

Development and Climate
Case Study for China: Energy Sector

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Long-Term Development Goal

By Middle of 21st Century, China will reach the level of OECD countries at end of 20th Century

Four times of GDP in 2000 by 2020.

Sustainable development

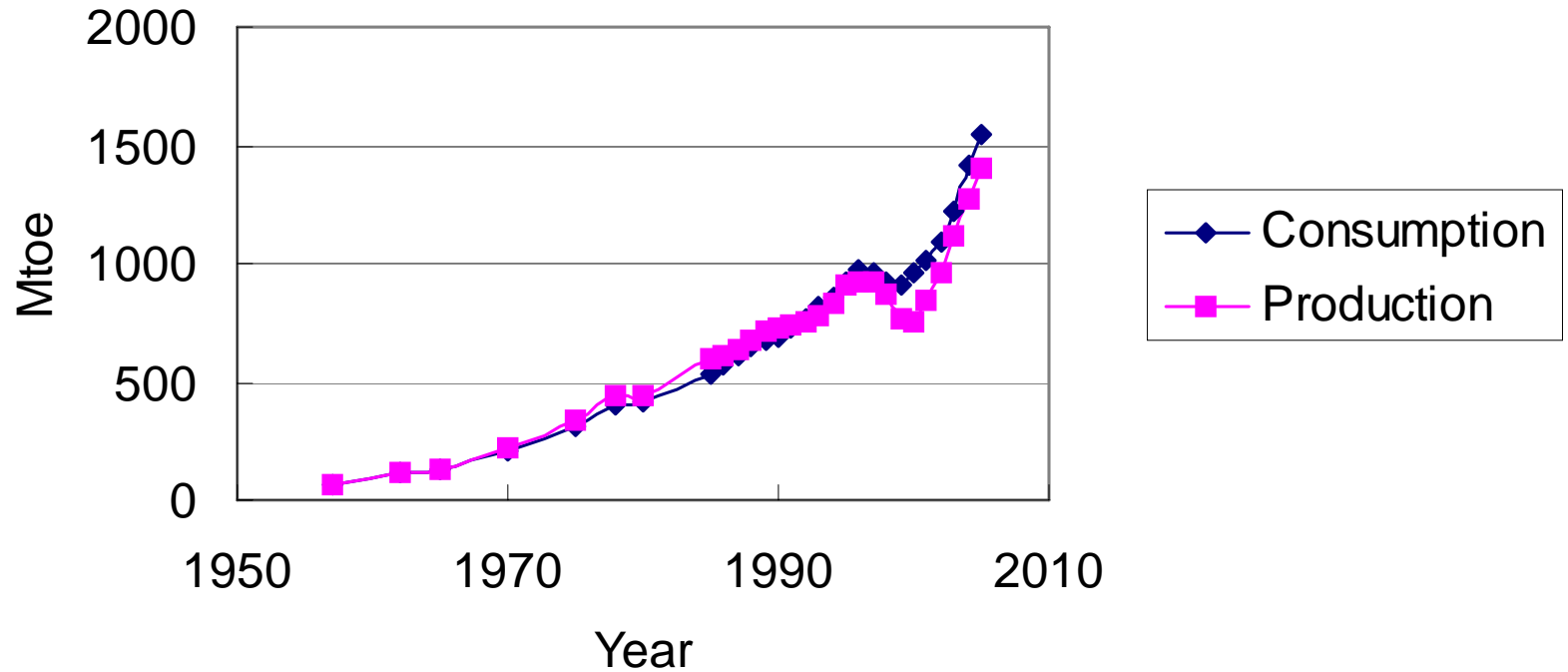
Recognized as basic strategy for China's social-economic development.

Basic strategy means it will last at least several decades.

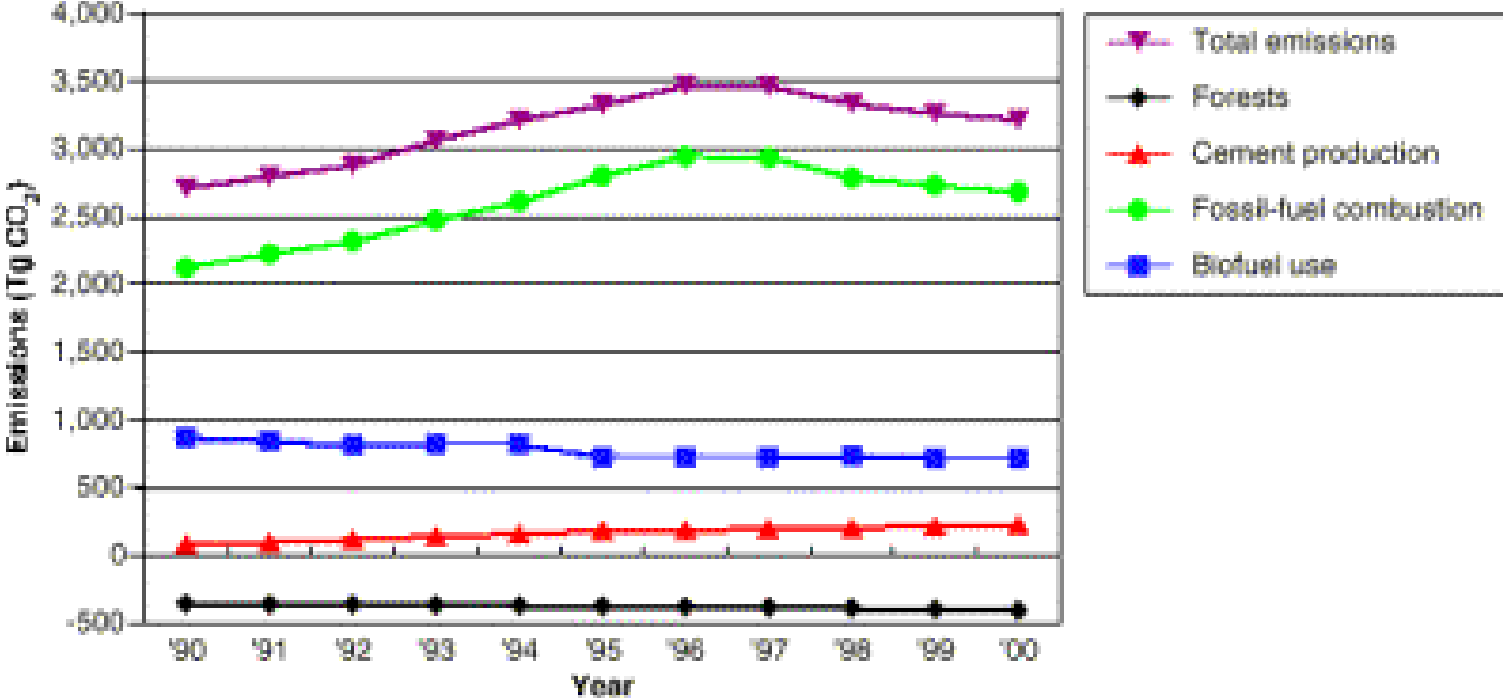
Contribution to Climate Change

- Energy Conservation: 550mt-C(1980-1999)**
- Renewable Energy Development: 20.06 Mt CO₂**
- Nuclear Energy: 14.1TWh**
- Rural Energy: 90.42 Mt CO₂/year**
- Reforestration(1980-1996): 2.4 billion t CO₂**
- Population Policy: 0.21 billion t C/year**

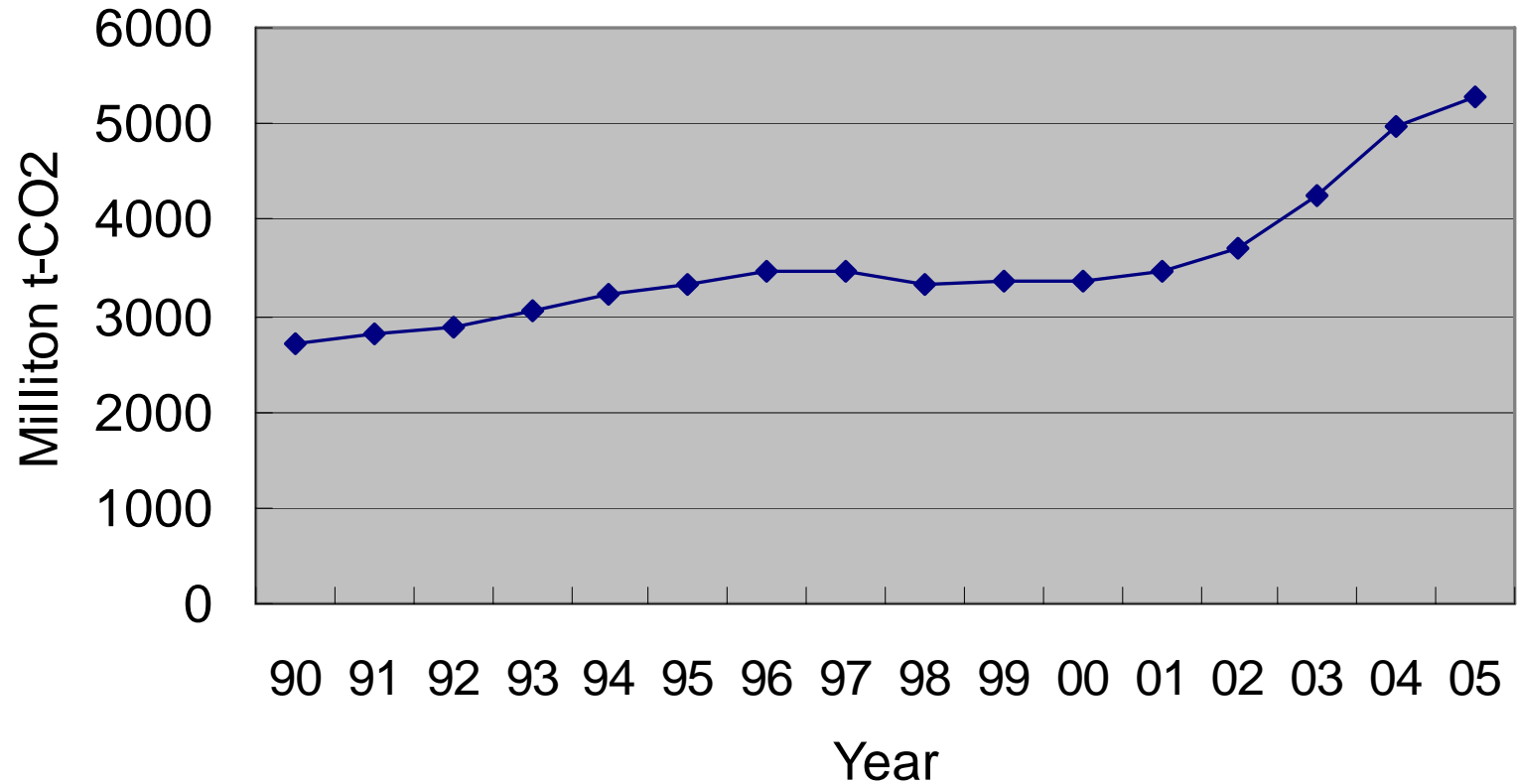
Energy Production and Consumption in China, 1957-2005



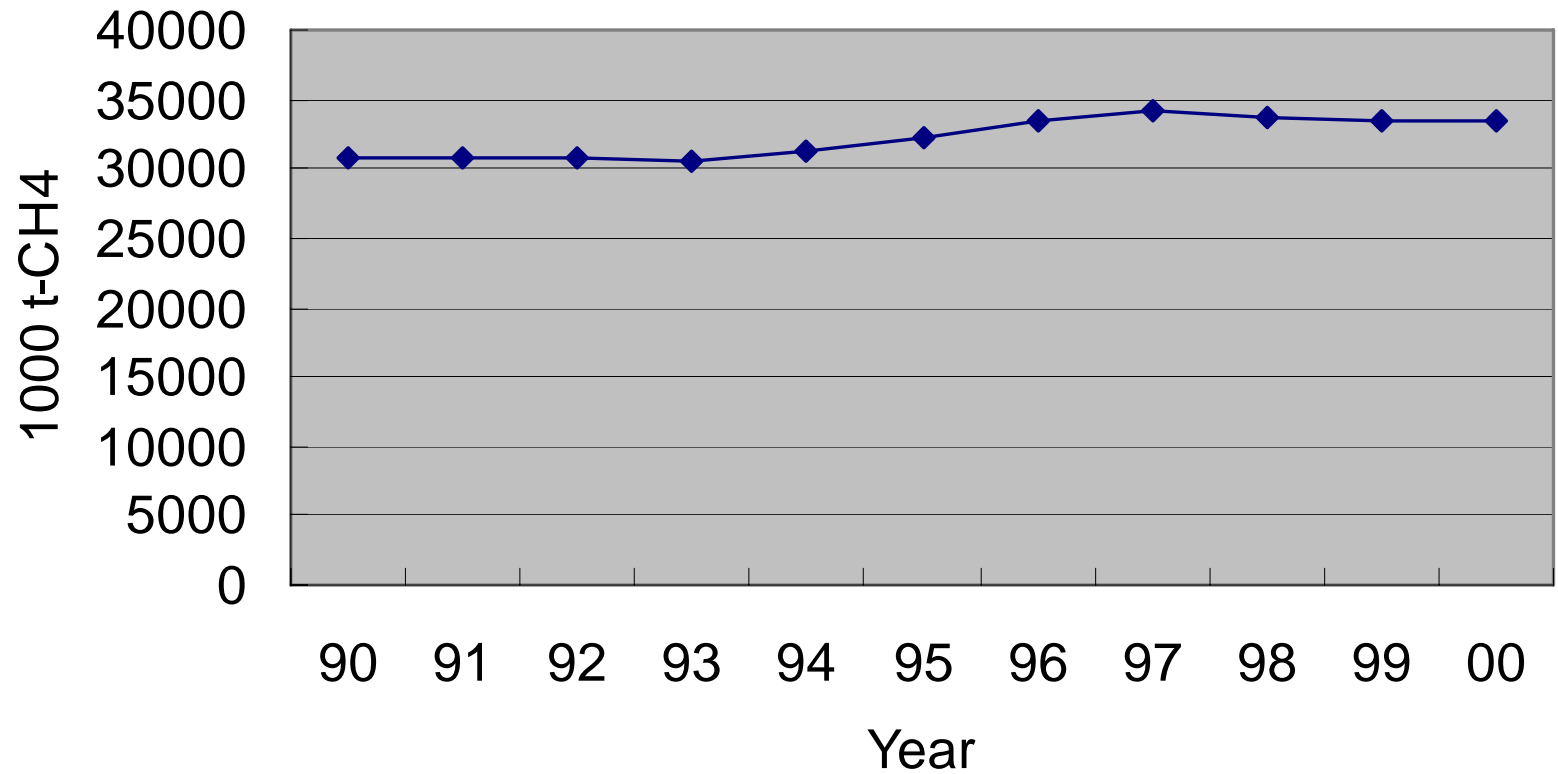
CO2 emission in China



CO2 Emission in China, 1990-2005



CH₄ Emission in China



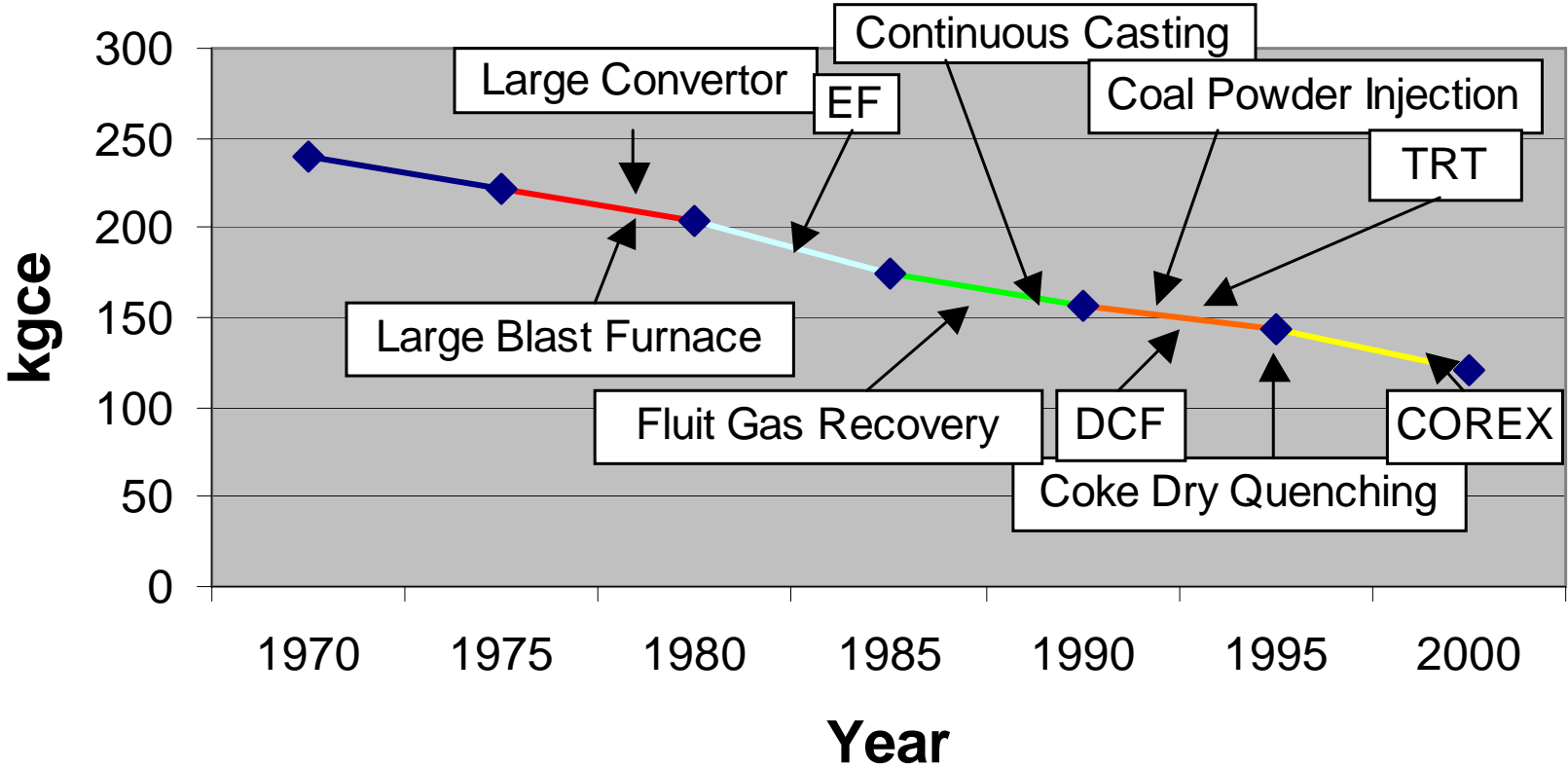
Figures for China

Population growth rate	0.7 percent per year
Per capita GDP	Exchange rate= US\$853; PPP=\$3,475
GDP growth rate	7.8 percent per year
Residential electricity consumption	132 kWh per person per year
Persons below poverty line¹	30.0 million
Persons without electricity	23 million
Persons per vehicle	79

Policies in energy sector

- ☐ **Energy efficiency planning**
- ☐ **Energy efficiency standards**
- ☐ **Price favourable for independent power plant investor**
- ☐ **Tax derating for co-generation, energy saving building**
- ☐ **Loan favourable for energy conservation project by different interest with average 30% lower**
- ☐ **Price for energy saving by enterprise**
- ☐ **Subsidy for energy saving stove in rural area, biogas promotion and city banquette production**
- ☐ **Organize important energy conservation project by government**
- ☐ **Opening of energy price**
- ☐ **Reforming of energy industry**

Unit Energy Use in Steel Making Industry



Gaps

- ☰ **High cost to implement the regulation. There some time high cost to implement emission control regulation**
- ☰ **Social difficulties. Some emission is from low income area where increasing income is the leading factor. Much more comprehensive policies should be developed for emission control**
- ☰ **Low capacity to implement policies. Because of the low personal ability for administration and monitoring**
- ☰ **Policies are not well-designed. Sometime the policies could not work well for the local condition to reach the target**
- ☰ **Availability of clean technologies. In many case, advanced clean technologies are there but with high fixed cost, it is hard to be adopted by users in China**

Conflicts

- ☰ **Coal based energy use serious air pollution problems**
- ☰ **Large amount of mining has bad impact on land use and water quality**
- ☰ **Fossil fuel combustion emits GHGs**
- ☰ **Because of domestic energy resource limitation, large amount of oil will be imported from international market, which will reduce domestic capital stock**
- ☰ **Energy industry is a low profit sector which could not contribute well to economy development**
- ☰ **Institutional structure is under reforming to provide a good environment for energy industry development, but answer is not clear**

Possible indicators to capture the development perspective in China

Issues	Key driving force	Possible indicators
Social development issues	GDP growth	GDP growth rate
		GDP per Capita
		Mix change of industries
		PPP index
		Population growth rate
		Education level
		Labour availability rate
Technology progress issues	Technology	R&D expenditure (as % of GDP)
		Technology level
		Foreign investment
		Foreign investments in climate change related technology and projects
		Number of collaborative foreign projects on climate change related technology development
Energy issues	energy availability	Indigenous energy resources used (as % of total energy used)
		Fossil fuel imports (as % of total value of imports)
		Per capita annual energy consumption (kg of oil equivalent)
		Per capita annual electricity consumption (kwh)
		Share of fossil fuel based electricity generation (as % of total electricity generated)
		Rural area electrification rate
		Energy efficiency improvement rate
		GHG emission from energy activities
		Local pollutant emission from energy activities
		Desulphurization rate

Possible indicators to capture the development perspective in China

Issues	Key driving force	Possible indicators
Development policy issue		Share of rail traffic in freight transport (as % of total billion ton km)
		Share of rail traffic in passenger transport (as % of total billion passenger km)
		Railway route electrified (as % of total route km)
		Share of fossil fuel based electricity generation capacity (as % of total generation capacity)
		Coal based electricity generation capacity within 200 km of mine mouths (as % of total generation capacity)
		Average office commuting time in cities above one million population
		Waiting time for a new landline telephone connection
Employment indicators		National unemployment level
		Productivity of formal sectors (sector output/ employee)
		Productivity of informal sectors (sector output/ employee)

Energy Sector Themes and Potential SD Indicators

	Themes	Sectoral and Project Level Indicators
Energy supply and consumption	Supply and demand including structure, efficiency, fuels, and costs	Energy balance Efficiency of conversion and end use (intensity index) Costs (per. energy unit)
Exhaustible resources	Non-renewable energy	Extraction and regeneration rates (e.g. biomass)
Environmental impacts	Climate change Air pollution Water Waste	CC vulnerability GHG emissions Air pollution Water pollution
Accessibility	Supply to business and households Transmission Other infrastructure Markets	Energy balance Transmission systems Markets: Structure, coverage, efficiency Informal markets Fuel wood collection

Energy Sector Themes and Potential SD Indicators

	Themes	Sectoral and Project Level Indicators
Affordability	Costs Investments	Cost measures Capital requirements and costs Energy expenditures relative to total production costs Energy expenditures relative to household expenditures for different income segments Time spent on energy provision
Health	Life expectancy Nutrition Epidemics	Life expectancy Infant mortality Major diseases
Education	Literacy rates Enrolment	Literacy rates Primary and secondary education (time, persons) Provision of light for reading Time for energy provision that substitutes education Skilled labour educated through energy management

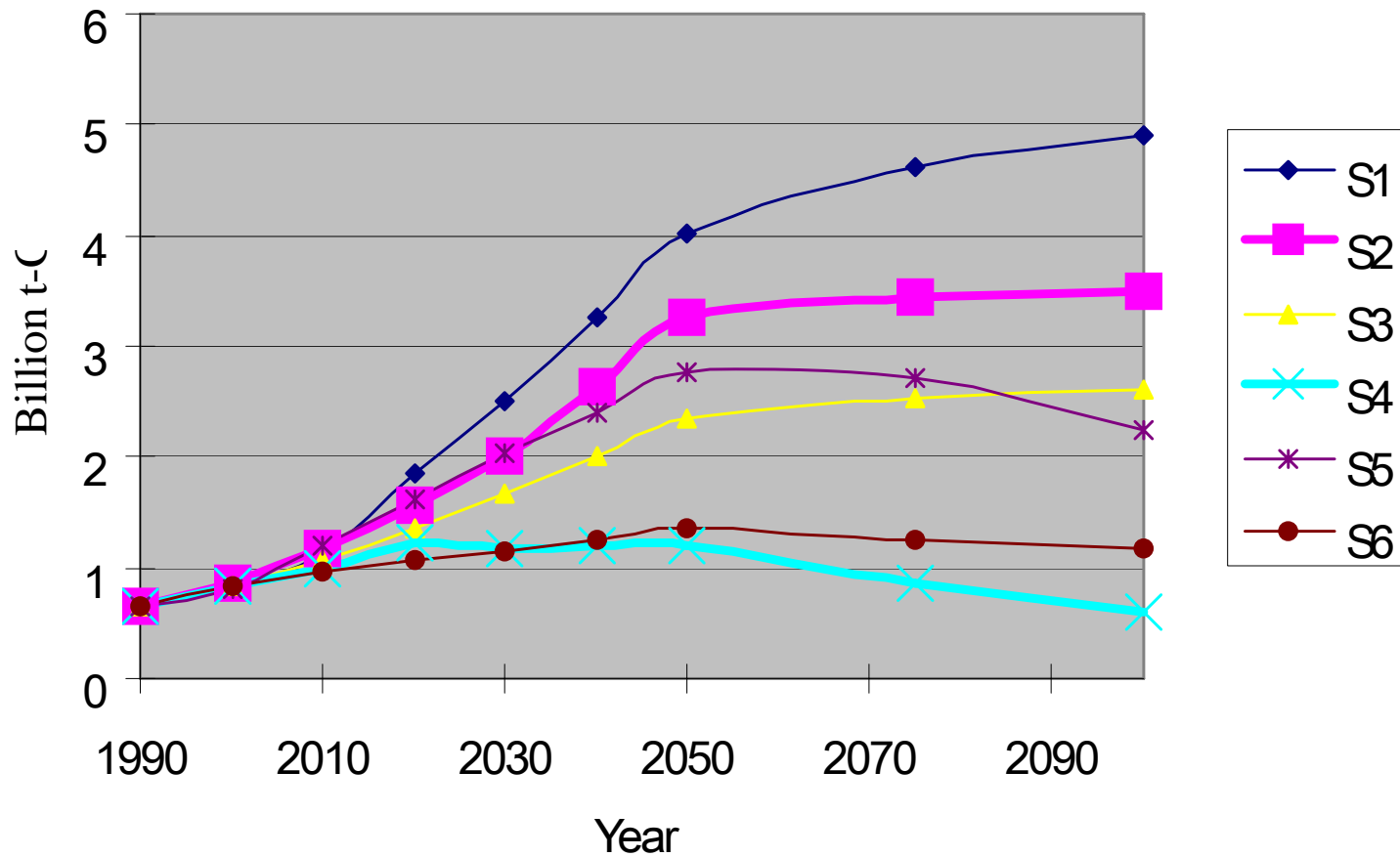
Illustrative Example of how the SD Impacts of Introducing a Biogas plant

SD Indicators	Biogas plant versus woodfuel and kerosene
Costs	Capital costs and O&M of biogas plant Replacement of costs of woodfuel onsumption and kerosene lamps
Energy access and affordability	Gas for cooking and lighting Electricity production for local industry (off grid) Most likely decreased energy costs
Employment	Employment of construction and maintenance staff Decreased employment for people related to woodfuel and kerosene supply
Environmental impacts	Biogas plant implies reduced local air pollution and GHG emissions
Education	Improved lighting facilitates reading Time savings due to reduced fuel collection enables children to increase school attendance
Income generation	Power for local industry increases business opportunities and thereby employment and income Households can supply more labour due to less time spend on fuel collection Decreased income of fuelwood and kerosene sector

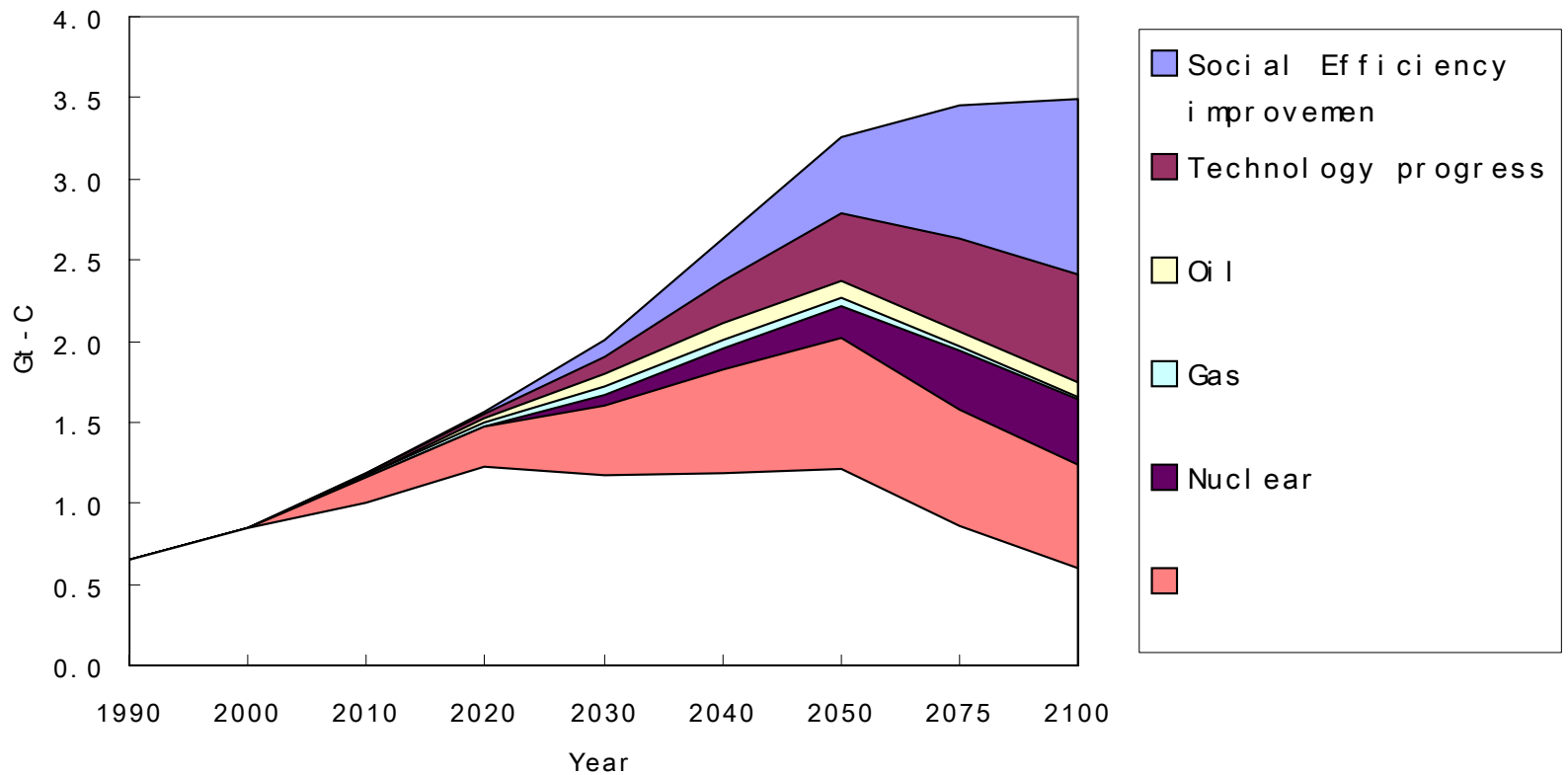
Scenario for China

- S1: Traditional development pattern
- S2: Conventional development(BaU)
- S3: Energy policy intervention(SD)
- S4: Environmental driven
- S5: Tiger economic development
- S6: Grey economic development

CO2 Emission in China



Contribution to the CO2 emission Reduction



Key technologies for long-term energy perspective

- Modern renewable energy production (solar energy etc.)
- Advanced nuclear power generation
- Fuel cell
- **IGCC/Advanced clean coal technologies**
- Advanced gas turbine

- Unconventional nature gas and crude oil production technologies
- Syn-fuel production technology

Policy implementation

 *Combine policy with domestic sustainable development strategy*




 *Develop win–win opportunities*

 *Integrate policies with the national energy development plan*

 *Use international mechanisms such as CDM*

 *Match domestic economic instruments*




Gap between plan and actuarial situation

-  **Renewable energy development framework: wind turbine capacity 1000MW by 2000**
-  **Actuarial capacity by 2000: 360MW**
-  **Major reason:**
 - No enough financial incentive**
 - Low local production capacity**
 - A new player need more experience**

Gap between plan and actuarial situation: another case

Started from 1998, China's government closed most small-size coal mine and statistic show reduction of coal output in recent year and then reduction of consumption, in order to improve efficiency, environment and security. However some accident shows the case is not true.

Key questions

-  **How to provide sufficient energy to support rapid growing economy and people life standard.**
-  **How to solve the problem on environment impact during energy sector development, which is an important issue in China's energy development and sustainable development**
-  **How to established a well-development energy industry to support economy development in China**

Basic assumption for SD scenario

GDP	National planning before 2050, 7.5% from 2000 to 2010, 5.1% from 2010 to 2050. After that, 2.1% from 2050 to 2100
Population	National control plan, reach peak between 2040 to 2050 by around 1.6billion, then reduce to 1.5 by 2100
Per capita GDP	11 thousand US\$ by 2050(1990 price), 26 thousand US\$ by 2100
GDP mix	Rapid development of tertiary industry
Primary energy demand elasticity	0.43
Energy use technology progress	Fully diffusion of advanced energy use technology by 2050, technology efficiency is 30% higher than that in 2000, fuel cell vehical will be widely used by 2030
International trade	Generally improving of international trade, no trade bulwark
Annual average marginal cost improvement of energy exploitation technology	Coal: 0.4% Oil: 0.8% Natural gas: 0.3%

Basic assumption for SD scenario

Non-Conventional energy use	Non-Conventional gas is needed after 2040, small demand for non-conventional oil
Modern renewable energy such as solar	Cost will be US\$0.04/kWh by 2050
Nuclear technology progress	Capacity will be more than 170GW by 2050, cost to be US\$0.045/kWh
Hydropower utilization	More than 910TWh by 2050
Modern biomass utilization technology	More than 70mtce biomass is available at cost lower than US\$50/tce
Life style	Full use of clean energy, high ownership of electric appliance, commercial energy is widely use in rural area
Transport development	Rapid development, public transport oriented
Diet preference	Rapid increase of meat demand
Forest development	National plan, generally increase of forest by reforestation

Case Study: Clean coal technology development

Review

Scenarios

SD Indicators

Suggestions

Reporting and Outreach

Report available at www.developmentfirst.org

Workshops

Asia-Pacific Energy, Environment Modeling Workshop

Criteria for the Region

Impact from Climate Change

From western region

Local participation

Environment Problem faced

Economic Capacity/Development trend

Energy Supply/Food supply