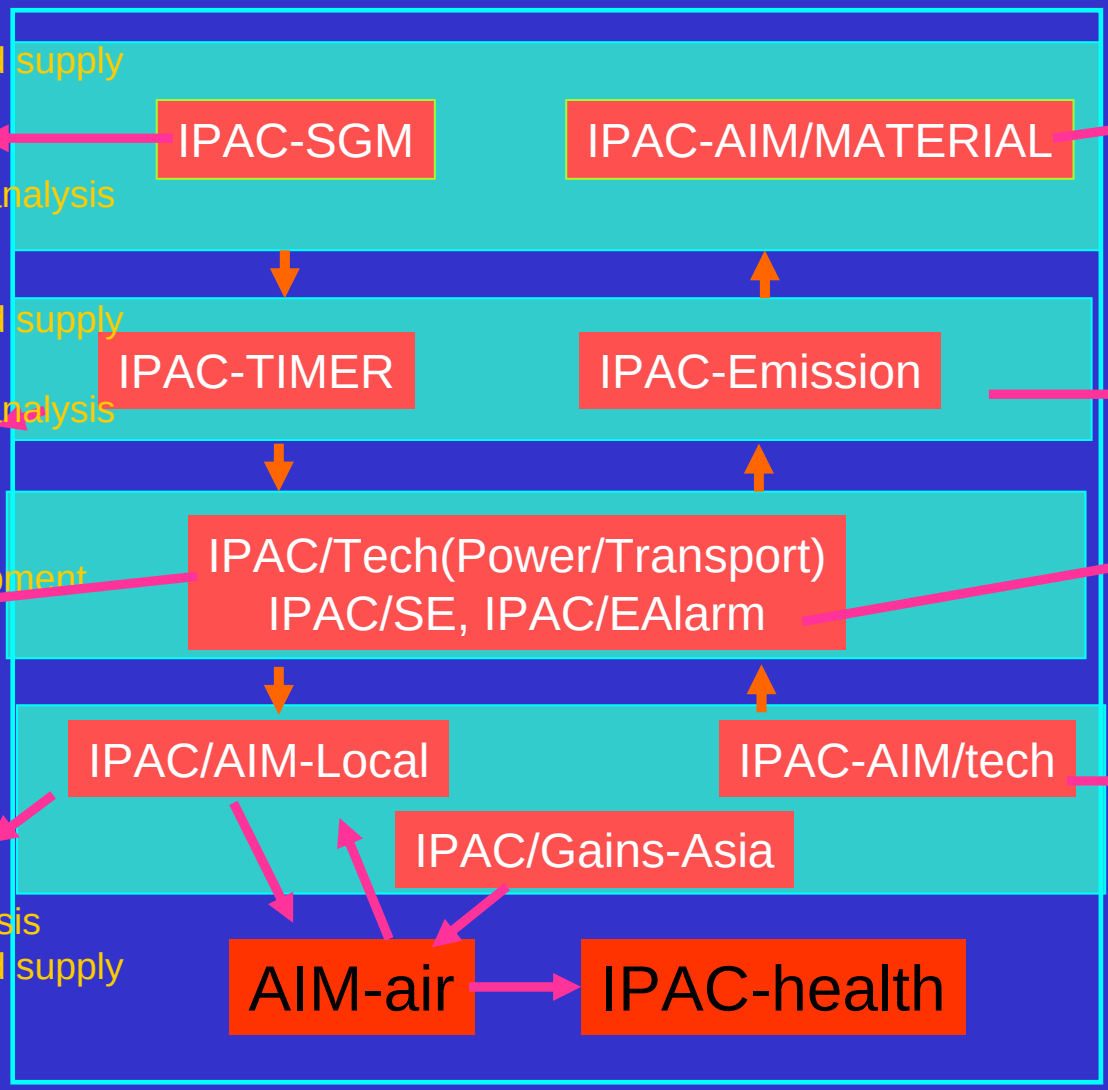
Low Carbon Sociaty Scenario up to 2050 for China

Jiang Kejun

Energy Research Institute

Japan Low-Carbon Society Scenarios toward 2050 Project symposium

Framework of Integrated Policy Model for China (IPAC)



Energy demand and supply
Price/investment
Economic impact
Medium/long-term analysis

Energy demand and supply
Price/investment
Medium/long-term analysis

Technology development
Environment impact
Technology policy

Region analysis
Medium/short analysis
Energy demand and supply
Technology policy

Environment industry
Pollutant emission
Medium/long-term analys

Energy demand and supp
Full range emission
Price, resource, technolog
Medium-long term analysi
Economic impact

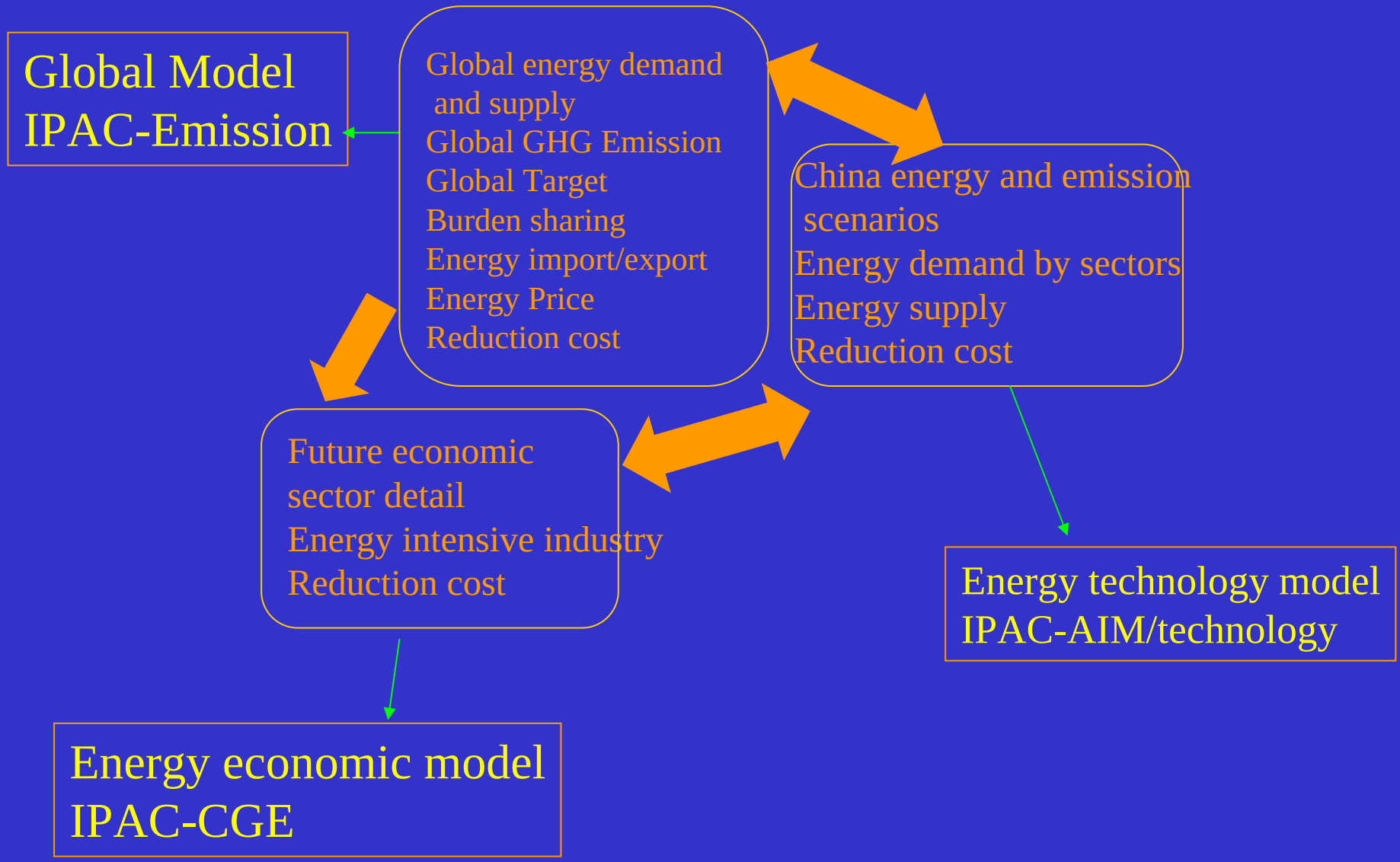
Short term forecast/
energy early warning

Medium/short term
analysis
Technology
assessment
Detailed technology
flow

Climate Model

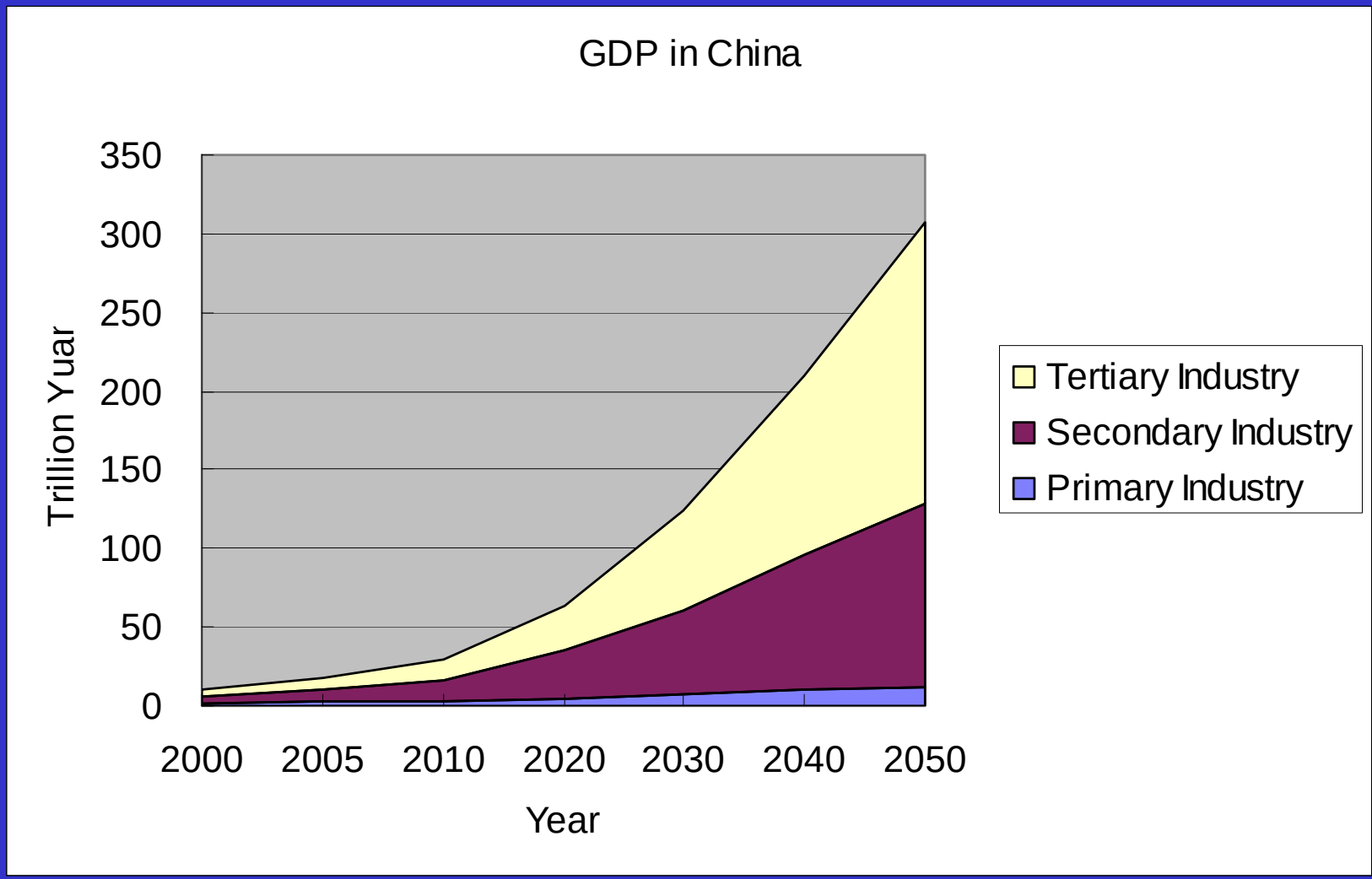
ERI, China

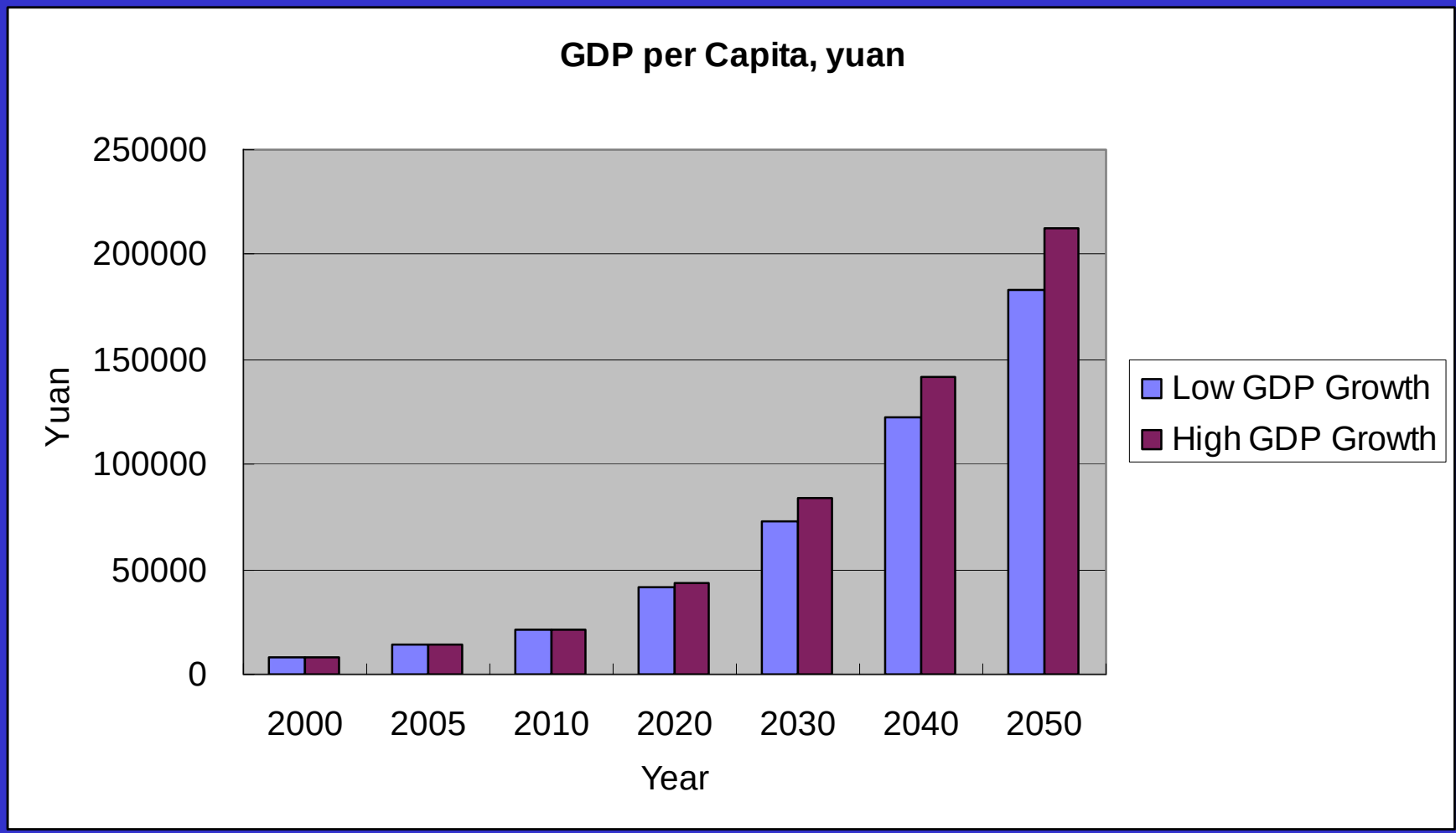
Methodology framework



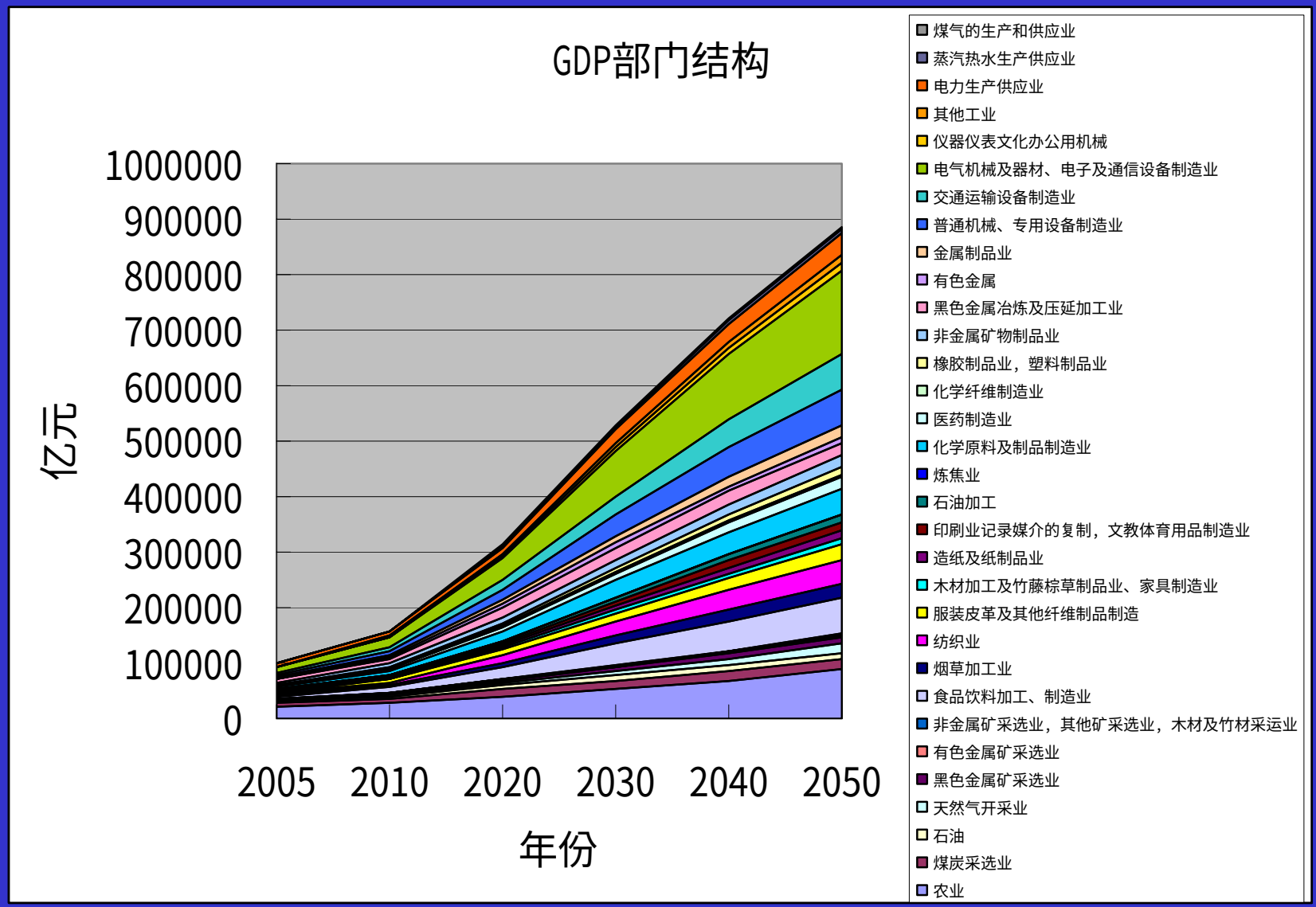
GDP growth rate: BaU

	2005-2010	2010-2020	2020-2030	2030-2040	2040-2050
GDP	10.04%	7.67%	5.85%	4.09%	2.82%
Primary	4.12%	3.72%	2.60%	2.39%	2.06%
Secondary	10.99%	7.52%	5.22%	3.08%	1.86%
Industry	10.98%	7.47%	5.26%	3.11%	1.90%
Construction	11.06%	7.87%	4.96%	2.88%	1.55%
Tertiary	10.53%	8.59%	6.90%	5.11%	3.57%


GDP in China
350
300
250
200
150
100
50
0
Trillion Yuar
2000
2005
2010
2020
2030
2040
2050
Year
Tertiary Industry
Secondary Industry
Primary Industry


GDP per Capita, yuan
250000
200000
150000
100000
50000
0
Yuan
2000
2005
2010
2020
2030
2040
2050
Year
Low GDP Growth
High GDP Growth

GDP by sectors



Products output in major sectors, BaU

	Unit	2005	2020	2030	2040	2050
Steel	Million ton	355	610	570	440	360
Cement	Million ton	1060	1600	1600	1200	900
Glass	Million Cases	399	650	690	670	580
Copper	Million ton	2.6	7	7	6.5	4.6
Aluminum	Million ton	8.5	16	16	15	12
Zingc&Lead	Million ton	5.1	7.2	7	6.5	5.5
Soda Ash	Million ton	14.67	23	24.5	23.5	22
Caustic	Million ton	12.6	24	25	25	24
Paper	Million ton	62	110	115	120	120
Fertilizer	Million ton	52.2	61	61	61	61
Ethylene	Million ton	7.56	34	36	36	33
Ammonia	Million ton	46.3	50	50	50	45
Calisium	Million ton	8.5	10	8	7	4

Population

	2005	2010	2020	2030	2040	2050
Population	1307.56	1360.00	1440.00	1470.00	1470.00	1440.00
Urbanization rate	43%	49%	63%	70%	74%	79%
Urban Population	562.12	666.40	907.20	1029.00	1087.80	1137.60
Person per Household	2.96	2.88	2.80	2.75	2.70	2.65
Urban Household	189.91	221.94	288.00	336.76	364.78	380.38
Rural Population	745.44	693.60	532.80	441.00	382.20	302.40
Person per Household	4.08	3.80	3.50	3.40	3.20	3.00
Rural Household	182.71	189.68	181.03	159.97	151.59	144.00

Vehicle fleet, BaU, 10000

	2000	2005	2010	2020	2030	2040	2050
Total Vehicle	1609	3160	6836	19538	39672	56372	60524
Passenger	854	2132	4869	16330	35376	50314	53117
Freight	716	1027	1967	3208	4296	6058	7407
Car	670	1919	4589	15970	34866	49594	52217
Family Car	57	1100	3589	14770	33466	47994	50617
Other Car	613	819	1000	1200	1400	1600	1600
Mini-Bus	108	131	162	202	275	374	450
Large Bus	75.3293	82.3080335	117.6	158.4	234.6	345.6	450
Bus	184	214	280	360	510	720	900
Motor Cycle	3771	6582	9947	10942	12036	12036	11434
	0.2	3.0	9	31	67	93	97

Vehicle fleet, Low Carbon scenario, 10000

	2000	2005	2010	2020	2030	2040	2050
Total Vehicle	1609	3160	6227	18583	36318	51717	55810
Passenger	854	2132	4299	15504	32323	46083	48922
Freight	716	1027	1928	3079	3995	5634	6888
Car	670	1919	3921	14982	31558	45075	47662
Family Car	57	1100	3145	14032	30454	43675	46062
Other Car	613	819	776	950	1104	1400	1600
Mini-Bus	108	131	265	313	383	524	214
Large Bus	75.3293	82.3080335	113.4	208.8	382.5	483.84	1045.8
Bus	184	214	378	522	765	1008	1260
Motor Cycle	3771	6582	9848	10613	11193	11193	10634

Transport, Low carbon scenario

		2005	2010	2020	2030	2040	2050
Family car ownership, per 100HH	Urban	3.37	14	36	65	77	78
	Rural	0.08	0.2	8	38	70	90
Family car annual travel distance, km		9500	9500	9300	8635	8300	7480
Average engin size of family cars, litter		1.7	1.6	1.6	1.6	1.5	1.4
Fuel efficiency of car, L/100km		9.2	8.9	7.1	5.9	4.8	4.1
Share of MRT in total traffic volume, %		0.011	0.016	0.025	0.046	0.1	0.21
Share of Biofuel, %		1.10%	1.30%	4.1%	7.70%	12%	13%
Share of electric car, %		0%	0.12%	3.2%	6.80%	12.5%	19.8%
Share of fuel cell car, %		0%	0%	0.80%	1.60%	4.70%	7.90%

Identify efficiency promised technologies: fully used by 2020

Sector	Technologies
Steel Industry	Large size equipment (Coke Oven, Blast furnace, Basic oxygen furnace ,etc.), Equipment of coke dry quenching, Continuous casting machine, TRT Continuous rolling machine, Equipment of coke oven gas, OH gas and BOF gas recovery , DC-electric arc furnace
Chemical Industry	Large size equipment for Chemical Production, Waste Heat Recover System, Ion membrane technology, Existing Technology Improving
Paper Making	Co-generation System, facilities of residue heat utilization, Black liquor recovery system, Continuous distillation system
Textile	Co-generation System, Shuttleless loom, High Speed Printing and Dyeing
Non-ferrous metal	Reverberator furnace, Waste Heat Recover System, QSL for lead and zinc production
Building Materials	dry process rotary kiln with pre-calciner, Electric power generator with residue heat, Colburn process, Hoffman kiln, Tunnel kiln
Machinery	High speed cutting, Electric-hydraulic hammer, Heat Preservation Furnace
Residential	Cooking by gas, Centralized Space Heating System, Energy Saving Electric Appliance, High Efficient Lighting
Service	Centralized Space Heating System, Centralized Cooling Heating System, Co-generation System, Energy Saving Electric Appliance, High Efficient Lighting
Transport	Diesel truck, Low Energy Use Car, Electric Car, Natural Gas Car, Electric Railway Locomotives
Common Use Technology	High Efficiency Boiler, FCB Technology, High Efficiency Electric Motor Speed Adjustable Motor, Centrifugal Electric Fun, Energy Saving Lighting

IPCC Range

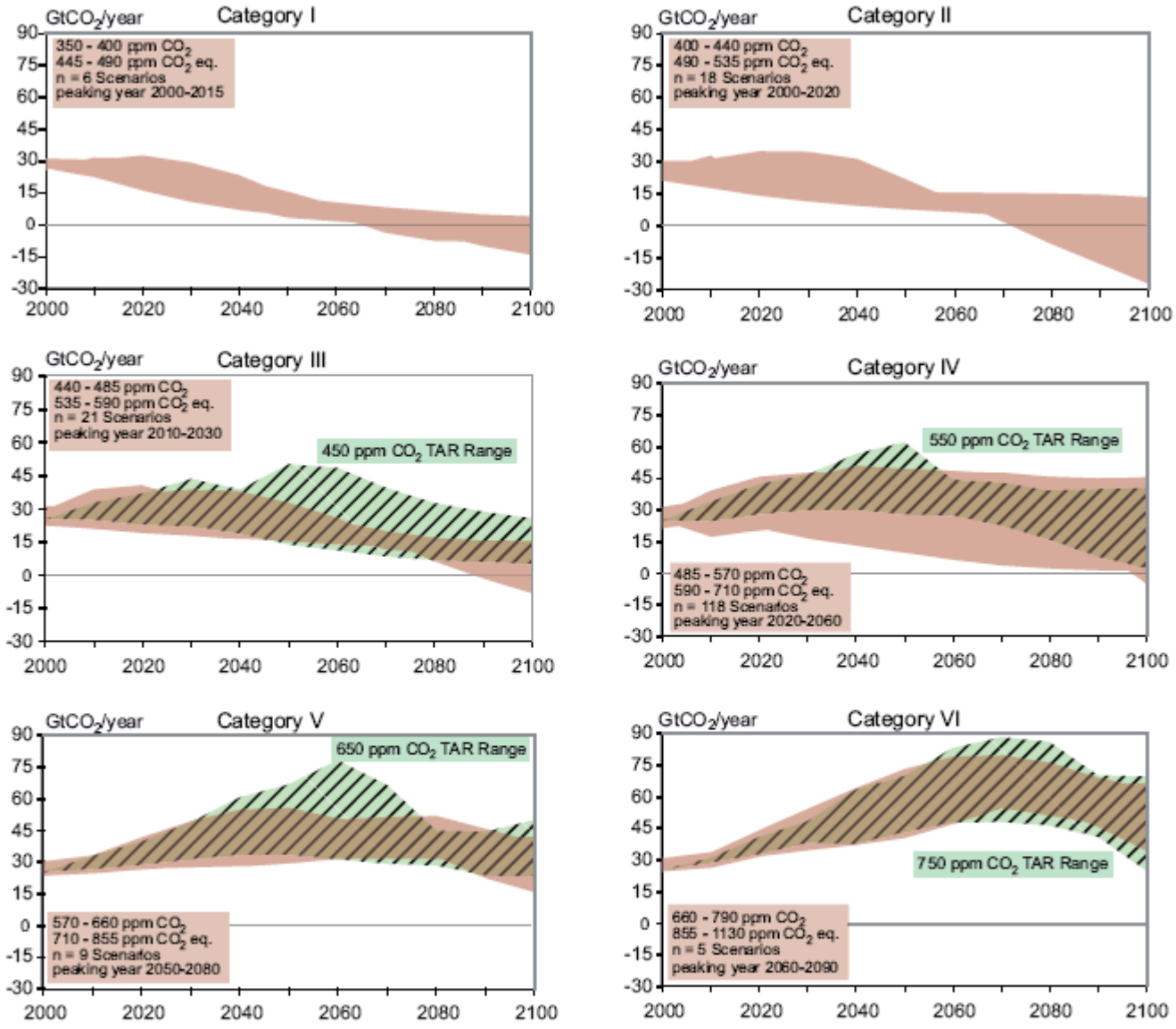
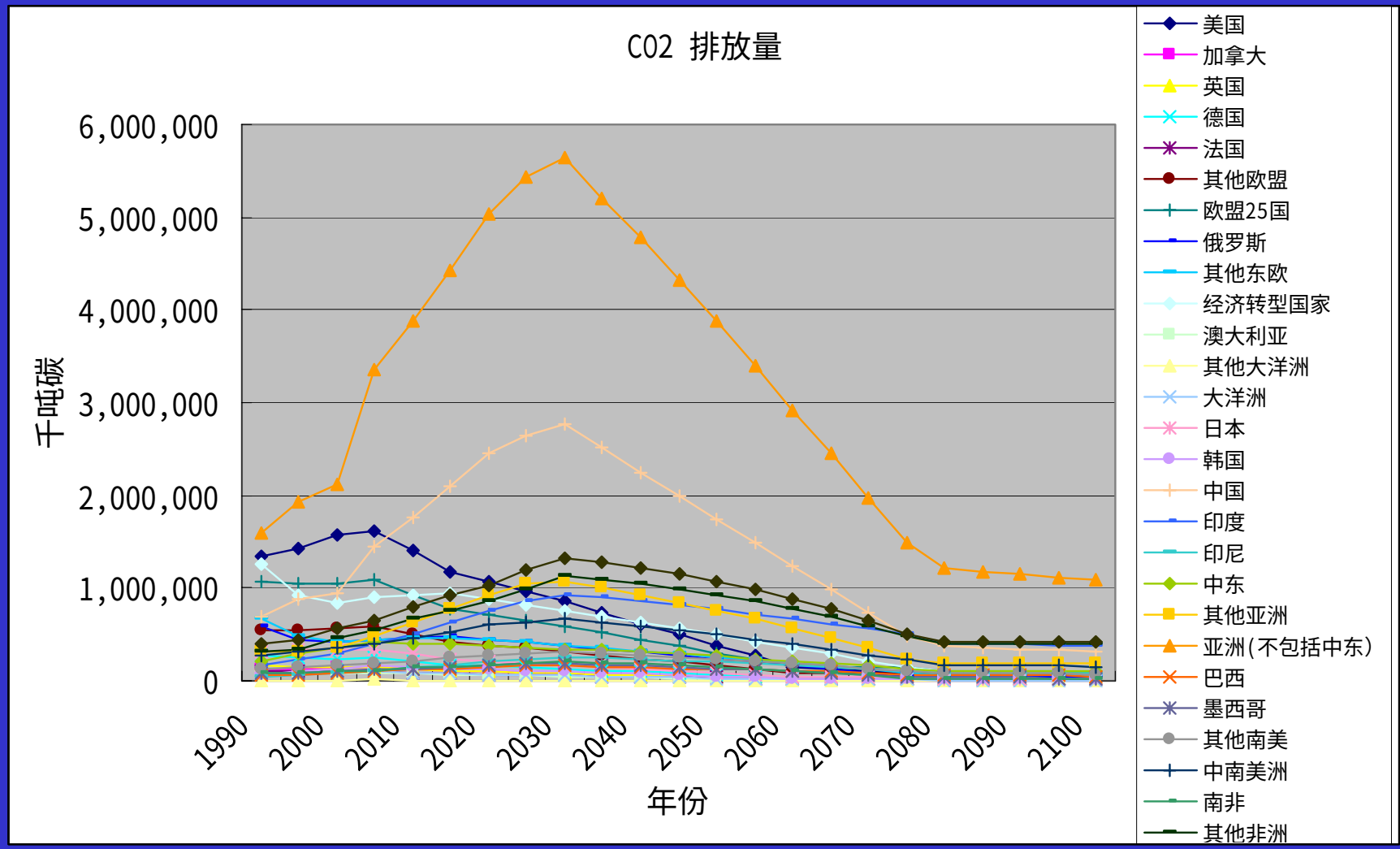
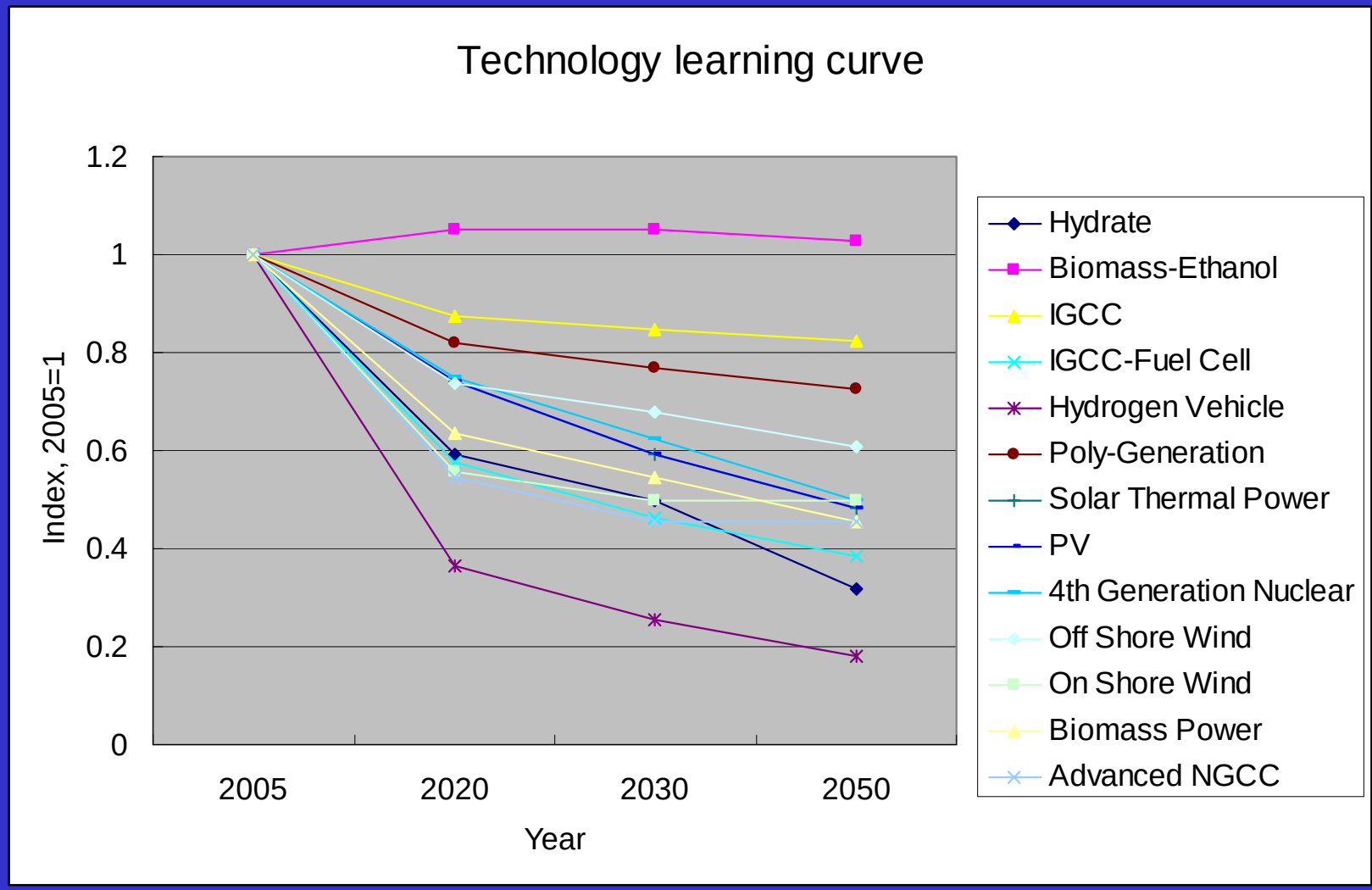
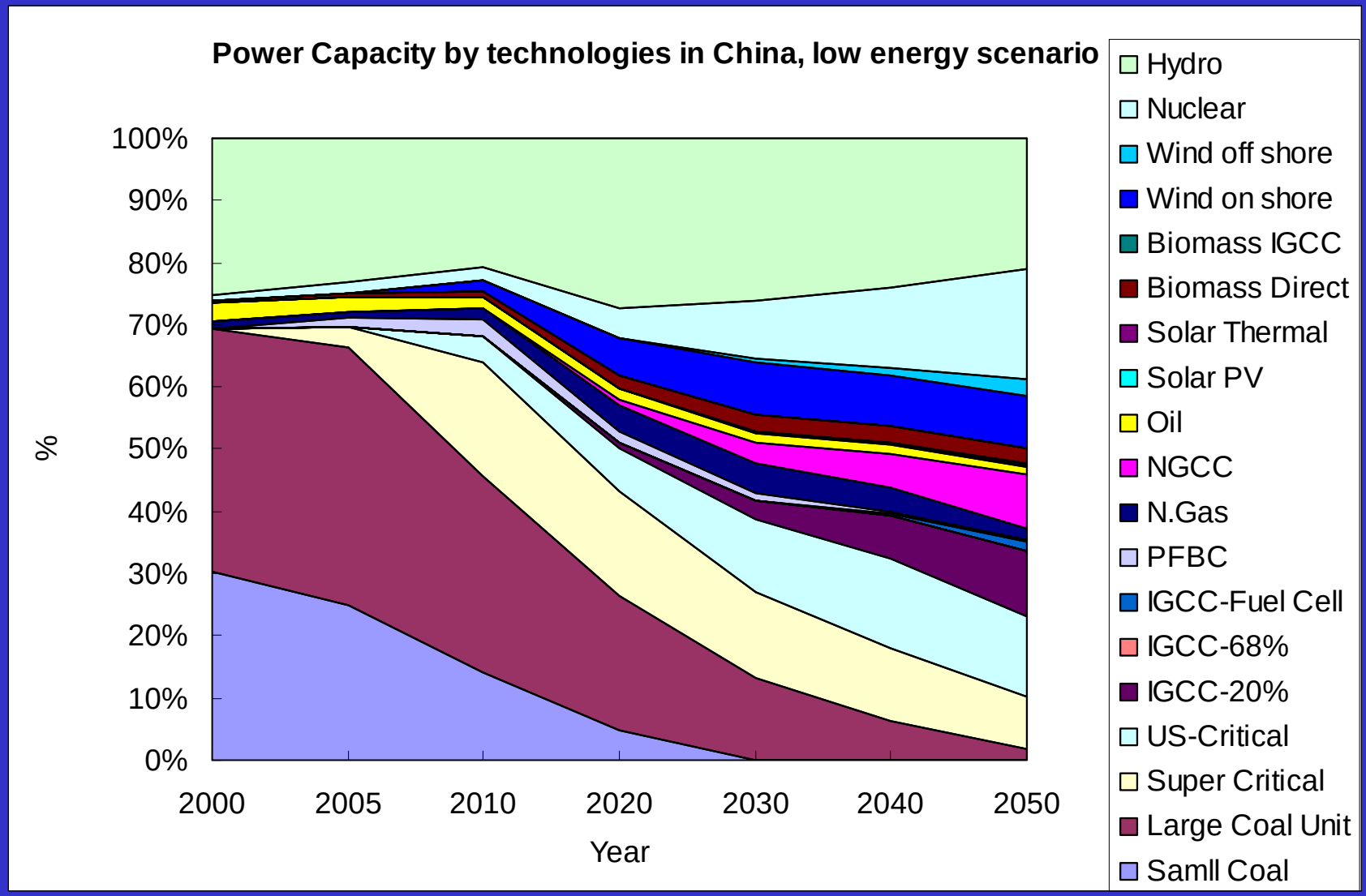


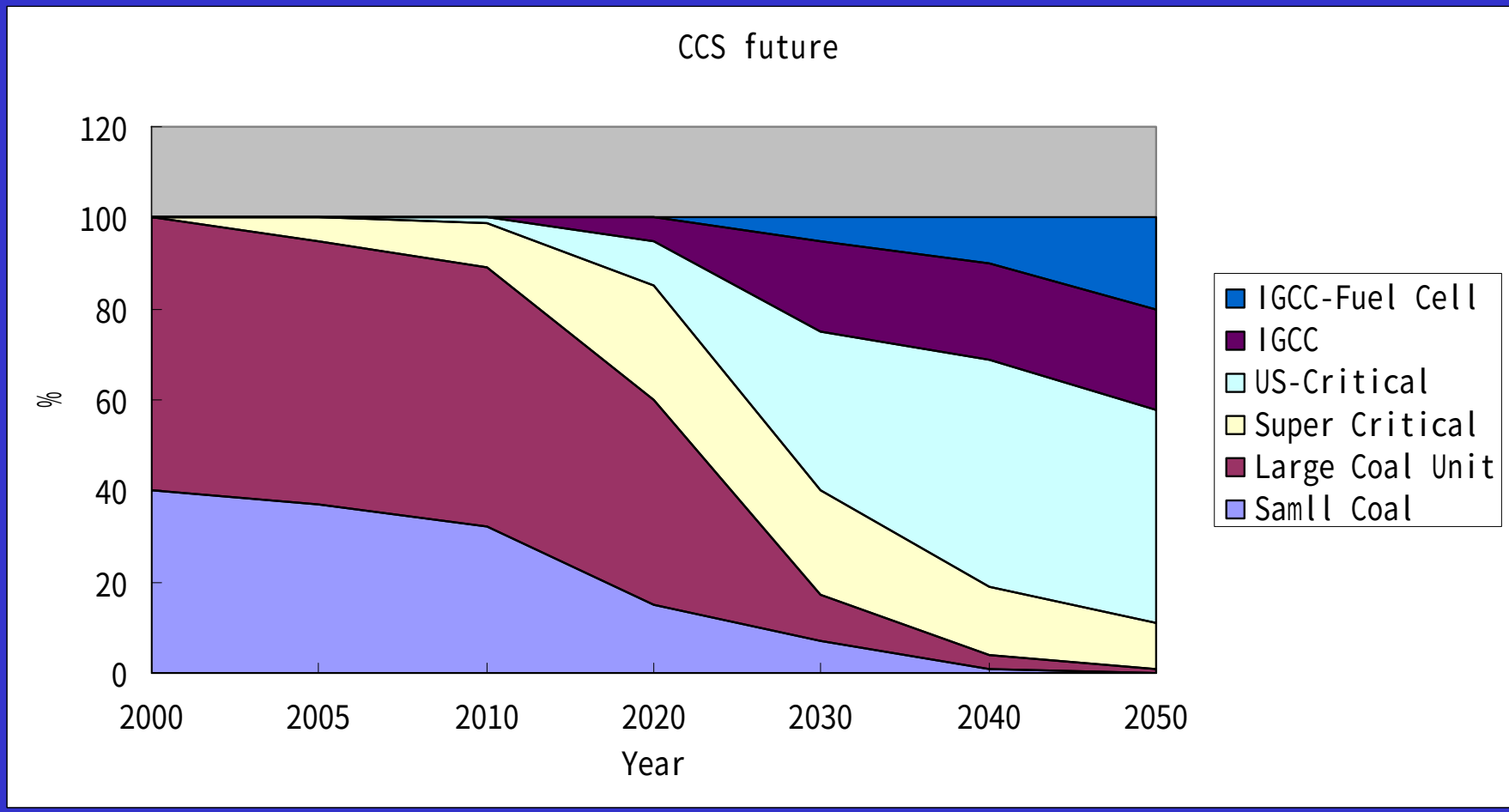
Figure SPM.7: *Emissions pathways of mitigation scenarios for alternative categories of stabilization levels (Category I to VI as defined in the box in each panel). The pathways are for CO_2 emissions only. Light brown shaded areas give the CO_2 emissions for the post-TAR emissions scenarios. Green shaded and hatched areas depict the range of more than 80 TAR stabilization scenarios. Base year emissions may differ between models due to differences in sector and industry coverage. To reach the lower stabilization levels some scenarios deploy removal of CO_2 from the atmosphere (negative emissions) using technologies such as biomass energy production utilizing carbon capture and storage. [Figure 3.17]*

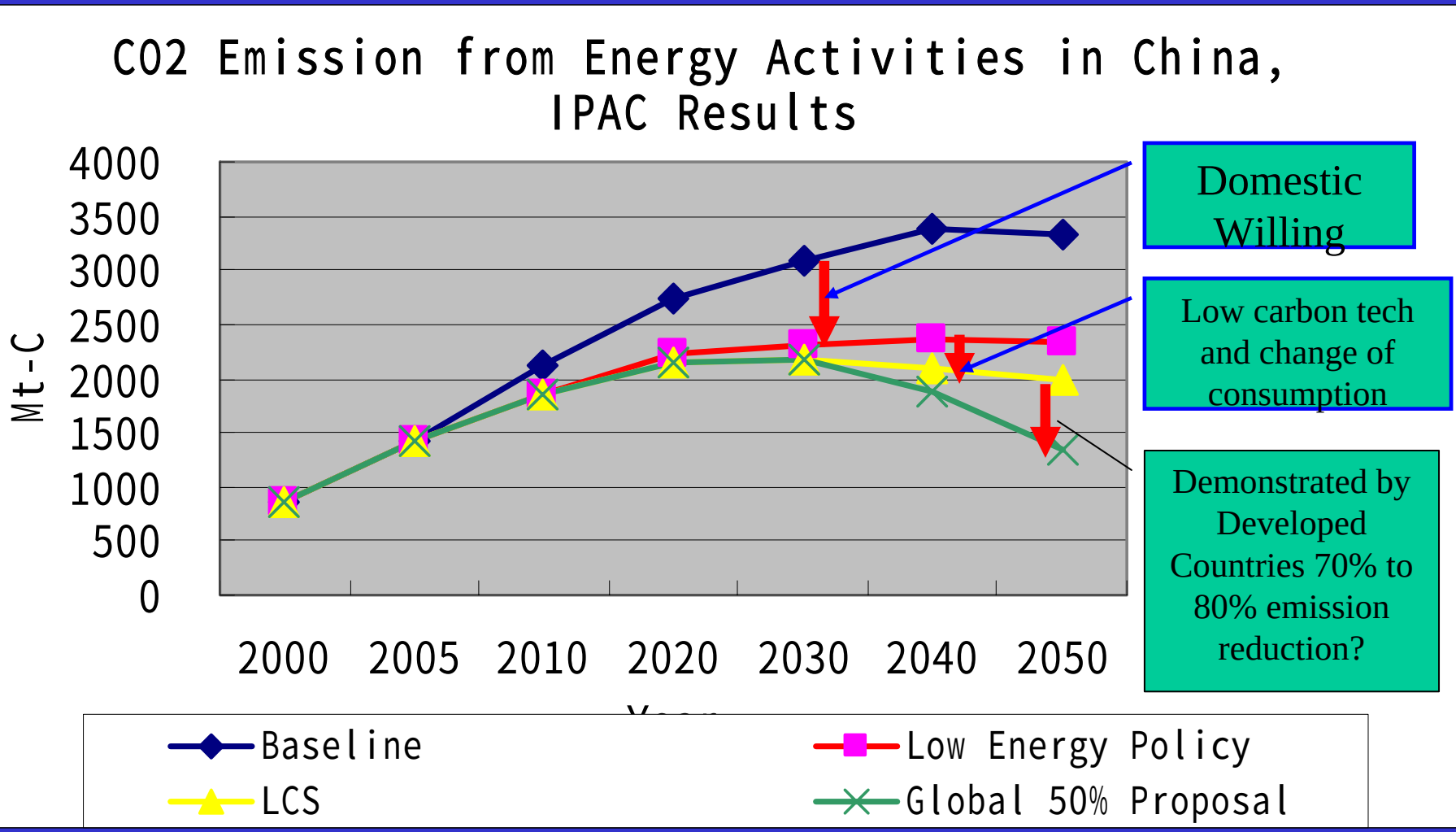
CO2 Emission, Per Capita Convergence, 540ppm

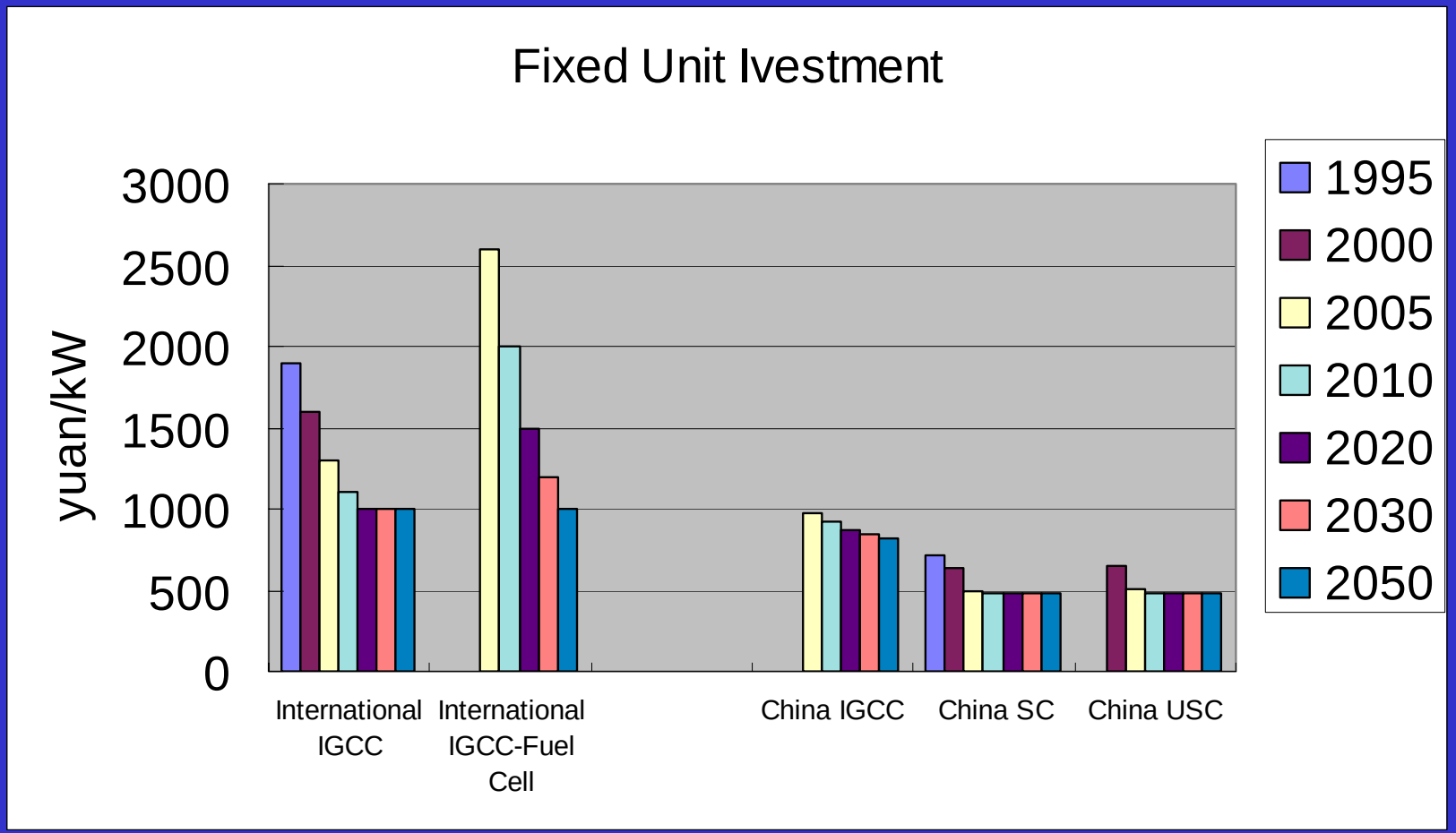



Technology learning curve
1.2
1
0.8
0.6
0.4
0.2
0
Index, 2005=1
2005
2020
2030
2050
Year
Hydrate
Biomass-Ethanol
IGCC
IGCC-Fuel Cell
Hydrogen Vehicle
Poly-Generation
Solar Thermal Power
PV
4th Generation Nuclear
Off Shore Wind
On Shore Wind
Biomass Power
Advanced NGCC


Power Capacity by technologies in China, low energy scenario
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
%
2000
2005
2010
2020
2030
2040
2050
Year
Hydro
Nuclear
Wind off shore
Wind on shore
Biomass IGCC
Biomass Direct
Solar Thermal
Solar PV
Oil
NGCC
N.Gas
PFBC
IGCC-Fuel Cell
IGCC-68%
IGCC-20%
US-Critical
Super Critical
Large Coal Unit
Samll Coal


CCS future
120
100
80
60
40
20
0
%
2000
2005
2010
2020
2030
2040
2050
Year
IGCC-Fuel Cell
IGCC
US-Critical
Super Critical
Large Coal Unit
Saml Coal

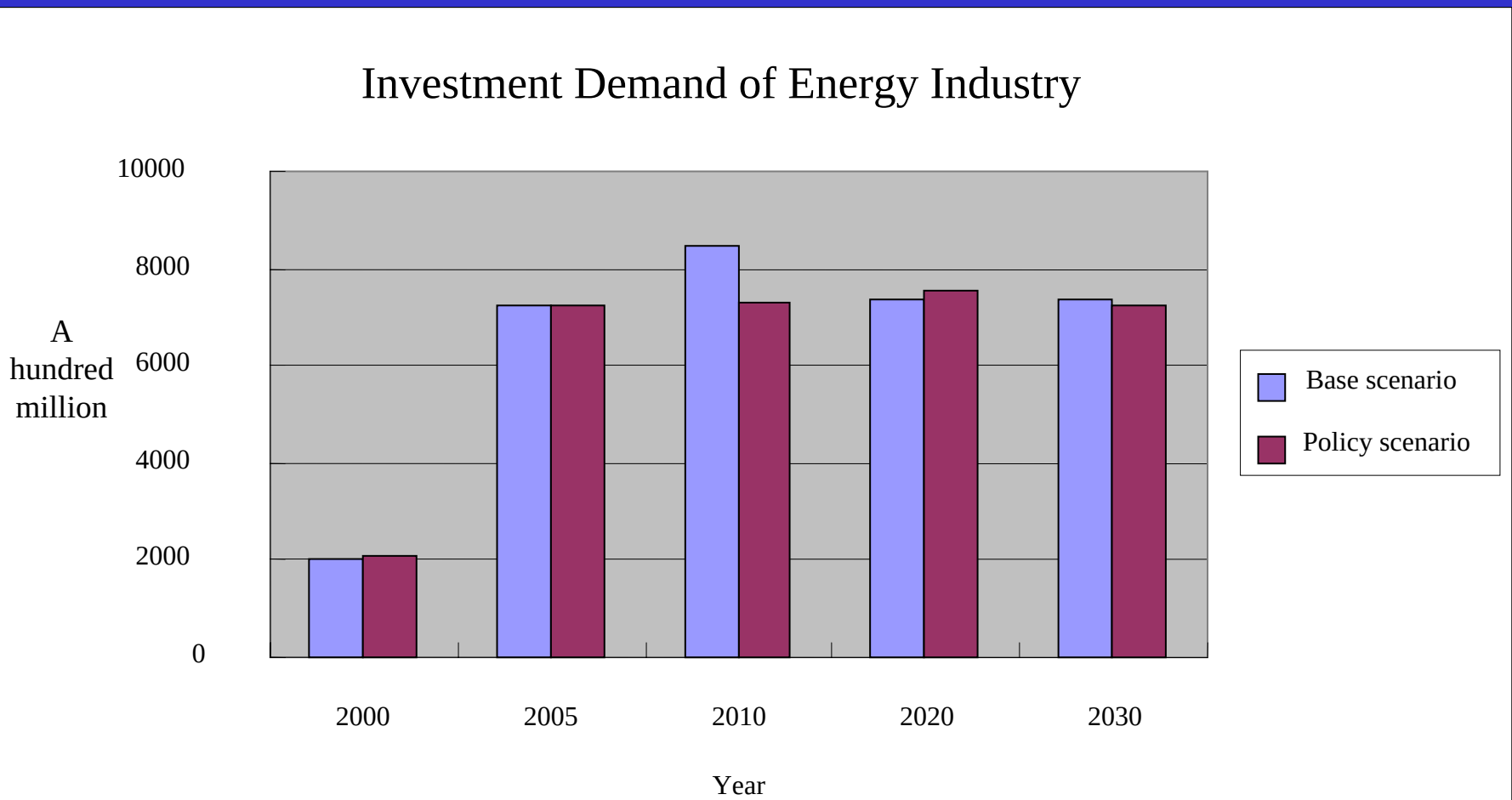

CO2 Emission from Energy Activities in China, IPAC Results
4000
3500
3000
2500
2000
1500
1000
500
0
Mt-C
2000
2005
2010
2020
2030
2040
2050
Year
Baseline
Low Energy Policy
LCS
Global 50% Proposal
Domestic Willing
Low carbon tech and change of consumption
Demonstrated by Developed Countries 70% to 80% emission reduction?


Fixed Unit Ivestment
yuan/kW
3000
2500
2000
1500
1000
500
0
International IGCC
International IGCC-Fuel Cell
China IGCC
China SC
China USC
1995
2000
2005
2010
2020
2030
2050

Chinese Manufactured green cars, picture from 2008 Beijing Automobile Exhibition


EV

Stockholm: back to bicycle and walking


Investment Demand of Energy Industry
10000
8000
6000
4000
2000
0
A hundred million
2000
2005
2010
2020
2030
Year
Base scenario
Policy scenario

National Energy Expenses