



Nuclear Energy in China: Before and After Fukushima

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Outlines

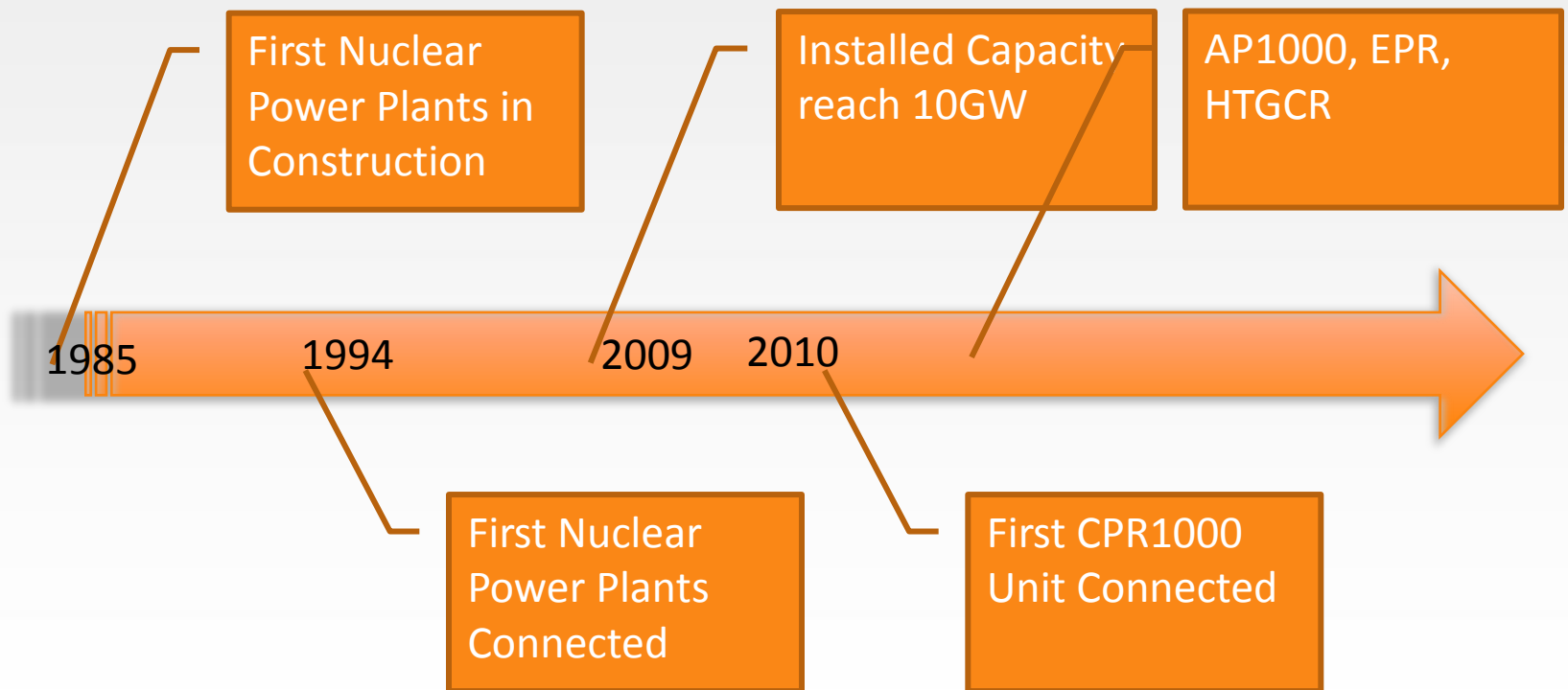
- Nuclear in China: Present and Future;
- Why Booming?
- Nuclear and 450ppm;
- China's nuclear power policy after Fukushima;



Nuclear in China: Present and Future



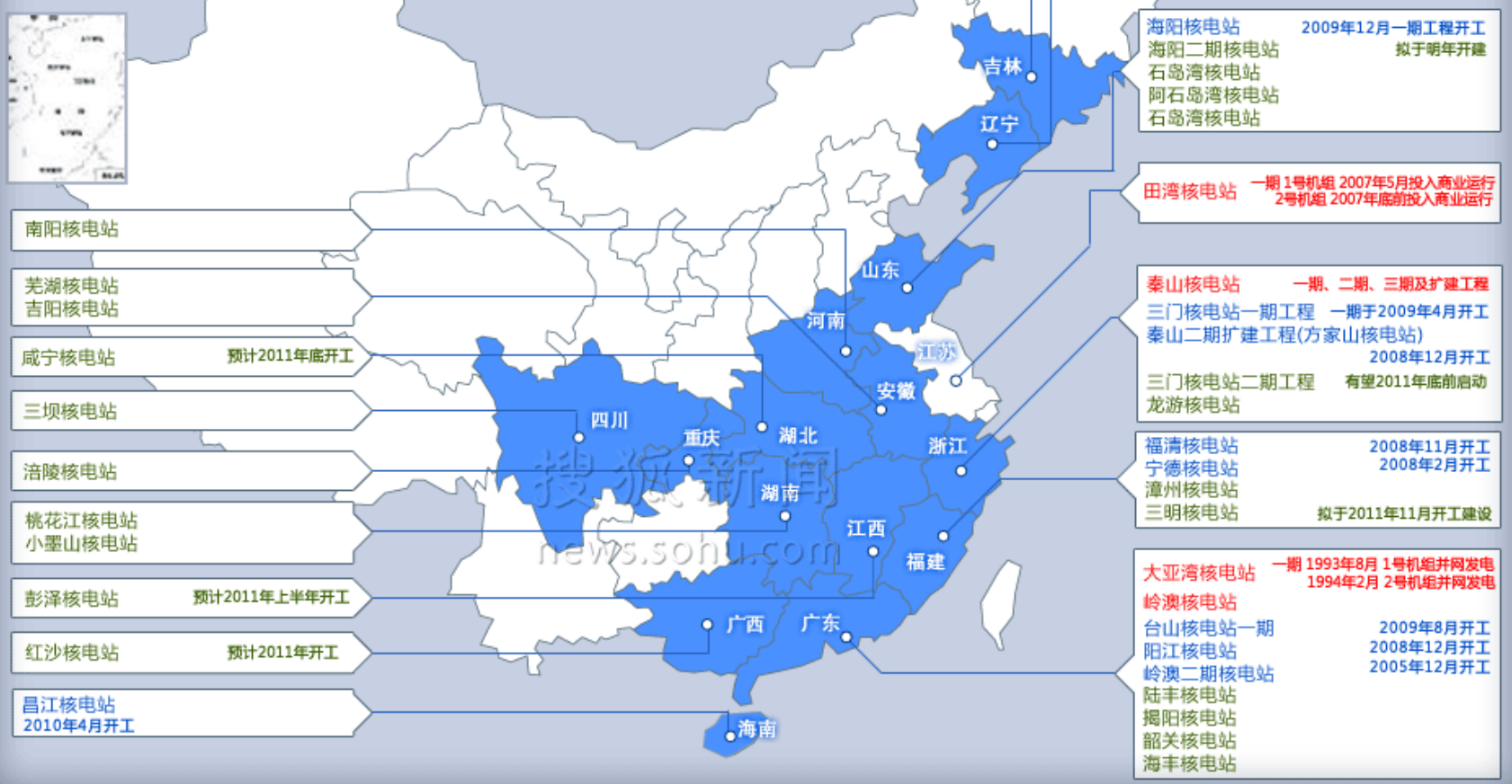
A Brief History





Sites of Nuclear Power Plants in China

Red: Existing Nuclear Power Plants
Blue: Nuclear Power Plants in Construction
Green: Feasibility Study Approved



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Medium and Long-term Plan

- Medium and Long-term Plan for Nuclear Power (2005 to 2020)
- Principles:
 - 1) to actively promote construction of a nuclear power plant;
 - 2) to promote independent and domestic products for a nuclear power plant;
 - 3) to adhere to the reactor line of a thermal neutron reactor – fast neutron reactor - fusion reactor;
 - 4) to achieve self-design, self-production, self-construction and self-operations for a 1000MW PWR;
 - 5) to reduce the cost by a competitive bidding.



Medium and Long-term Plan

- The medium term target is to expand the nuclear power plant capacity in operation into 40GW by 2020;
- This target is based on two assumptions:
 - Projected total generation capacity will reach 1000 GW in year 2020;
 - Share of nuclear will increase to 4%;
- Both assumptions have changed, latest capacity projection will be around 1400 GW, and Director of National Bureau of Energy declare a new share target of 5%;
- It is expected that nuclear capacity will reach 70GW to 80GW in year 2020, 160-200GW in year 2030, 400-450GW in year 2050;

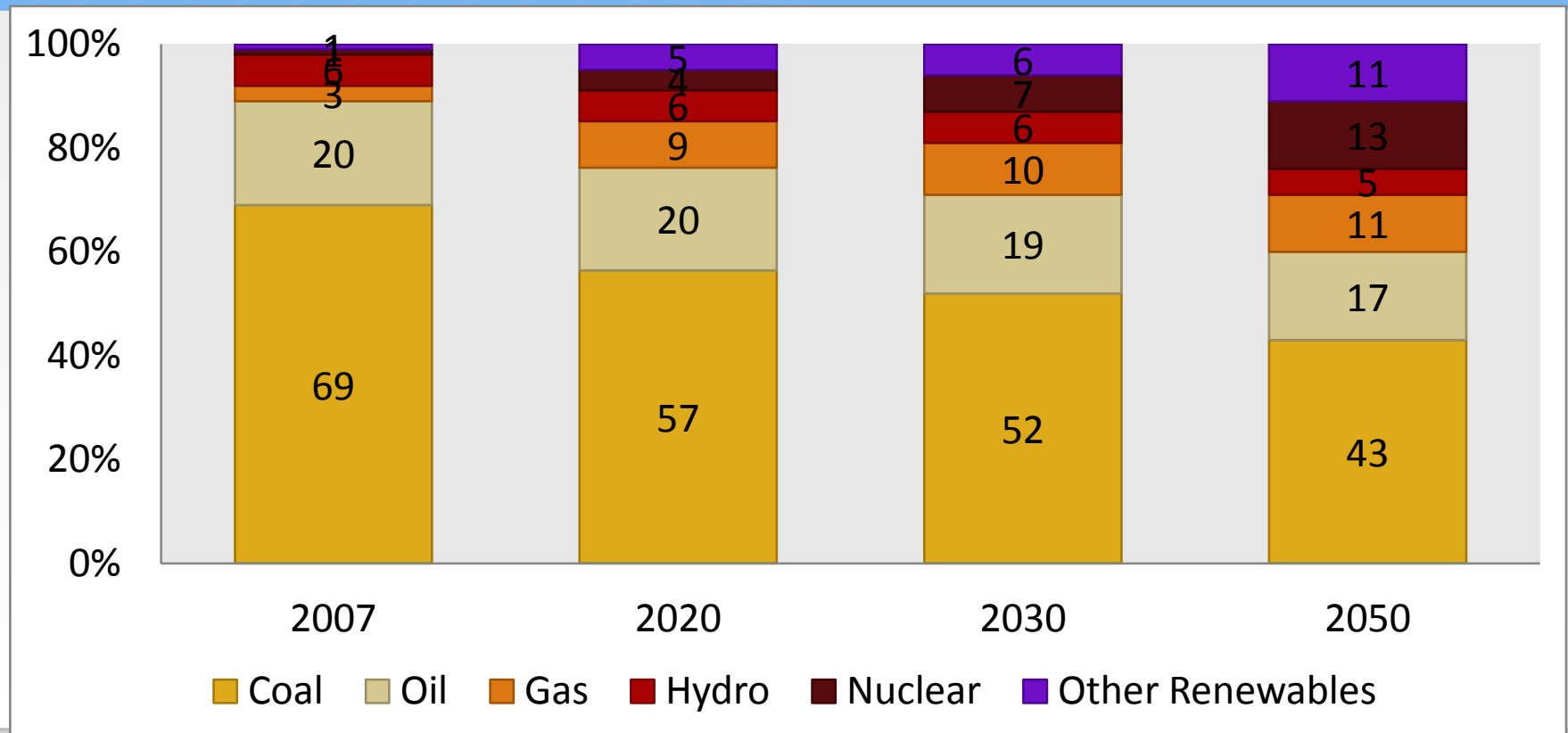


Statistics of Nuclear Power Plants Sites

	Sites	Unit	Capacity (GW)
Existing Plants	7	11	9.1
In Construction	7	22	21
FSR Approved	6	11	12
PFSR Finished	33	66	66
Planned	33	66	118
Total	53	110	250

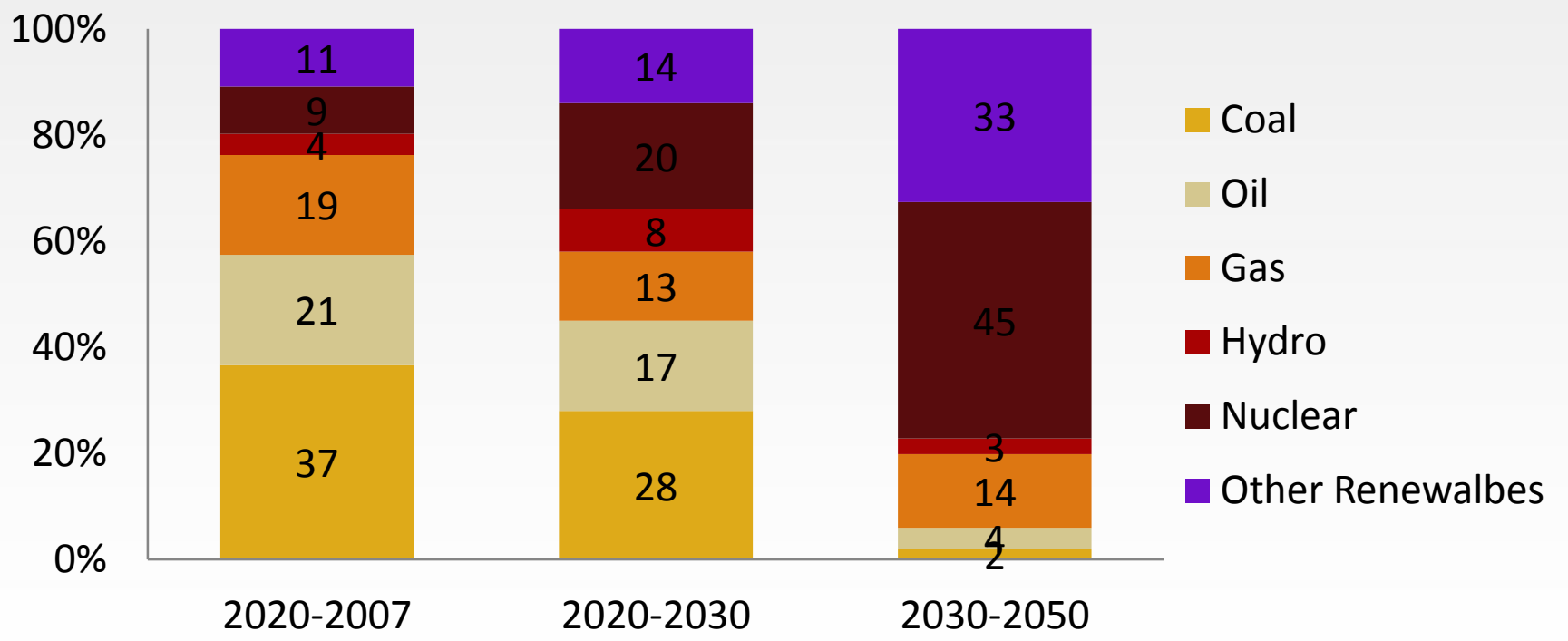


Energy Mix in the Future





Energy Mix in Incremental Energy Supply





Why Booming?

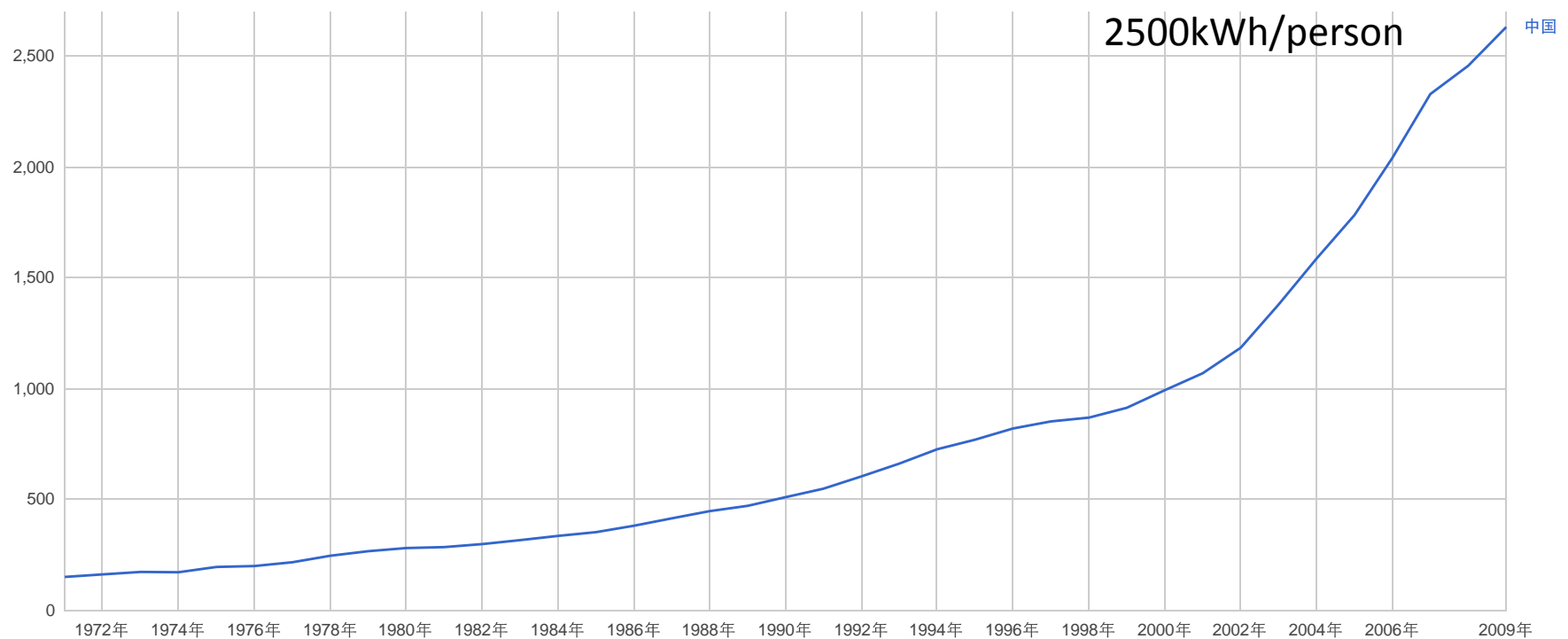


Reason for booming

- Growth of electricity consumption;
- n with other alternative technologies;
- Mitigation Pressure;
- Energy Security?

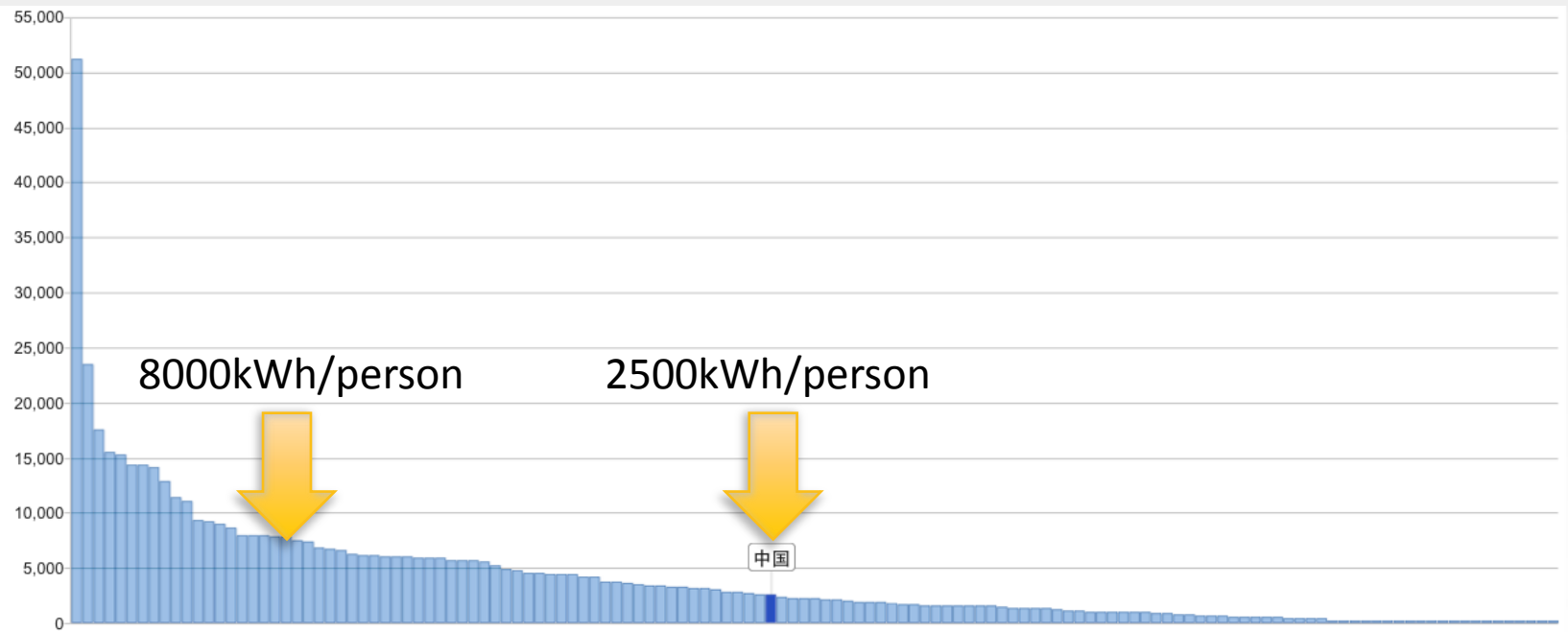


Increasing Per capita electricity consumption (1972-2009)





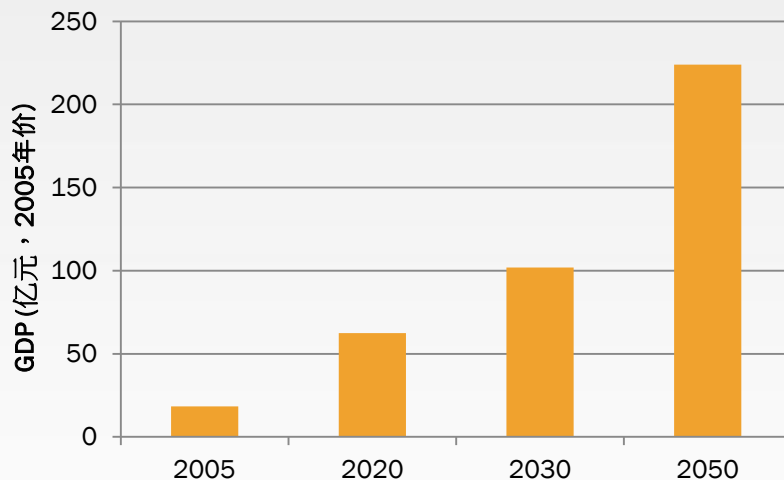
Per capita electricity consumption in 2009





1. Fast growing economy will continuously drive growth of energy consumption and related emission

Energy and Emission Trends



GDP growth rate

2005 ~ 2020 : 8.5%

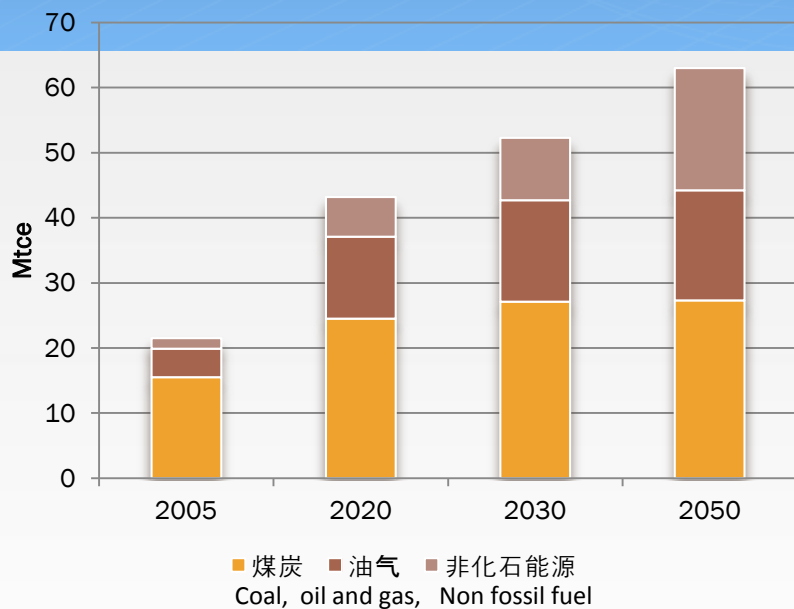
2020 ~ 2030 : 6.0%

2030 ~ 2050 : 3.8%

Year 2050: GDP per capita will reach 20000 \$ (2005 price)



Energy and Emission Trend



- ▶ Even energy intensity decrease by 40% and 80% in year 2020 and 2050, energy consumption will still double and triple at that time.
- ▶ Production of coal will achieve 4 billion tons in 2030, breaking resource and environment capacity limitation.
- ▶ Dependence rate of oil will achieve 65-70%.

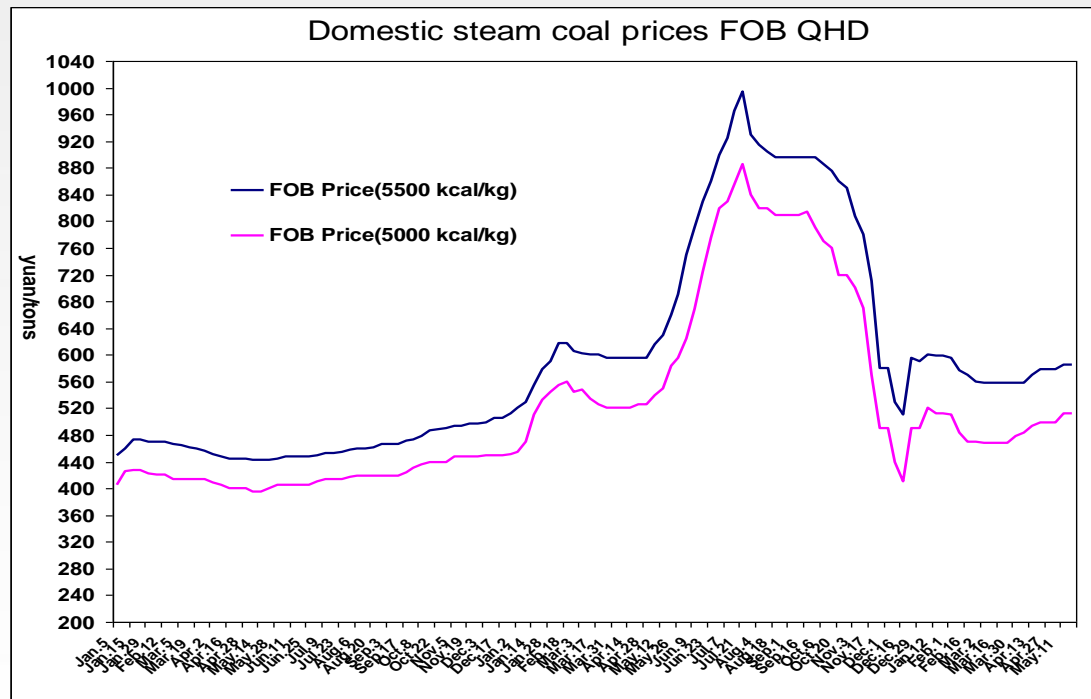


Comparison with other technologies

	PWR	AP1000	EPR1500	Coal
Investment cost	11.45	14.52	16.59	5.72
Fuel cost	6.94	6.86	5.76	14.04
O&M cost	5.85	5.53	5.88	3.89
Total levelized cost	24.25	26.91	28.23	23.65

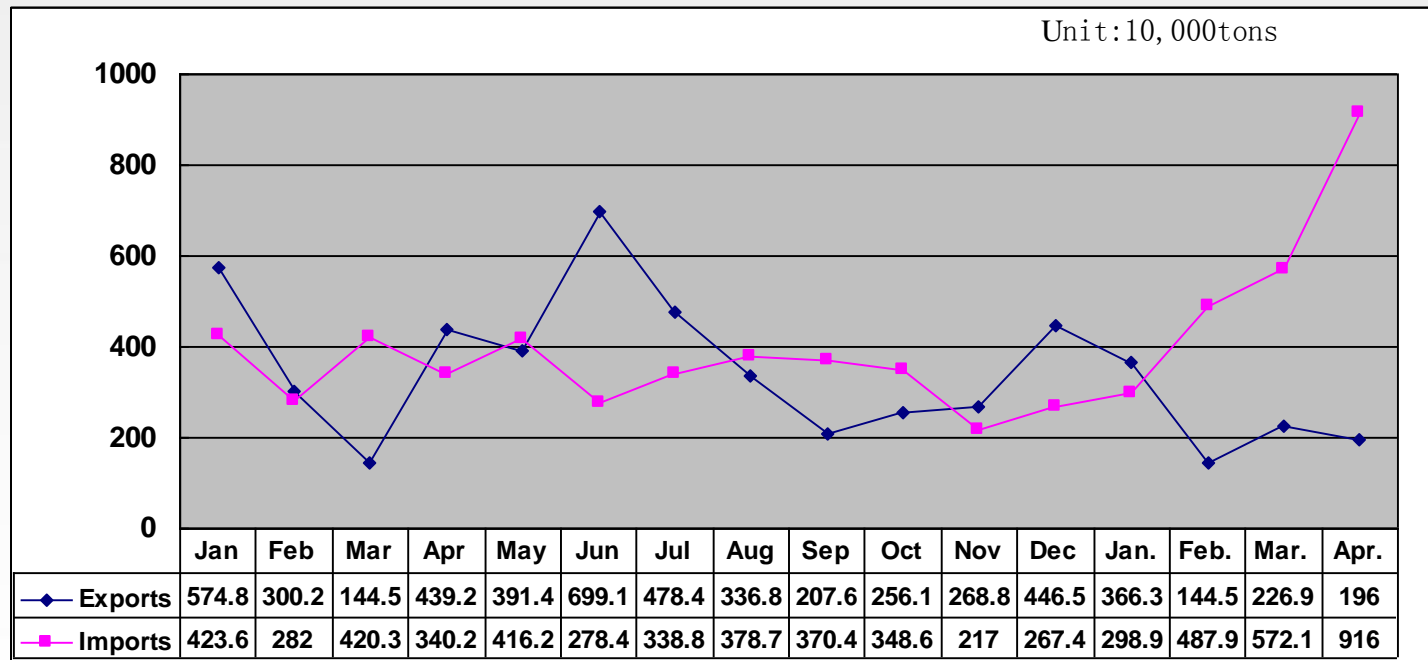


Trend of Coal Price



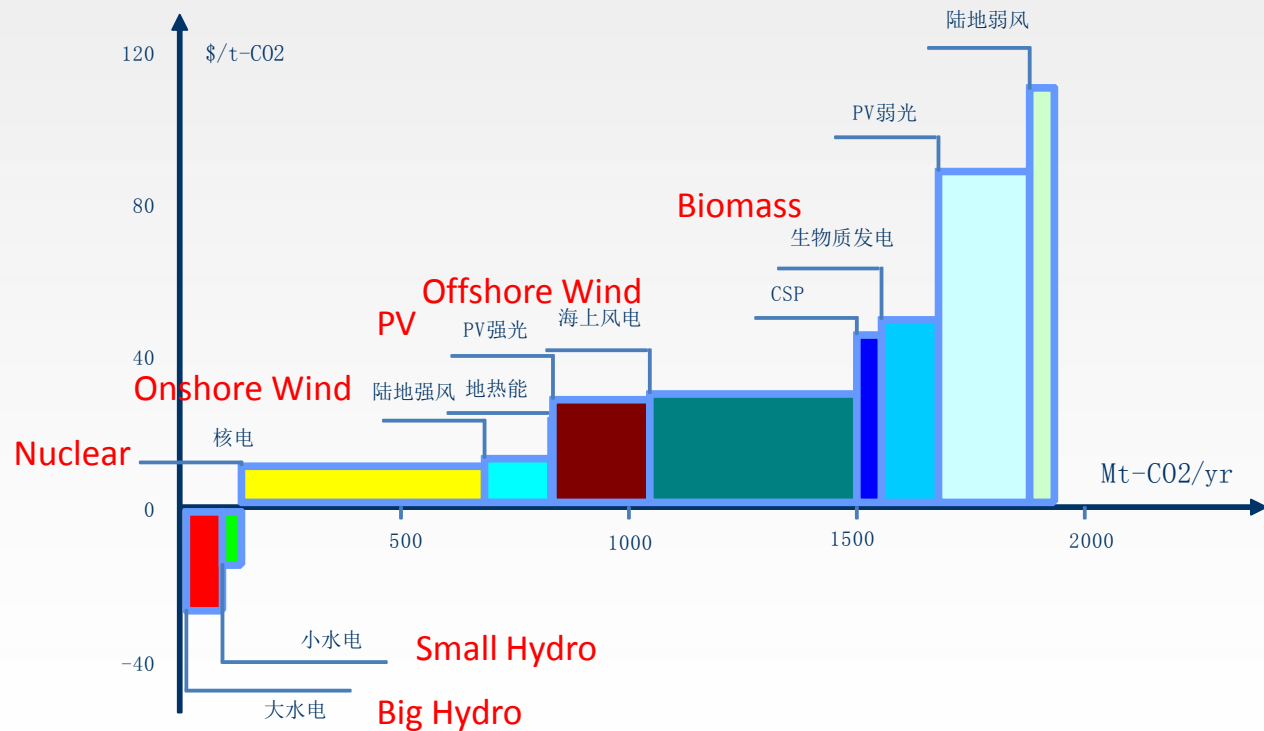


Coal Import and Output





Marginal Abatement Cost Curve



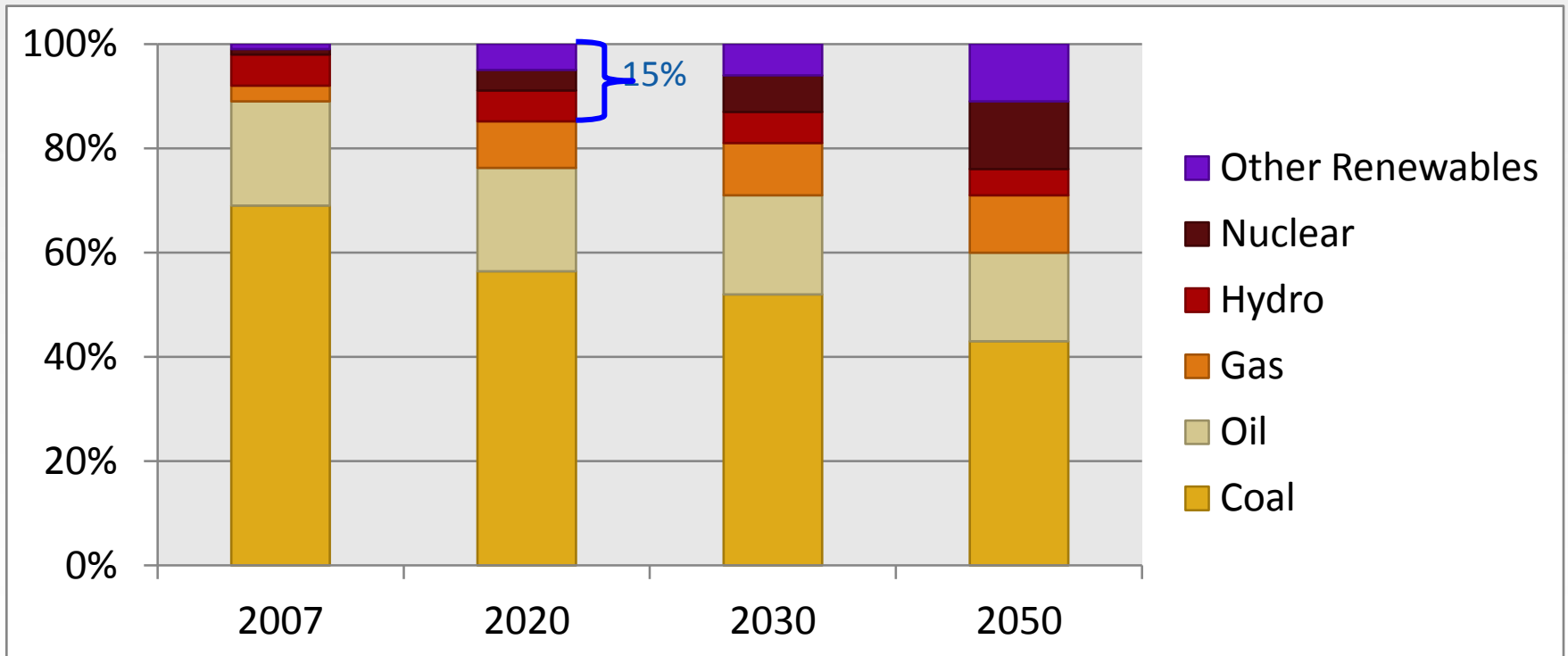


China's Mitigation Action

- China will endeavor to *lower its carbon dioxide emissions per unit of GDP by 40-45% by 2020* compared to the 2005 level;
- China will Increase *the share of non-fossil fuels in primary energy consumption to around 15% by 2020*;
- China *will increase forest coverage by 40 million hectares and forest stock volume by 1.3 billion cubic meters by 2020* from the 2005 levels;

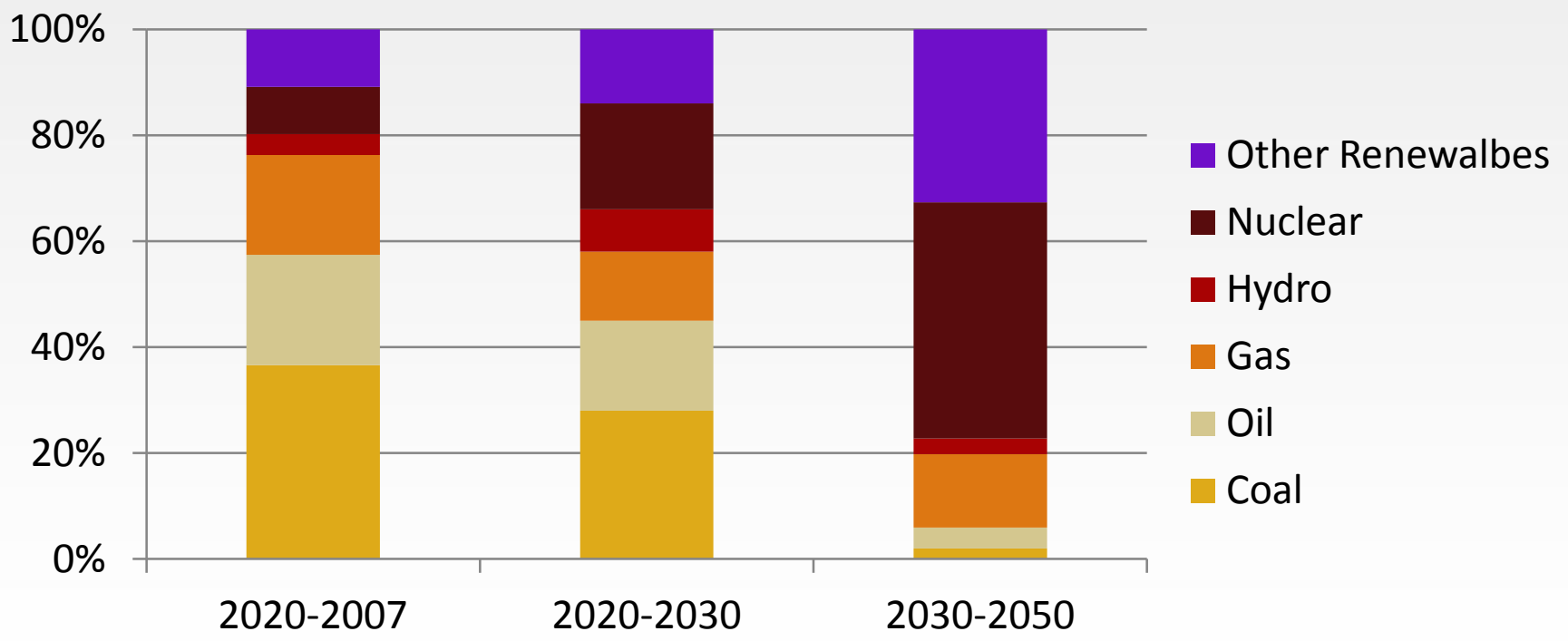


Energy Mix in the Future



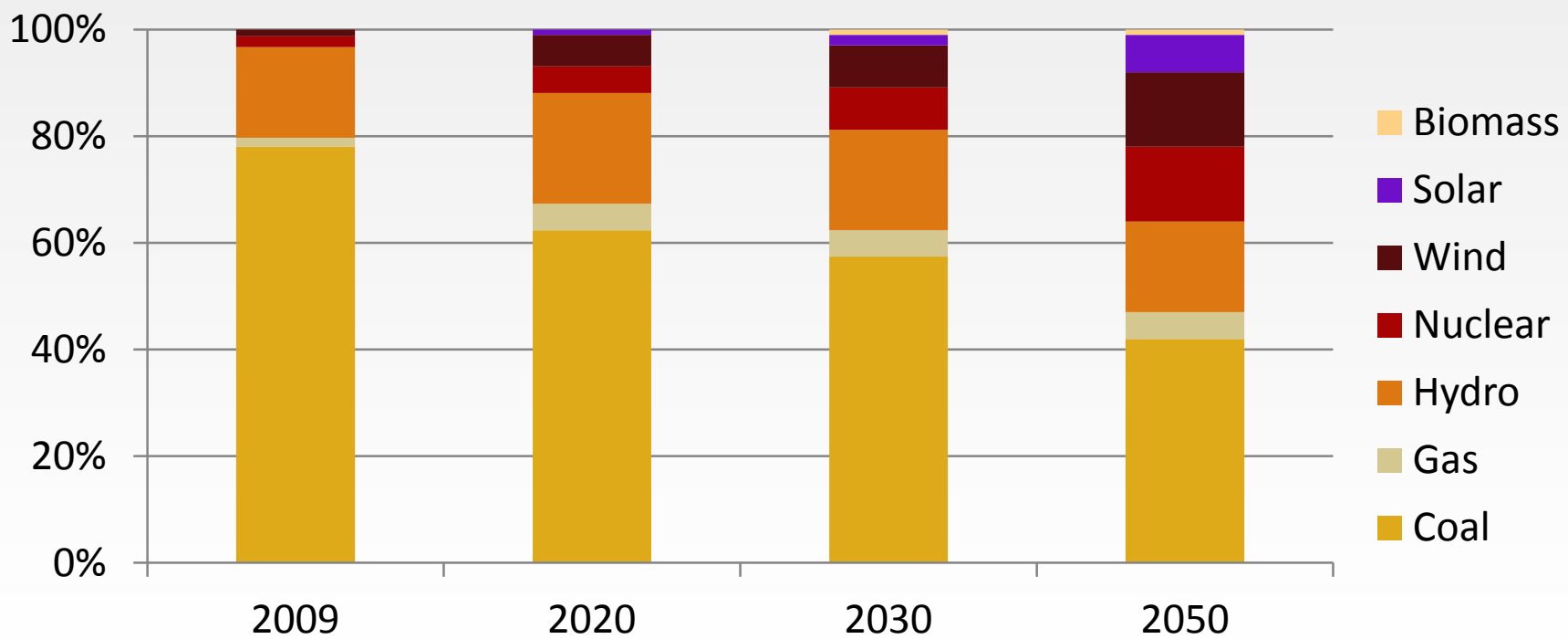


Energy Mix in Additional Energy Supply





Share in Generation Capacity

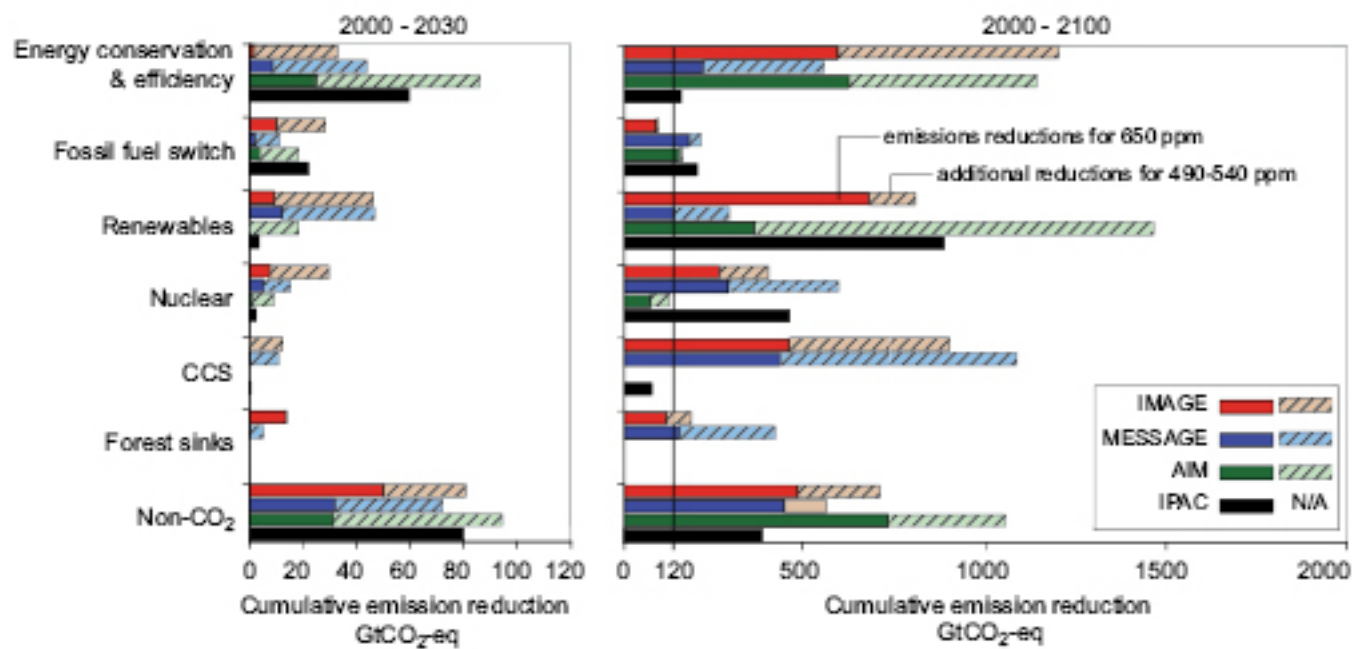




After Fukushima: Nuclear and 450ppm



Assessment in AR4



Source: IPCC 2007



Nuclear development and 450ppm

- BAU: nuclear capacity 424 GW;
- Mitigation scenario: additional 119-356 GW, total 543-780 GW;
- Consistent with IAEA estimation in year 2010;

Region	2008	2010		2020		2030	
		Low	High	Low	High	Low	High
North America	113.3	114	115	126	130	127	168
Latin America	4.0	4.0	4.0	6.9	8.0	10.8	23
Western Europe	122.5	119	122	90	131	82	158
Eastern Europe	47.5	47	47	68	81	83	121
Africa	1.8	1.8	1.8	2.8	4.1	6.1	17
Middle East and South Asia	4.2	7	10	13	24	20	56
South East Asia and the Pacific						0	5.2
Far East	78.3	79	80	138	165	183	259
World total	371.6	372	380	445	543	511	807

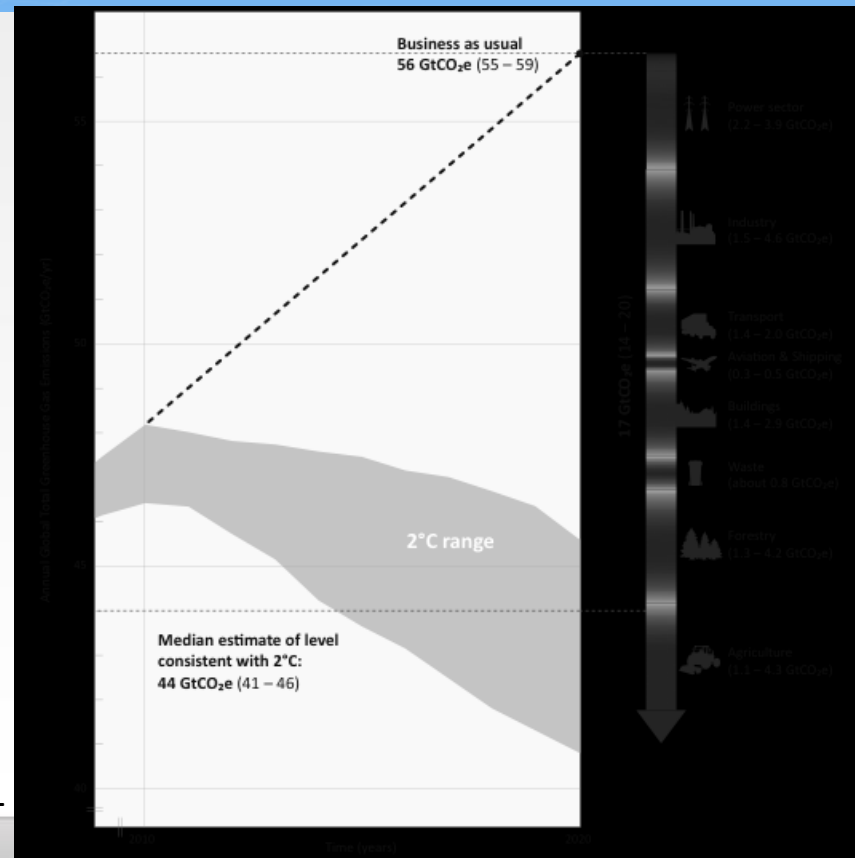
Source: IAEA 2010



But what will happen after Fukushima

- Low nuclear development scenario from IEA: 14%-10%;
- Almost impossible to achieve 2 degree target;
- Golden age for gas?

Source: UNEP 2011





China's Nuclear Policy After Fukushima



Response from government

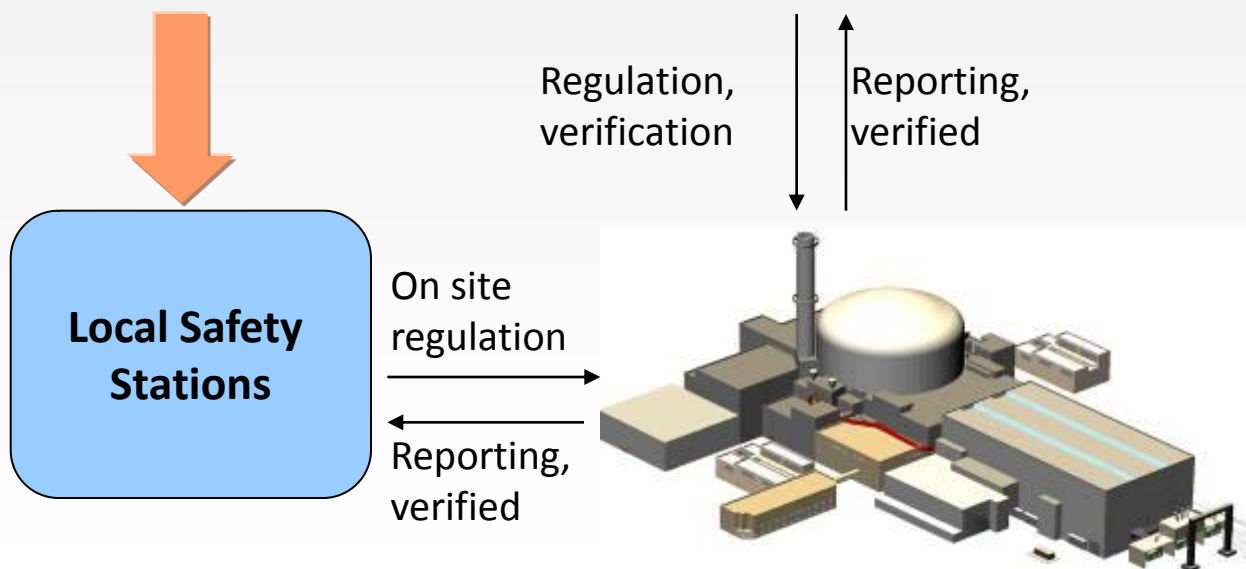
State Council Meeting Chaired by Prime Minister at 18 March 2011

- Comprehensive safety review for existing nuclear facilities;
- Enhancing safety management of existing power plants;
- Comprehensive review on nuclear plants in construction;
- Temporally stop approval for new nuclear projects;



Nuclear Safety Regulation

National Nuclear Safety Administration





Safety Review

- Joint safety review by Ministry of Environment (National Nuclear Safety Administration), National Bureau of Energy, National Bureau of Earthquake;
- Started from April 2011, end at Aug 2011;
- Report back to State Council;





General Conclusion from Review

- Safety in existing nuclear power plant can fulfill requirement of nuclear safety regulation and latest safety standard of IAEA; Safety risk is under control and nuclear safety can be guaranteed;
- Take further measures to enhance response measures, design standards for flooding, earthquake and tsunami, safety standards will be further improved;
- National bureau of energy established a new department “department of nuclear power” to enhance regulation;
- National nuclear safety administration expand its technical support staffs;



Long run perspective

- Prime ministers reiterate China will continue its nuclear development strategy “developing nuclear power efficiently on the basis of ensuring safety”;
- Approval process might be reopen early of year 2012;
- Fukushima will not change China’s nuclear strategy in long run;



Conclusion

- ❑ China still has the most ambitious nuclear power plan in the world;
- ❑ Goal is 80 GWe by 2020, 200 GWe by 2030 and 400 GWe by 2050, to generate 25% of electricity supply by 2050;
- ❑ Booming of nuclear is due to a combination of fast economic growth, decreasing cost compared with other alternatives, and energy security concerns;
- ❑ After Fukushima China launched a major nuclear safety review but overall plan still in place;



Conclusion

- Fukushima will make 450 ppm target even more difficult;
- China will stick to its nuclear policy in long run;
- In short term, Fukushima will slow down approval process and have impact on 2020 targets of China's nuclear development;
- In the long term, nuclear will still be dominated resource in China's energy mix;