中国的节能目标和2050能源前景
China's Energy Target and 2050 Energy Vision

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中 国 可 持 续 能 源 项 目
The China Sustainable Energy Program

邓小平 "三步走"战略
Deng Xiaoping's "Three-Step Strategy

- 第一步从1981年到1990年国民生产总值翻一番，解决人民的温饱问题；
- 第二步从1991年到20世纪末，国民生产总值再翻一番，人民生活达到小康水平；
- 第三步到21世纪中叶，人均国民生产总值达到中等发达国家水平，人民生活比较富裕，基本实现现代化

1. **Increase 1980 GDP by one-fold, and insure basic living standards;**
2. **By the end of the century, double GDP, and increase the standard of living to a level of relative comfort;**
3. **By mid 21st century, bring GDP up to par with mid-level developed nations, and raise the standard of living to a level of relative prosperity, while undergoing basic modernization.**

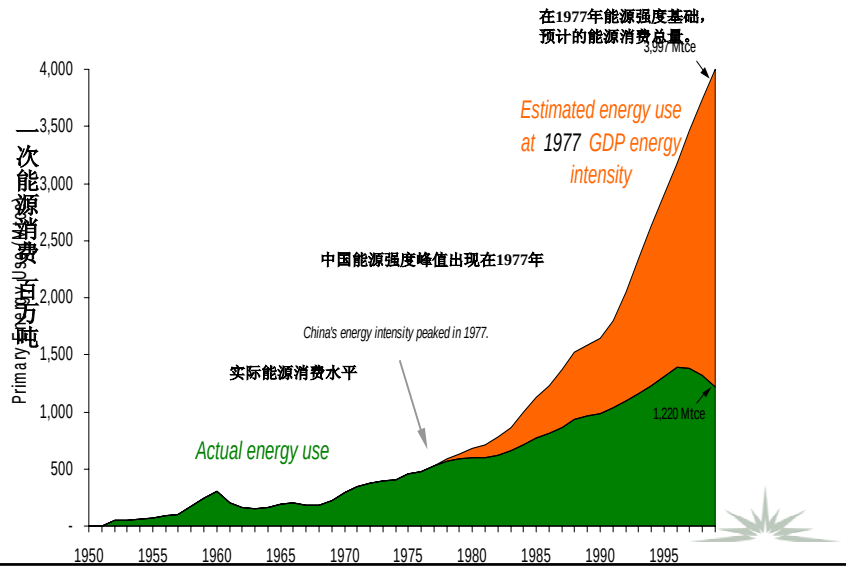
中国的能源禀赋—能源效率、可再生能源和供应安全的基点

The Foundation for Energy Efficiency, Renewable Energy, and Energy Security in China

- 中国人均能源资源占有量远比世界平均值要低，人均煤炭占有量仅约为世界人均水平的1/2，石油仅约1/10，天然气约1/20。
- 从长期看，国内能源供应将面临潜在的总量短缺，尤其是石油、天然气的供应将面临结构性短缺。

- **Coal, oil, and natural gas reserves per capita in China are 1/2, 1/10, and 1/20 of the global average.**
- **China faces a shortage of oil and natural gas supply in the long term.**

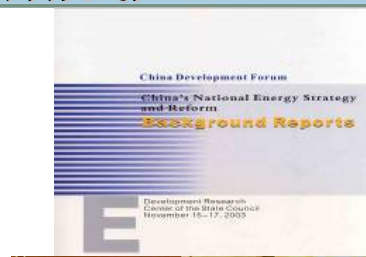
低碳发展之路和能源效率
1980—2000年，能源效率的提高使得中国实现能源消耗翻一番GDP增长翻两番
Low-Carbon Paths and Energy Efficiency: From 1980 to 2000, China's GDP quadrupled while energy consumption doubled



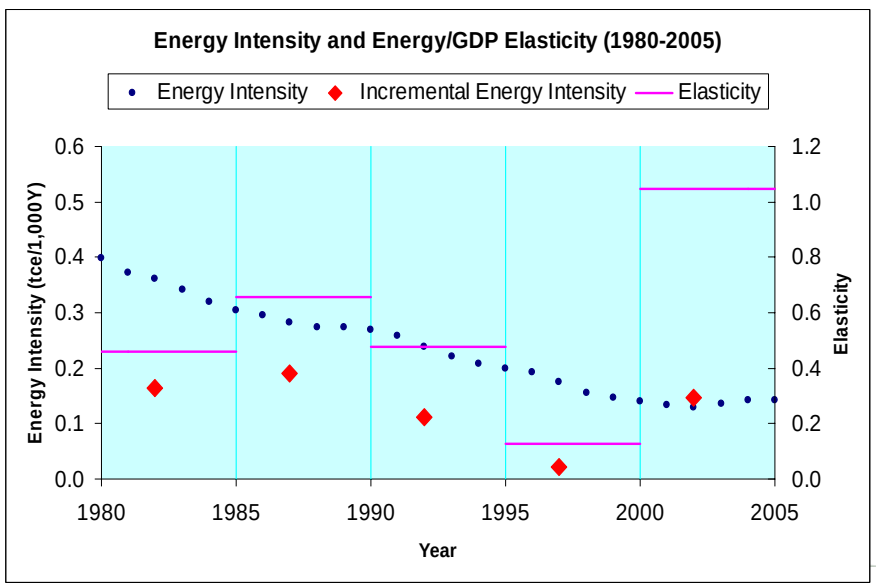
China's National Energy Plan 2020
中国2020能源规划

- **Energy Supply Security**
- **Priority to Energy Efficiency**
- **Energy Mix Optimization**
- **Environmentally Friendly**
- **Market Transformation**
- **Led by Government**

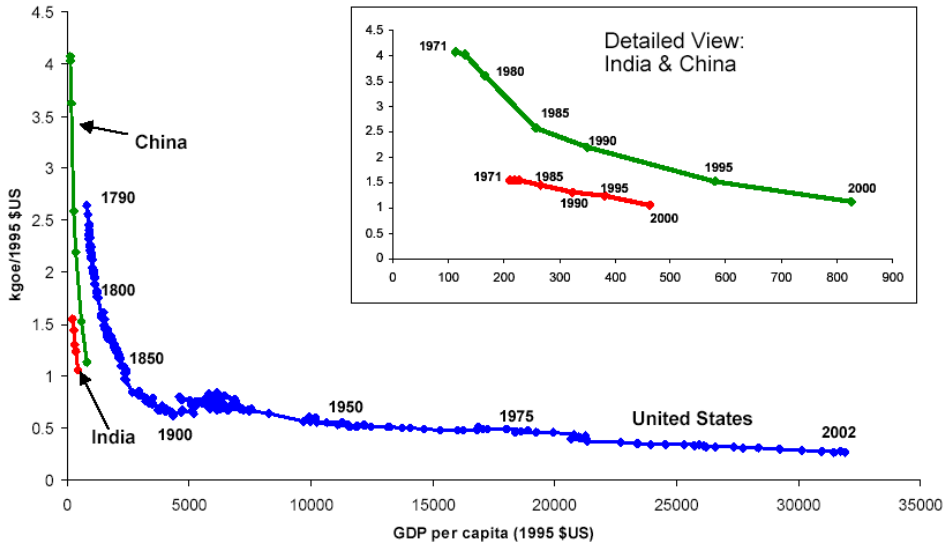
- 保障安全
- 节能优先
- 结构优化
- 环境友好
- 市场转变
- 政府引导



Energy Consumption Elasticity, 2000-2005
2000-2005能源消费挑战



China's Energy Intensity
中国能源强度



2010 Priorities 十一五目标

Premier Wen Jiabao

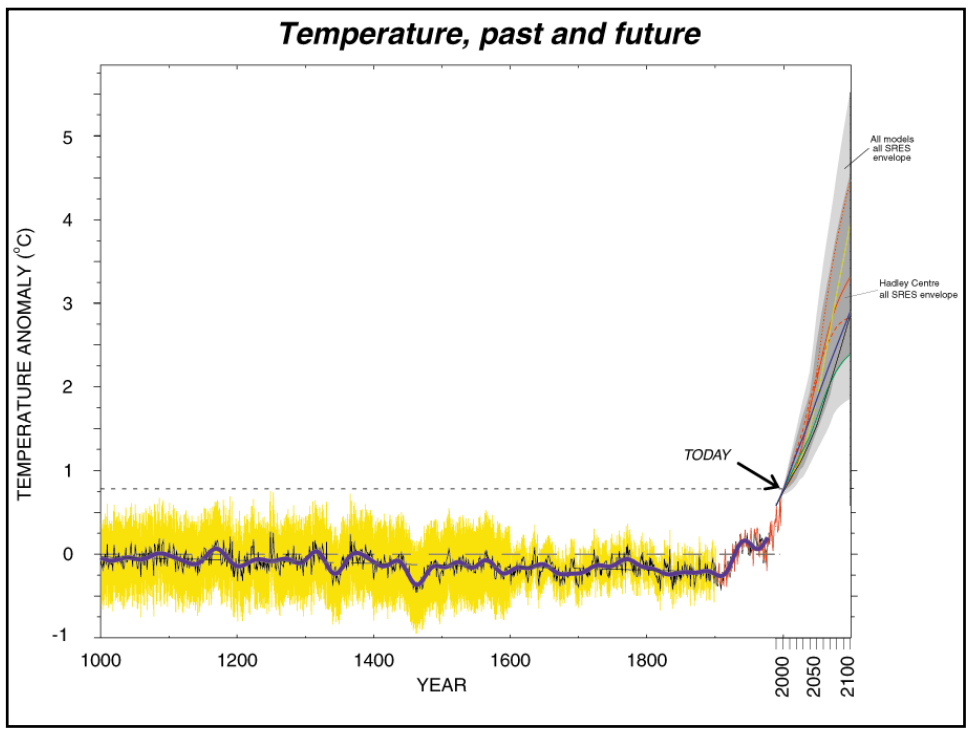
- •能耗强度降低20%
- •主要污染物排放降低10%
- •土地安全

- **• Energy Intensity Target: 20% Reduction**
- **• Major Environmental Pollutants: 10% Reduction**
- **• Land Security**

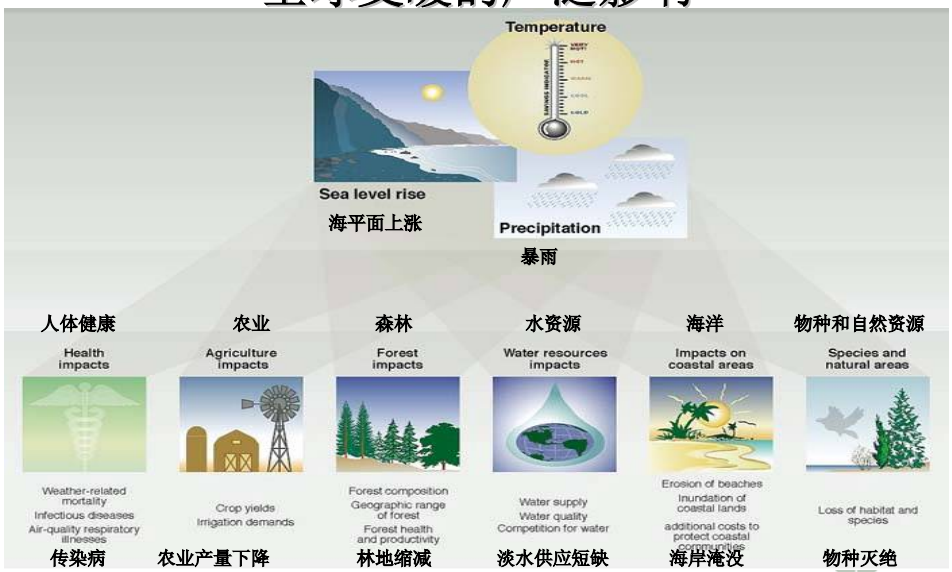
20%节能目标的意义
Significance of the 2010 Energy Target

- 量化目标是一个创造
- 优化经济结构的杠杆
- 能源持续供应的保障
- 经济和政治目标
- 保护环境应对气候变化的措施

- **The first quantitative target.**
- **A lever to optimize economic structure.**
- **A safeguard for energy supply security.**
- **A political and economic target.**
- **A measure to cope with environmental degradation and global warming.**



Global Warming: Broad Impact
全球变暖的广泛影响



Shrinking Polar Ice 极地冰盖收缩

Satellite image of arctic ice in the summer of 1979

1979年夏季的北极冰盖

vs.

2003

2003年夏季的北极冰盖

NASA photograph

The Impact of Climate Change
气候变化全球影响

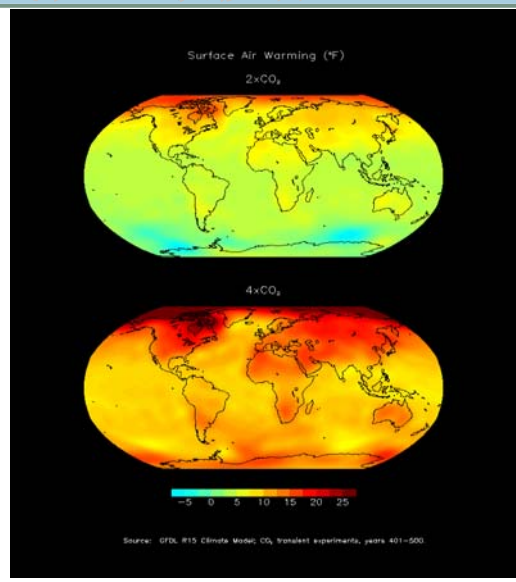
- **2X CO2**

•CO2浓度升高两倍

- **4X CO2**

(more likely)

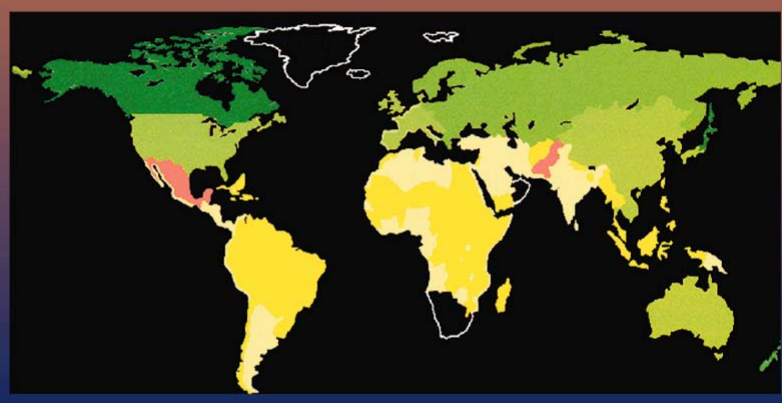
CO2浓度升高四倍



Source: Princeton Geophysical Fluid Dynamics Lab

农业资源变化：CO_2浓度升高一倍对全球农业产量的可能影响

Agricultural Resources: Potential Change in Grain Yield due to Doubled CO_2



-30% -10% 10% 30%

Percent of Change in Yield

农业产量增减比例

Based on GISS model; physiological CO_2 effects included

Source: Rosenzweig and Hillel (1993)

Rising Sea Levels
海平面升高

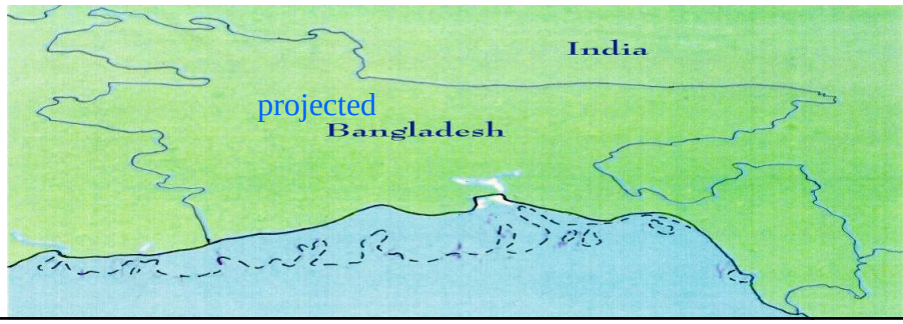
-洪水频发导致当地百姓流离失所

最危险的是沿海岛屿和低地
孟加拉国：海平面没升高1米，预计将失去17%的土地；1千3百万人口面临威胁

- **Increased risk of floods,** potentially displacing tens of millions of people.

- **Highest risk:** Small island states and low-lying deltaic areas.

- **Bangladesh:** Projected to lose 17% of its land area with a 1 meter sea level rise; low adaptive capacity; 13 million people at risk.



Water Scarcity 水资源匮乏

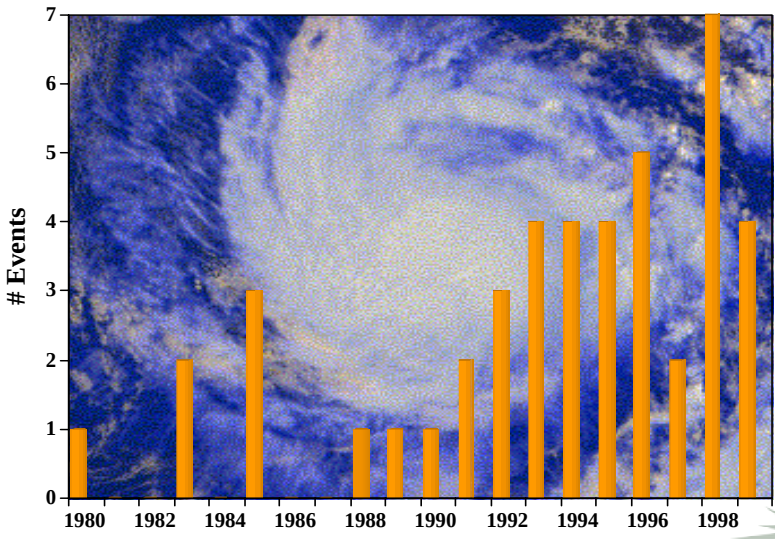
• 全球1/3的人口面临水荒.

• 未来30年受水资源匮乏影响的人口将增加一倍.

• **One third of the world's population is now subject to water scarcity.**

• **The population facing water scarcity will more than double over the next 30 years.**

Frequency of Billion-Dollar Weather Disasters
气象灾难导致的经济损失



健 康
Health

- Weather Related Mortality
- Vector-borne Diseases
- Air Quality Illnesses

- 因气候变化导致的死亡
- 病媒传染性疾病
- 空气污染导致的疾病

气候变暖在中国
Global Warming in China

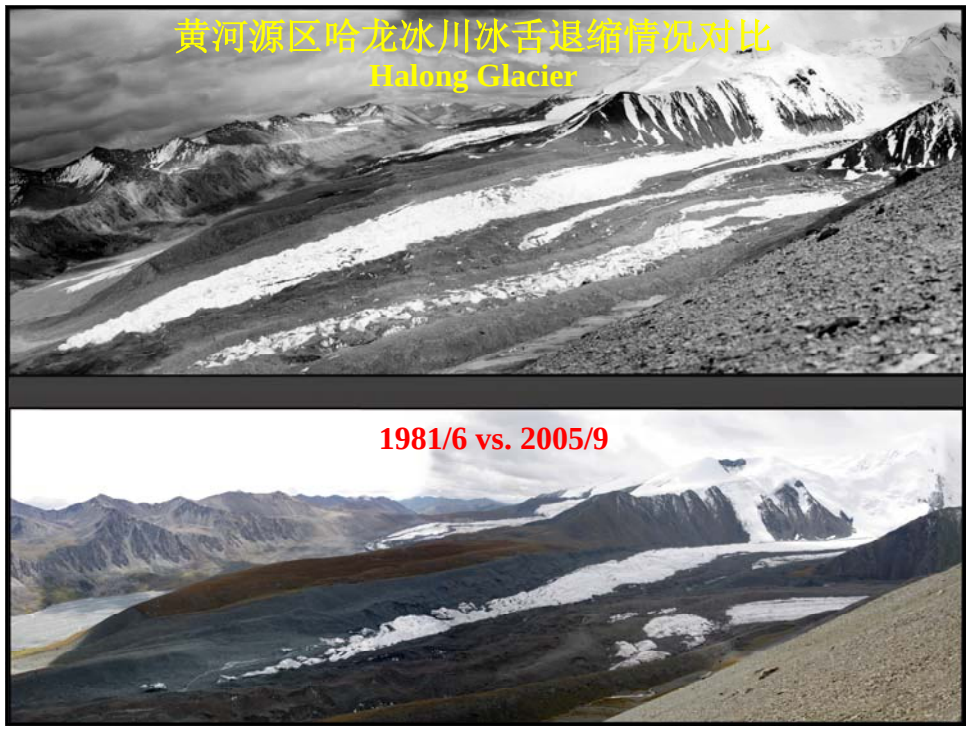
- 冰川融化
- 极端天气
  - 沙尘暴
  - 干旱
  - 洪水

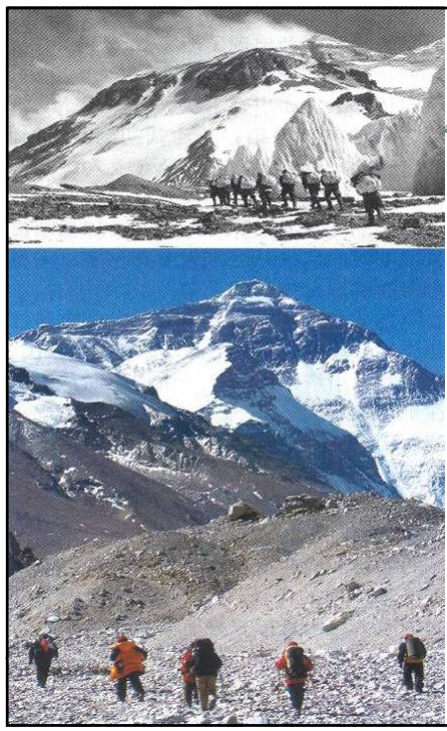
- **Glacial Melting**
- **Natural Disasters**
  - **Sand Storms**
  - **Drought**
  - **Floods**

冰川融化　Melting Glaciers

贡嘎雪山冰川是我国海拔高度最低的冰川，十几年来已退缩几百米。

The Mt. Gongga glacier has shrunk several hundred meters in the last decade.





中国水塔青藏高原
The Tibetan Plateau
"Water Tower"

珠穆朗玛峰 冰川消融情况

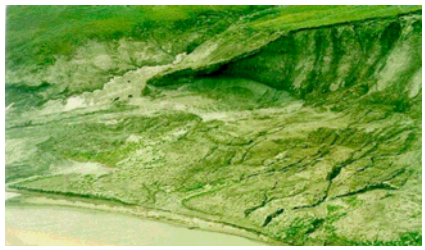
上图：中国登山队1960年5月

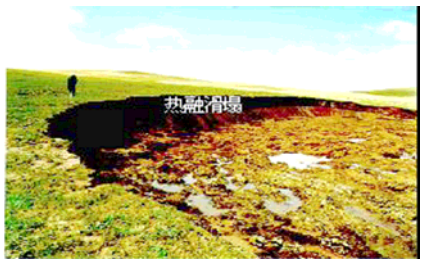
下图：中国登山队和测绘队2005年5月

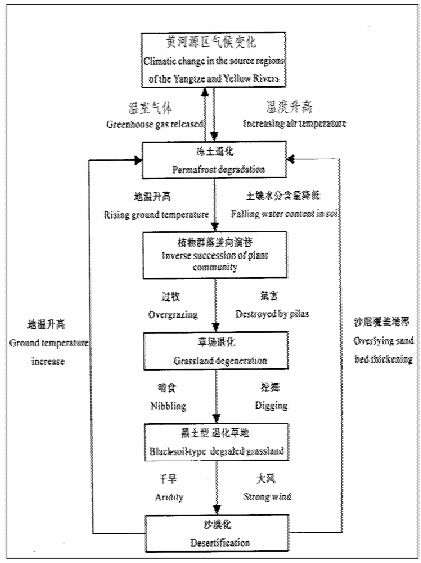
Photographs of the glacier under Mount Everest

- **Upper: May 1960**
- **Lower: May 2005**

冻土融化及其连锁效应
Consequences of Permafrost Degradation



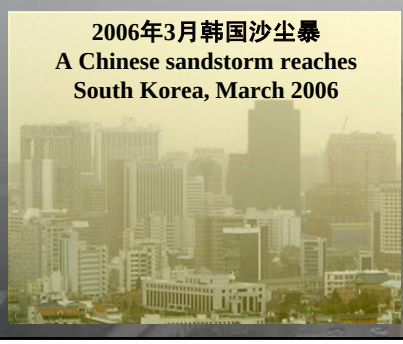




北京沙尘暴 Beijing Sandstorm, Spring 2006

上世纪60年代特大沙尘暴在我国发生过8次，70年代发生过13次，80年代14次，90年代23次，2000年至今已有20多次

In the 1960s there were 8 sandstorms; 13 in the 1970's, 14 in the 1980's and 23 in the 1990's. Since 2000, 20 severe sandstorms have been reported.



2006年3月韩国沙尘暴
A Chinese sandstorm reaches South Korea, March 2006

2006年全国15个省（区、市）遭受伏旱，1803万人临时饮水困难，作物受旱面积1.3亿亩。重庆长达两个月的高温突破百年记录。

Summer 2006:

- **Drought = 15 provinces**
- **Water scarcity = 18.03 million people**
- **Affected farmland = 0.13 billion mu**

台风 Typhoon

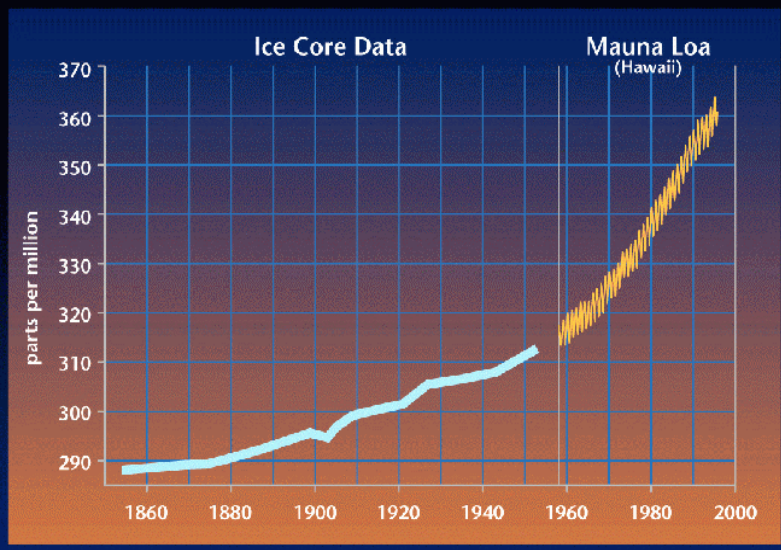
台风：

2006年台风登陆偏早、偏多、灾害偏重，已造成1500人死亡或

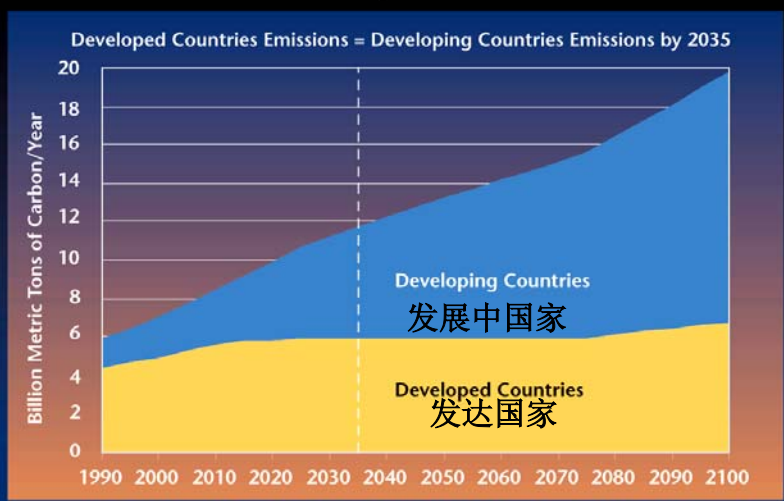
2006 Typhoon:

- **Dead and missing = 1,500**
- **The frequency and economic impact of typhoons has increased significantly.**

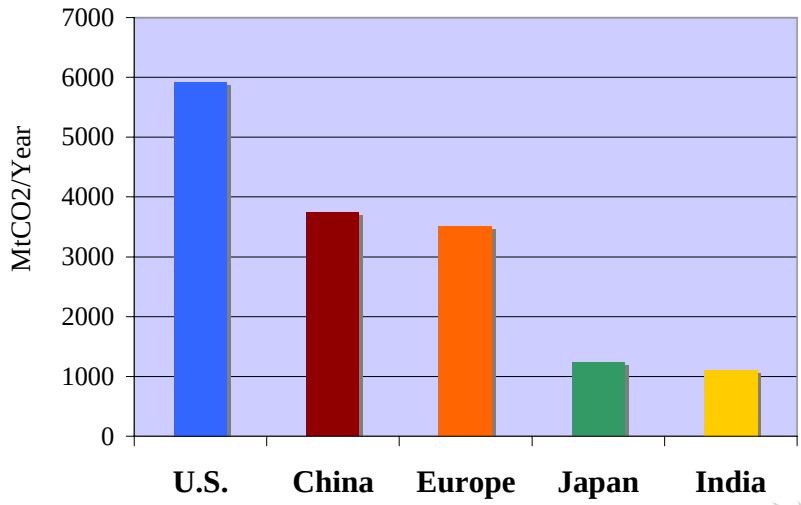
二氧化碳密度变化趋势
Carbon Dioxide Concentrations



发达国家和发展中国家二氧化碳排放，1990-2100年
Developed and Developing World CO_2 Emissions, 1990-2100

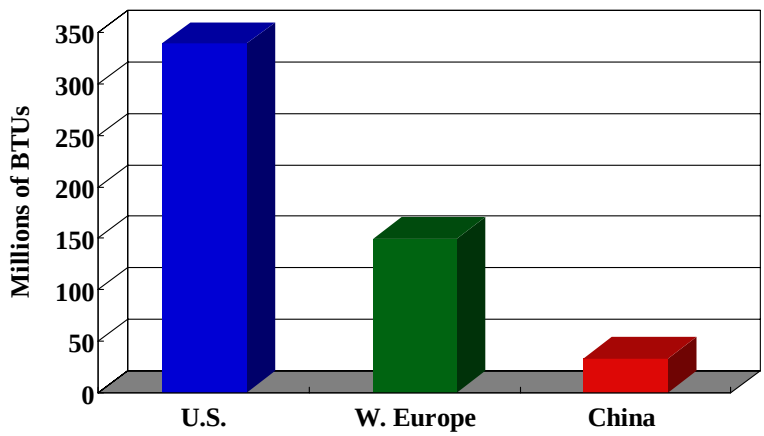


World Carbon Dioxide Emissions
主要国家二氧化碳排放对比



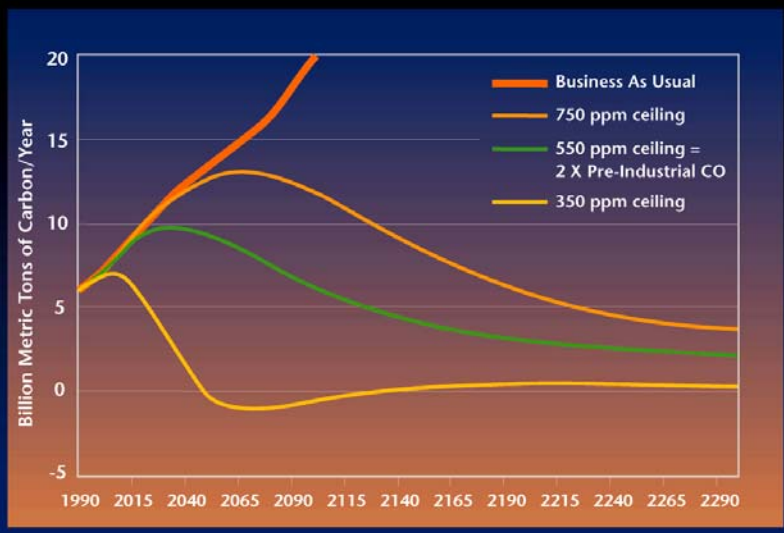
Source: Worldwatch Institute

Energy Consumption Per Capita
人均能源消耗



Source: Energy Information Administration, 2002

大气层稳定排放途经
Atmospheric Stabilization Emissions Paths



普华永道《2050年的世界：全球发展对碳排放和气候变化政策的影响》
2050 Forecast：PricewaterhouseCoopers

- **“若各国‘依然故我’，到了2050年，全球碳排放将增一倍以上。三大经济体系中国、印度和美国）占全碳排放的比例将从目前的45%上升到一半以上，欧占全球排放量的比例则会目前的约15%至不足9%。**
- **“目前已经存在技术上可行，而且成本相对低廉的控碳排放的方法。预测显示如果采取这些办法，会令2050年的国内生产总值GDP下降最多约2-3%,换言之，只要牺牲约一年的经增长，就能令2050年的碳放减少约60%”**

1. **Business As Usual:**

- Global carbon emissions could more than double.
- The ‘Big 3’ economies (China, US and India) are projected to account for over half of global emissions, up from around 45% today.
- The EU’s share of global emissions will decline from 15% to just under 9%.

2. **There are technologically feasible and low-cost options to control carbon emissions.**

- The estimated cost to GDP of following such strategies is no more than 2-3% in 2050, equivalent to sacrificing one year of economic growth to reduce carbon emissions by 60% 2050

世界自然基金会《2006年地球生命力报告》
World Wildlife Fund 2050 Forecast： 2006 Living Planet Report

- “如果人类按照目前的速度消耗资源，到2050年，地球人将用掉相当于2个地球的自然资源”.
- 1970年至2003年： 脊椎物种种群减少1/3，
- 1961至2003年二氧化碳排放增加9倍。

- If current trends continue, humans will need two planets' worth of natural resources every year.
- Species populations have diminished by 1/3 between 1970 and 2003.
- CO2 emissions have risen 9 fold between 1961 and 2003.

2050 Forecast
英国《全球气候报告》
British Global Climate Change Report

前世界银行首席经济师 尼古拉斯•斯特恩爵士

- 气候变化将使全球GDP每年损失5%；如果考虑到更广泛的风险和影响的话，估计损失将上升到GDP的20%或者更多。
- 以目前的趋势发展下去，未来50年，全球温度将升高2-3度。
- 全球变暖带来的经济破坏规模与重大战争和经济大萧条相比不相上下。
- 如果目前不进行碳减排，未来将付出高于5-20倍的代价。

Nicholas Stern, former World Bank chief economist

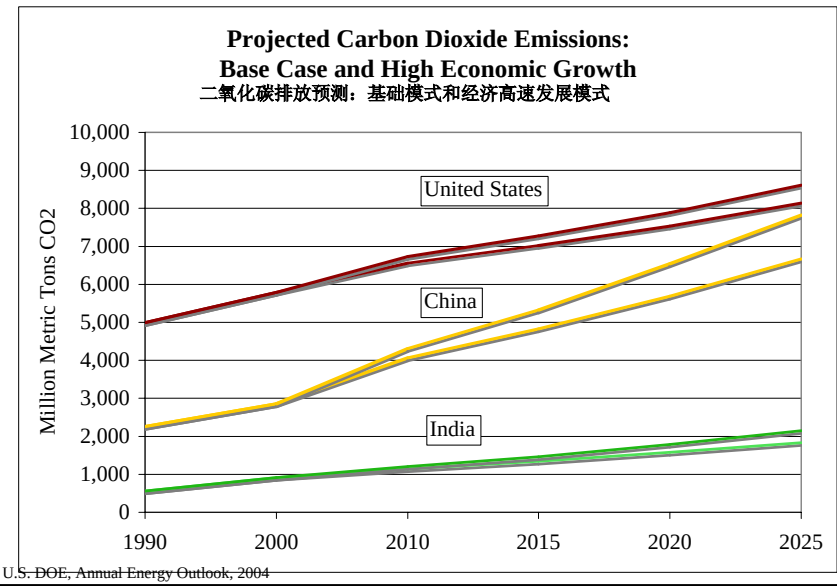
- Global warming will cause global GDP loss of 5% per year. If broader risks are considered, the potential GDP loss rises to 20%.
- At current rates, global temperature will rise 2-3 ºC in the next 50 years.
- Failure to act could plunge the world into an economic crises on par with the 1930s depression and the damage of two world wars.
- If we don’t act now, the cost of action will rise by 5 to 20 times in the future.

China's 2050 Forecast: 中国

- 根据2004年中国气候国别影响的研究，气候变化对中国潜在的威胁的可能是存在的和巨大的。在气候变暖的大背景下，中国的干旱和洪涝灾害将增加，中国山地冰川普遍退缩，西部山区冰川面积减少了21%以上；水资源利用受到较大的威胁。农业生产费用增加，减产趋势为主，生产潜力降低10%左右。全球变暖对中国的冻土、沼泽、荒漠产生严重的影响。中国沿岸与5个区域的海平面上升30-70厘米甚至更高。水供应和水质降低。这种变化都是不可逆转的.

- **Global warming has the potential to be enormously destructive:**
  - China's droughts and floods will increase, and glaciers will retreat (glaciers in the western mountainous regions will be reduced by 21 percent), posing a grave threat to water resources.
  - Agricultural production costs will increase, such that production will tend to decrease and production capacity will fall by roughly 10 percent.
  - Global warming poses a serious threat to China's frozen regions, marshlands, and deserts.
  - Sea levels in the five coastal regions will rise by at least 30 to 60 cm.
  - Freshwater supply and quality will diminish.

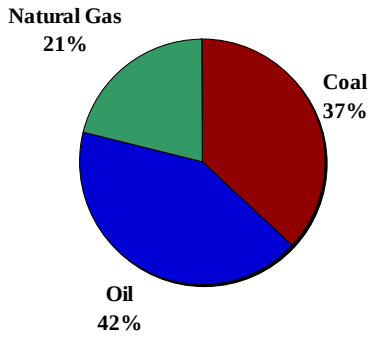
China & Global Warming
中国和全球气候变暖



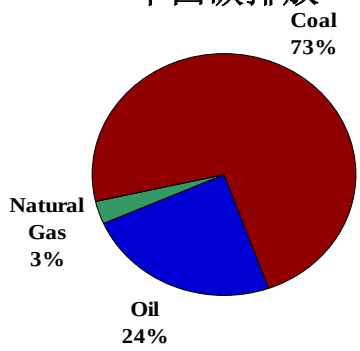
Source: U.S. DOE, Annual Energy Outlook, 2004

Biggest Culprits: Coal and Cars
罪魁祸首：煤炭和汽车

U.S. Carbon Emissions
美国碳排放



China Carbon Emissions
中国碳排放



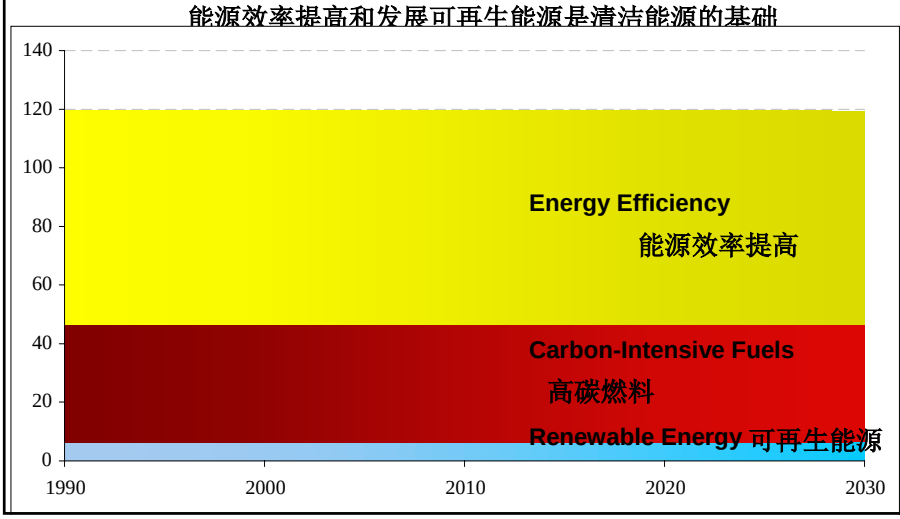
Source: IEA, 2004

2050 Energy Goals
中国能源发展2050年目标

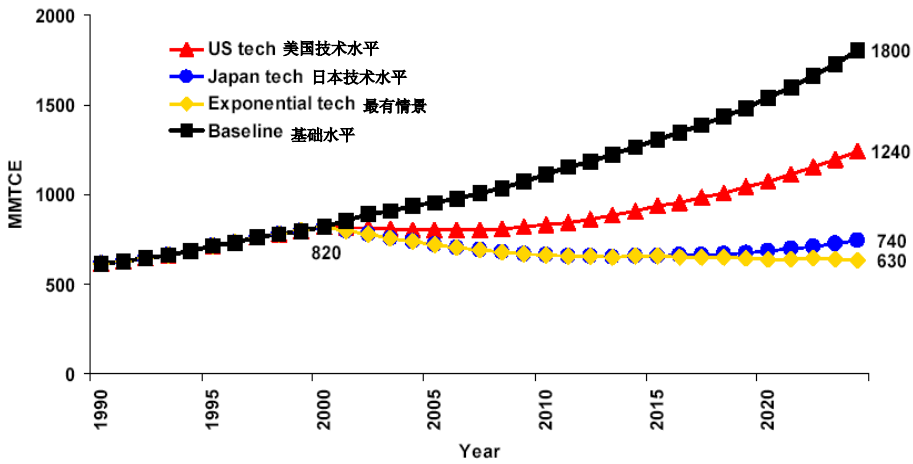
- **CO_2 concentration < 380ppm**
- **Temperature Increase Threshold < 2 ℃**
- **二氧化碳大气浓度< 380ppm**
- **大气温度平均升高< 摄氏2度**

A Clean Energy Future
清洁能源未来图景

Energy efficiency and Renewable Energy are Fundamental for a Clean Energy Future
能源效率提高和发展可再生能源是清洁能源的基础



China's Emissions With Technological Advancement
科技发展和中国的排放水平



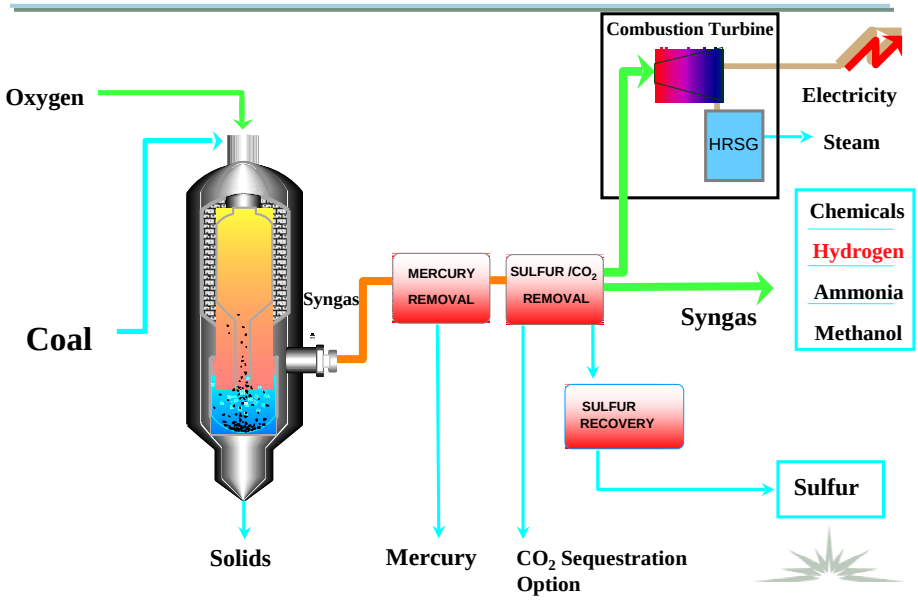
Source: P. Bernstein, S. Tuladhar, and W. D. Montgomery, "Potential For Reducing Carbon Emissions from Non-Annex B Countries through Changes in Technology", forthcoming in *Energy Economics*

Technology Solutions
科技发展解决路径

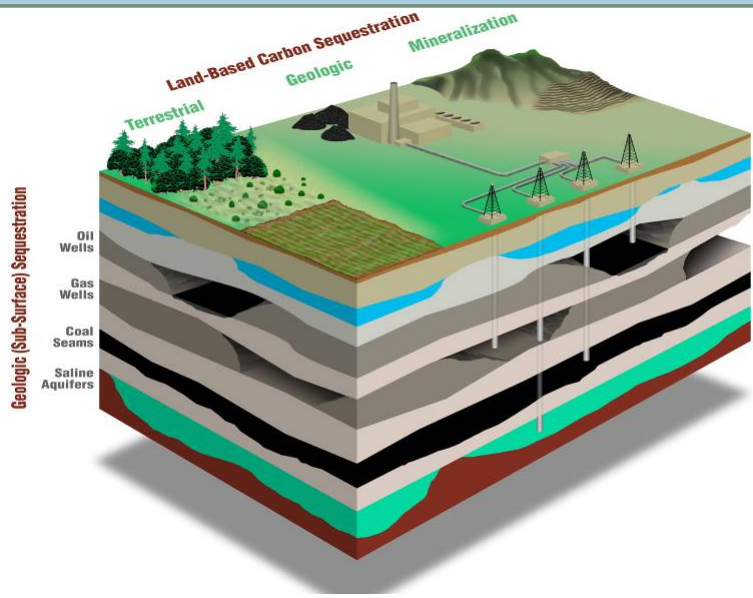
QuickTime?and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Poly Generation 煤气化多联产

Feeds ***Gasification*** ***Gas Refining*** ***End-products***



Geologic Sequestration of CO2
二氧化碳地理埋存



行动:欧盟 Actions: EU

- 《提高能源效率行动计划》：2020年前实现将能源效率提高20%的目标
- 家庭能源使用效率提高27%，
- 工商企业提高30%，
- 交通行业提高26%，
- 制造业提高25%。

Action plan to improve energy efficiency: By 2020, reduce energy efficiency by **20%**

- **27% improvement by household appliances**
- **30% improvement by enterprises**
- **26% improvement by the transportation sector**
- **25% improvement by manufacturing**

California 2020 Climate Targets
加州2020气候目标

June 1, 2005 Climate Policy Act　2005年 6 月 1 日气候政策法案

- **By 2010: Cut emissions to 2000 levels　排放控制在２０００年的水平**
- **By 2020: Cut emissions to 1990 levels　排放控制到１９９０年水平**
- **By 2050: Cut emissions to 80% below 1990 levels　排放在１９９０年基础上再减少８０％**

Source: Union of Concerned Scientists

California 2020 Energy Goals
加州2020能源目标

汽车标准:
到2016年，汽车碳排放减少30%

可再生电力标准:
提高可再生电力配额2017 年达到20%,2020达到33%

能效项目:
每年减少用电１％，天然气消耗0.5%

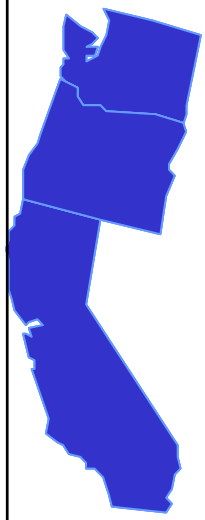
Automobile Standards: 30% CO2 reduction from new cars and light trucks by 2016.

Renewable Electricity Standard: Large utilities must increase renewable energy purchases, reaching 20% by 2017, 33% by 2020.

Efficiency Programs: Electricity and natural gas efficiency programs must reduce electricity use 1%per year, natural gas by 0.5% per year.

Source: Union of Concerned Scientists

U.S. Carbon Reduction Policies
碳减排政策



西海岸几个州达成地区减排协议:

- 设定二氧化碳减排目标
- 加严家用电器能效标准
- 购买混合动力汽车
- 减少使用柴油
- 二氧化碳排放报告
- 提高可再生能源利用比例

West Coast States have agreed to pursue regional carbon reductions:

- Set CO_2 reduction targets
- Tighten appliance standards
- Joint purchase of hybrids
- Reduction of diesel use
- CO_2 emissions reporting
- Increase in renewable energy

英国气候变化项目
UK Climate Change Program

• 建立于2000年

•京都议定书承诺，到2008-2012年，温室气体排放相对于1990年的数值将减少12.5%.

• 到2010年，国内CO2的排放量相对于1990年减少20%.

• Established in 2000

• Kyoto Protocol: commitment of a 12.5% reduction in greenhouse gas emissions by 2008-2012 relative to 1990.

• Domestic goal: 20% CO2 emissions reduction relative to 1990 by 2010.

英国碳基金 UK Carbon Trust

- 由气候变化税设立
- 作为一个促进工商业领域碳排放减少的独立机构运作
- 通过现场走访等方式给工业企业提出建议
- 为能效项目提供低成本贷款
- 为碳减排技术的早期阶段提供风险投资

- **An independent body to promote carbon reductions in industry and commerce.**
- **Funded through Climate Change Levies.**
- **Advises industry (e.g. site visits)**
- **Provides low-cost loans for energy efficiency projects.**
- **Provides venture capital for investments in early-stage carbon reduction technologies.**

中国碳基金 China's Carbon Trust

- **10月26-27日，中国举办亚洲碳博览会：（中国）谈减排贸易收入不纳入国家预算，实行单独管理单独运营，继续用于气候变化活动及相关的环保活动**
- **摩根斯坦利将在未来5年，投资约30亿美元与碳排放信用额度及其他温室气体减排项目。**

- **The Asia Carbon Trade Exhibition:**

All revenue from China's carbon trade will go to fight global warming and increase environmental protection.

- **Morgan - Stanley:**

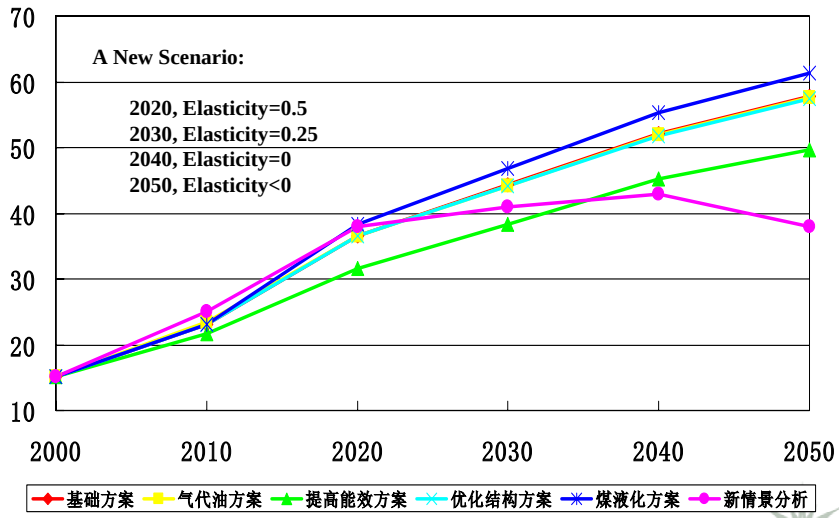
Will invest 3 billion USD and credit to greenhouse gas reduction programs in the next 5 years.

邓小平“三步走”目标 – 2050
Deng Xiaoping’s Three-Step Strategy—2050

- 采用能效目标，以高效的、清洁的、低碳的、可持续的和低成本的能源保证社会经济目标的实现。

- **Implement energy efficiency standards to achieve social and economic development goals through clean, low-carbon, sustainable and low-cost energy options.**

2000-2050: Energy Demand Scenarios
2000-2050能源需求情景



谢谢 Thank you

fqyang@efchina.org

中 国 可 持 续 能 源 项 目

The China Sustainable Energy Program