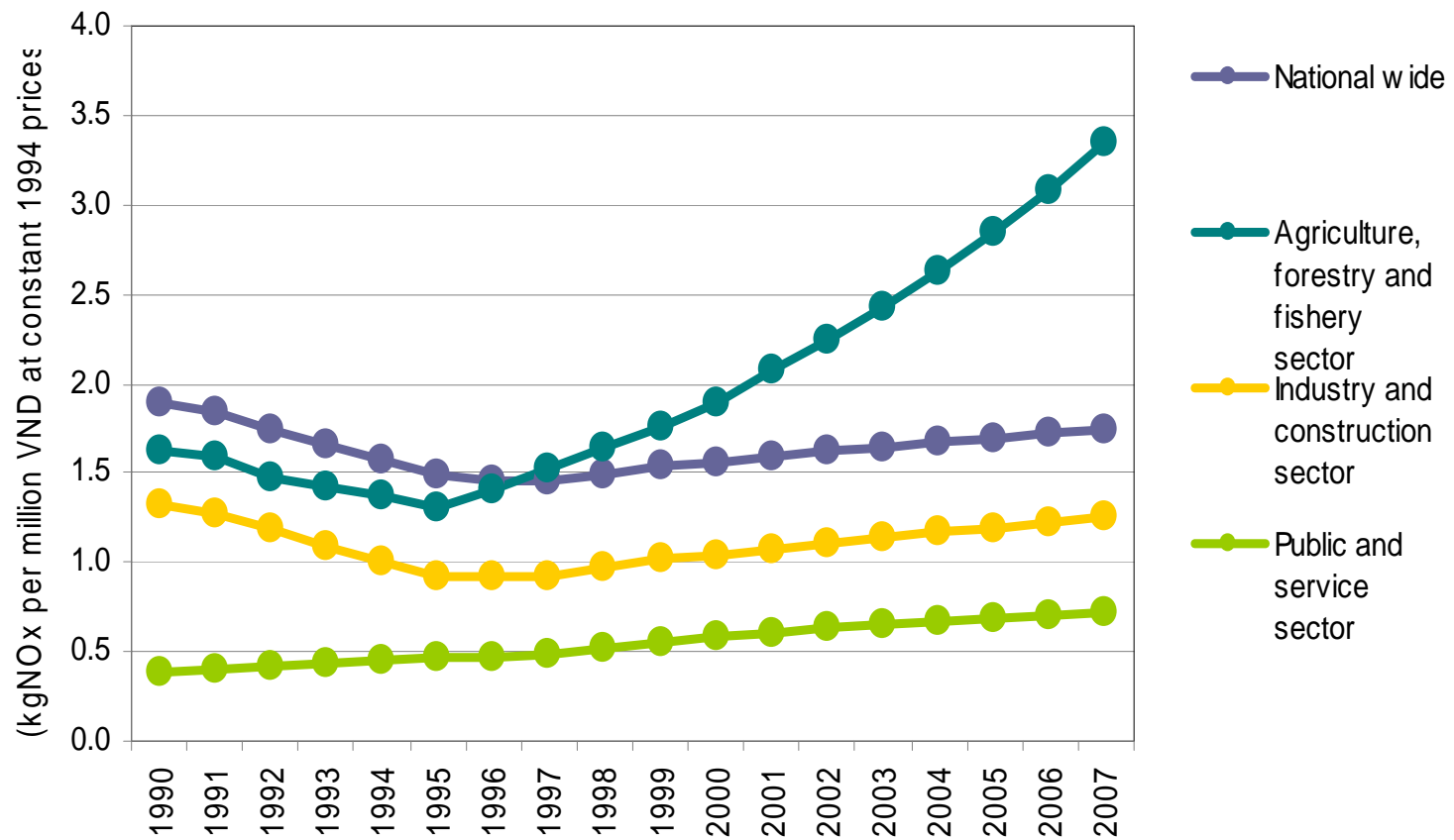


# ESCAP EEI: Case of Viet Nam



# ESCAP EEI: Case of Viet Nam

NOx pollution intensity by economic sector





# Conclusion

- The EEI framework allows great flexibility for countries to choose the most relevant and appropriate indicators based on two major conditions.
  - (1) an established priority in national policy areas in the pursuit of economic growth with less resource consumption and pollution, and
  - (2) the availability of supporting data for assessment.





# *Thank You*

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