

Energy and Green House Gas Mitigation Technologies

Japan Society for the Promotion of Science-Imperial College London-University of Tokyo Symposium
on Climate Change

Thursday 28th and Friday 29th September 2006



Imperial College London, South Kensington Campus, London SW7 2AZ



The Role of Research Universities as an Engine for Innovation



September 28, 2006

Hiroshi Komiyama
President, University of Tokyo

University of Tokyo

Established in 1877



Converted to an
autonomous corporation
in 2004

Imperial
University



National
University



Autonomous
Corporation

Mission of the University of Tokyo

The University of Tokyo Charter (2003)

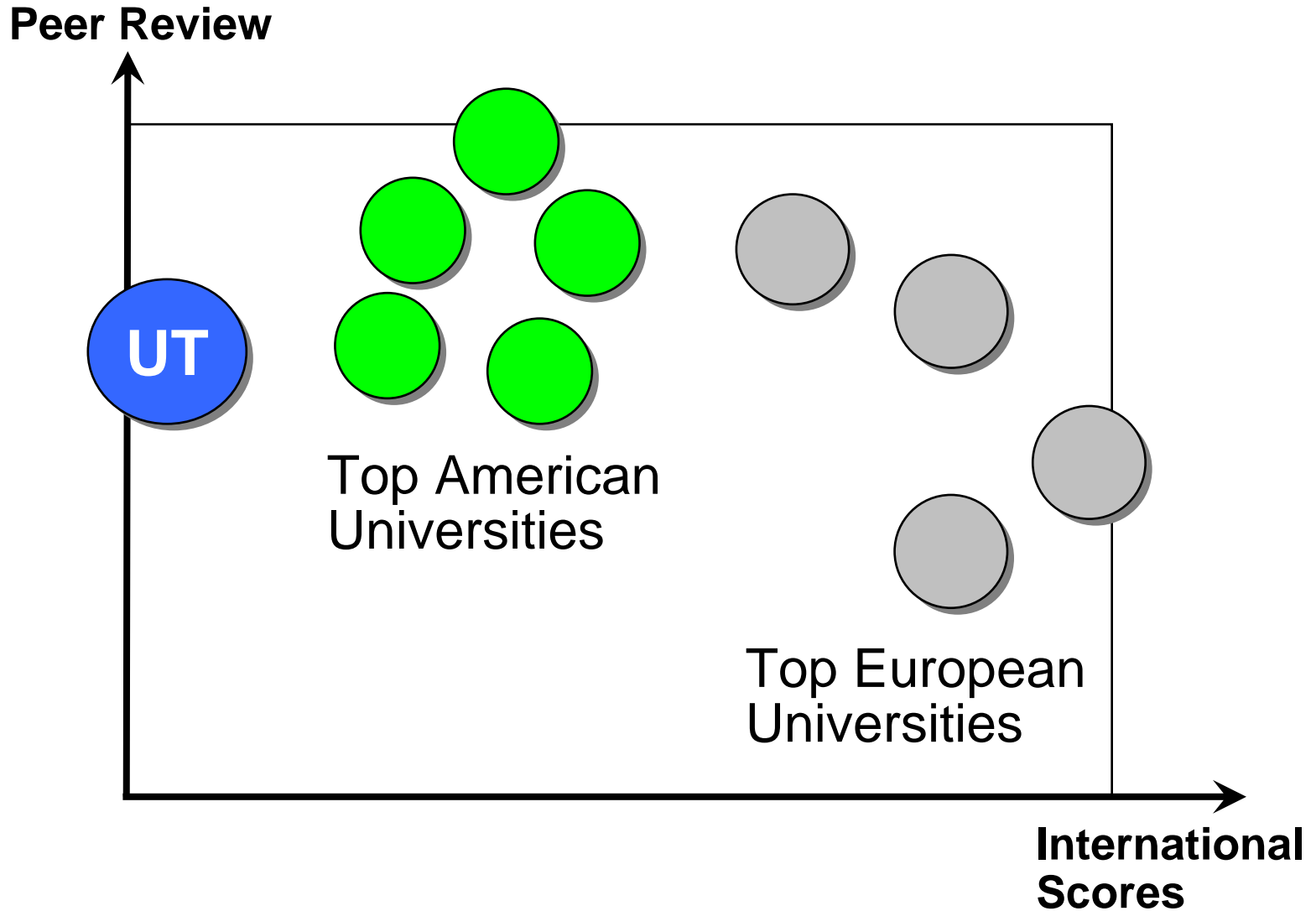
Perform world-class research and Education

Serve the public good of the world from Asian perspective

Use knowledge to strengthen ties with Asia

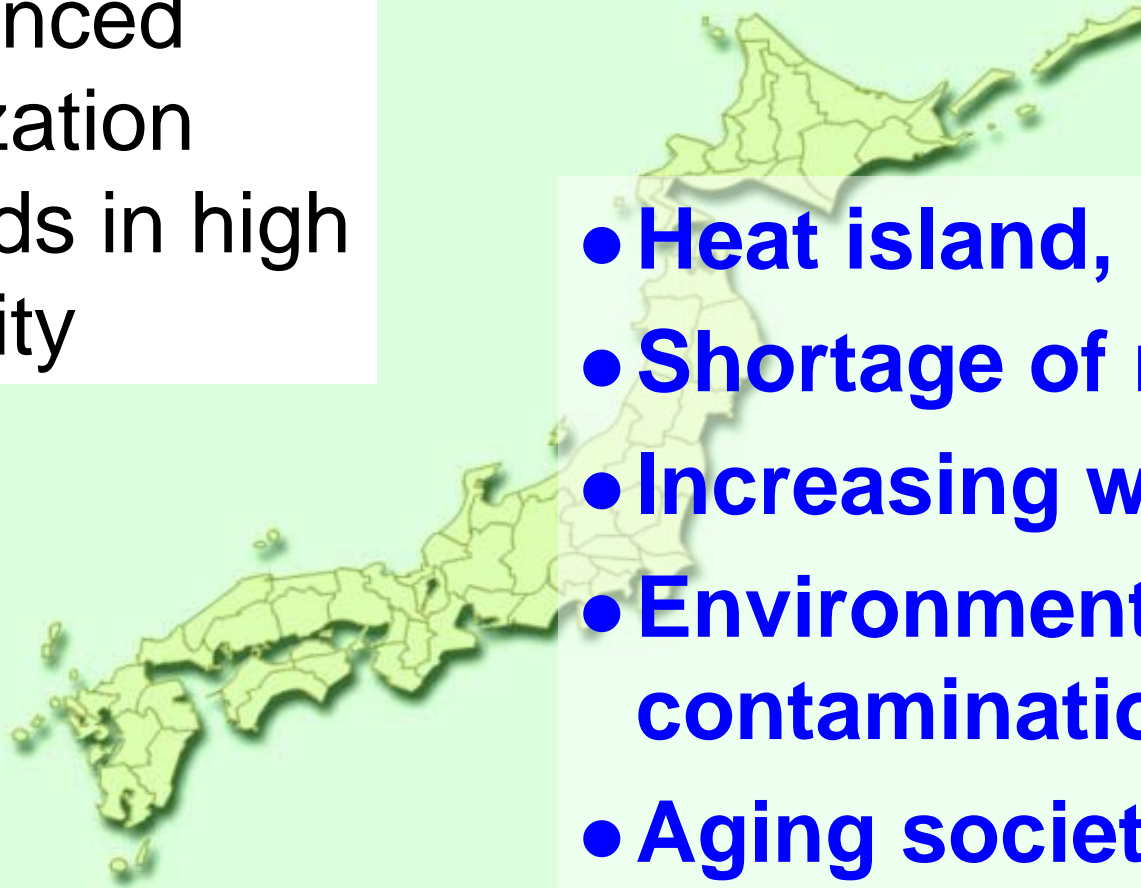
Become a center linking Europe, Asia and America

University of Tokyo Peer Review vs. Int'l Scores



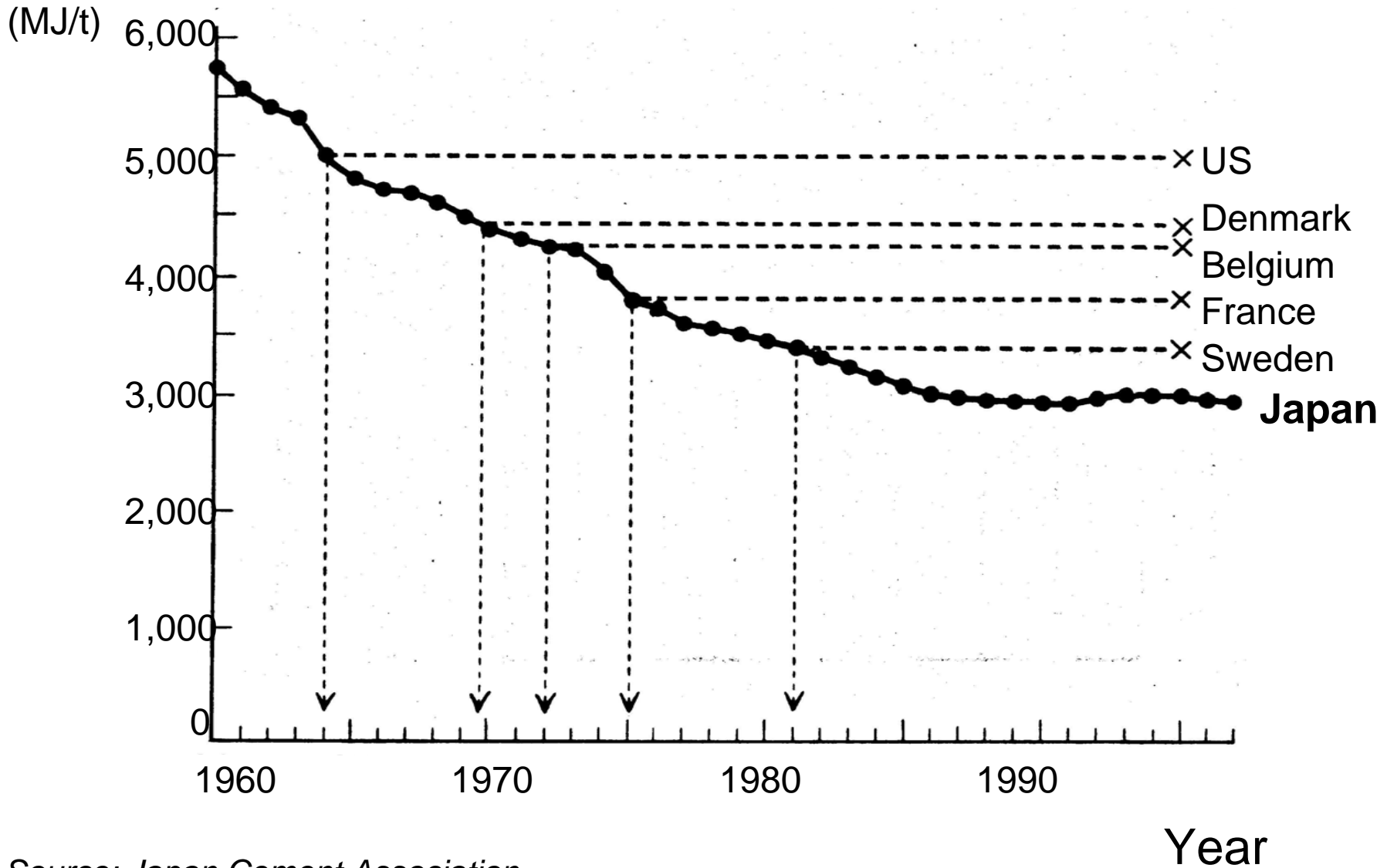
Japan at the Frontier of Emerging Problems

Advanced civilization crowds in high density



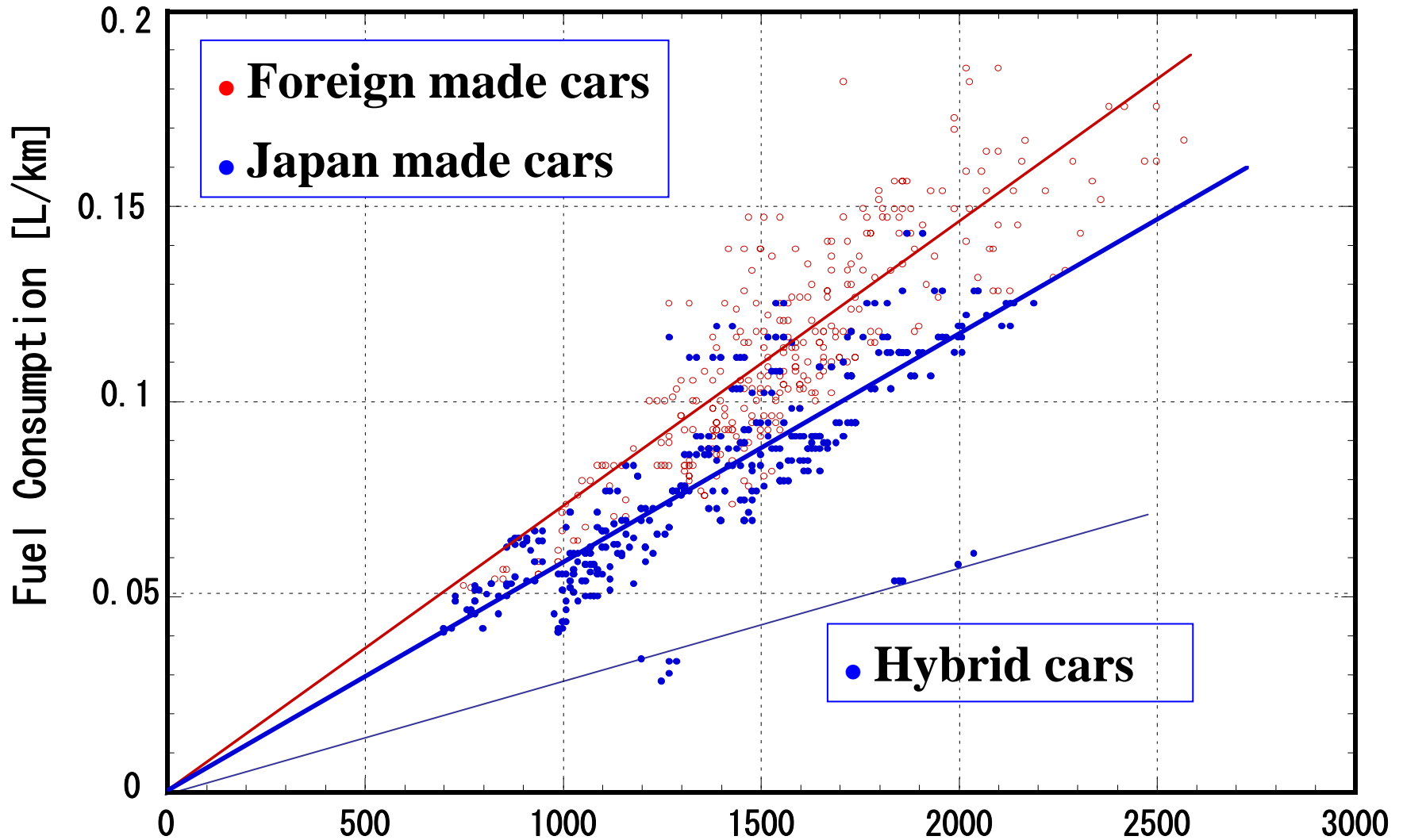
- **Heat island,**
- **Shortage of resources,**
- **Increasing waste,**
- **Environmental contamination,**
- **Aging society,**
- **Etc.**

Energy Consumption for Producing Cement



Source: Japan Cement Association

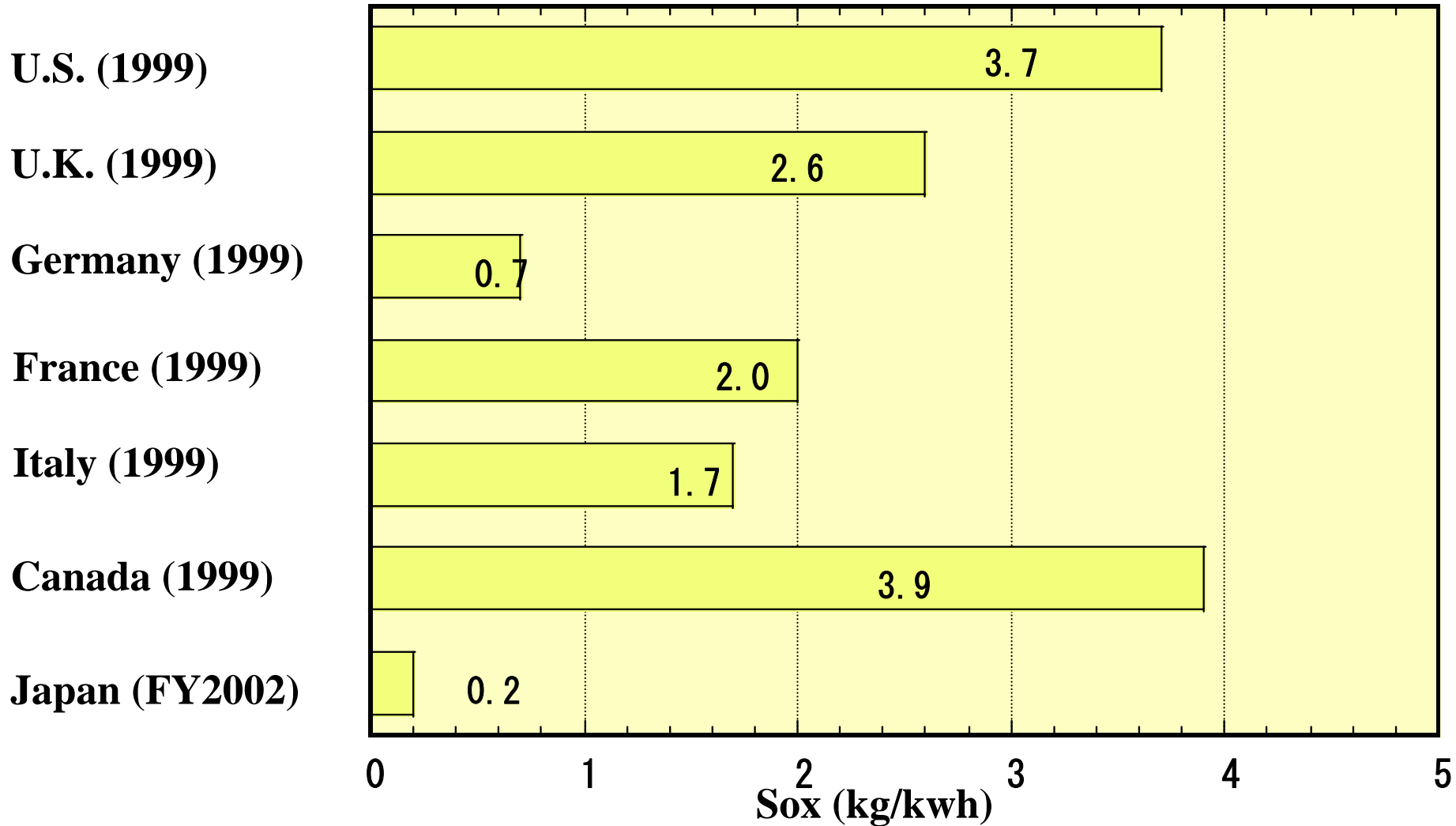
Automobile Fuel Consumption by Origin



Data Source: Yahoo! Japan Autos

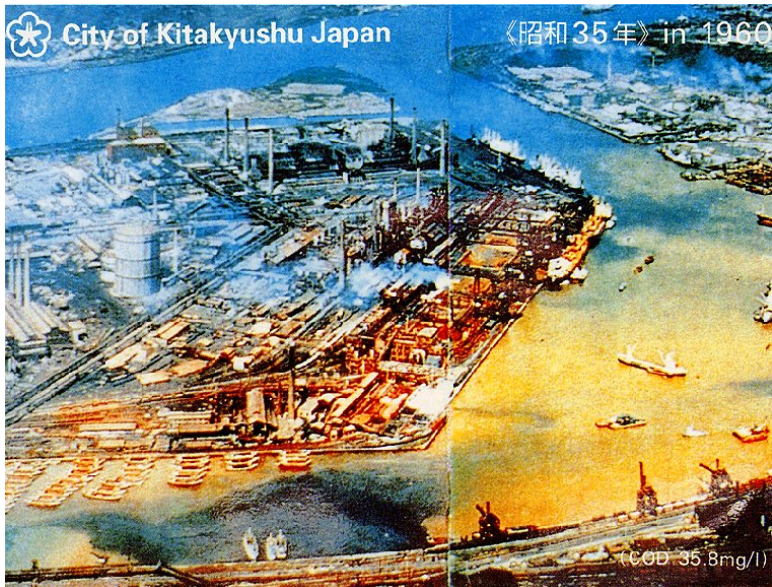
Vehicle Weight [kg]

Emission of Sulfur Oxides from Thermal Power Plants



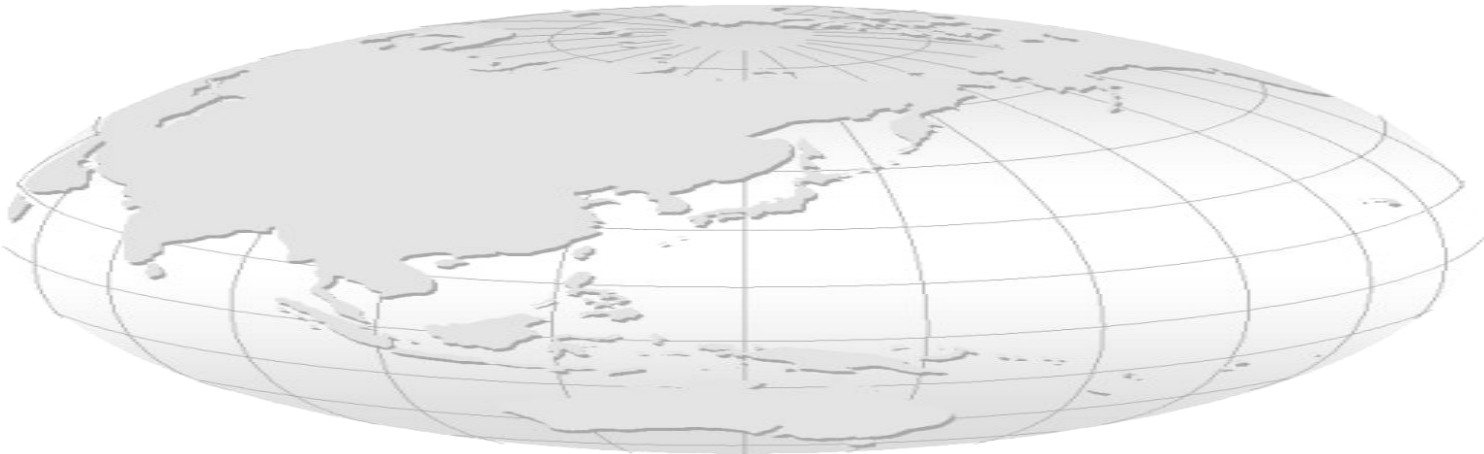
Data Source: Tokyo Electric Power Company, web-site


Overcome Environmental Problems in Kita-Kyusyu City



Japan at the Frontier of Emerging Issues

- Heat island
- Scarce resources
- Increasing waste
- Environmental contamination
- Aging society

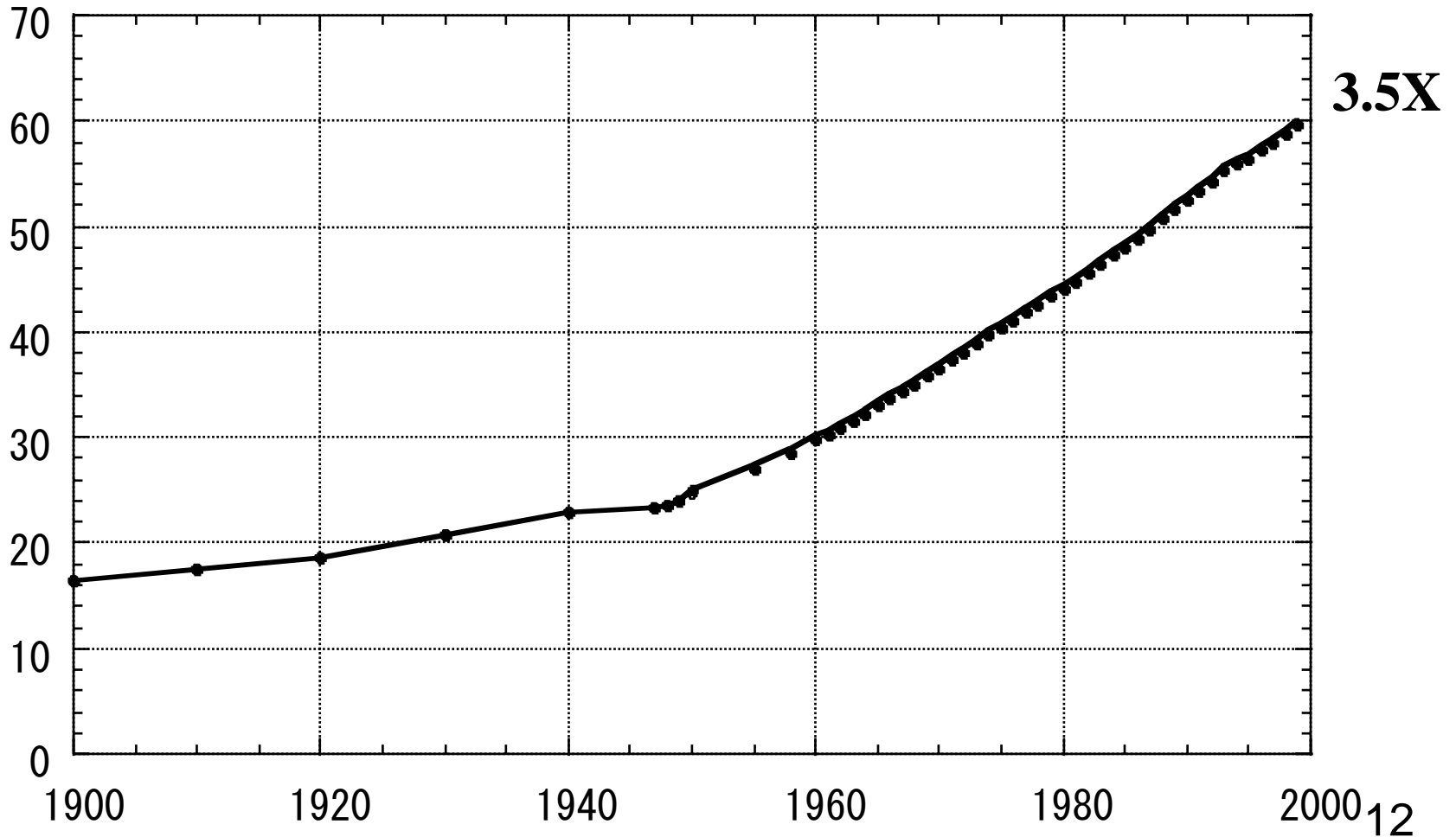




**The Explosive Expansion
in the 20th Century
and the Negative Legacy**

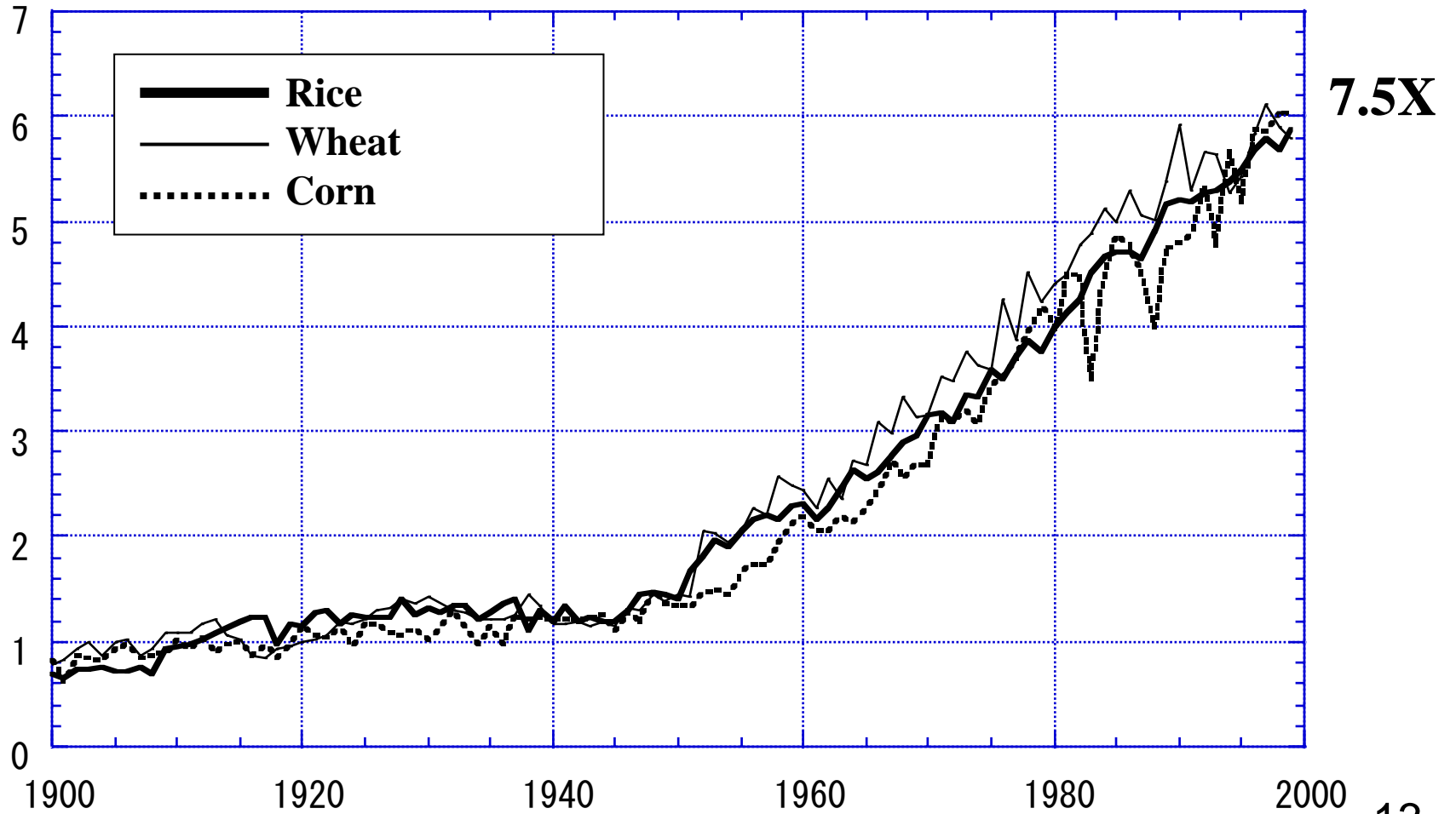
The World's Population

(10^8)



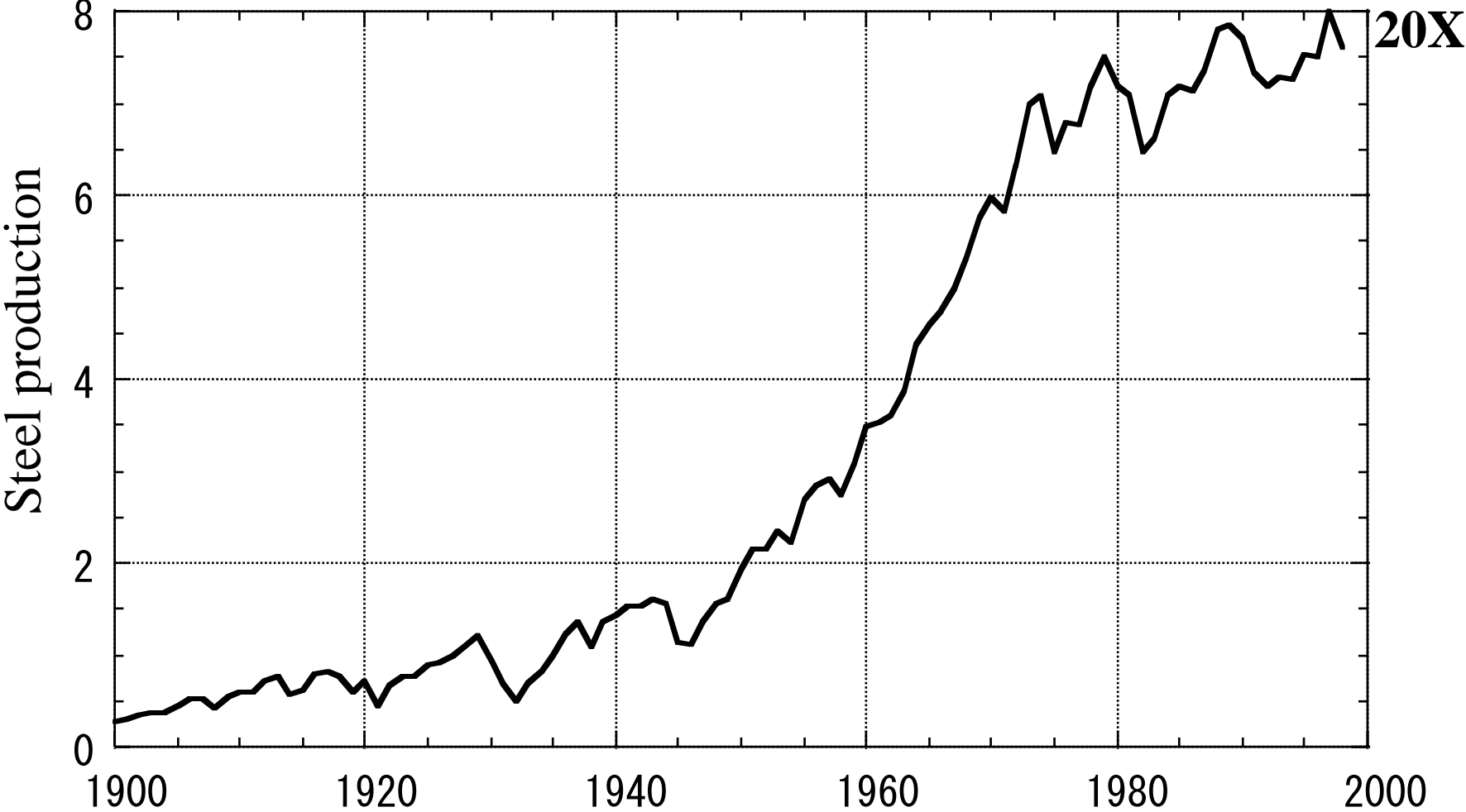
Major Crops

(10⁸t)

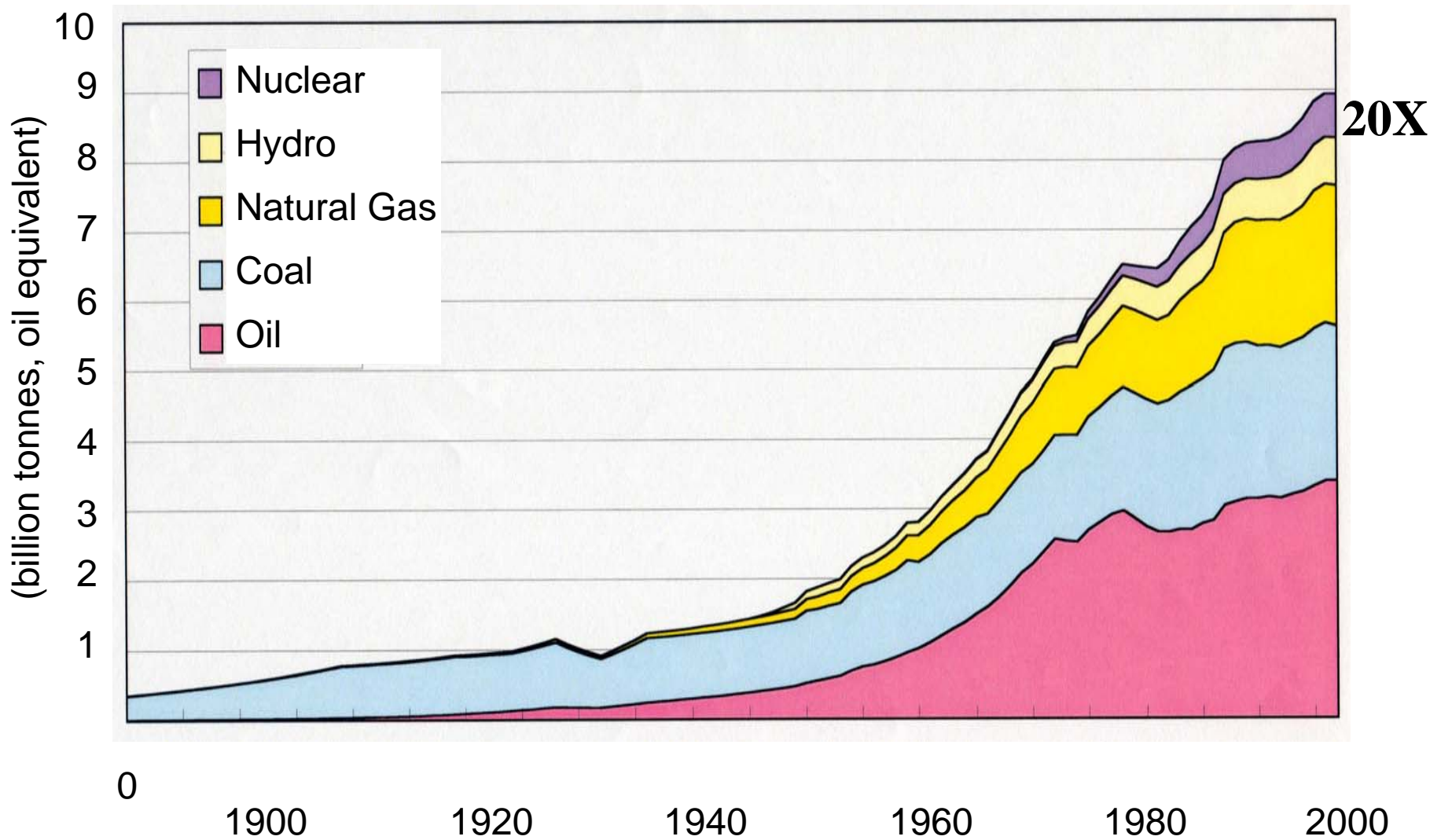


Steel Production

Hundred million tons/year



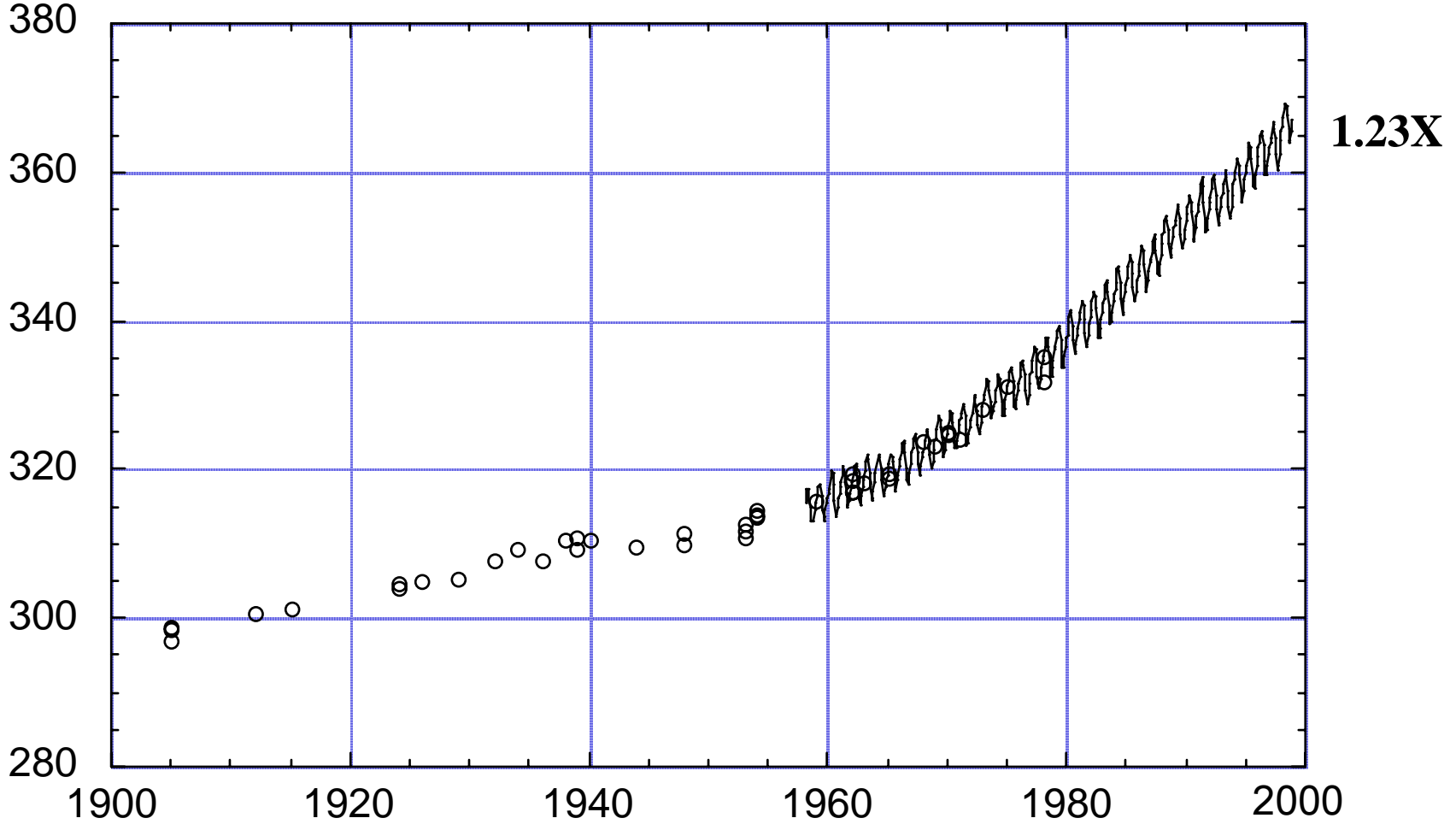
Energy Consumption



Sources: UN Statistical Yearbook, BP Statistical Review of the World Energy

CO₂ Level

(ppm)



Source: National Oceanic and Atmospheric Organization

Explosive Expansion of Knowledge in the 20th Century

1900

2000

Sun Light

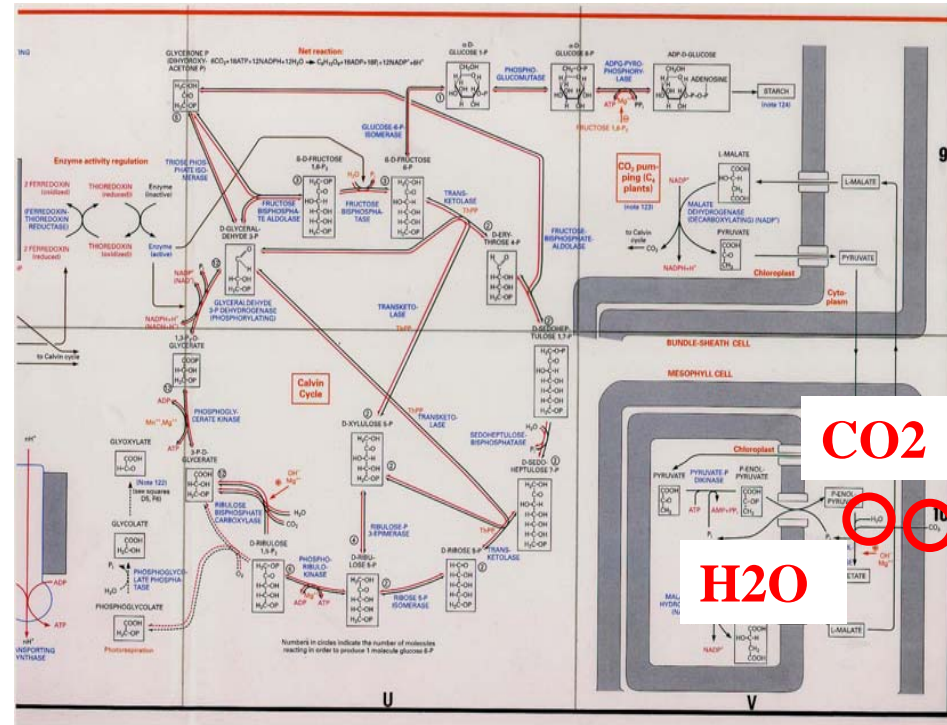
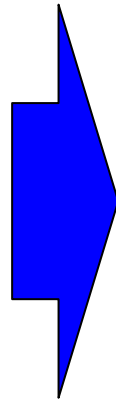
CO₂

H₂O

Chlorophyll

O₂

Carbohydrate



CO₂

H₂O

Lost in Complexity

Experiment on Re-Submission

12 Articles (Published in well known journals)

Only 3 out of 38 publishers/reviews recognized these are re-submitted

9 Articles survived

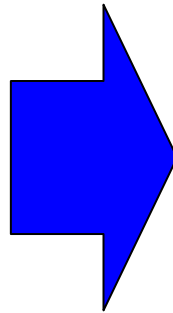
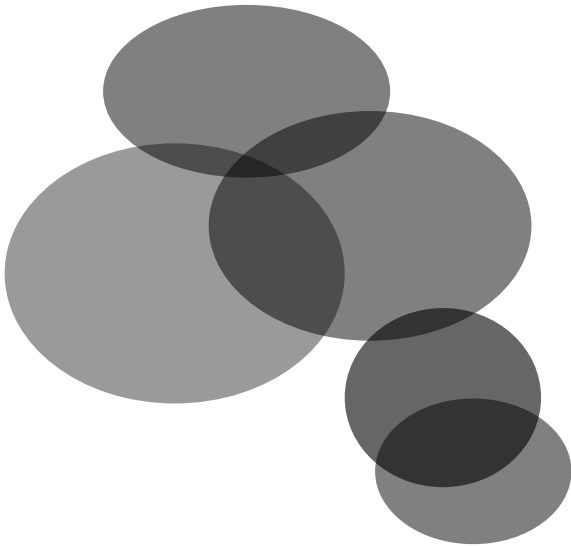
3 Articles (Recognized as re-submission)

1 Article
(Accepted again)

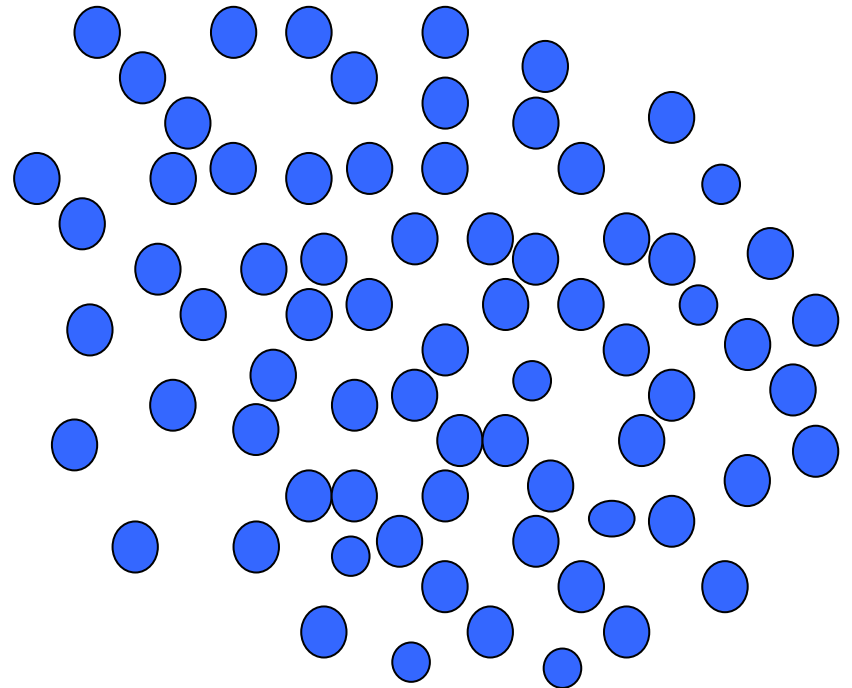
Peters DP, Ceci SJ. Peer-review practices of psychological journals: The fate of published articles, submitted again. *The Behavioral and Brain Science*, 1982.

Subdivision and Compartmentalization of Science

1900

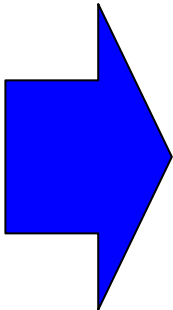
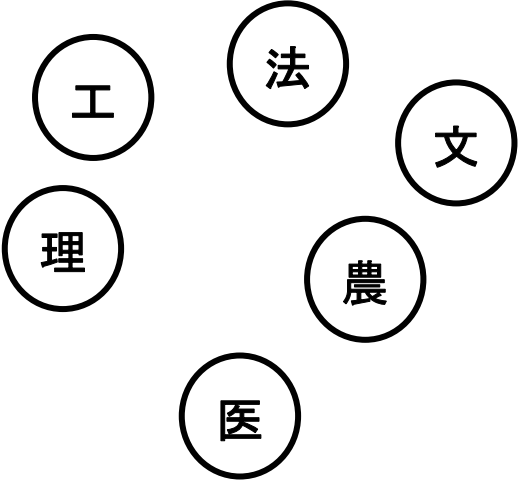


2000

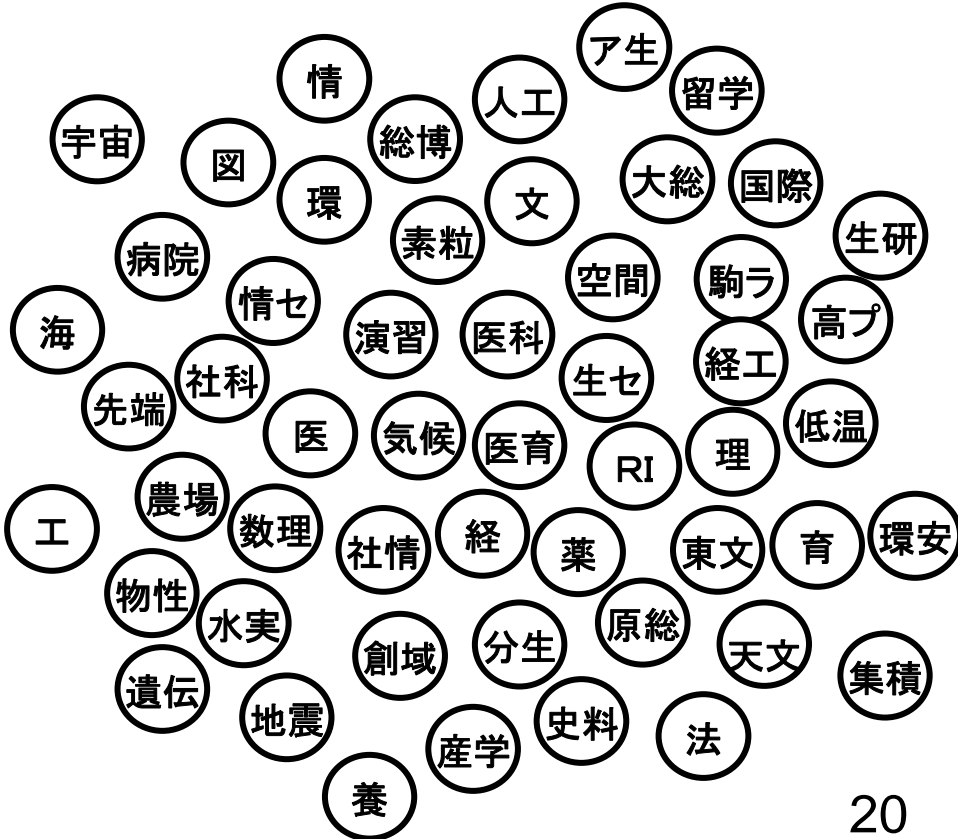


Subdivision of the University of Tokyo Organization

1900



2000



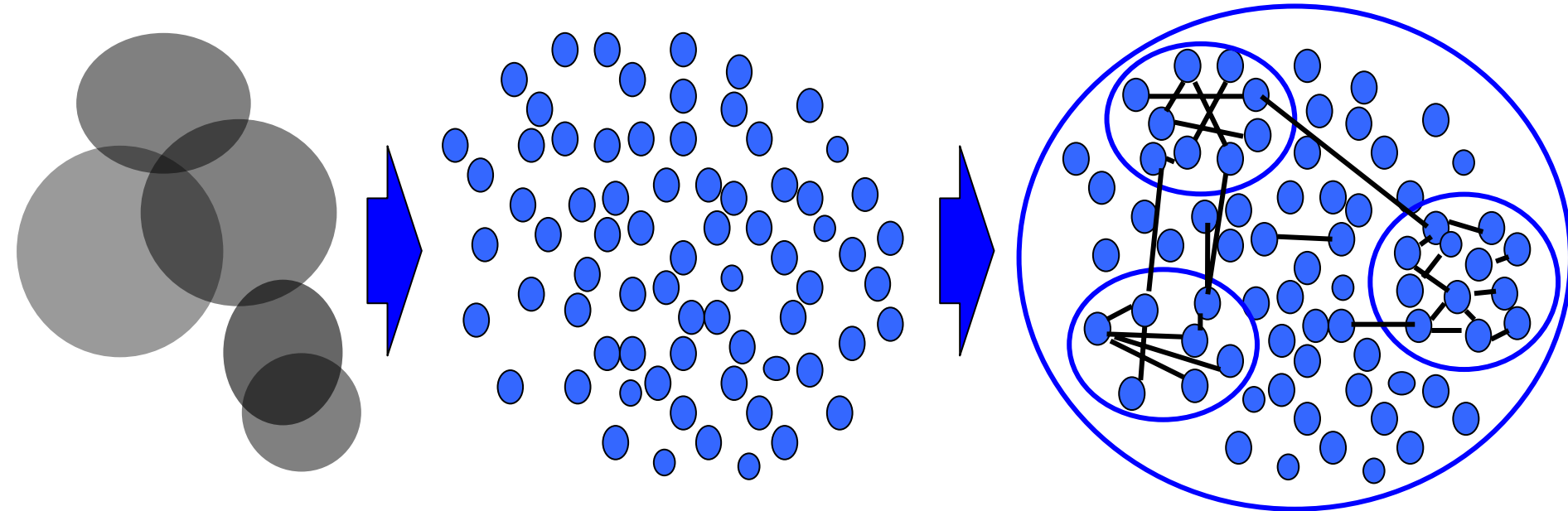


Structuring of Knowledge as an Answer

The Role of Universities

**Specialization
and
Subdivision**

Structuring



Science Integration Project

1. Human Simulation

genome \rightarrow human (\rightarrow society)

2. Material Simulation

atom \rightarrow material (\rightarrow artifacts)

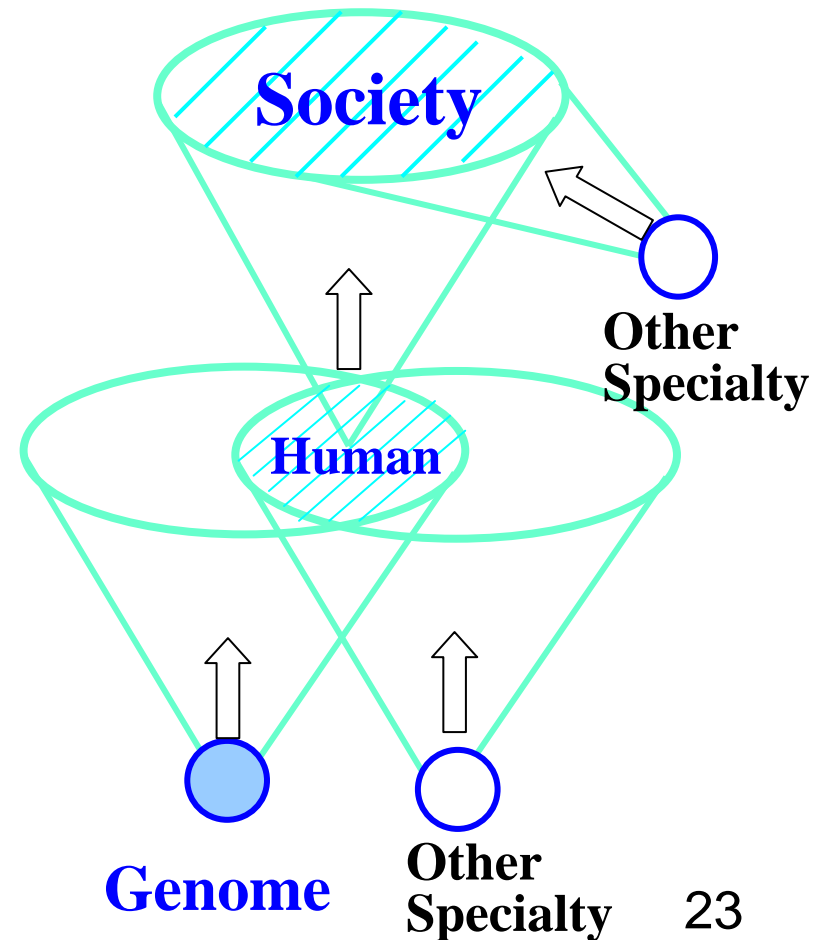
3. The Earth Simulation

material \rightarrow the earth

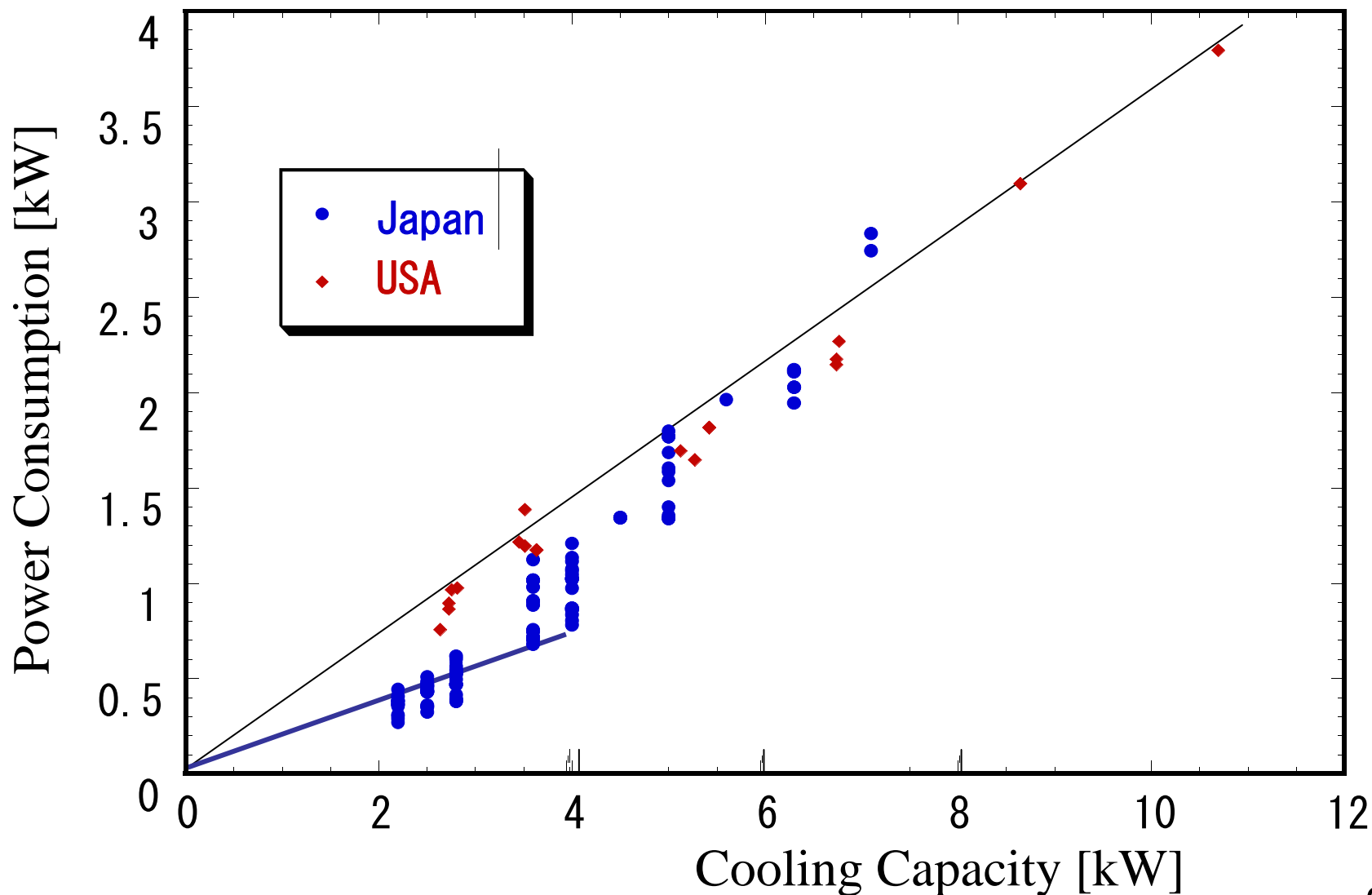
4. The Space Simulation

Big bang \rightarrow Future

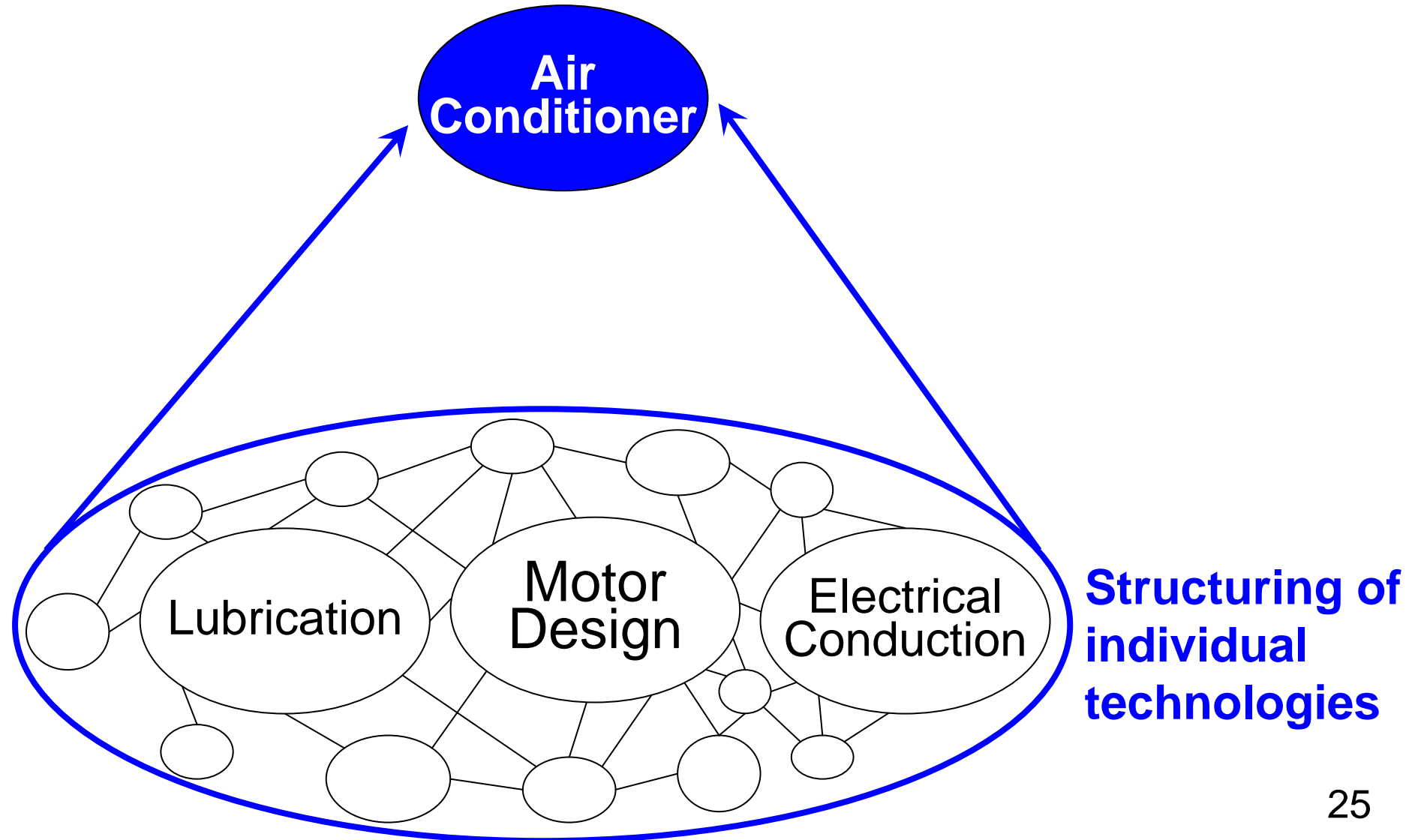
Integration



Air Conditioner Cooling Capacity vs. Energy Consumption



Structuring of Technologies for Air Conditioning



Monsoon Climate-suited Komiyama Eco-House

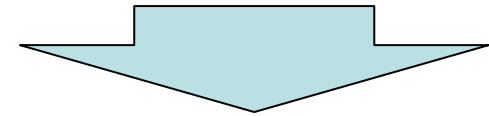


**Solar Cell System:
3.6 KW (Achieved 3.7kW)**

Hot Water System: $C_p=3$

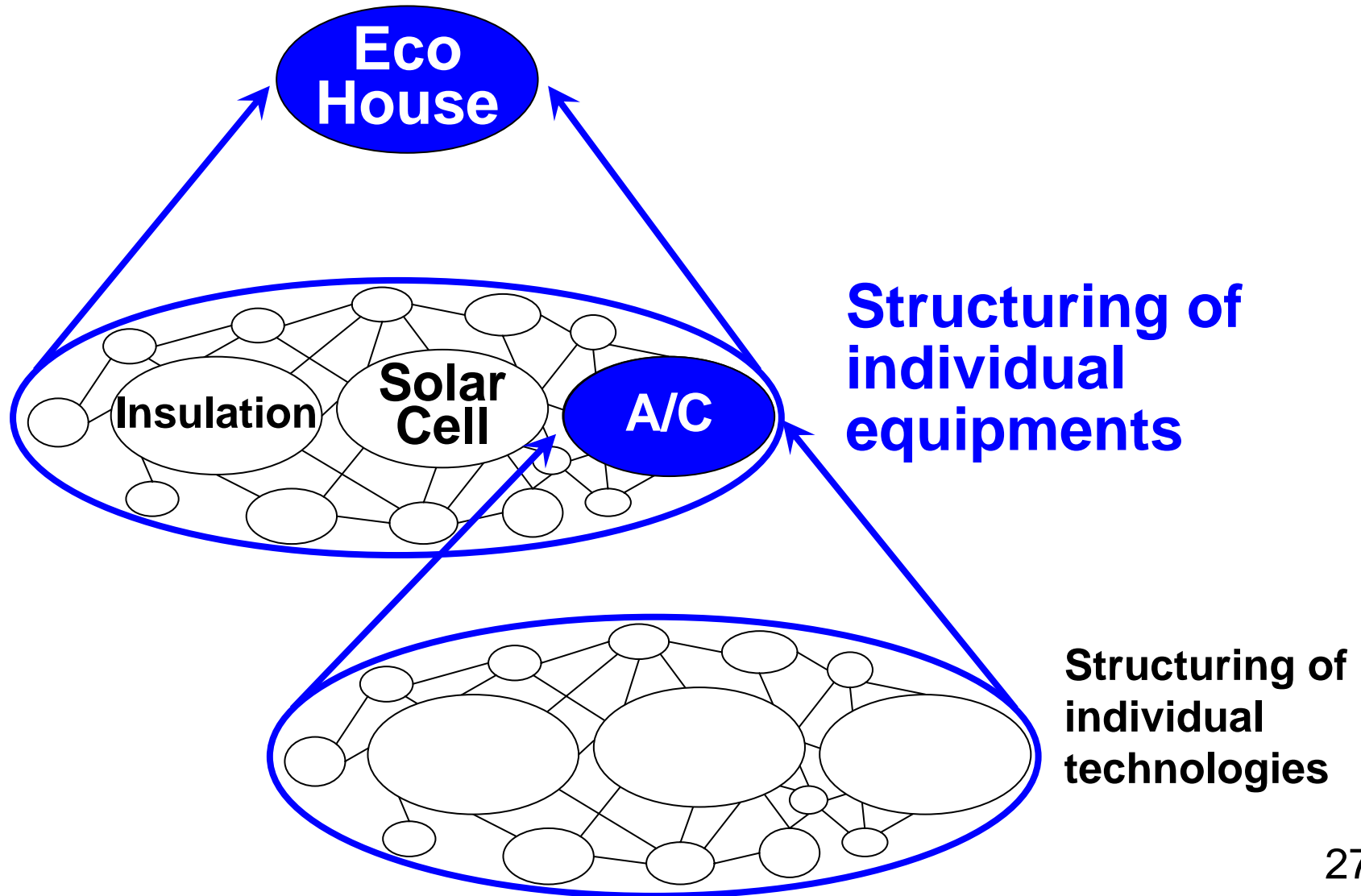
Insulation: $K=1.6 \text{ w/m}^2\text{K}$

Heat/Humidity Exchanger

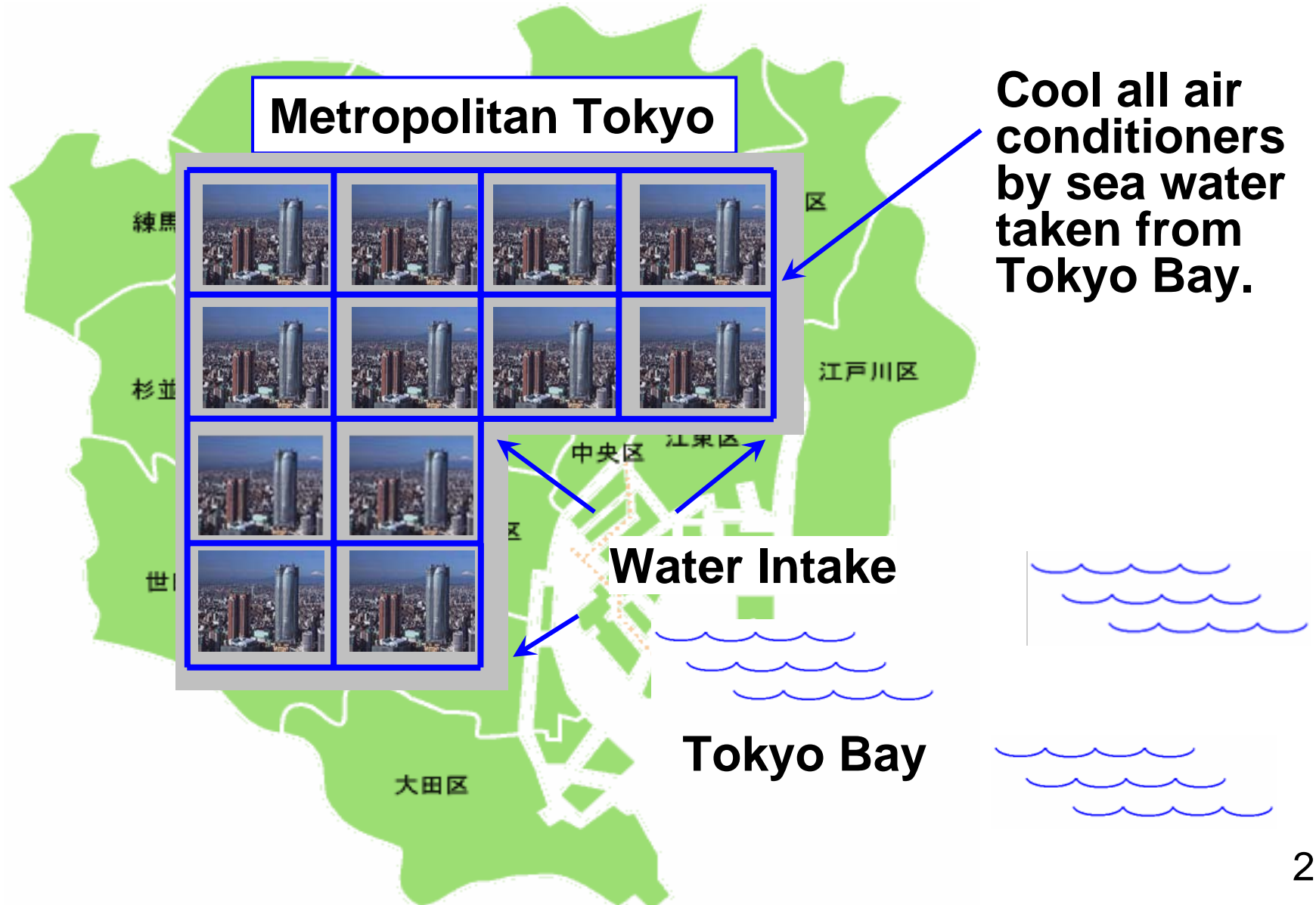


**Energy Self-Sufficiency
Rate: **55%****

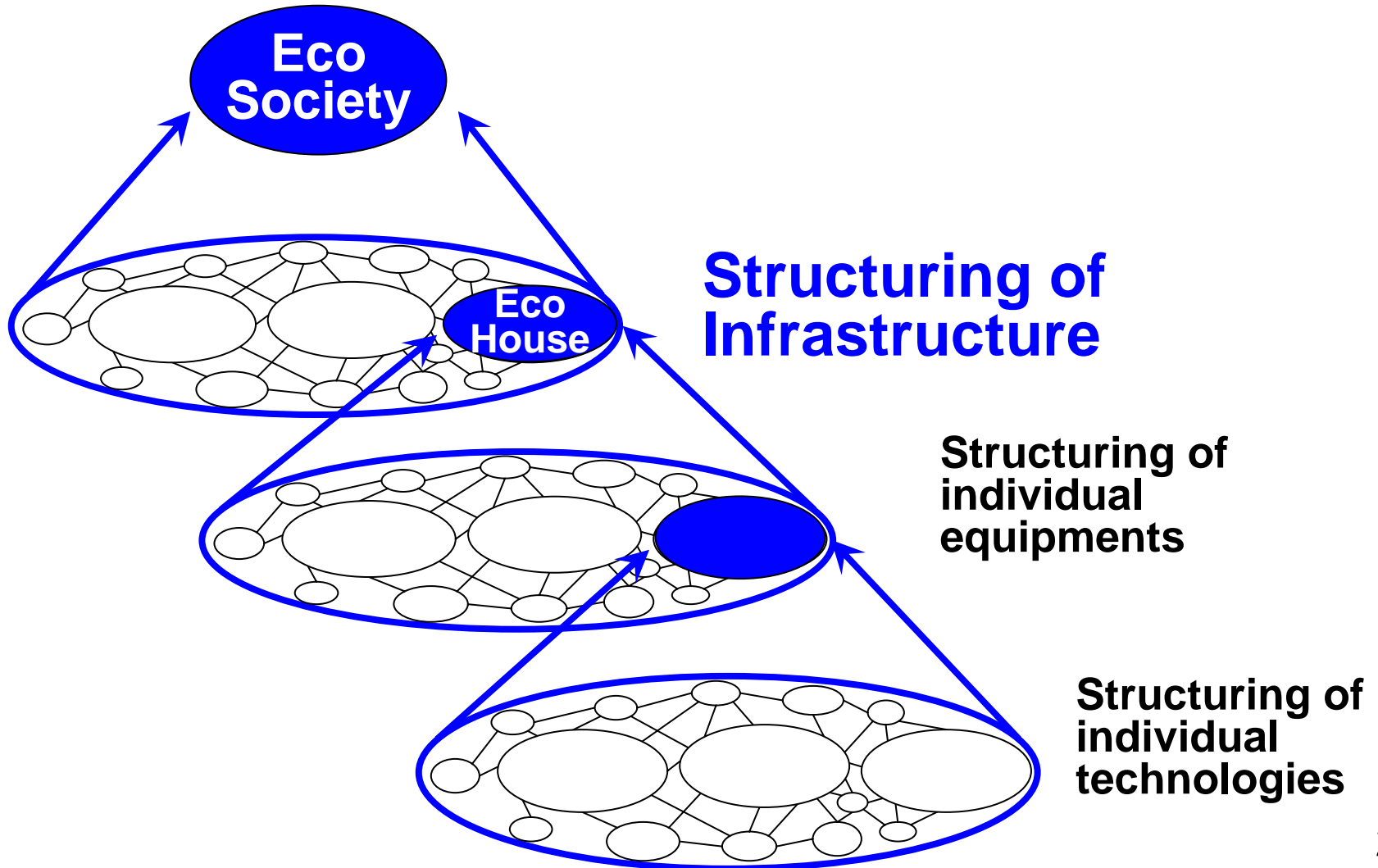
Structuring of Equipments and Devices for Eco House



Tokyo Waterbed Plan -- Curing the Heat island



Structuring of Infrastructure for Eco Society



IR3S

The objective of Sustainability Science

To clarify the mechanisms that are damaging the global, social and human systems and the linkages among them, and develop visions and policies for repairing and rebuilding these three systems and their linkages.

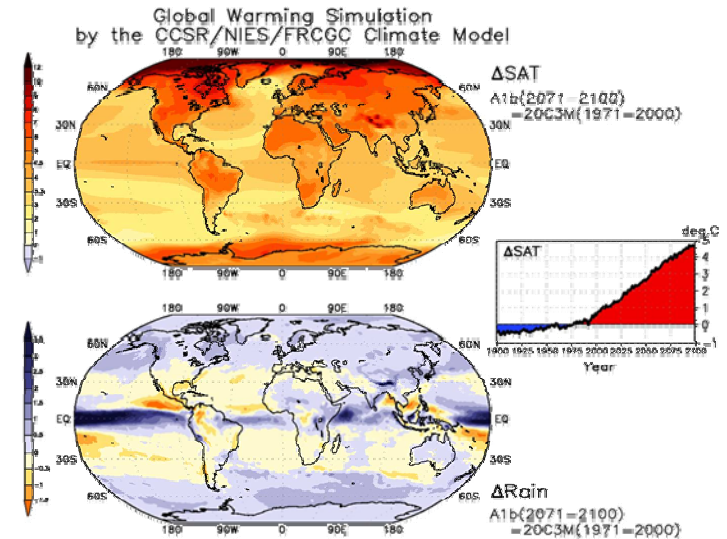


Global System

Atmosphere, Geosphere, Hydrosphere and Biosphere

- Climate Changes
- Depletion of Resources and Energies
- Damage to Eco-System

→ Threats to the human kind in the 21st Century



Social System

(Man-made structures: Politics, Economy, Industry)

- Economic Growth
 - Technological Innovation
 - Environmental Pollutions
 - Widening Disparities
 - Aging society with decreasing birth rate
- Reconstruct social infrastructure for sustainable life



Human System

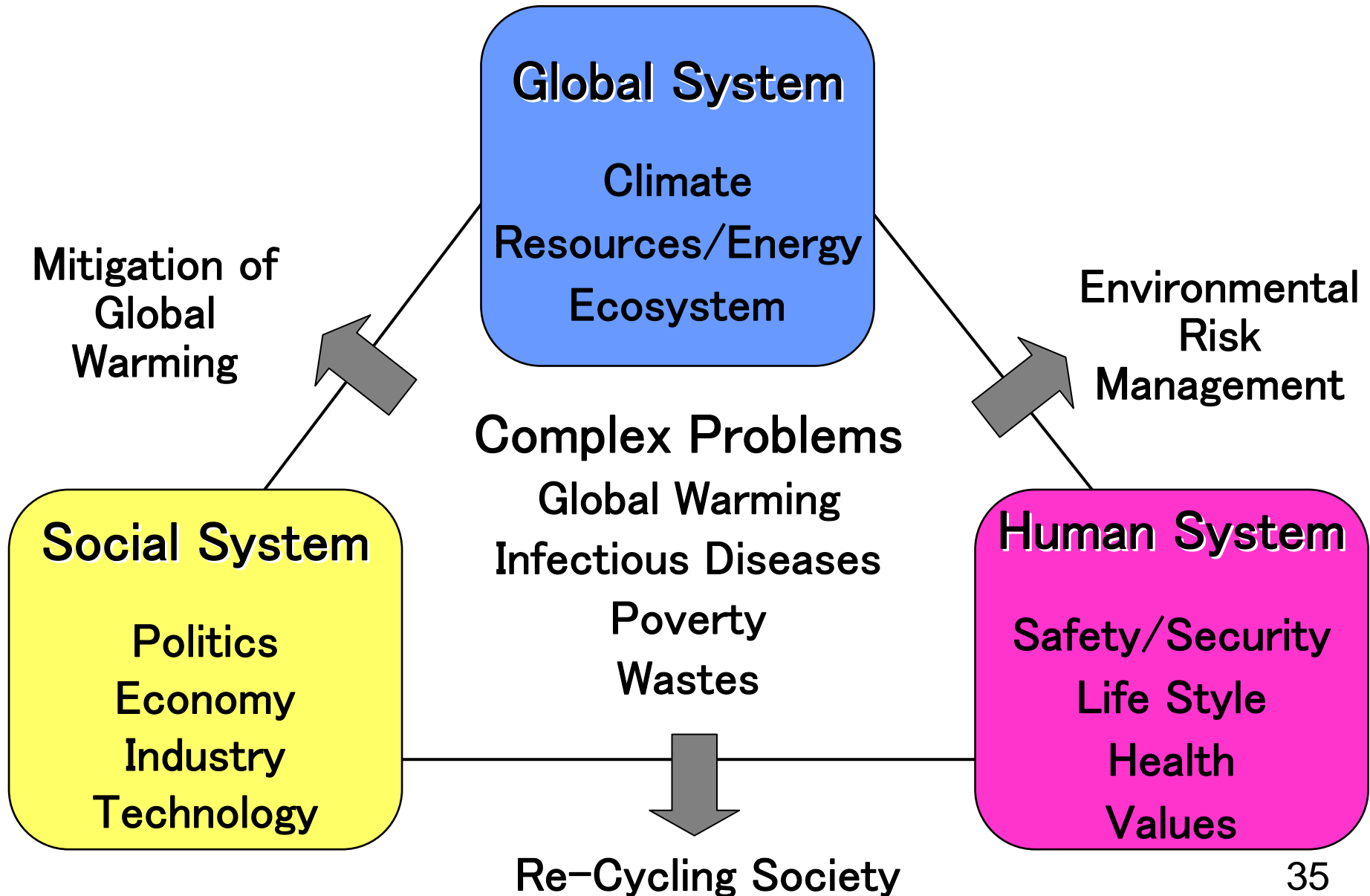
(Health, Safety, Security, life style, values)

- Threats to Safety/Security
- Health Problems
- Infectious Diseases
- Poverty
- Famine

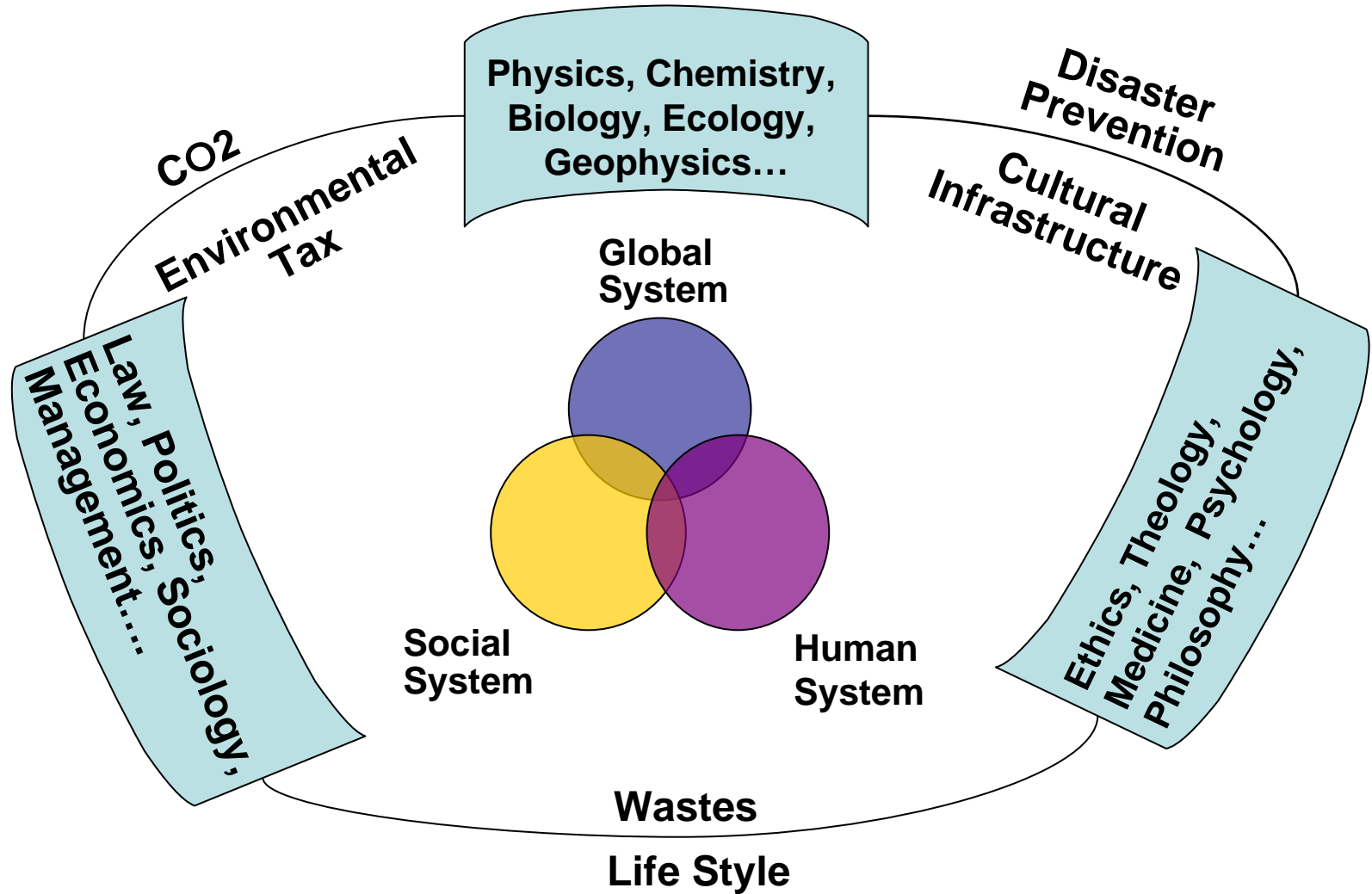
⇒ Realize safe and secure human life



Interactions among Three Systems



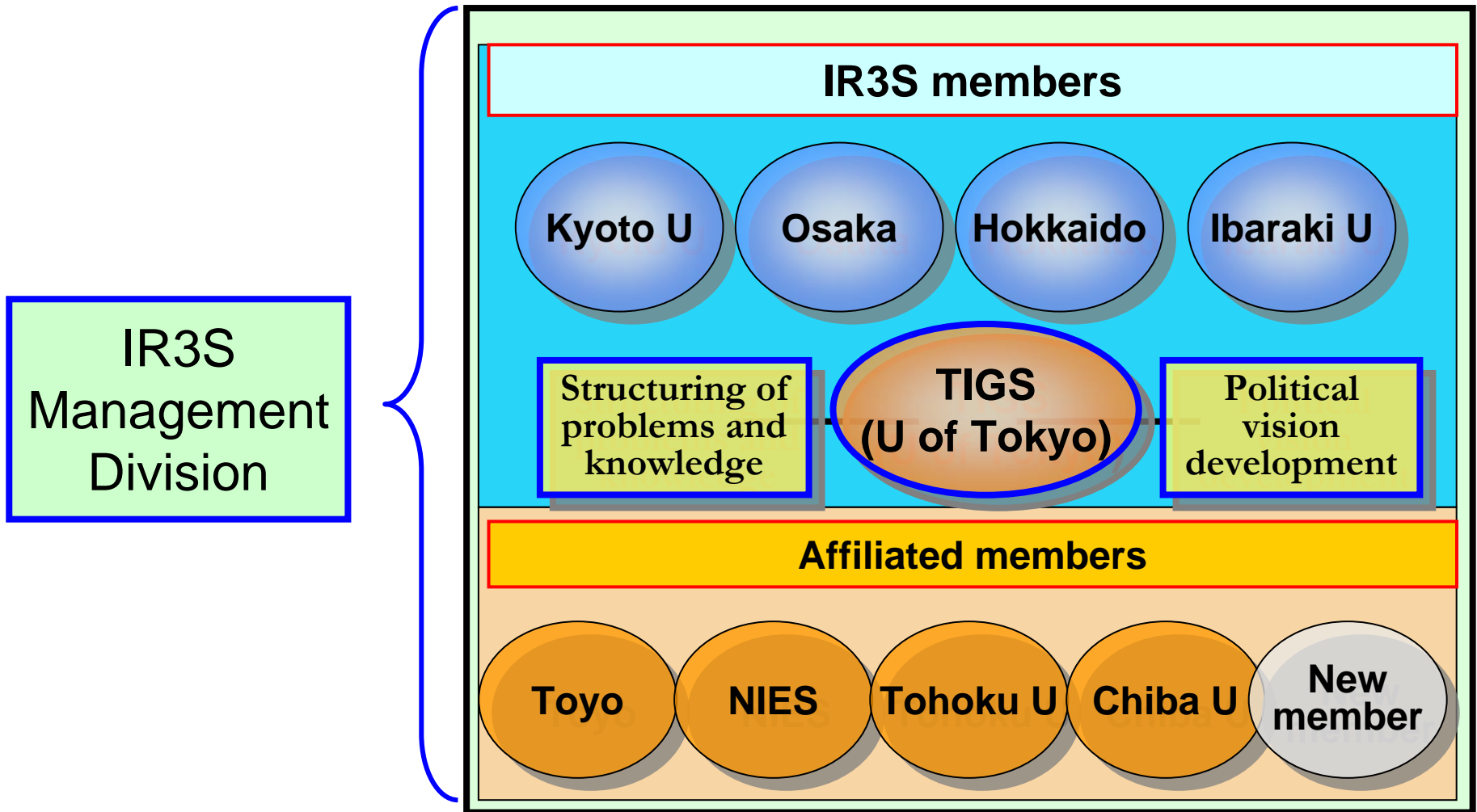
Transdisciplinary Approach



Sustainability Science:

- Stems natural and social sciences
- Link disciplines by standards and indexes

Integrated Research System for Sustainability Science (IR3S)



Global Collaboration

