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International Conference on Science and Technology for Sustainability
"Global Innovation Ecosystem"

Urgent Need for "Sustainability Development"

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Change in Environment of R&D in Science and Technology

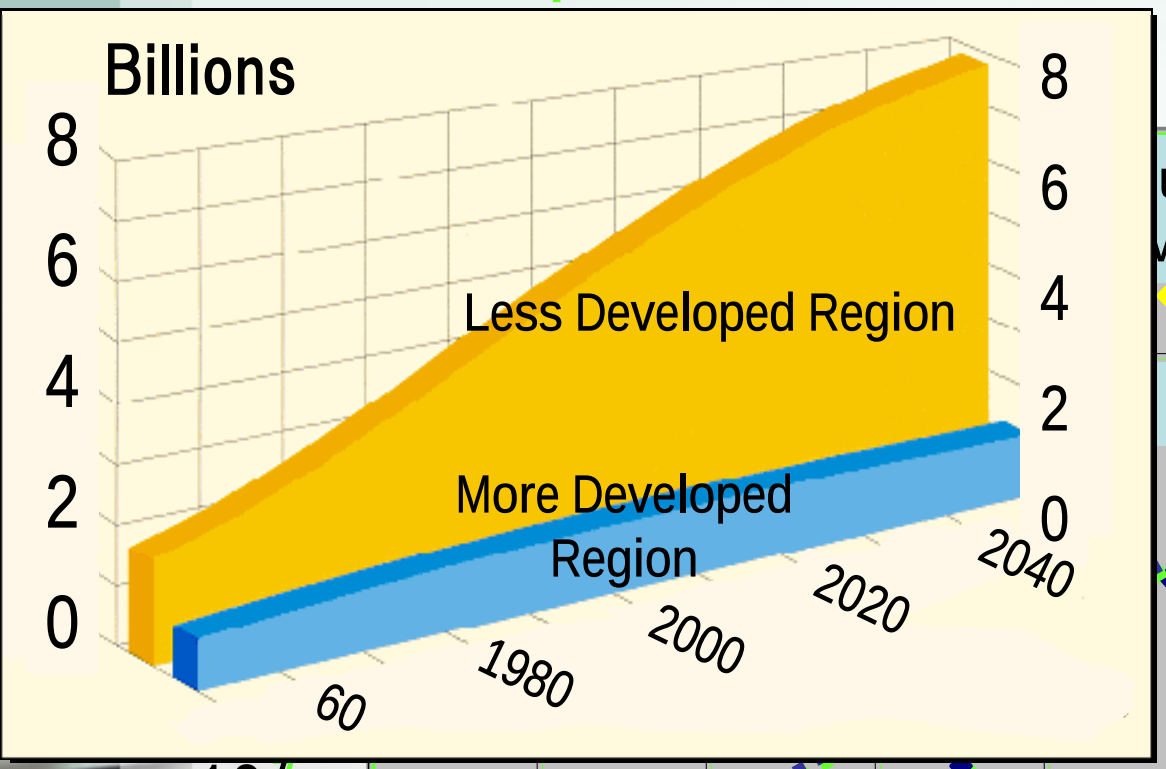
—Globalization and Role of Innovation—

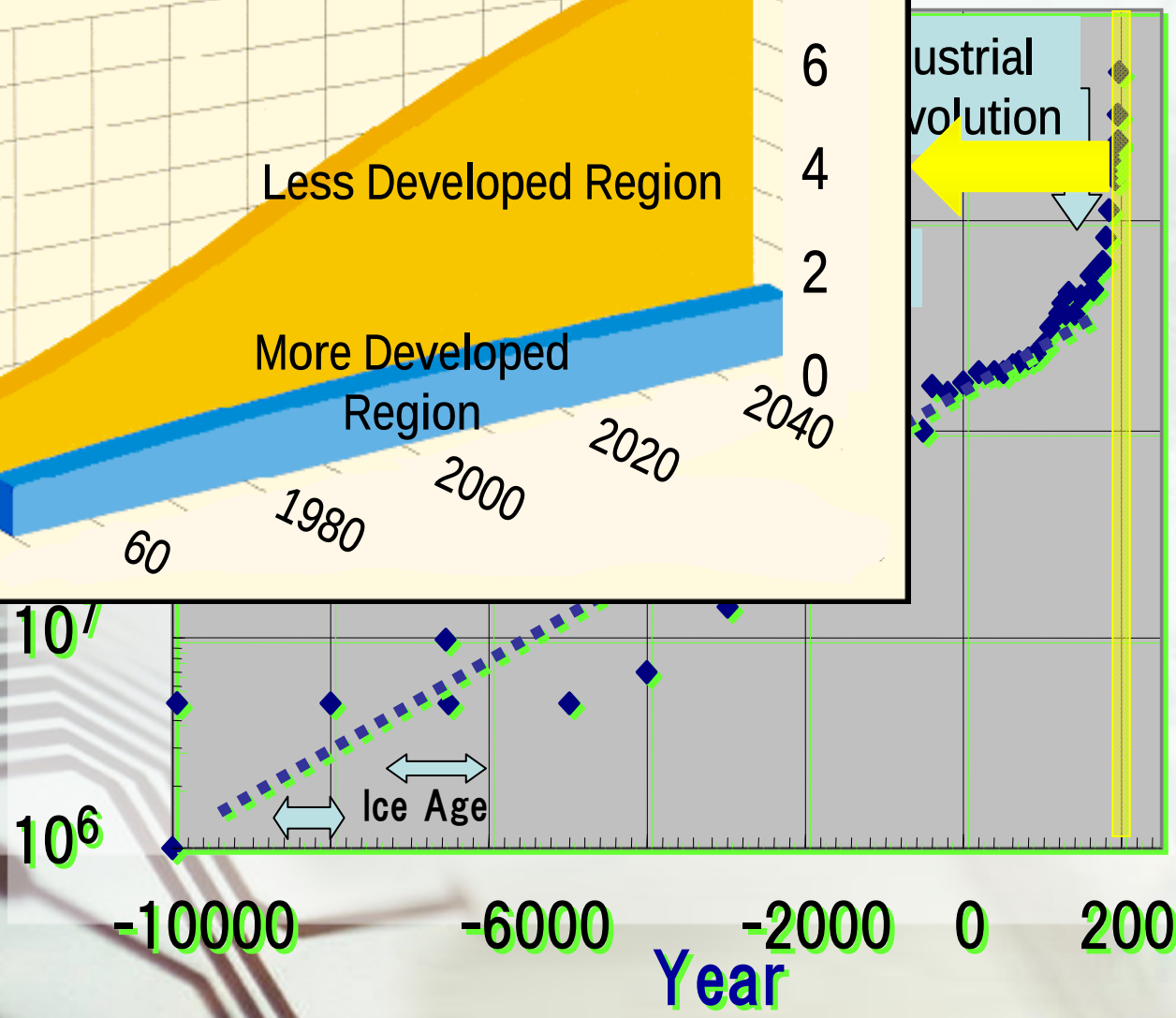
- Understanding of the Limited Capacities
  - Enlargement of science & technology and its outcomes
    - Population explosion and activation of human activities
  - Minimization of the Globe
    - Collapse of East-West dipole structure, Globalization of Market Economy
    - Diminishing information distances due to the progress of ICT technologies
    - Improved understandings of earth physical systems through climate change issues
- Paradigm shift is needed to cope with the limited capacities
- Science & Technology should contribute to finding a vision of sustainable human societies within finite capacities

Epochs of Human History

- Evolution of Man 5 million yrs. bp, Great Lift Valley
  - East Africa (Ethiopia)
  - Upright walking, tools, languages, use of fire (0.7 to 1.3mill yrs. bp)
- Evolution of Agriculture 8-10 thousand yrs. bp, Younger Dryas
  - Palestine, Mesopotamia, Nile Delta, Southeast Asia, China, etc.
  - Adoption of agriculture, stock-breeding, rice-farming, earthware, settlement
- Start of Cities 3.5-4 thousand yrs. bp
  - 4 Civilizations (Egypt, Sumer, Huang River, Indus River)
  - Irrigation, Industrialized Agriculture, Excess wealth, Division of labor, City walls)
- Outbreak of Sciences 17C Little Ice Age
  - Only in Europe
  - Descartes, Bacon, Newton, Boyle, Lavoisier, etc.
  - Mechanistic view of nature, Industrial Revolution (late 18C)
- Current Problems
  - Gigantic human activities, Finiteness of our environmental capacities

Population Trends on the Earth





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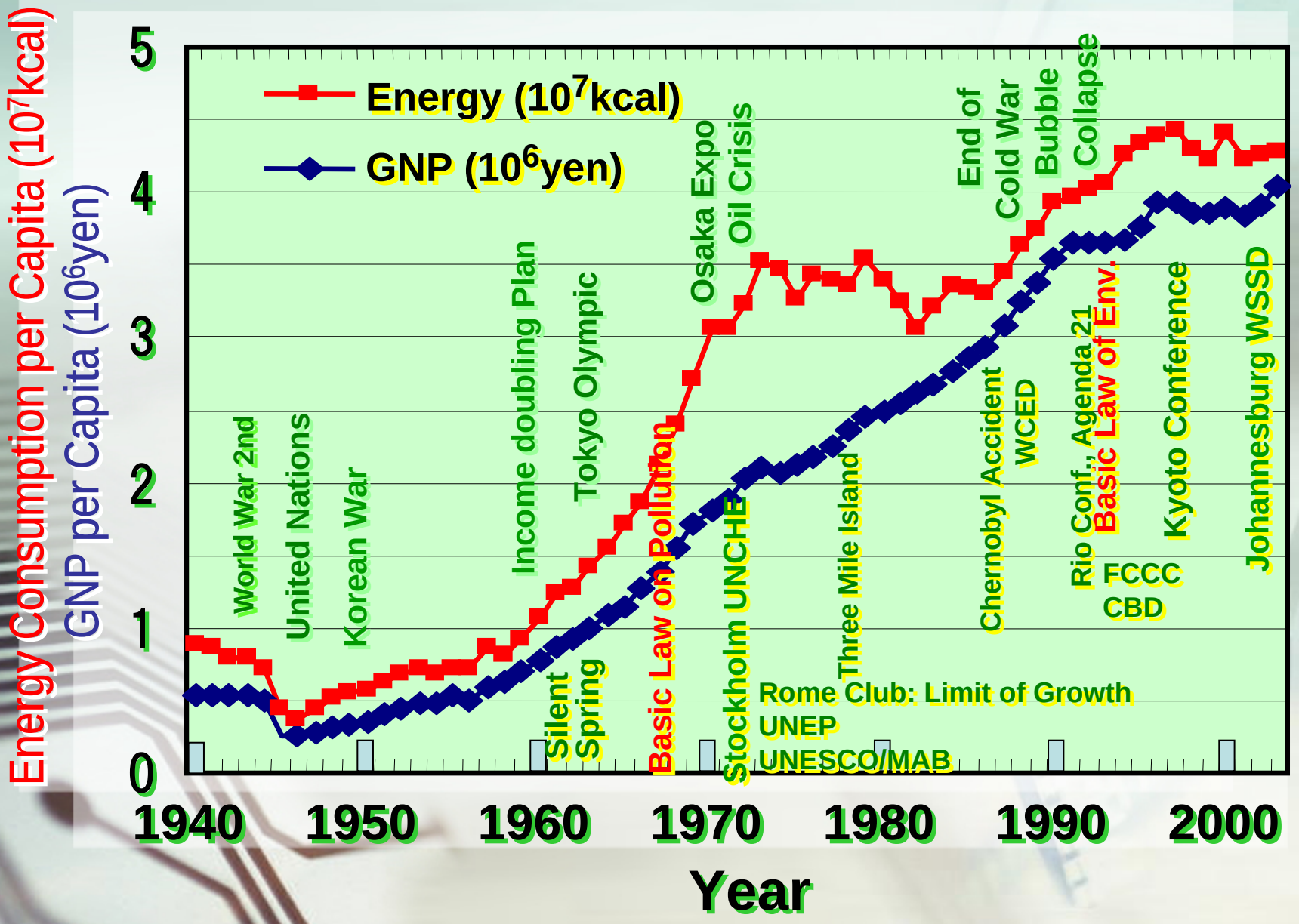
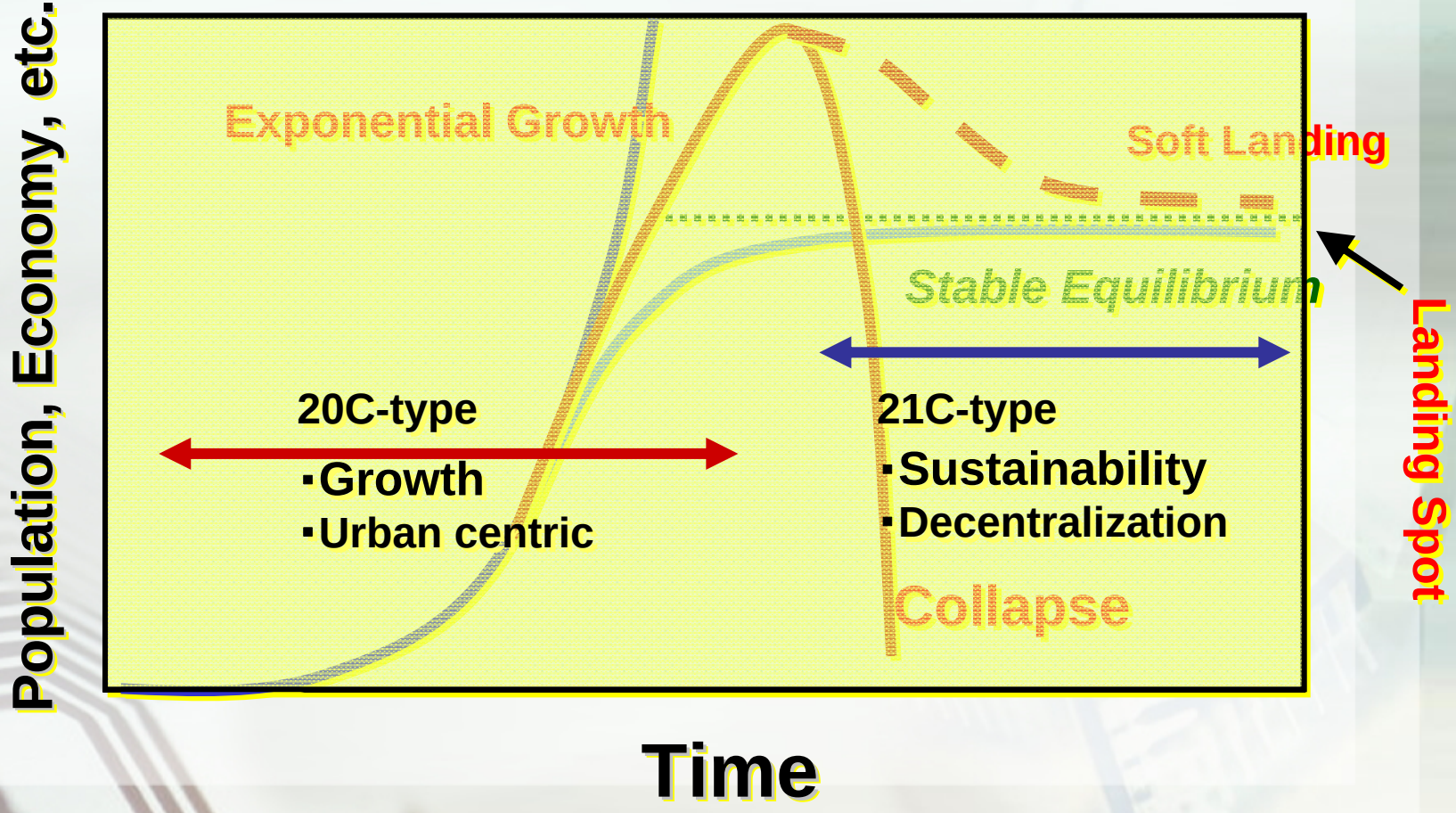
Past Development Patterns of Japan, 1940-



Typical Patterns of Growth



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Typical Components in Paradigm Shift

Growth Paradigm	⇒	Sustainability Paradigm
• Industry/Production		
Manufacturing	⇒	Service/Maintenance
Mass production	⇒	On-demand, appropriate
Labor productivity	⇒	Resources productivity
• Economy		
Material Flow Eco.	⇒	Stock centered, Service Eco.
• Environment		
End-of-pipe	⇒	Upstream, system revision
• Science & Technology		
Linear Model	⇒	Demand pull, social needs
• Policy Decision		
Differential	⇒	Integral/holistic
Projection	⇒	Back-casting

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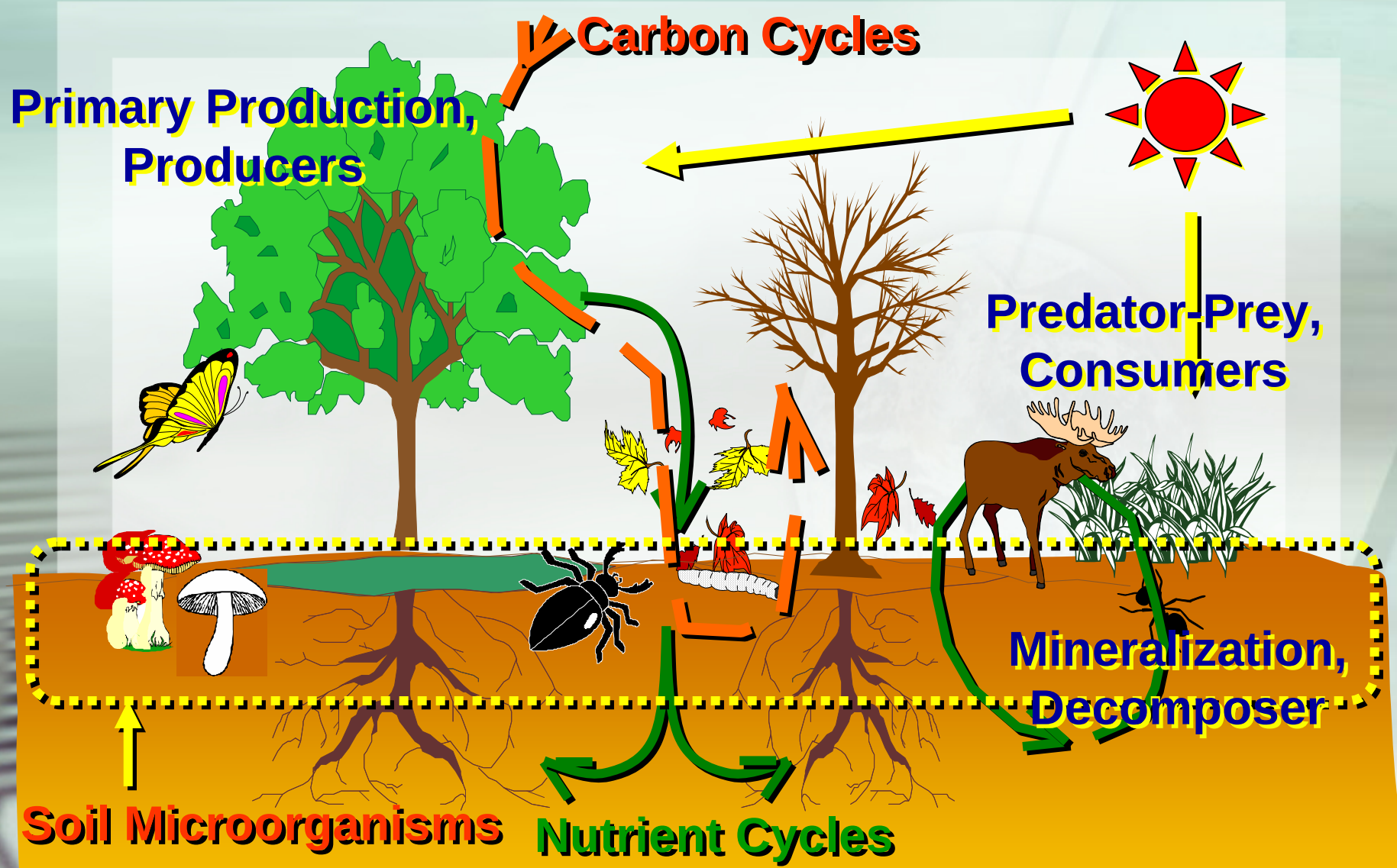
Landing Spot: where and how

- **Limits of resources/environmental capacities**
  - **Allowable amount of material resources utilization?**
  - **Allowable amount of energy utilization?**
  - **Allowable amount of environmental load?**
- **Establishment of Vision on "Sustainable Human Activities"**
  - **Vision-pull (back-casting) policy making needed.**
    - **What is "Dematerialization"?**
    - **What is "Low Carbon Society"?**
    - **What type of Economy Mechanism can carry "Sustainability"?**

An Example of R&D Targets of Japan

- **Climate Emergency**
  - **Heiligendam G8 agreement: Reduce carbon emission from human activities on the earth 50% by 2050.**
    - **Total emission at present, 7.2 billion tonC must be reduced by half by 2050 when population may be 9.2 billion on the earth.**
- **Systematic R&D schedule for reducing carbon emission from 2.5(current) to 0.4 ton/capita/year by 2050**

Natural Ecosystem at a Glance



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What is “Ecosystem”?

- A functional unit consisting of all the living organisms (plants, animals, and microbes) in a given area, and all the non-living physical and chemical factors of their environment, linked together through nutrient cycling and energy flow.
- Living organisms are continually engaged in a set of relationships with every other element constituting the environment in which they exist.

Natural Ecosystem

- Driving Force of a Functional System: Energy
  - Photosynthesis driven by solar energy (UV)
  - Energy conversion through Food Web
    - Structure of ecosystem, material flows
  - Radiation of thermal energy toward cosmic space
- Material Cycles in a Functional System: Carbon balance, Nutrient cycles
  - Primary producers/consumers/decomposers
- Components: Variety of Living Things and Inorganic Environment
  - Five Kingdoms

Five Kingdoms of Life

- **Kingdom Animalia**
  - **32 divisions, 1,000,000 species**
  - **Multicellular animals, without cell walls and without photosynthetic pigments, forming diploid blastula.**
- **Kingdom Plantae**
  - **9 divisions, 250,000 species**
  - **Haplo-diploid life cycles, mostly autotrophic, retaining embryo within female sex organ on parent plant.**
- **Kingdom Fungi**
  - **5 divisions, 100,000 species**
  - **Haploid and dikaryotic (binucleate) cells, multicellular, generally heterotrophic, without cilia and eukaryotic (9 + 2) flagella (undulipodia).**
- **Kingdom Protista**
  - **27 divisions, 250,000 species**
  - **Unicellular protozoans and unicellular & multicellular (macroscopic) algae with 9 + 2 cilia and flagella (called undulipodia).**
- **Kingdom Monera**
  - **16 divisions, 10,000 species**
  - **Unicellular and colonial--including the true bacteria (eubacteria) and cyanobacteria (blue-green algae).**

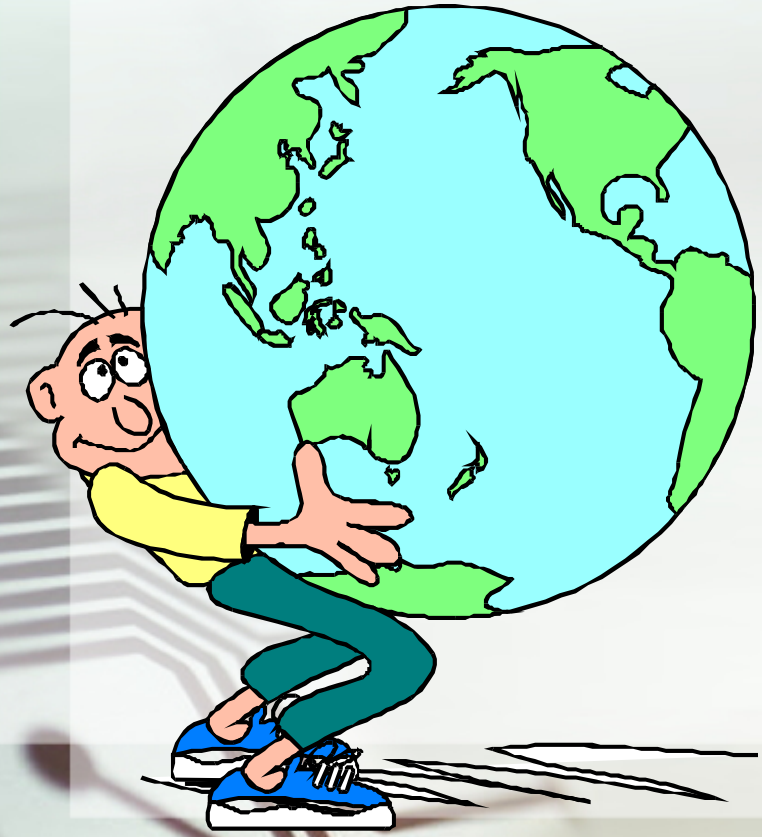
Behavior of Living Species

- Structure of ecosystems are spontaneously determined through interactions among component species
- Predator-prey relations
- Symbiosis and Competition
- Symbiosis among various species
  - Mutualism (+,+)
  - Commensalism (+,0)
  - Amensalism (-,0)
  - Antagonism, parasitism, predation (+, -)
- Importance of Biodiversity

“Innovation ecosystem”?

- System components such as living things?
  - State, organization, group, researcher, citizens
  - What are interactions among components? Symbiosis and competition
- Driving force such as Energy?
  - Money, pressure, or will?
  - Money may be the only one conserved.
- Material Flows?
  - Information, intellectual properties
  - Hard to consider continuity of information etc.
- Spontaneous structurization?
  - Pursuit of Company-profit, national profit or personal profit.
  - Hard to convert an Ego-system to an Eco-system

"Innovation for Ego" System to "Innovation to cope with Eco-limit" System



Thank you

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