JST Green Innovation Symposium

Common Desire to Green Innovation and Sustainable Development

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National Natural Science Foundation of China (NSFC)

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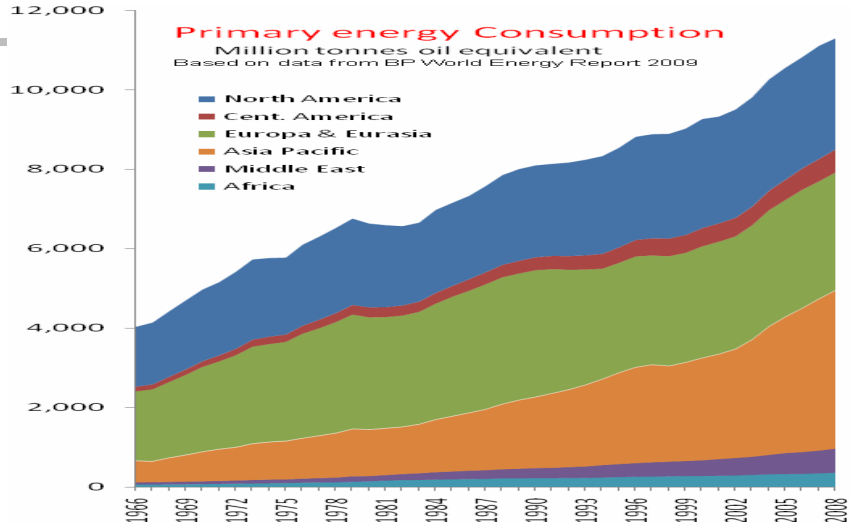
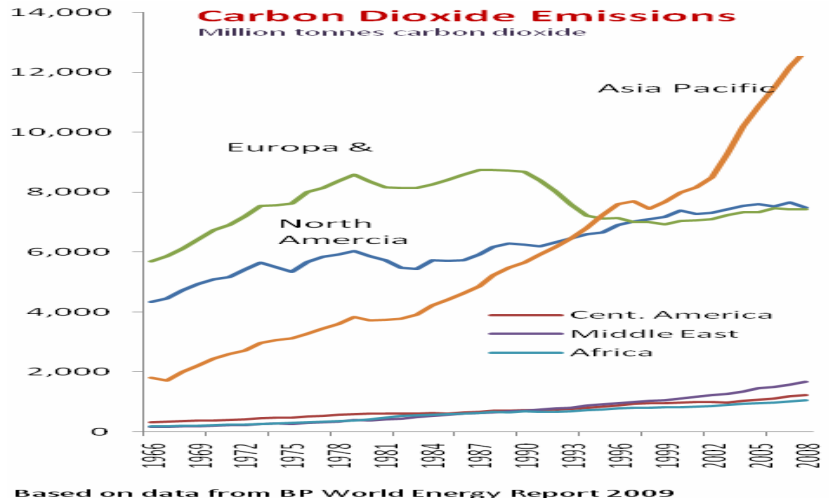
The challenge for better living and future

- We live in the same earth. Good environment and sustainable development is our common desire.
- Climate change influences all countries, depending on natural conditions and development situations.
- Besides great contributions of natural factors, human activities and burning of fossil fuels are key factors to environment and climate change.
- Climate change is a complex system. It needs more scientific researches and technology innovations.

The world total energy consumption and GHG emissions still raise in recent years, which influence global climate and threat future energy security.

- There are historical accumulation and nowadays consumption.
- Developed areas have big and steady amount of energy demand and CO2 emission.
- Some developing areas (such as Asia pacific) have significant increasing amount of energy consumption and CO2 emission. They play more and more important roles in the world.

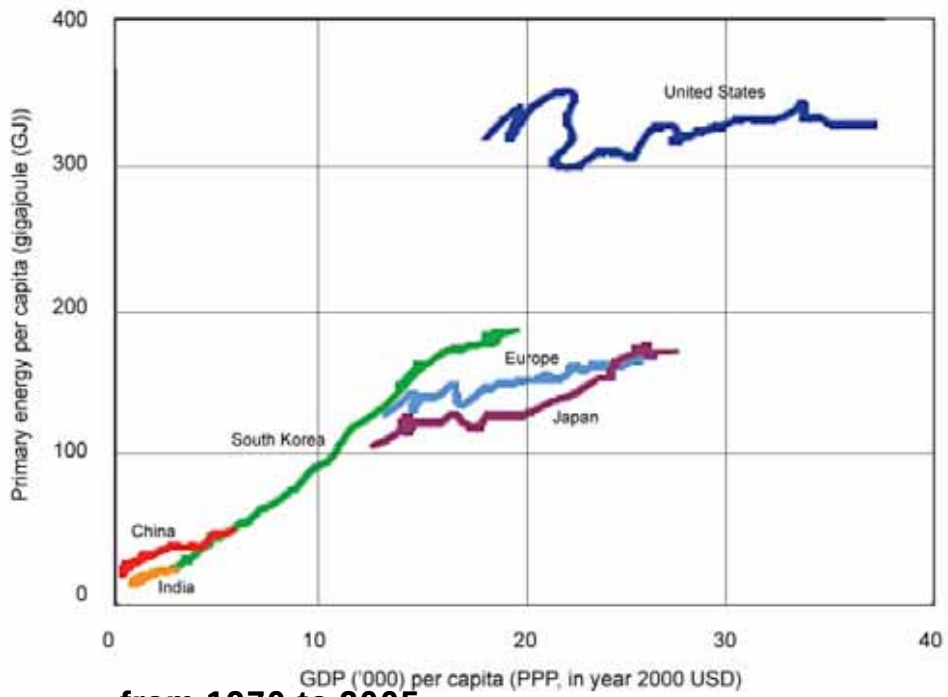




Energy pattern is linked with economy condition

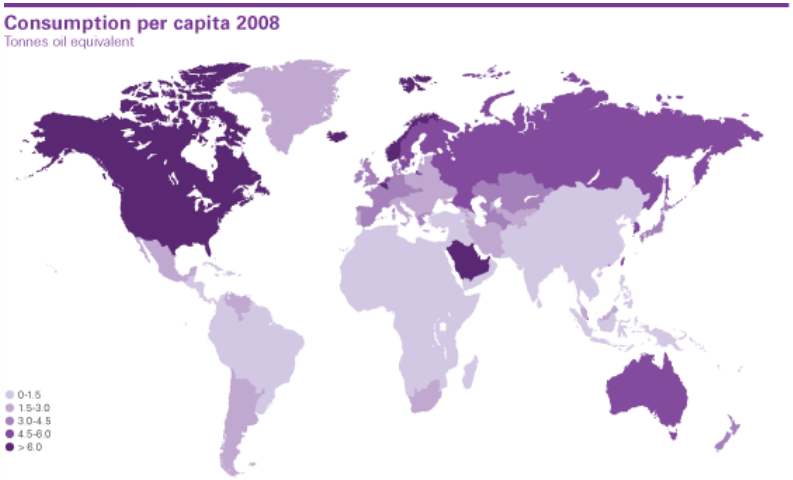
--- the need for basic living and requirement for better live

World Energy Council 2009
World Energy and Climate Policy: 2009 Assessments



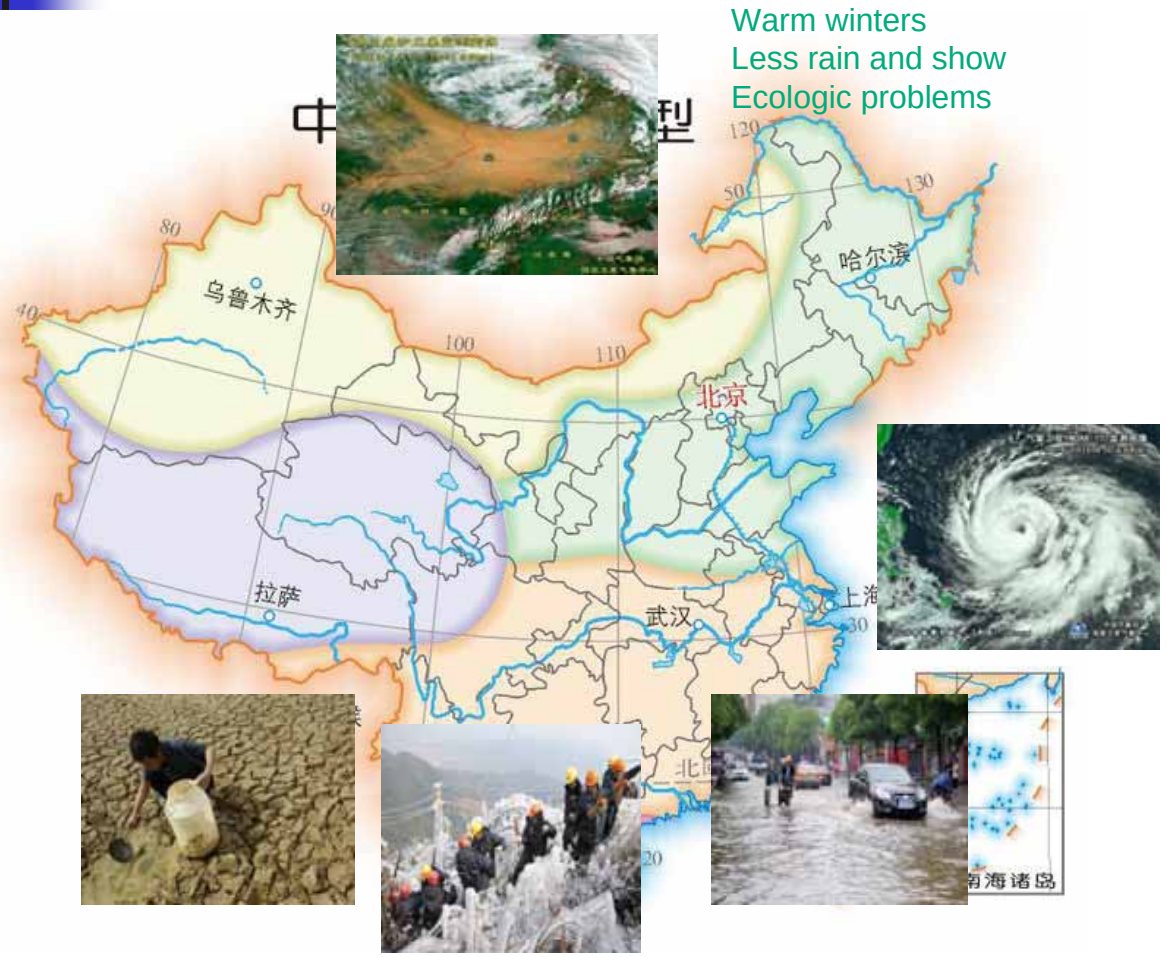
from 1970 to 2005.
Source: Shell International BV, 2009

An urban resident consumes 3-4 times more energy than a rural people.



More developed and higher income consume more energy per capita.

Every country is a contributor as well as a bearer for climate change, the same situation for China.



China is a big country, with several regions of different natural conditions and industrial stages.

It suffers a lot of natural disasters from extreme weather, such as warm winters, cold spring, hot summers, draught or flood, and ecologic problems

Chinese pattern is moving toward sustainable

primary, rough, environment-friendly and now for sustainable

- After 30 years of rapid development, economy and living condition were improved significantly, but there are also many problems.

- Iron and Steel
- Cement
- Non-ferrous metals
- Chemicals
- Raw materials
- Automobile
- Construction
- Agriculture and food

- Industrialization
- Urbanization
- modernization

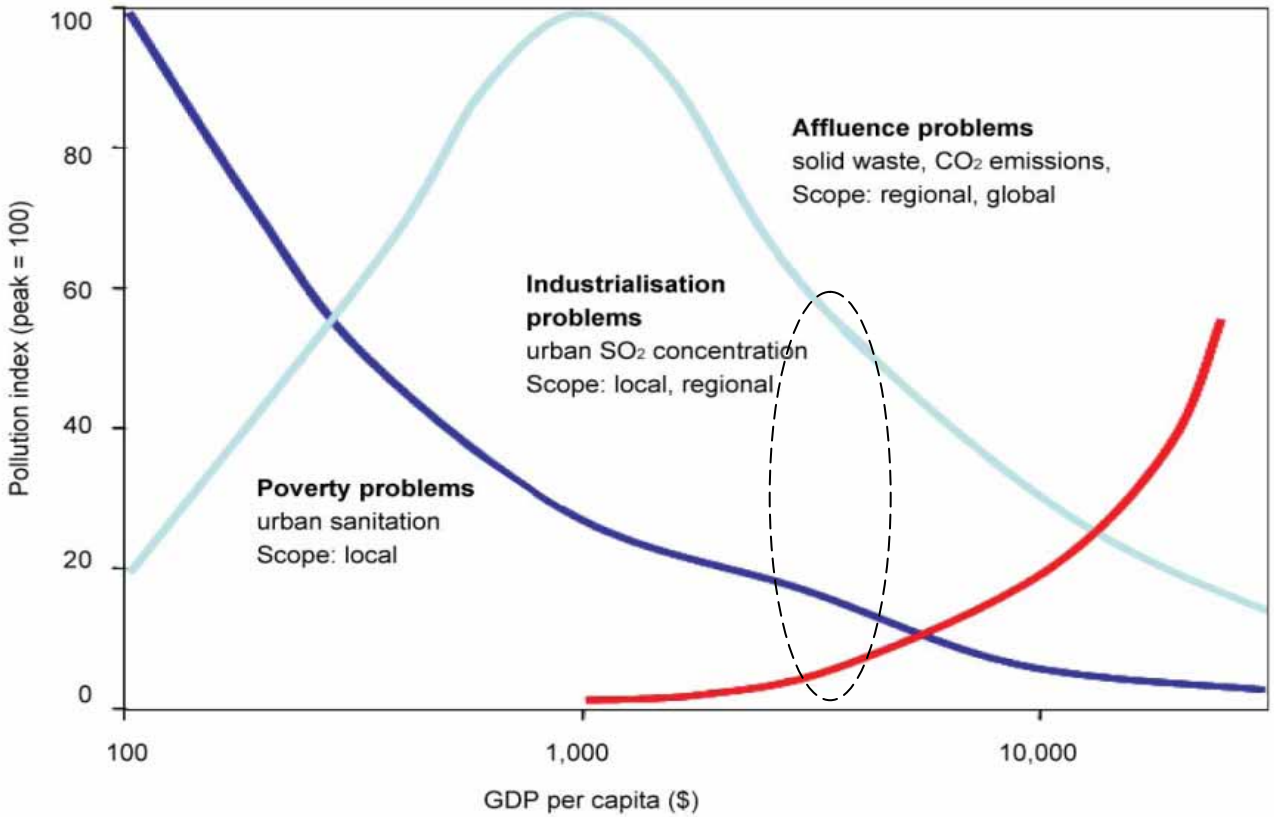
- more wealthy
- better live
- more product output
- innovation ability

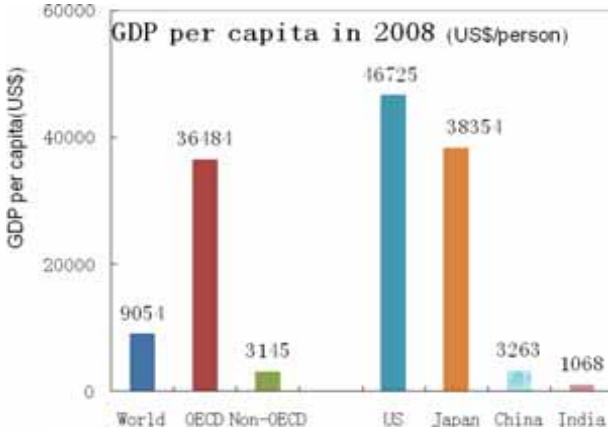
- energy consumption
- Use of mineral resources
- Urban and industry problems
- Water and waste pollutants
- Ecological problems
- CO2 and other gases emission
- Occupy Lands for farming and forest

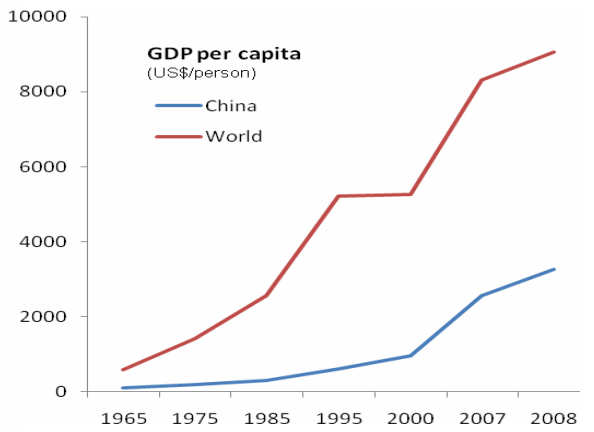
There is a combination of three types of problems in the front of new stage.

(GDP per capita of China is 1/3 of world average)

Environmental priorities and stages of development
Source: World Bank, 1992

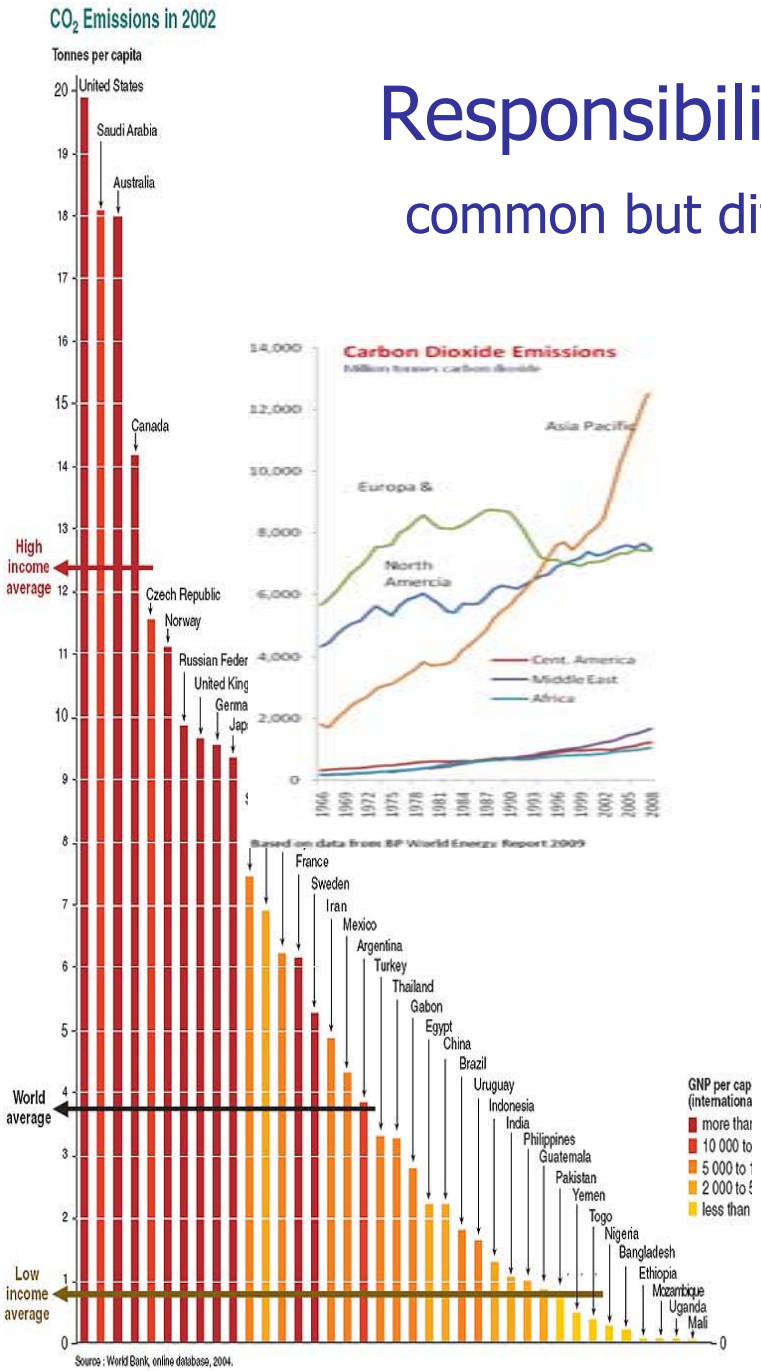






Responsibility to Past, Current and Future

common but differentiated ---- Principle of Tokyo Protocol

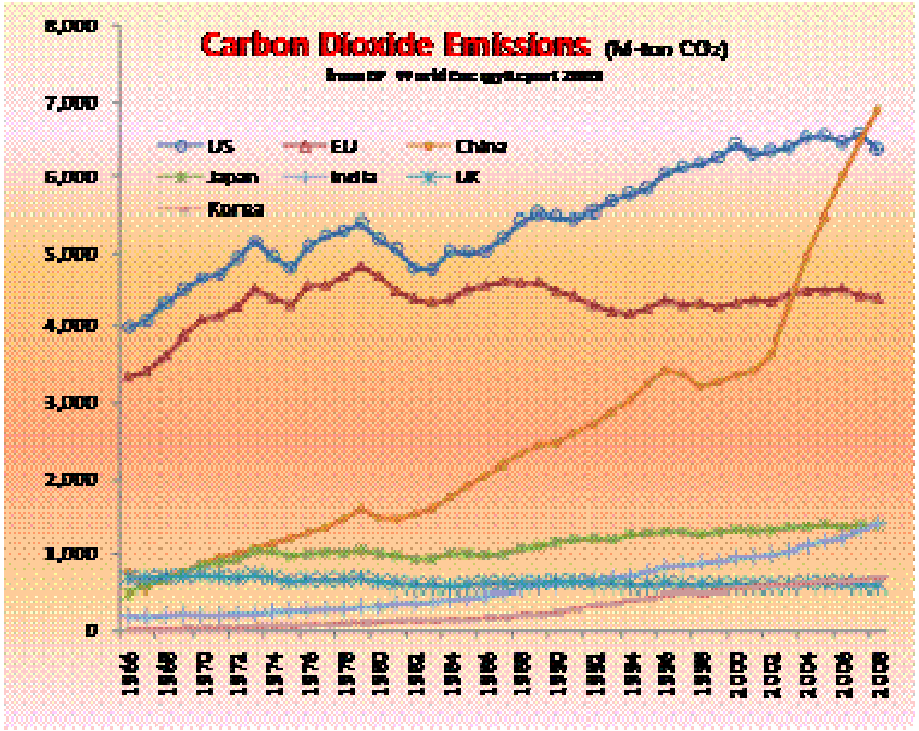


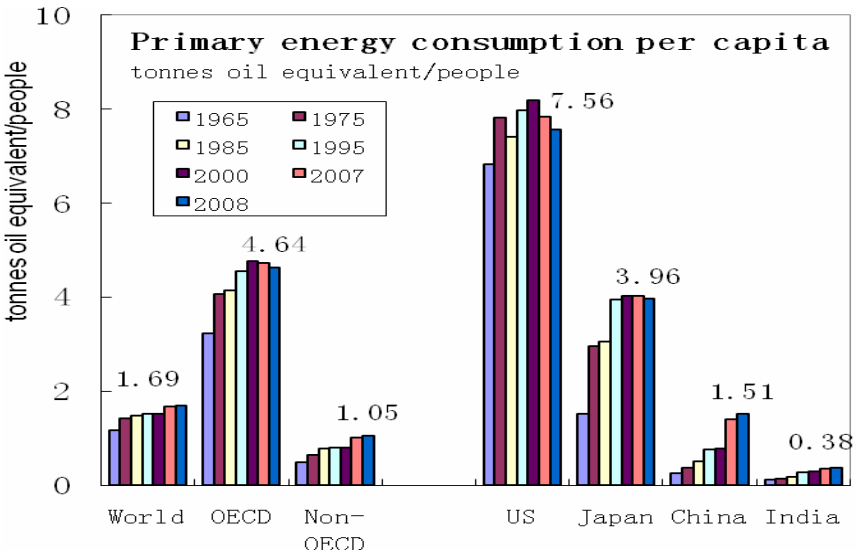
UNFCCC Preamble:

"Noting that the largest share of historical and current global emissions of GHG has originated in developed countries, that per capita emissions in developing countries are still relatively low and that the share of global emissions originating in developing countries will grow to meet their social and development needs."

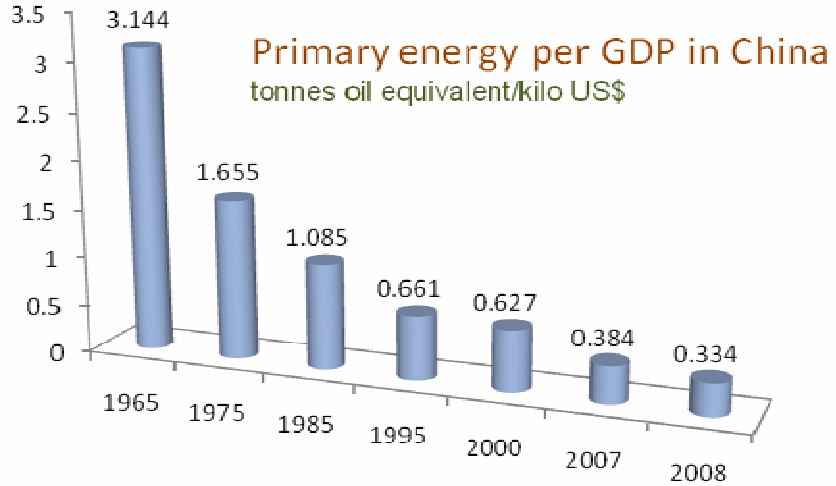
China has made voluntary promise and will take active measures to slice carbon intensity in 2020 by 40 to 45 percent compared with 2005 levels.

High in total and low in per capita





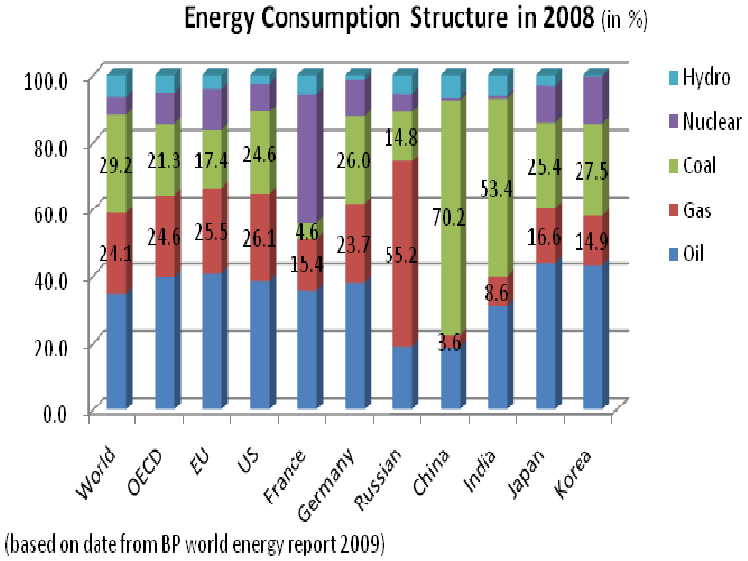
- Force elimination of backward production capacity, mainly for power, coal, iron and steel, cement, coke, nonferrous metal, paper, leather, dyeing plants.
- In 2010, to shut down small thermal power stations up to 10 million kilowatts, 25 million tons in iron, 6,000,000 tons in steel, 50 million tons in cement, 330,000 tons in electrolytic aluminum and 530,000 tons in paper et al.
- Accelerate key energy saving projects, by administration and reformation of traditional industries.



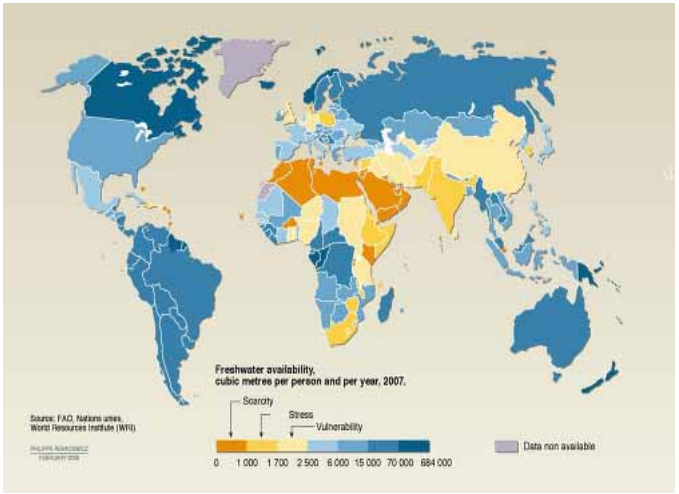
- Vigorously promotion of energy efficient technologies and products, such as efficient air conditioning, energy efficient cars, energy-saving motors and other products, new energy vehicles, energy-saving lamps
- Adjust economic and energy saving policies, such as reform of energy prices. To apply price ladder for residential electricity and punitive tariffs for over standard enterprise in energy consumption
- To promote the use of renewable energy and nuclear energy of less CO2 emission

There are a lot of problems which may turn into momentum to make adjustments.

- GDP per capita is low, ranking below 100 in the worl
- many regions are still in primary developing stages;
- Many products are in low end of manufacture chain;
- many heavy industries and raw material production;
- 70% energy consumption is based on coal.



(based on date from BP world energy report 2009)



Water resource per capita in the world

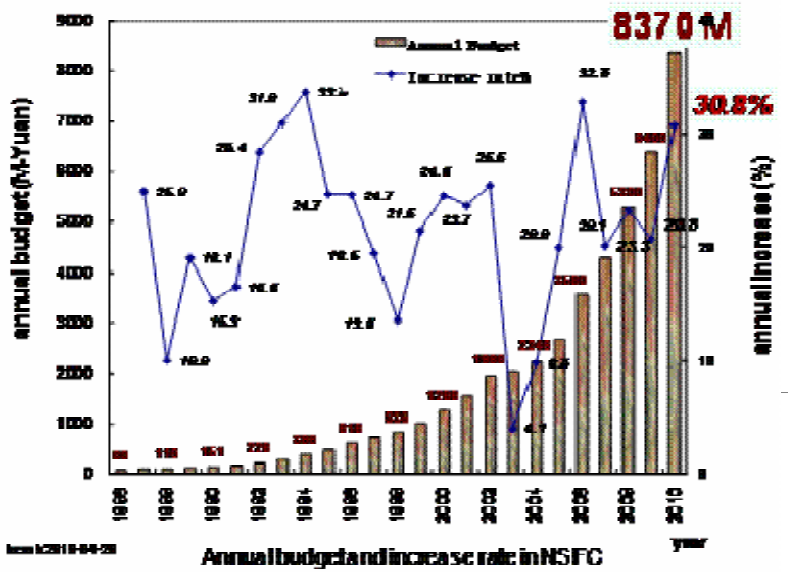
- large population and labor force with low income.
- Low water resource per capita , only one quarter of world average.
- unfavorable natural conditions, especially in the large western areas

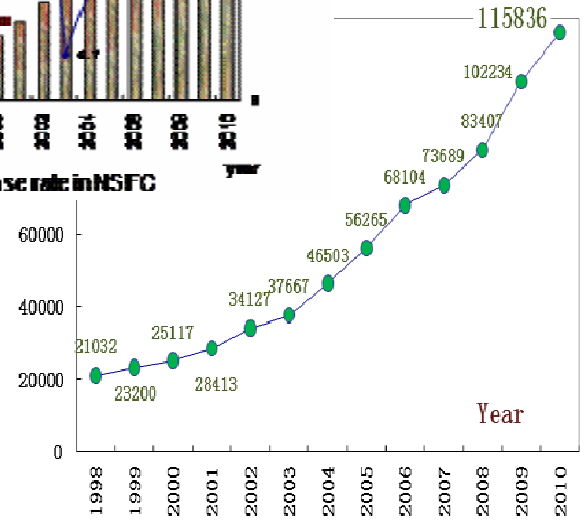
Science and Technology Innovations are always critical to sustainable world

- Green innovations provide many opportunities for economical and social developments as well as for people's living styles.
- It is a complex and very tough task, especially to promote practical and affordable green approaches in large scale and to meet requirement of sustainable developments.
  - More researches needed to understand climate change better.
  - In the age of advanced sciences and technology, even small progress needs a lot of science and technology innovations.
  - More efforts needed to transfer advanced affordable technology to developing areas.
  - More funding and international collaboration needed on innovations.

NSFC, the funding agency of China, encourages innovative basic researches

Annual budget and proposals increased fast





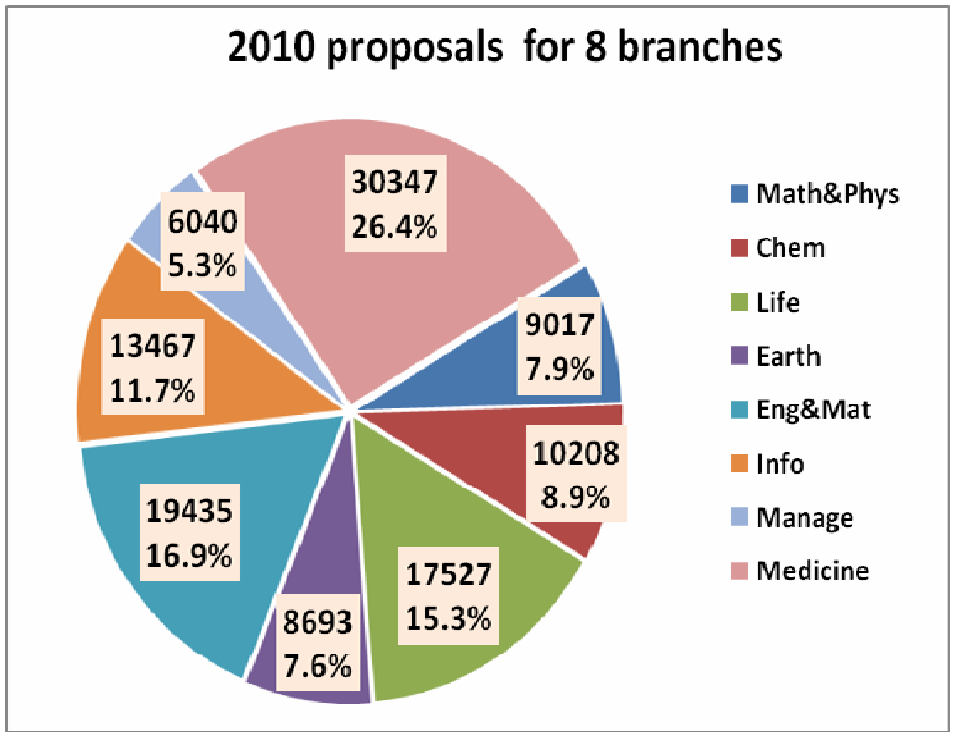
- Strategic innovation
- High quality talents
- Good scientific environment
- Management of excellence

The basic researches have two driving forces:

- **requirements from development of science**
- **requirements from economical and social developments**

Green innovations and sustainable development have been the priorities of NSFC and its subordinate departments for many years.

NSFC funds many general researches and oriented researches



- General programs
- Key programs
- Major programs
- Major research plan
- Key Int. Cooperation

Major Research Plan (MRP) – Integrated and Interdisciplinary Researches

- Priority oriented -- Combine top-down and bottom-up
- Long term researches, step by step in 6-10 years
- A group of projects and more funding (1500 million Yuan)
- priority-oriented, including multi-disciplinary researches and integrated innovations

NFSC has initiated 25 MRPs until now.

- Four are strongly focused on Climate Change.
- Some others are partially liked.
- New one will be initiated soon.

Ecosystem and Hydrology in Heihe river area

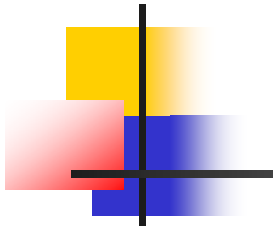
International Collaborations

Global change and regional responses

Environmental and ecological sciences in western China

energy utilization and protection of western environments

MRP ---- the Major Research Plan: Global change and regional responses



- select some typical areas in east Asian mainland and coastal waters which are sensitive to global change, taking the carbon and nitrogen cycle, water cycle and monsoon evolution as main issues,
- targeting researches on sea - land - atmosphere interactions in Asian monsoon region and human activities on regional environmental change, in order to obtain understandings of regional environment responds, response means, role of process, dynamic mechanism and future trends with global change

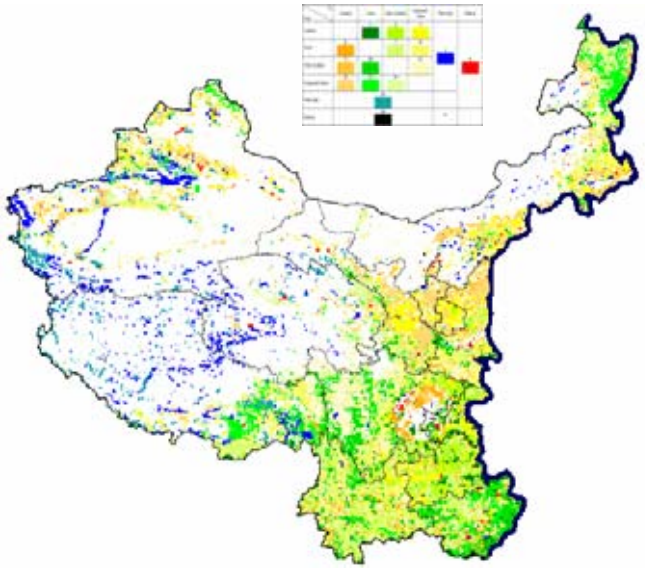
Focus on the five directions step by step in 8-10 year

- Variation of marine environment and response to global change
- Evolution of the East Asian monsoon and its relationship to global change
- Sea - land - atmosphere interaction with the water cycle and the relationship with global change
- Ecological processes and ecological security of some key areas , and their response and feedback to global change
- Physical and mathematical issues for global change and regional response.

MRP: Environmental and ecological sciences in western China

Aimed at environment, ecology and sustainable development in western China, to answer 3 main questions:

1) How is the modern environmental pattern formed?
2)How to distinguish natural and human factors in the environmental and ecological evolution?
3)under the global change, how does the future environment and ecology go?

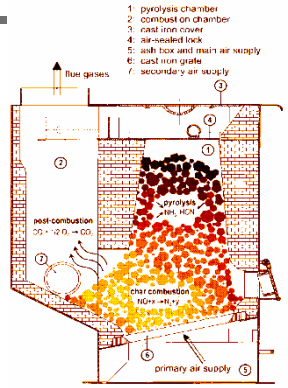


20 years' Changing patterns of land use between 1980-2000

Focus on four themes:

- Evolution and future trends of the environment system;
- water cycle and sustainable utilization of water resources;
- Progressive change and adaptation of ecosystem;
- human activities and the environment protection;

MRP: Key Issues on Energy Utilization and Environmental Protection for Western China



1. Prediction and Modeling of Energy Supply and Demand Structure
2. Market mechanisms for Western energy development and utilization
3. Assessment of impact of Major energy projects on water environment.

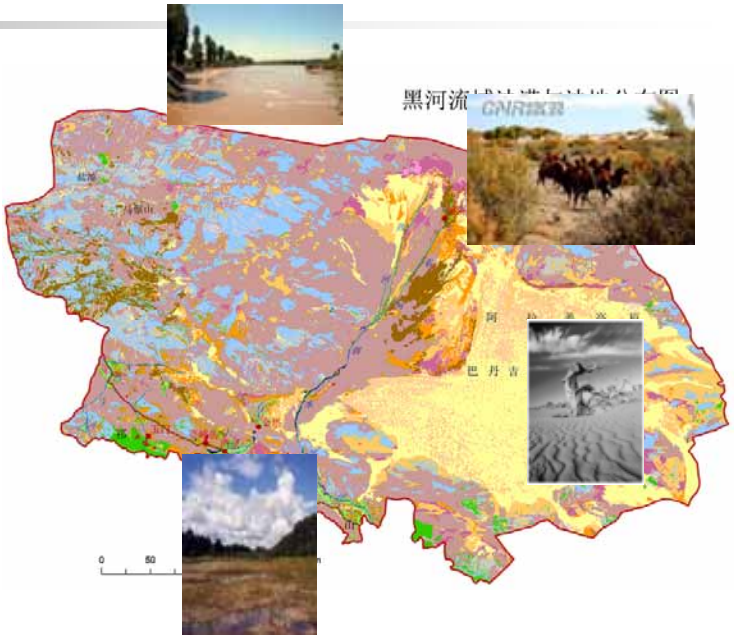
main directions:

1. Sustainable strategy of Western Energy Resources
2. Multifunctional pattern of energy utilization
3. Innovation of clean use of coal based energy
4. solar catalytic hydrogen production and power system
5. Science bases for some energy engineering.

1. New combustion mechanism with low-pollution emissions
2. Cost saving and recycling of pollutants with desulfurization and denitrification.
3. ultra-high voltage transmission in high altitude

Integrated researches on Ecosystem and Hydrological Processes in Heihe river area

Heihe River Basin is the second largest inland river basin in Northwest China, which across three different kinds of natural environment cells.



It is a complex system with many factors of climate effects and human activities, such as land desertification, salinization and water pollution.

- To study typical interaction of hydrology, soil, ecology, atmospheric and human activities
- Climate change along the ice - permafrost - River - Oasis - Desert diverse natural landscape zones along the altitude.
- Adaptive dynamic control of water resources in Heihe River Basin and the ecological restoration

International Collaboration Researches

Three resources:

- Based on general programs up 15-20% budgets
- Additional money for General exchange and collaboration
- Joint Priority-Oriented Programs between NSFC and other agencies

- JST
- JSPS (A3)
- NSF-K (A3)
- others

- NSF
- DFG
- ECUK
- others

NSFC-JST joint programs

Innovations in environment and pollution control which reduce energy consumption and CO2 emission

- Formation of atmospheric fine particles and ozone with Asian mega-cities
- Formation and control of CO2 and other multiple pollutants from coal combustion under oxygen gas reheat cycle
- Pollution control and ecological rehabilitation of lake based water
- Monitoring, simulation and control of UASB waste and waste water treatment
- Acid soil acidification and Bioremediation
- Carrier transport mechanism in solid-state dye-sensitized solar cell
- Enzyme-based biological fuel cell

The "Carbon East Asia" project of A3-program of China-Japan-Korea

- Measurement and prediction of carbon sink in East Asia terrestrial ecosystems
- Comprehensive research and modeling of carbon cycle in East Asia ecosystem based on flux observation network

NSFC-JSPS joint program

to understanding of climate response in typical areas and innovation for renewable energy

- Climate significance of Tibetan Nanpu Mo Yumco sediment proxy and environmental rebuild
- Water and heat cycle in the Nam Co basin by use of remote sensing and field monitoring data
- Ecological and hydrology issues in the Large Irrigation Area under downstream of Yellow River
- Study of high efficient solar hydrogen production by semiconductor photo catalytic materials and environment purification
- Photovoltaic properties of photosensitive chromophore functional state semiconductor carbon nanotubes
- Application multi-objective decision making model and algorithm in transport network optimization

NSFC-RCUK joint programs for carbon capture and storage
(new proposals are under peer review)

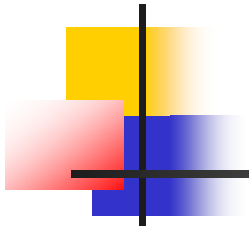
- Determination and simulation of CO2 injection and migration
- A new route for CO2 capture and production of synthesis gas
- Next generation high performance activated carbon adsorbent for CO2 capture in IGCC process
- Carbon dioxide capture by solid phase adsorption for coal-fired power plant
- New membrane catalytic micro-reactor for CO2 capture based on pre-combustion decarburization
- Multiphase flow, migration destination and prediction of its potential impact on groundwater quality for CO2 geological storage
- Penetration mechanism and numerical simulation for supercritical CO2 in porous coal medium
- integration mechanism on fossil fuel conversion and CO2 capture
- Power generation system of new coal-based solid oxide fuel cell for carbon capture
- Modeling and optimization of CCS pipe networks and case study
- CO2 capture, storage and catalytic converter with modified ionic liquid

NSFC – NSF joint programs

- Asian Monsoon - Environmental Evolution and growth of the northern Tibetan Plateau
  (use geological record and all available information in the north plateau and adjacent areas, to recover evolutionary history of the inland arid and Asian monsoon in long time scale)
- Design, synthesis and application of new polymer materials for high efficiency photovoltaic solar cells
  (energy conversion efficiency of solar cell is over 9%.)
- Integrated electro-catalytic of Nano-scale crystal for fuel cell application

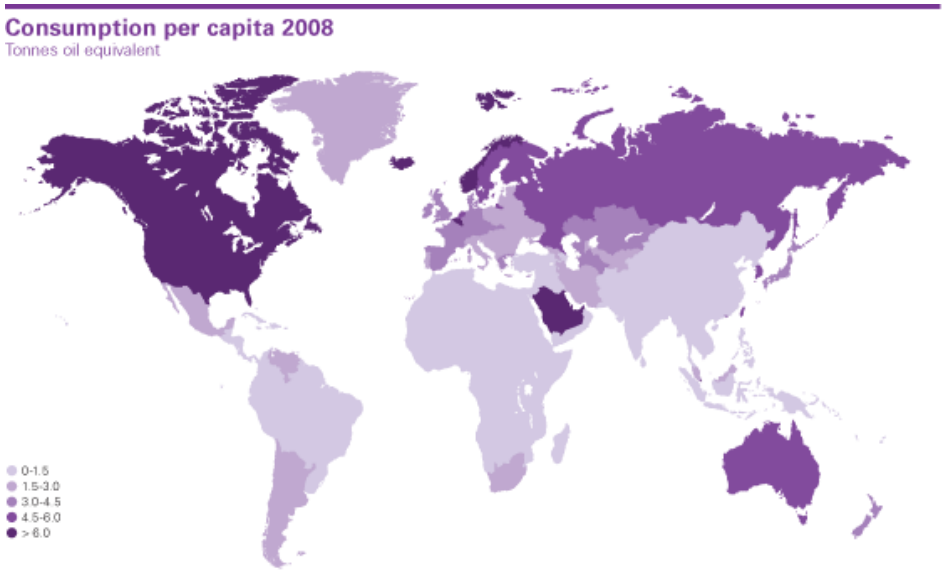
Suggestions

- To make more opportunities to bring scientists, engineering and agency people together to discuss the climate change, and then focus on some priority innovations to work together.
- Make a well designed strategy based on Asia issues as a global initiatives, to have more regional response researches under global change. To share data, compare results, work on rules, and promote application.
- Broader fields of researches are required to unclear questions. To attract more scientists from other fields to work with climate scientists.



- Noting that even solar cell and wind generator sometimes cannot reduce CO2 emission if they do not have enough life and conversion efficiency, it is suggested to have more LCA assessment for different energy-saving approaches so that to find proper balance points.
- Connecting more with innovations on energy saving or efficiency, resources utilization and environment issues , which are beneficial to good climate and sustainable.

Thanks!



Work together to promote green innovations to keep our global green and sustainable.