Optimizing Clean and Efficient Energy Technologies through Tax and Fiscal Policy

利用财税政策推动清洁能源技术发展

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1

Advantages and limitations of free-market economies

自由市场经济的优势及局限

- **Free-markets provide powerful incentives for innovation (One works hardest for self-gain)**
- **They are more nimble than regulated economies**

- **自由市场能够有力地激励创新（人们为了自身利益而拼命工作）**
- **自由市场经济比计划经济更加灵活**

Question: How many free-market economists does it take to change a light bulb?

问题：更换一只灯泡需要多少名自由市场经济学家？

Answer: None. If it needed changing, free-market forces would have taken care of it.

答案是：一个都不需要。如果要更换灯泡，自由市场本身会解决这个问题。

2

The downsides of free-market economies
自由市场经济的劣势

- Free markets do not always account for “externalities” (e.g. pollution, climate change)
- Public goods need to be supported by taxation (e.g. national security, roads and bridges)
- “Survival of the fittest” does not always mean “survival of the best”. (e.g. unethical or predatory business practices). Regulation and transparent legal enforcement is needed
- Free markets do not respond well to long term problems or international/global issues. (e.g. international fishing, international pollution) Regulatory treaties? International Taxes?

- 一直以来，自由市场都不能很好地解决“外部成本”问题（例如：污染、气候变化）
- 公共财产（例如：国家安全、公路和桥梁）需要税收的支持
- “适者生存”并不一定表示“优者生存”。（例如：不道德的或损人利己的商业行为）。我们需要对其进行调控和法律实施透明化
- 自由市场不能很好地解决长期问题或国际性/全球性问题。（例如：国际捕捞、国际污染）监督公约?国际税收?

3

The externalities related to energy
与能源相关的外部成本

- Energy dependence costs
- 能源依赖成本
- Environmental costs
- 环境成本

Polices that modify free-markets.
改革自由市场的途径

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- Stimulating long term investments in research and development to commercialization

- 全球性激励措施 (胡萝卜), 反激励措施 (大棒), 强制 (法规)
- 鼓励对技术商品化研发的长期经费投入

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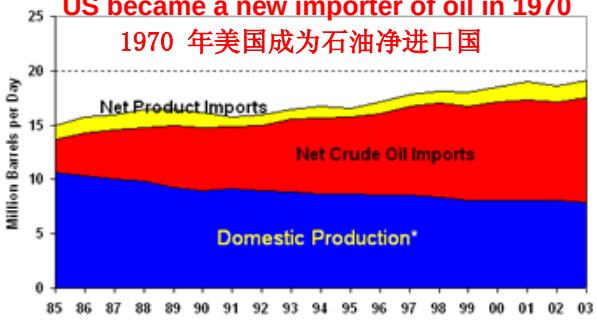
U.S. Oil Production and Imports

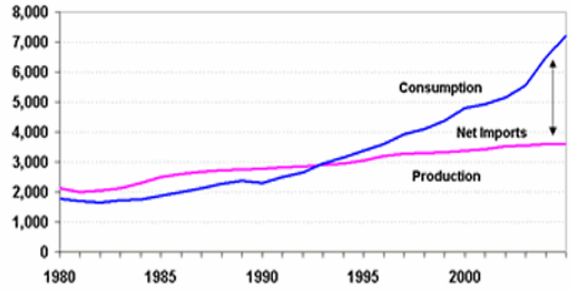
US became a new importer of oil in 1970

1970 年美国成为石油净进口国



China oil consumption and production 1980 -2005

1980 – 2005 年期间中国石油消耗与产出情况



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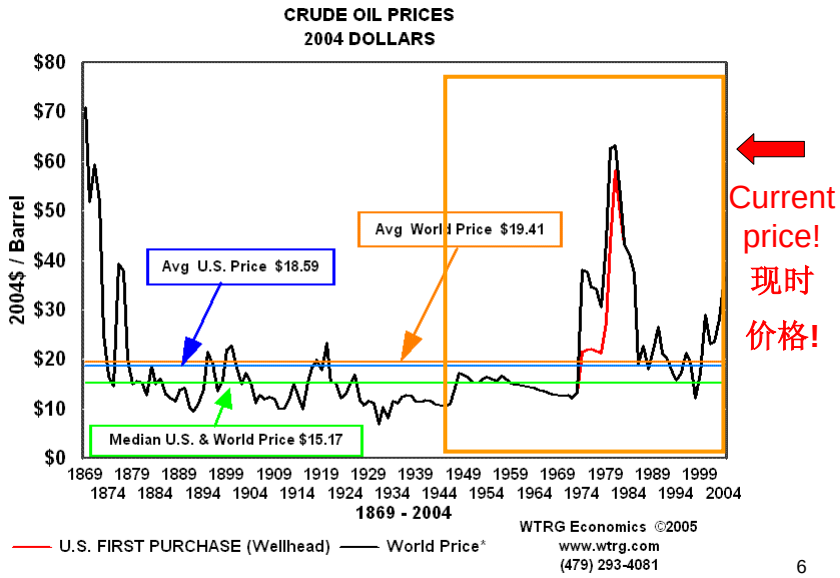
Uncertain cost of energy

不确定的能源成本



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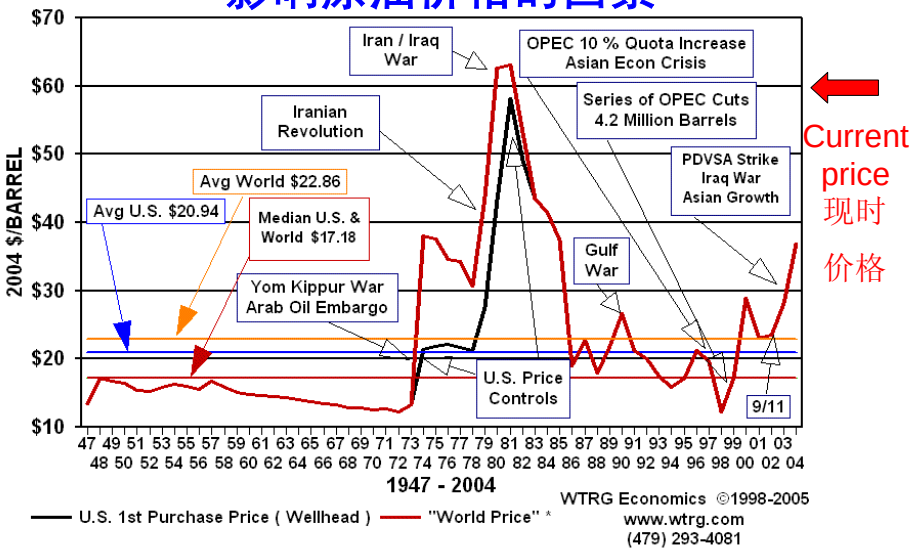
Factors affecting crude oil prices
影响原油价格的因素



Current price 现时价格

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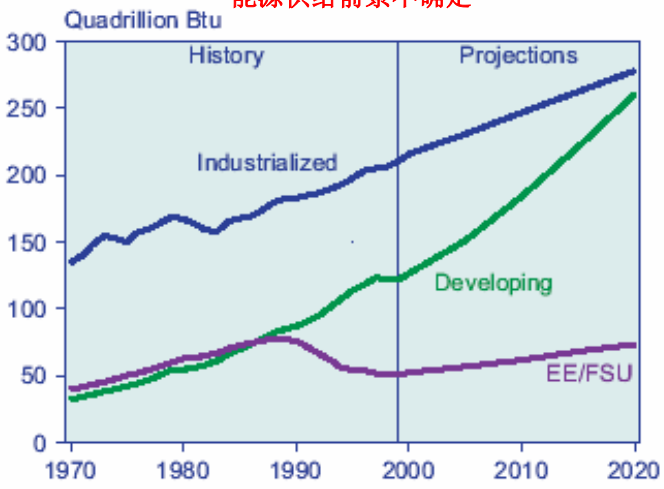
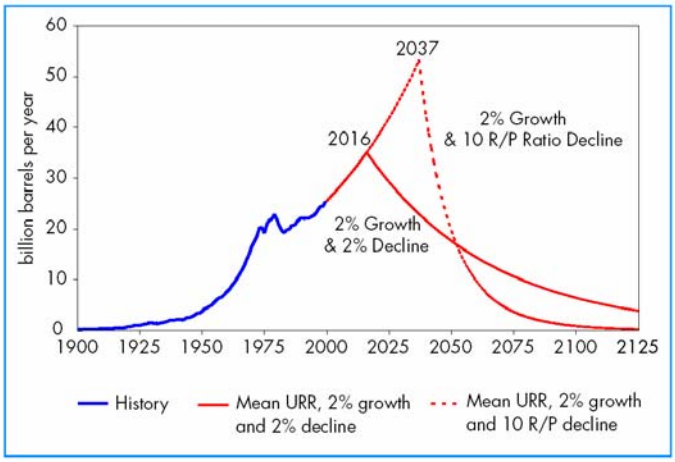
World Energy Consumption from 1970-2020 is projected to triple: uncertain *access* to energy

1970 年至 2020 年期间全球的能源消耗量将增长三倍：能源供给前景不确定



"Hubbert Curves" with different assumptions of rate of decline using GSGS and DOE best estimates of *total* discovered and undiscovered global reserves

根据GSGS 与 DOE 对已探明及未探明全球石油总储备的精确估算所推测的不同石油产量下降率的 " Hubbert 曲线图 "



Source: *World Energy Outlook, 2001* by the International Energy Agency, a body of the Organization for Economic Co-operation and Development (OECD)

资料来源：*《世界能源展望》（2001 年）*
经济合作与发展组织 (OECD) 国际能源总署

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Greg Baker/Associated Press
Greg Baker/美联社

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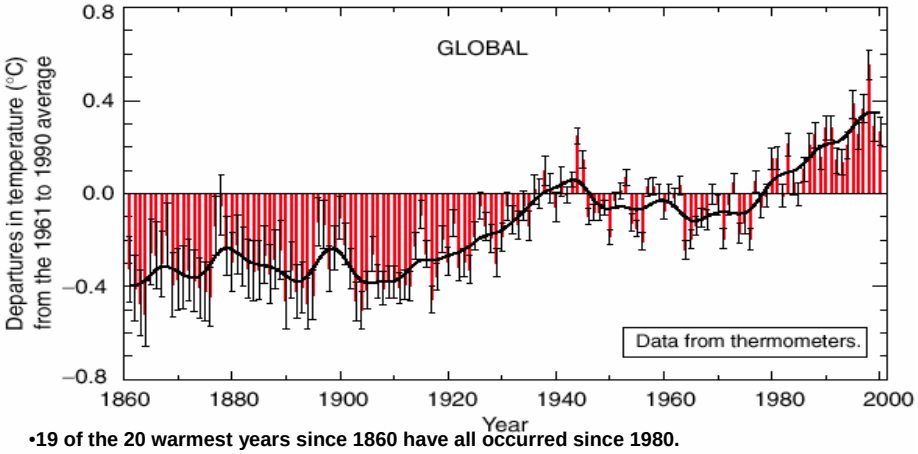
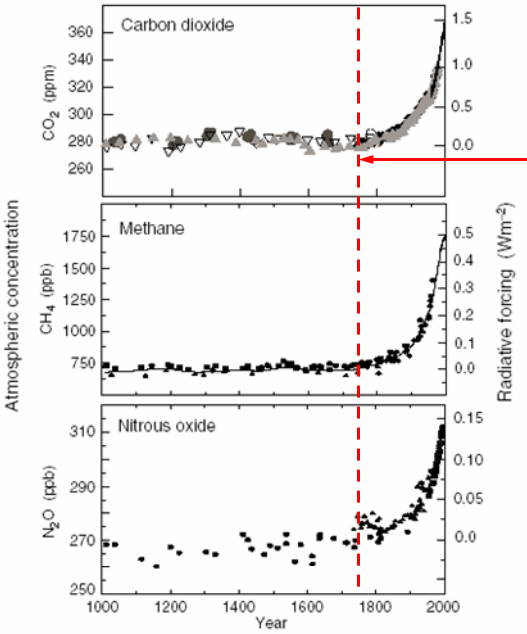
Song Yang/Imaginechina

Average global temperature rise since 1860
1860 年以来全球平均气温上升情况



- 19 of the 20 warmest years since 1860 have all occurred since 1980.
- 1998 was the warmest year in the instrumental record and probably the warmest in 1,000 years.
- 在 1860 年以后出现的 20 个最暖和的年份中，有 19 年是出现在 1980 年以后。
- 1998 年是历史记载中最暖和的年份，同时很可能也是过去 1000 年中最暖和的一年。

Concentration of Greenhouse gases
暖室气体在大气中的浓度



1750, the beginning of the industrial revolution

1750 年工业革命开始

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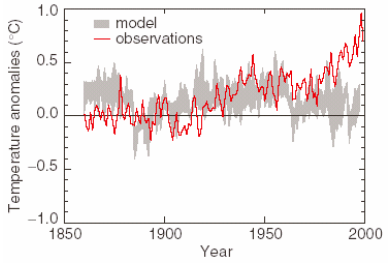
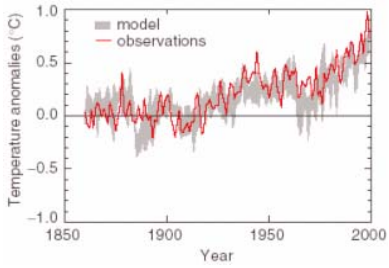
Can we predict the past?
我们可以推测过去吗？



Climate change due to natural causes (solar variations, volcanoes, etc.)

自然原因所引起的气候变化
(太阳变化 , 火山爆发等)



Climate change due to natural causes and human generated greenhouse gases

自然原因与人类活动造成的温室气体所共同引起的气候变化

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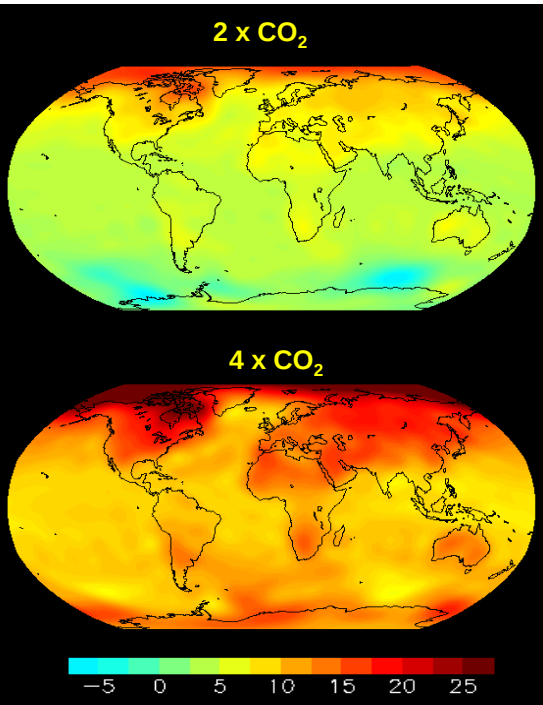


Computer simulations by the Princeton Geophysical Fluid Dynamics Lab for CO2 increases above pre-industrial revolution levels:

2x CO_2 : 5 – 8° F

4x CO_2 : 15-25° F

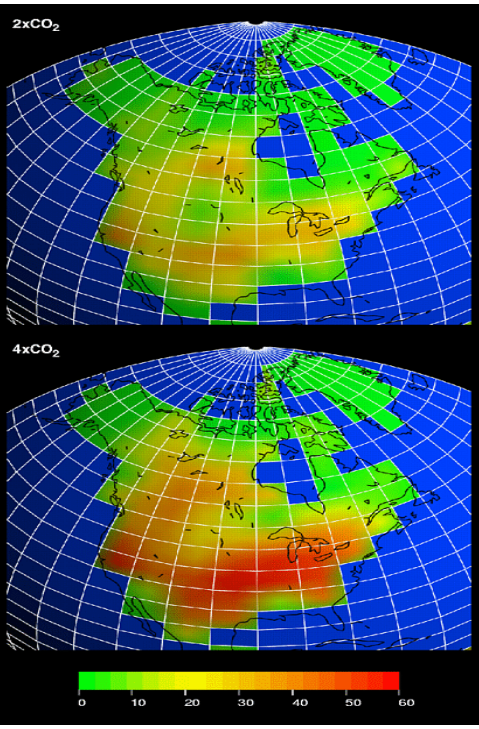
美国普林斯顿地球物理学流体动力实验室开发的计算机模拟技术显示，工业革命以后CO_2排放量超过了工业革命以前的水平：

2x CO_2 : 5 – 8° F

4x CO_2 : 15-25° F

Pre-industrial: ~275 ppm
Today: ~380 ppm

工业革命前: ~275 ppm
现在: ~380 ppm



Summer soil moisture in N America under doubled & quadrupled CO_2 (from the Princeton GFDL model)

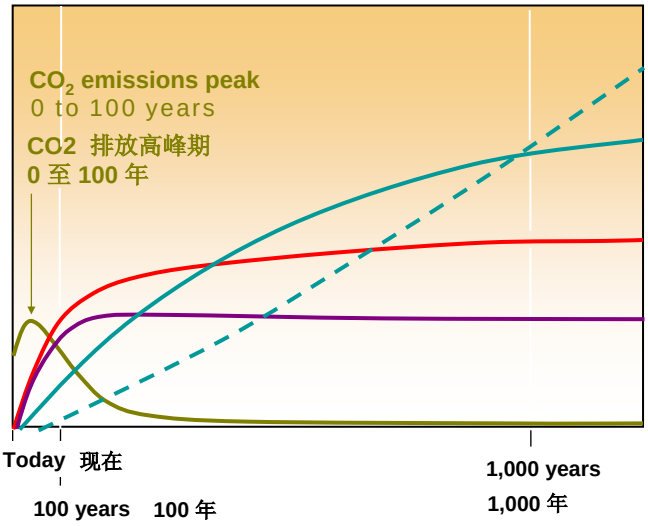
Mid-continent soil-moisture reductions reach 50-60% in the 4xCO_2 world.

当CO_2 含量分别为现在的2和 4 倍时，夏季北美土壤水分的变化情况 （普林斯顿地球物理学流体动力实验室气候预测实验 ）

当世界 CO_2 含量为现在的 4 倍时，中部北美大陆的土壤水分将减少 50-60%。

CO_2 Concentration, Temperature, and Sea Level Continue to Rise Long after Emissions are Reduced

即使在CO_2 排放量降低很长一段时间后， CO_2的浓度、气温及海平面仍将持续上升



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A dual strategy is needed:
需制定双重战略：

1) Conservation: maximize energy efficiency and minimize energy use, while insuring economic prosperity

2) Provide incentives to develop new sources of clean energy

1) 节约：在保持经济增长的同时，最大地提高能源利用效率以及减少对能源的使用

2) 鼓励开发新的清洁能源

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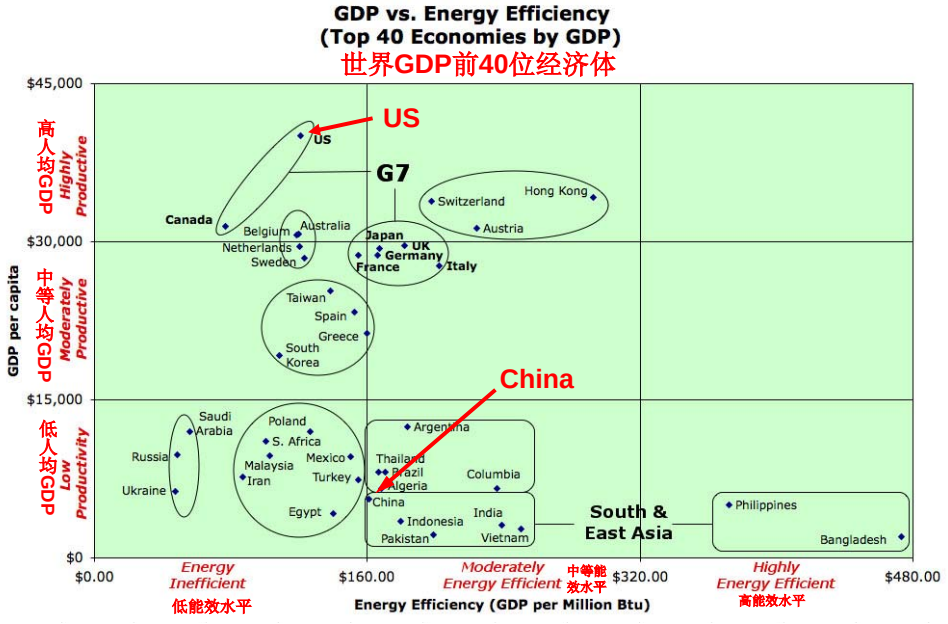
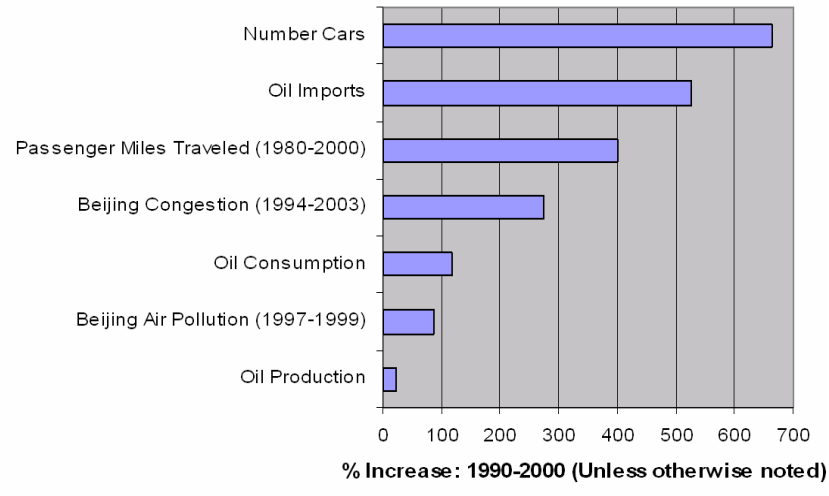
人均GDP和能源效率的关系



Externalities associated with China's transportation growth
与中国的交通增长相关的外部成本



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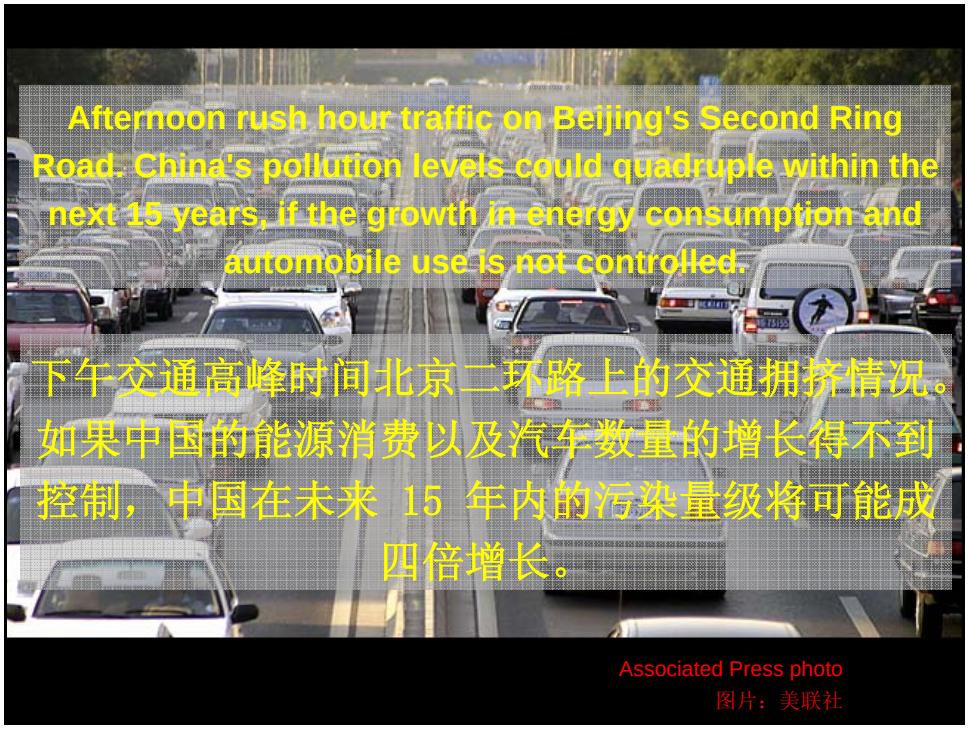
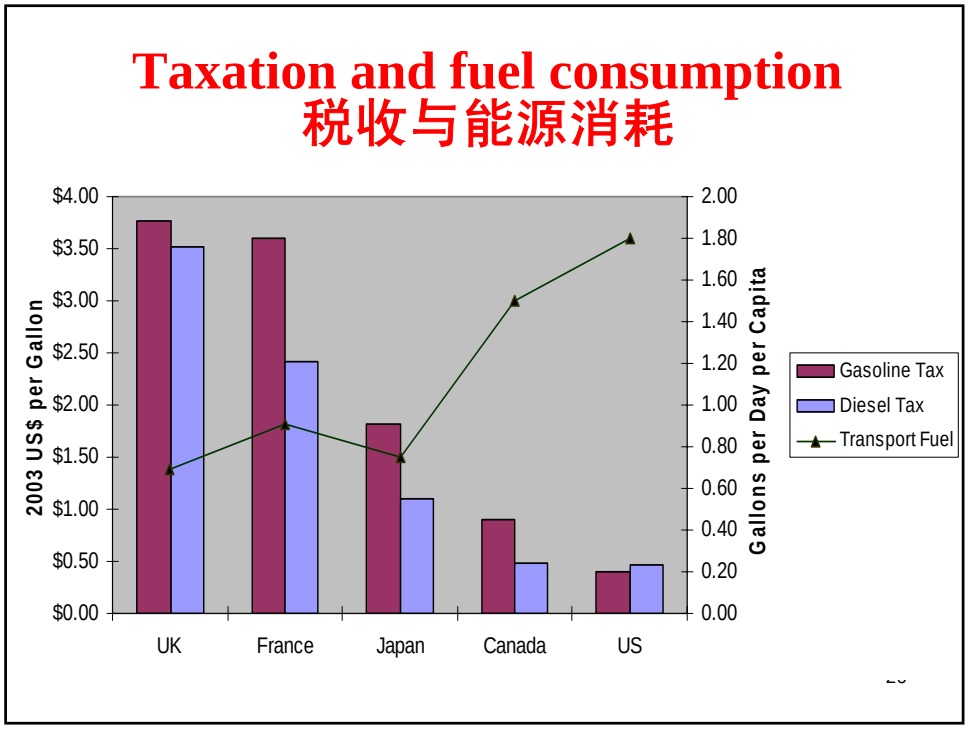
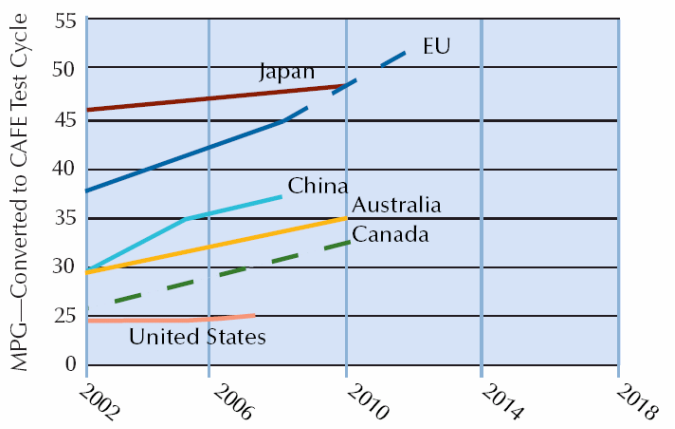

Afternoon rush hour traffic on Beijing's Second Ring Road. China's pollution levels could quadruple within the next 15 years, if the growth in energy consumption and automobile use is not controlled.
下午交通高峰时间北京二环路上的交通拥挤情况。如果中国的能源消费以及汽车数量的增长得不到控制，中国在未来 15 年内的污染量级将可能成四倍增长。
Associated Press photo
图片：美联社


Taxation and fuel consumption
税收与能源消耗
2003 US$ per Gallon
$4.00
$3.50
$3.00
$2.50
$2.00
$1.50
$1.00
$0.50
$0.00
Gallons per Day per Capita
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
UK
France
Japan
Canada
US
Gasoline Tax
Diesel Tax
Transport Fuel

Higher cost of gas is correlated with fuel efficiency of automobiles

汽油的高价格与汽车的燃油效率密切相关



Control of automobile usage and efficiency requires both control by regulations and cost dis-incentives (tax on gas and large car purchases)

汽车使用率及燃油效率的控制既需要法规也需要高成本的反激励措施（如：征收汽油税以及对购买大型汽车的用户课税）

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Traffic congestion in cities can not be solved by more roads alone. Note the relative congestion of light rail, buses and cars

城市交通堵塞问题不能仅仅依靠修路解决。注意轻轨、公交车及轿车的相对堵塞情况

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Bus rapid transit
快速公交系统

Three options to mass transit with large variations in cost.

大运量的公共交通三种方案的费用差别很大

地铁
Subway

轻轨
Light rail

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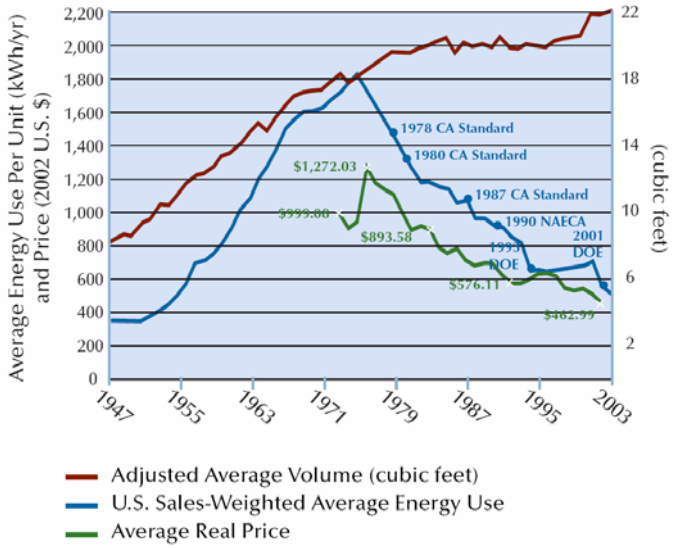
Regulation stimulates technology: Refrigerator efficiency standards and performance. The *expectation* of efficiency standards also stimulated industry innovation

法规有利于促进技术的开发：冰箱能效标准及性能。进行能效标准预测也有利于刺激行业的创新



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- 激励措施（税收减免），反激励措施（课税或制定上限），控制（调控）
- 鼓励对商品化技术研发的长期经费投入

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California utility companies now urge and help their customers conserve electricity

美国加州电力公司开始鼓励并帮助用户节约用电

Profit to utility companies was decoupled from the amount of energy sold.

电力公司的利润不再与能源销售额挂钩。

- Initially, US electric utility industry were a regulated monopolies where rate-of-return on investments was set by regulatory agencies. Utility companies promoted the use of energy to maximize profits.
- Environmental regulations and disallowances of investments by state regulators of nuclear power generation created financial stresses in utility companies.
- "Least-cost Planning" is in place. Energy conservation decreases the need to build more power generating plants. Fair return of investment is guaranteed.

- 起初，美国电力事业部门是一个投资回报率由监管机构制定的受控垄断性行业。 电力公司通过推广对能源使用的方式增加利润。
- 由于环境法规的出台以及禁止对核发电进行管控的国家监管部门进行投资，电力公司开始感受到了经济压力。
- "最低成本规划"开始实施。能源节约减少了对建造更多发电厂的需求，从而保证了合理的投资回报。

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My concerns about the current California utility system
我对目前加州电力系统甚为担忧

- Changes in the cost of fuel are passed through to the consumer (Compromises incentives to the utilities companies to be more energy efficient)
- There are no incentives for utility companies to invest in long term research
- The electricity generation and distribution industry is becoming in danger of becoming more de-integrated.

Micro-economics forces to maximize profits might encourage companies to stimulate higher energy usage by selling more energy intensive "services".

- 燃油价格的变化被转嫁到了消费者身上

（抵消了电力公司追求节能的动力）

- 缺少对电力公司投资长效技术研发的激励
- 发电与配电部门面临日益分立的危险

以增加利润为目的的微观经济因素将促使电力公司通过提供更多的能源密集型"服务"促进能源更多的使用。

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International Energy Agency (IEA) Carbon Emission forecast
国际能源总署 (IEA) 对碳排放的预测

Between 2003-2030:

New Coal Plants = 1.4 TW

New Natural Gas Plants = 1.9 TW

2003-2030 年期间:

新建火力发电厂 = 1.4 TW

新建天然气发电厂 = 1.9 TW

Carbon emission in the next 30 years will add 3x more CO_2 emission than the previous 250 years!

未来 30 年碳排放量将比前 250 年 增加 3 倍!

Energy from tar sands, shale oil, methane hydrates … will be as bad as coal for greenhouse gas emissions.

沥青砂、贝岩油、甲烷水合物等能源与煤炭一样会排放出大量的暖室气体。

Limiting CO_2 is the biggest economic problem
二氧化碳减排是最大的经济问题

- A carbon tax or carbon cap is needed
- Clear signals should be given that a tax or cap *will occur* so that companies can plan.
- Private (industrial) and public investments in renewable sources must be encouraged.
- Progressive changes in the carbon tax/cap should be initiated to stimulate research and development of alternative solutions.

- 应实施碳税和碳排放总量控制
- 应给予企业明确的总量控制信息和标准，方便企业规划执行
- 必须鼓励对可再生资源进行私募（产业）与公募投资
- 应逐步变更碳税及碳排放限量标准以鼓励对可替代能源的研发

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Carbon Sequestration needs more research
继续进行碳埋存技术研究

- Long term storage and environmental safety are yet to be proven.
- Cost is also an issue! Using present technology, sequestration costs are $100 - 300/ton of avoided carbon emissions.
- The US Department of Energy has a target to reduce the cost of carbon sequestration to $10 or less per net ton of avoided emissions by 2015.

- 长期储存技术和环境安全评估仍需进一步证实。
- 费用也是问题！使用现有的技术，一吨碳排量的埋存费用为 **100 – 300** 美元。
- 美国能源部计划在 **2015** 年前将一净吨碳排量的埋存费用减至 **10** 美元甚至更低。

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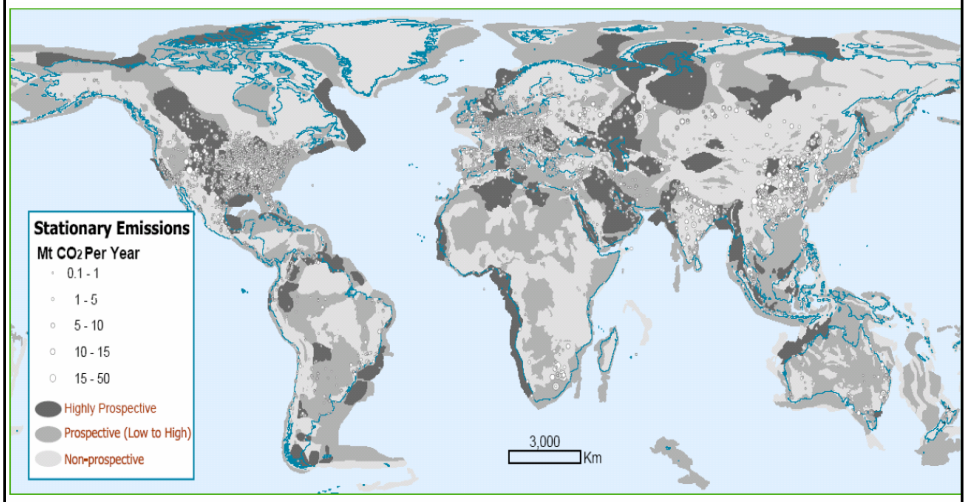
CO_2 emission sources and sedimentary basins with geological storage potential
二氧化碳排放源及具有地质储藏潜力的沉积盆地



Is large scale sequestration possible in China?
在中国大规模应用碳埋存技术可行吗？

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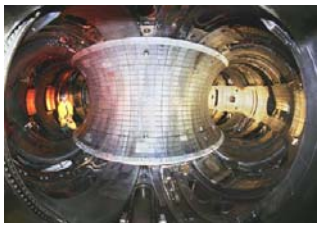
Potential Sources of Carbon Neutral Energy
潜在的无碳能源

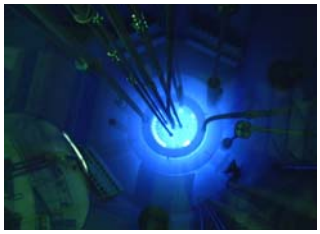
1. Nuclear Fusion
1.核聚变



Magnetic plasma confinement or inertial fusion. At least 40 - 50 years in the future

磁离子约束或惯性聚变。至少需要 40 – 50 年的时间

2. Nuclear Fission
2.核裂变

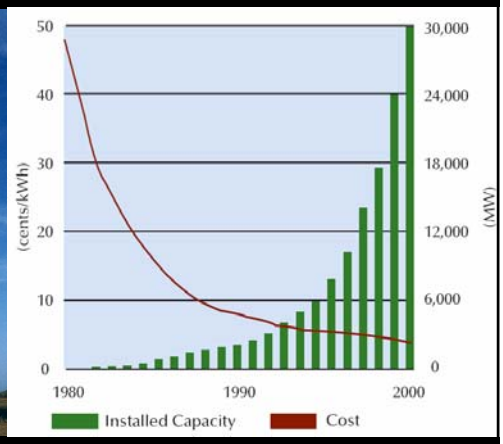


Waste and Nuclear Proliferation
废料及核扩散

3 TW = One new GW reactor every week for the next 50 years)
3 TW = 未来 50 年每周产生一个新的 GW 核反应堆

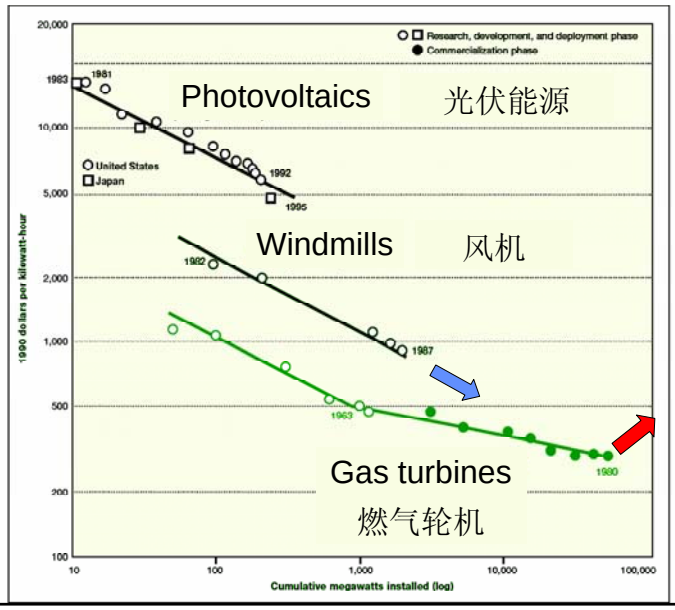
Tax incentives and rebates were essential to stimulate continued development of power generation from wind

税收优惠与退税措施是鼓励对风力发电继续研发的必要措施



Cost of electricity generation (1990 dollars/kilowatt hour)

发电成本（1990 美元 / 千瓦时）



Photosynthesis: Nature has found a way to convert sunlight, CO_2, water and nutrients into chemical energy

光合作用：大自然已经寻找到了一种将阳光、二氧化碳、水分及营养物质转化成化学能的方法

The majority of a plant is structural mate 植物的大部分是由结构物质组成

Cellulose 纤维素	40-60% Percent Dry Weight 占干重的 40-60%
Hemicellulose 半纤维素	20-40%
Lignin 木质素	10-25%

Sunlight
CO_2, H_2O,
Nutrients

阳光、二氧化碳、水分、营养物质

→ Biomass 生物能 → Chemical energy 化学能

Self-fertilizing, drought and pest resistant
自我繁殖、抗旱、抗病虫害

Improved conversion of cellulose into chemical fuel
提高纤维素转变成化学燃料的效率

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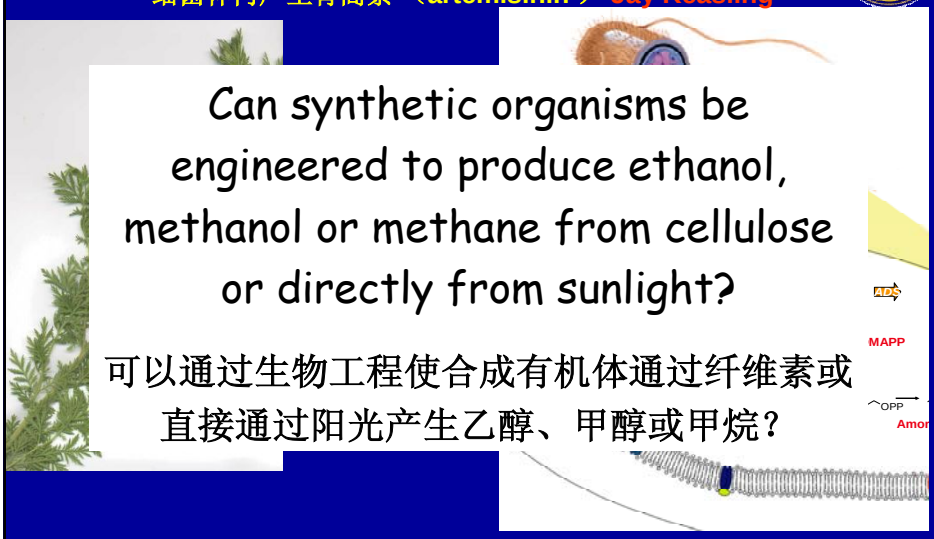
Synthetic Biology:
Production of artemisinin in bacteria Jay Keasling

合成生物学:
细菌体内产生青蒿素 （artemisinin ） Jay Keasling



Can synthetic organisms be engineered to produce ethanol, methanol or methane from cellulose or directly from sunlight?

可以通过生物工程使合成有机体通过纤维素或直接通过阳光产生乙醇、甲醇或甲烷?

and International 国际
National Concerns
国内 担忧

1) National security which is intimately tied to energy security

1）国家安全与能源安全密切相关

2) Economic prosperity

2）经济繁荣

3) The environment

3）环境

Sustainable, CO_2 neutral energy
可持续性无碳能源

End
结尾

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• The US phone system (AT&T) was a vertically integrated monopoly. Phone service was reliable and of moderate cost.
• 美国电话系统 (AT&T) 曾经是垂直一体化垄断系统。电话服务不仅可靠而且费用合理。

• Others wanted access to this market, claiming that competition would drive down prices.

• 其它公司以竞争有利于降低价格为由争先恐后地进入该市场。

• 20 years later our total phone bills are much higher due to competition to promote higher usage (text messaging, photograph transmission over phone data channels, …

• 20 年之后，由于各电话公司相互竞争和争夺用户而推出各种服务（如：短信、通过电话数据通道传输照片等等），导致我们的电话总费用比竞争前高很多。

Telecom companies are reluctant to invest in long-term research
电信公司不愿意对技术研发进行长期投资

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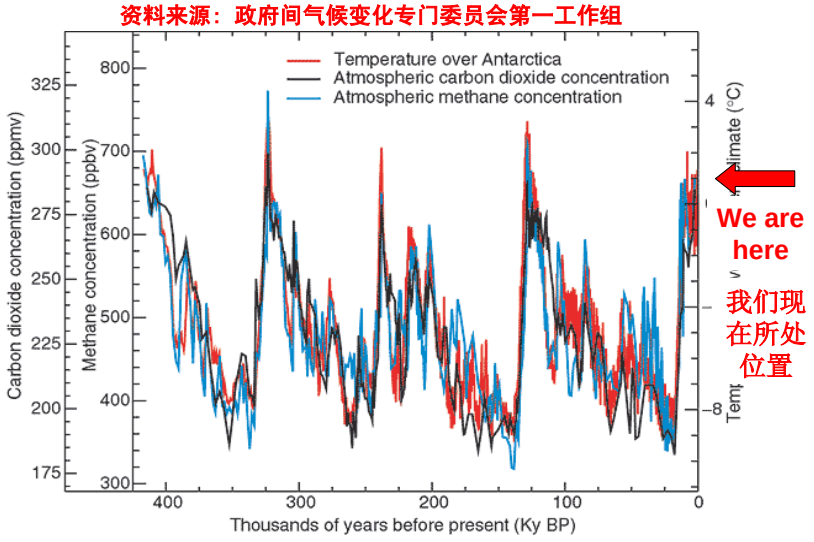
Temperature over the last 420,000 years

Source: Working Group I of the Intergovernmental Panel on Climate Change

过去 420, 000 年的气温变化情况

资料来源：政府间气候变化专门委员会第一工作组



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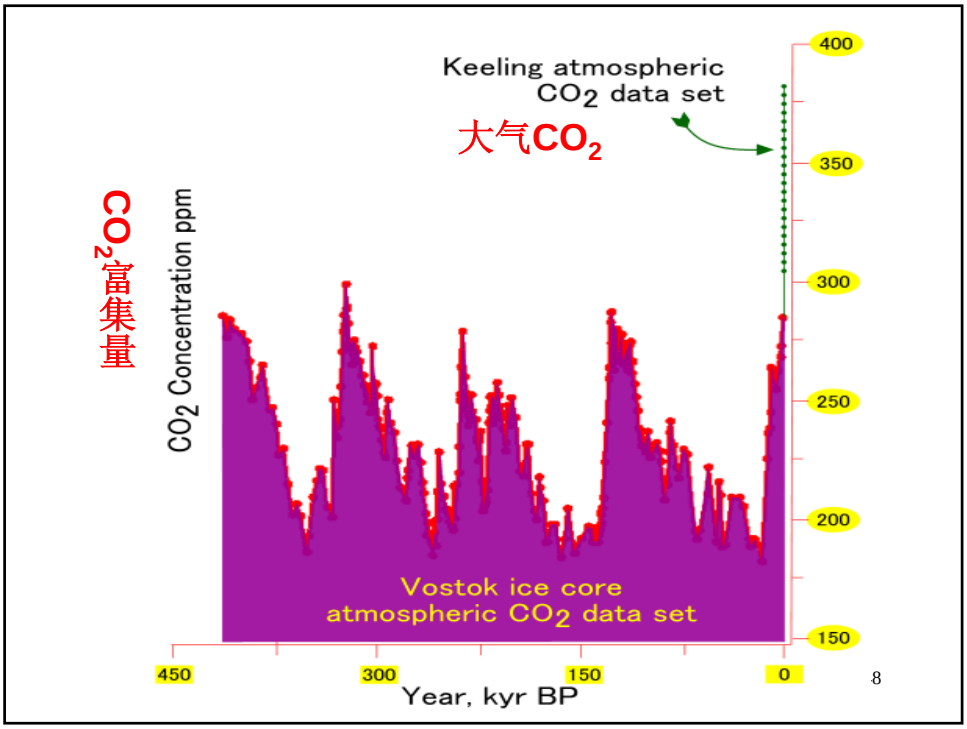

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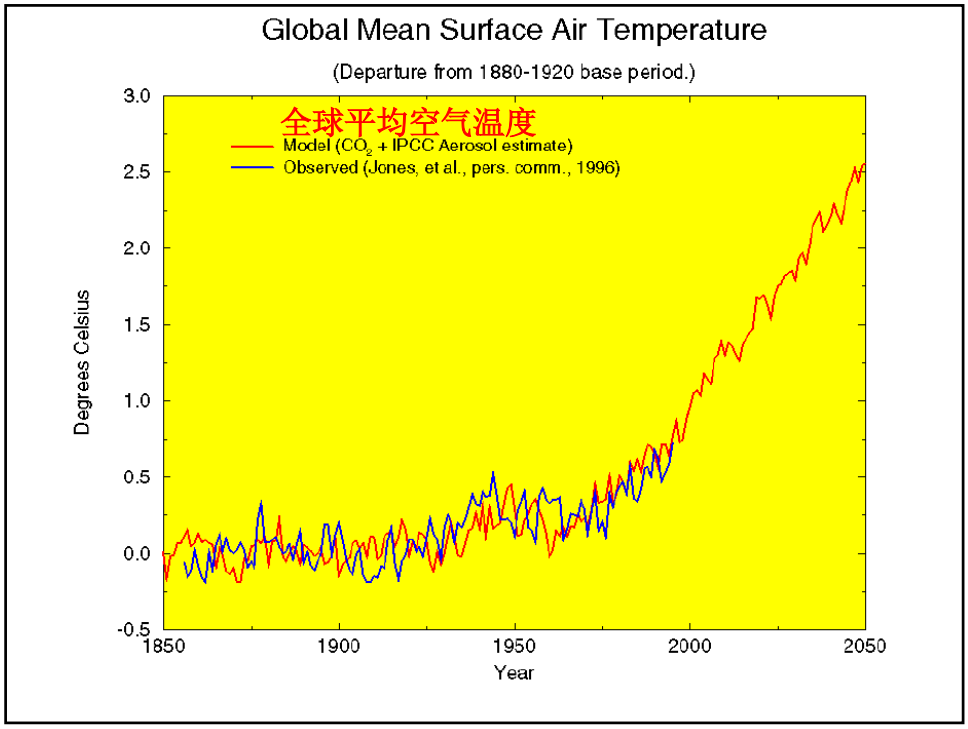
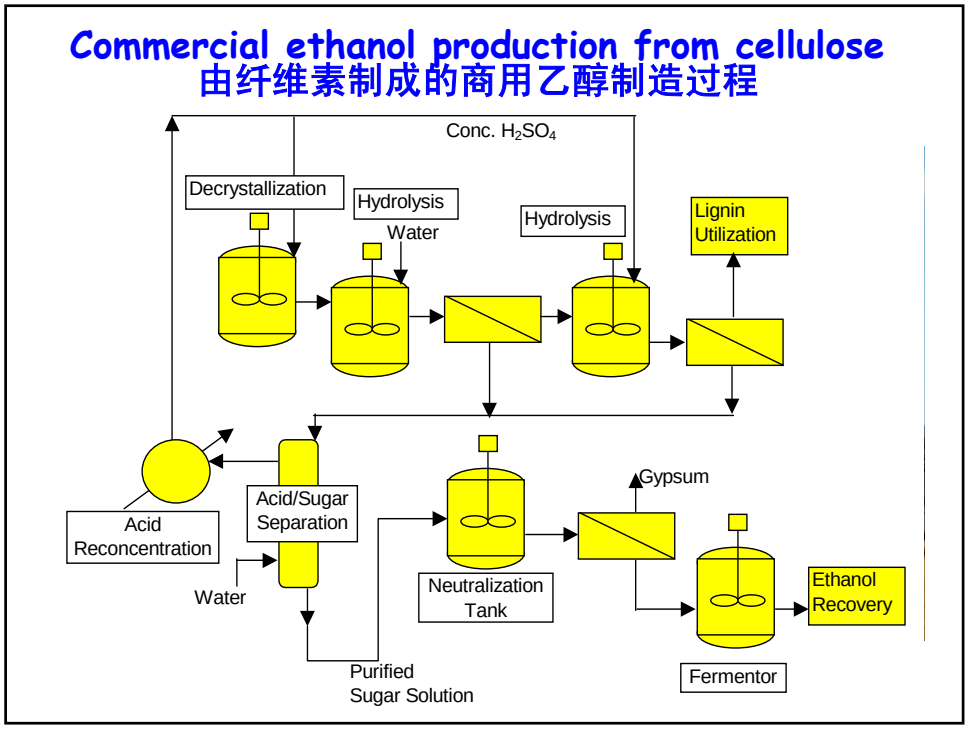

Global Mean Surface Air Temperature
(Departure from 1880-1920 base period.)
全球平均空气温度
Model (CO_2 + IPCC Aerosol estimate)
Observed (Jones, et al., pers. comm., 1996)
Degrees Celsius
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
1850
1900
1950
2000
2050
Year


Commercial ethanol production from cellulose
由纤维素制成的商用乙醇制造过程
Conc. H_2SO_4
Decrystallization
Hydrolysis
Water
Hydrolysis
Lignin Utilization
Acid Reconcentration
Acid/Sugar Separation
Water
Neutralization Tank
Gypsum
Ethanol Recovery
Fermentor
Purified Sugar Solution

There are dangers in dividing "public good" services such as transportation and energy suppliers into micro-business sectors.
将运输及能源供给等“公众利益”服务划分成不同的微观经济部门存在着一定的危险。

- A vertically integrated transportation system (monopoly) would provide incentives to optimize factors such as the cost of transportation energy, road construction, car use and efficiency, and mass transit.
- 垂直一体化运输系统（垄断行业）有利于刺激运输能源费用、公路修建、汽车使用与能效以及公共交通等因素的优化。

- My predictions:
Marketing bigger cars
•as safer cars would stop.
Investments in mass transit would increase.
- 我的预测:
汽车体积越大安全性
•越高的宣传推广将 终止。
对公共交通的投资力度将加大。

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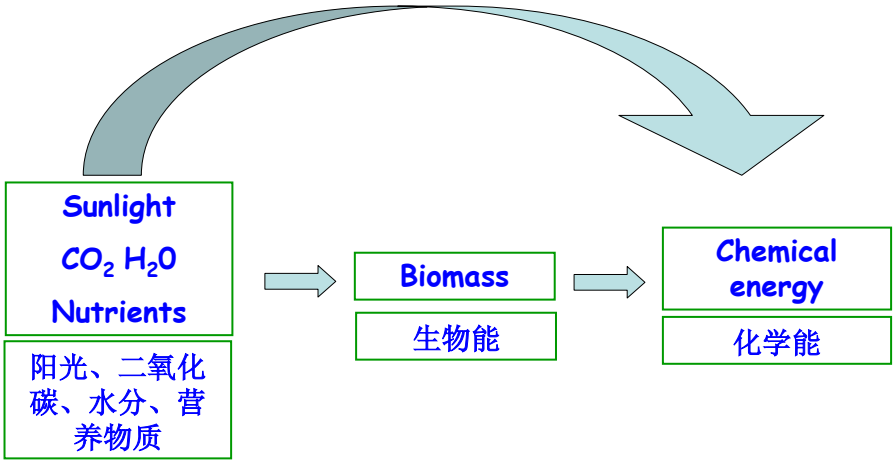
Can we modify existing organisms or design new ones to directly produce energy?
我们能否通过对现有有机物的转变或制造出新的有机物来直接生成能源？



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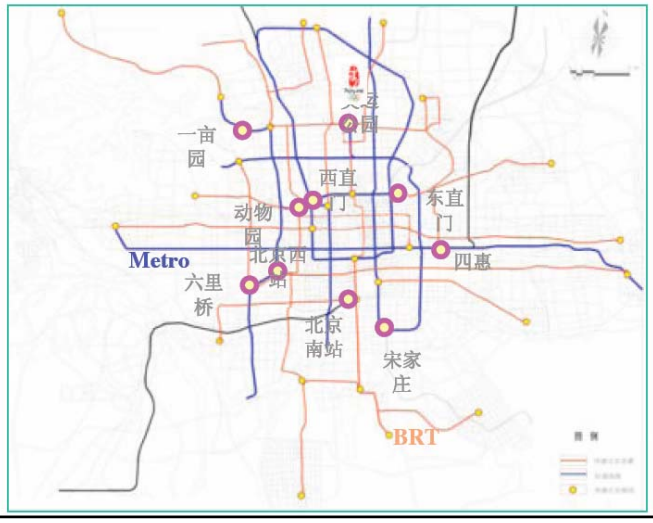
In order for a combined subway, light rail or and bus *rapid* transit system to succeed, dense coverage is needed. Clean and fast transportation is needed to lure middle class people who can afford to drive.

为了保证地铁、轻轨或者/以及*快速*公交综合系统取得成功，公交系统的覆盖面必须要密集。同时必须保证公交系统的清洁与快速从而吸引具有购买私家车实力的中产阶级人群使用公交系统。



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A diversified portfolio of investments is needed

需要投资渠道多样化

A solution may lie at the interface of biology and the physical sciences at the nano-scale

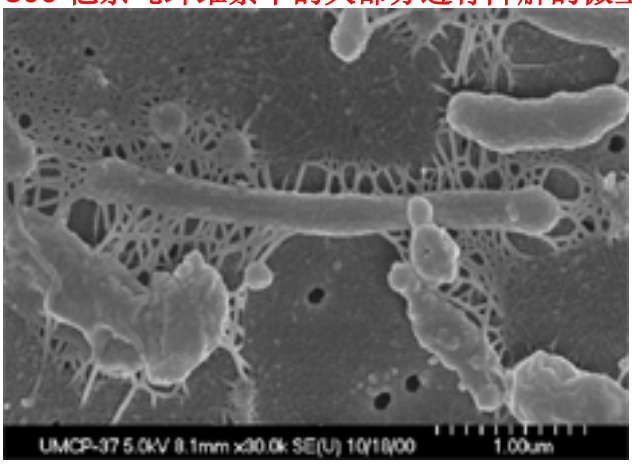
生物学与纳米级物理学之间的交互领域可能为问题的解决方案所在。

Microbulbifer degradans

微生物降解

A group of microorganisms that degrades of a significant portion of the 50+ billion tons of cellulose

一组将 500 亿余吨纤维素中的大部分进行降解的微生物。



可持续能源财政和税收政策研究
Tax & Fiscal Policy Options for Clean Energy Development

财政部财政科学研究所 苏 明
Professor Su Ming, Research Institute for Fiscal Science, Ministry of Finance
2005年11月16日/November 16, 2005

演讲的主要内容
Main Contents

一、能源财税政策的现状与问题
二、能源财税政策设计的国际经验
三、实现可持续能源战略的财税政策的思路和建议

I. Status quo and emerging problems in China's fiscal policies fostering energy development

II. International practices for fiscal policies fostering energy development

III. Fiscal policy recommendations for sustainable energy development

一、现状与问题

I. Status Quo and Emerging Problems

随着1994年财税体制改革的推进，财税政策日益走向规范，以前针对不同所有制、不同地区财税优惠政策趋于减少，其中，针对能源发展方面的财税优惠政策也被随之取消。

目前总体来看，我国并没有形成健全的能源财政政策体系，或者说，政府缺乏利用公共财政手段促进国家能源战略实施的系统观念。现有零星的财政税收政策措施难以发挥应有的效率，这是与新时期全面实施国家能源战略的需要不相适应的。

Since the 1994 reforms, fiscal policies have become increasingly standardized, and preferential policies favoring energy development have been reduced.

There is still no perfect system for fiscal policies supporting energy development.

The government has failed to utilize public finance instruments for a national energy strategy.

The existing fragmented fiscal policies are incompatible with the requirements of the national strategy for energy development.

一、现状与问题

I. Status Quo and Emerging Problems

（一） 对节能工作重视不够。政府在节能投入上处于相当不稳定的状态。而且，政府的直接投入只局限于研发和生产（技改）领域，在节能产品销售、使用、服务、回收、信息传播等方面几乎是一个空白。

（二）对低能效产品和因消耗能源而产生的环境污染问题缺乏惩罚性措施。

i. The government has not attached sufficient importance to energy-saving work.

Direct government investments have been limited to R&D and production (technological innovations).

Marketing, utilization, services, recovery, and information dissemination are ignored.

ii. Punitive measures for low energy-efficiency products and environmental pollution are inadequate.

一、现状和问题
I. Status Quo and Emerging Problems

（三）现有的政策体系中存在着抑制能源结构优化的问题。在电力能源的开发建设上，增值税的设计在一定程度上抑制了水力发电的建设。水电建设的特殊性在于，作为进项成本的投入是一次性完成的，应当根据水坝的不同使用年限分摊在各年中，作为增值税计算基数的进项抵扣项，而不应直接按售电收入计征其增值税。这样就加重了水电的税负，不利于水电的发展。

iii. The policy system obstructs optimization of the energy structure:

The current design of VAT constrains the development of waterpower generation.

Costs should be allocated to different years of dam usage and treated as an input discount item in calculating VAT.

Directly basing VAT on electricity sales revenues increases the burden on water power plants and directly obstructs waterpower development.

一、现状和问题
I. Status Quo and Emerging Problems

（四）对能源的无序开发、回采率极低造成能源资源的浪费现象，缺乏应有的政策措施。

iv. There are inadequate restrictive policy measures on energy-wasting, unorganized exploration and low rates of extraction.

（五）对开发新能源与可再生能源缺乏相应的政策支持。

v. The government has not established corresponding policy frameworks for developing new and renewable energy resources.

（六）应对能源安全问题特别是石油安全问题措施不够。

vi. There are no effective measures to counter energy safety problems, especially regarding oil.

二、国际经验
I. International Practices

从发达国家和一些发展中国家（包括美国、日本、欧盟、韩国等）可持续能源发展的历程看，利用财税政策推动可持续能源发展，有以下国际性经验值得重视：

（一）能源效率管理成为世界可持续发展的基本原则

1、能源效率管理已成为发达国家解决气候变化、减少温室气体排放的主要措施。

2、能源效率管理成为各国政府保障能源安全的重要措施。

3、加强能源效率管理，能有效地促进国民经济整体竞争力。

International sustainable energy development practices with implications for China:

i. Energy efficiency management as the basic principle for sustainable development internationally:

1. Energy efficiency has become a major measure to resolve climate change and reduce greenhouse gas emissions.
2. Energy efficiency management has become an important measure to secure energy safety.
3. Strengthening energy efficiency management can promote the overall competitiveness of the national economy.

二、国际经验
II. International Practices

（二）有效运用财政激励政策克服市场障碍，促进节能

1、进行长远规划

2、在制定财政激励政策时应全面综合考虑

3、根据市场确定财政激励的水平

（三）鼓励自愿协议的推行，减少温室气体排放，提高能源效率

（四）政府采购有助于加速能源新技术和新产品的推广利用。

ii. Effectively utilize fiscal incentives to overcome market constraints and improve energy efficiency:

1. Long-term planning.
2. Comprehensive consideration of all factors in formulating fiscal incentive measures.
3. Determining the level of incentives on a market basis.

iii. Encourage voluntary agreements to reduce greenhouse emissions and improve energy efficiency.

iv. Utilize government measures to accelerate energy technologies and the popularization of new energy efficient products.

三、思路和建议
III. Conceptions and Recommendations

总体思路：下一步，国家财政要运用正向激励政策，逆向限制政策、交叉补贴政策等，来推动可持续能源发展。正向激励政策包括预算投入政策、国债投入政策、财政贴息和补贴政策、税收优惠政策、政府采购政策等；逆向限制政策包括扩大消费税征收范围、加快开征燃邮税、开征能源税、改革矿产资源补偿费的征收办法等。

Next Steps:

The state should utilize positive incentives, negative restrictive measures, and cross-subsidy policies to promote sustainable energy development.

Positive incentives: Budgetary investments, national debt investments, financial discount loans and subsidies, tax incentives, and government procurement policies.

Negative restrictive measures: Expand the scope of the consumption tax, accelerate the fuel levy, initiate an energy tax, and reform the levies on mineral resource compensation fees.

三、思路和建议
III. Conceptions and Recommendations

（一）支持节能的财政税收政策建议

1．政府预算投入政策

（1）在经常性预算中，设立节能支出科目，安排相应的节能支出预算。主要用于节能科技的研究与开发；节能技术示范和推广；节能教育和培训；节能管理监督体系建设。

（2）整合预算内投资和国债投资，强化节能投资力度。

I Fiscal policies to improve energy efficiency

1. Government budgetary investments

(1) Establish an expenditure item on energy economization in recurrent budgets and arrange corresponding funds.

Funds should should be used for energy-efficient technology R&D, demonstration, and popularization,; education and training on energy efficiency; and construction of energy-saving management and monitoring systems.

(2) Consolidate budgetary investments and national-debt investments. Increase overall investment in energy–saving activities

三、思路和建议
III. Conceptions and Recommendations

（3）建立节能专项基金。

2．企业所得税优惠政策。

（1）鼓励节能产品生产的企业所得税优惠措施：

建议采取税率减半的直接优惠办法：对专门从事节能产品生产的企业，减半征收企业所得税；对非专门从事节能产品生产的企业，就其生产经营节能产品取得的所得，减半征收企业所得税。但要求企业分别核算节能产品生产经营所得，未分别核算或核算不清的不能享受税收优惠。

(3) Establish a special fund for energy economization.

2. Corporate income tax incentives to promote energy efficiency

(1) Corporate income tax incentives to encourage production of energy-economizing products

Direct incentives for halving the tax rate is recommended: For enterprises fully engaged in the production of energy–saving products, corporate income tax rate should be halved; For enterprises not fully engaged in the production of energy-saving products, their revenues deriving from the production and sales of energy-saving products can also enjoy half tax rate, but they must separate revenue accounts of energy-saving products and non-energy-saving products.

三、思路和建议
III. Conceptions and Recommendations

（2）促进节能产品使用和消费的所得税优惠措施

建议对企业为达到国家规定的能耗标准进行节能改造而购置的节能产品（设备），按其产品（设备）投资（购置）额的一定比例（如15%）从企业应纳所得税额中抵免，当年不足抵免的，可用以后年度应纳所得税额延续抵免，但最长不超过5年。对形成固定资产的节能设备，可适当缩短折旧年限或采取加速折旧的方法计提折旧。

(2) Corporate income tax incentives to promote the use and consumption of energy-efficient products.

For equipment purchased by enterprises to reach the energy-consumption standards set by the State, a certain percentage (e.g. 15%) of the purchase amount can be deducted from the taxable amount.

If the taxable amount of the current year is not sufficient for the deduction, the taxable amount for the following years (a maximum of 4 successive years) can be accumulated.

For energy-saving equipment that become fixed assets, a shortened depreciation period or accelerated depreciation should be allowed.

三、思路和建议
III. Conceptions and Recommendations

（３）明确企业所得税节能优惠目录

(3) Catalogue for Corporate Income Tax Incentives to Promote Energy Efficiency should be well developed.

３．政府采购政策

3. Government procurement policies

要加大节能产品认证力度；加快节能产品的政府采购步伐；节能政府采购要实行集中采购模式；试行节能产品的协议，供货制度；加强节能产品政府采购的宣传执行工作。

The authentication of energy-efficient products should be strengthened, and government procurement on energy-efficient products should be sped up.

Procurement should be based on a centralized model, and the contract supply system for energy efficient products should be attempted. Support for the government procurement of energy efficient products should be further reinforced.

三、思路和建议
III. Conceptions and Recommendations

（二）支持清洁能源的公共财政税收政策建议

ii. Fiscal policy recommendations to support the development of clean energy

1. 着力促进可再生能源发展的财税政策建议

1. Promote fiscal policy recommendations for sustainable energy development

（1）调整和完善可再生能源增值税政策。

(1) Adjust and improve VAT treatments on renewable energy resources

为扶持风力发电，其增值税税率还应降低，至少应与煤电相当或更低。关于小水电的增值税优惠政策，我们建议，一是普遍降低水电企业的增值税税率，至少要与火电大体一致。二是进一步降低小水电的增值税税率，大体保持在3%左右。

Wind power plants:

1. VAT treatment should be lowered to at least lower than or equivalent to coal electricity plants.

Small-sized hydropower plants:

1. VAT rate for all hydropower plants should be commonly lowered to at least equivalent level of coal electricity plants.
2. VAT rate for small-sized hydropower plants be maintained at about 3%.

三、思路和建议
III. Conceptions and Recommendations

（2）调整和完善可再生能源企业所得税政策。

在未来我国所得税并轨改革中，要从国家层面研究制定促进可再生能源发展的措施。一是对所有的可再生能源产品一律规定减按15%的税率征收企业所得税；二是实行投资抵免制度，即可再生能源企业的投资可以用新增所得税抵免一部分；三是实行加速折旧，加大研发费用的支出份额。

(2) Adjust and improve corporate income tax measures on firms engaged in producing and marketing renewable energy resources.

In the future consolidation of corporate income taxes, consideration for the development of renewable energy resources should be made from the national level:

1. A 15% corporate income rate should be used for all firms manufacturing or selling renewable energy products.
2. Investments of the renewable energy firms can be deducted by a certain amount in calculating income taxes.
3. An accelerated depreciation method should be used and expenses on R&D increased.

三、思路和建议
III. Conceptions and Recommendations

（3）调整和完善可再生能源设备进口关税政策。

国家为鼓励国内资金投向，今后对利用国内资金进口国外所有可再生能源的设备，应由外商企业一样，免征关税和进口环节增值税，以确保内外资企业保持同等“国民待遇”，并促使可再生能源发展。

(3) Adjust and improve import tariff treatments on equipments for producing renewable energy resources.

Encourage domestic investments in renewable energy.

Future purchases of renewable energy equipment by domestic firms should also enjoy the treatment of tariff and import VAT exemption to ensure domestic and foreign firms are treated equally.

三、思路和建议
III. Conceptions and Recommendations

（4）明确政府财政支持可再生能源的方向和重点

——加大可再生能源研究开发的政策支持力度。

——完善国家财政对可再生能源的补贴政策。

——着力支持农村的可再生能源建设。

（5）关于财政政策与银行信贷政策配合支持可再生能源发展问题。

(4) Clarify the directions and focus of financial support for the development of renewable energy.

We suggest:

- Increase policy support for R&D in renewable energy resources.
- Improve state subsidies for renewable energy.
- Focus on renewable energy development in rural areas.

(5) Integrate fiscal and banking credit policies to support the development of renewable energy.

三、思路和建议
III. Conceptions and Recommendations

2．加快我国核电发展的财税政策建议

今后为了加快我国核电发展，必须加强财税政策扶持力度。考虑到我国核电发展仍处于发展初期，建议加大政策扶持：

(1)加大财政支持。将支持核电发展列为专项，给予核电足够技术开发经费，重点支持先进技术的研究开发和设计自动化；政府与核电项目业主分担自主化依托项目的建设风险和“首堆工程费”，对自主化依托项目补贴适量的技术攻关经费。

2. Fiscal policy recommendations to accelerate nuclear power development in China.

We suggest the following fiscal measures:

Earmarked funds to support nuclear power generation, allowing for sufficient expenses in relevant R&D activities, focus on R&D for advanced technologies, and design automation.

The government should share the construction risks and “initiation expenses” of the automated projects with the nuclear power plant owners, and provide appropriate amounts of subsidies for their technological innovations.

三、思路和建议
III. Conceptions and Recommendations

(2) 是加大进口环节税收优惠政策支持。对国内不能生产或制造，需要进口的材料、部件或设备免征进口环节税。

(2) Import taxes should be exempt from relevant materials, and components or equipments that cannot be domestically produced.

(3) 是完善核电增值税政策。建议在2010年前把核电的增值税降低到小水电的税率（6%），以降低核电成本费用，增强核电的优势和竞争力，促进核电发展。

(3) VAT on nuclear-power plants should be lowered to the level of VAT on small-sized water power plants (6%), so as to minimize cost and support the competitiveness of nuclear power.

三、思路和建议
III. Conceptions and Recommendations

3．加快我国洗选煤发展的财税政策建议

3. Fiscal policy recommendations to accelerate washed coal development in China.

(1) 支持洁净煤的基础技术和共性技术研发，支持煤气、煤液化等环保性好、投入大、具有一定风险的洁净煤技术示范项目。

(1) Support R&D in basic clean coal technologies, as well as clean coal technology demonstration projects that are also environmentally friendly but more risky and call for larger investment, such as coal gas and liquid coal.

(2) 对于关键引进技术的消化吸收、示范项目所需进口设备和技术，给予进口关税、进口环节增值税优惠和融资支持；

(2) Incentives should cover tariff, export VAT and financing supports, as well as low-interest-rate loans or financial interest subsidies.

三、思路和建议
III. Conceptions and Recommendations

(3)对商业化的洁净煤技术项目，给予低利率贷款或财政贴息支持。支持选煤企业加大技术改造力度，将洁净煤技术项目优先纳入国家重点技改项目，享受节能专项贷款、企业技术创新贷款支持等。

(3) Encourage coal-selecting enterprises to promote technological innovations.

Include clean-coal technologies in key national innovation projects that enjoy energy-economizing loans and support for technological innovation.

三、思路和建议
III. Conceptions and Recommendations

(4)此外，要鼓励实施分段式二氧化硫排污收费方式：对于已采用先进技术、排放量很低的企业，降低收费额；对于未采用减排技术、对环境影响较大但又未超标的企业，调高收费标准，刺激企业采用有效的减排技术；对于严重影响环境、超标排放的污染源，实施惩罚性征收标准。

（三）促进能源结构调整、保障能源供应的财政税收政策

(4) Encourage the implementation of a "discriminatory" fee charge method on SO2 emissions:

- **Lower charges on low-emitting firms that utilize advance technologies.**
- **Increase charges on firms causing environmental problems but still within emission standard.**
- **Administer punitive charges on firms causing serious environmental problems and emitting beyond standards.**

iii. Fiscal policies to promote energy structural adjustment and to ensure energy supply

三、思路和建议
III. Conceptions and Recommendations

1．支持建立国家战略石油储备制度

在建立中国石油储备筹资模式时，既要借鉴国外经验，又要充分考虑国情。具体如何筹集这笔资金？根据国外经验，具体可以采取如下方式：

（1）设立专项基金，例如通过对成品油价的加价筹集，或者从某项税收（如石油消费税）收入中按一定比例；

（2）开征专门税种；

（3）发行专项国债。

1. Establish a national strategic oil reserve system

Both foreign experience and domestic specificities should be considered when financing the the national oil reserve. Foreign experiences suggest the following :

(1) Establish a special fund through price increases on finished oil or a proportion from other specific taxation sources (e.g. oil excise duty).

(2) Levy a special tax.

(3) Issue earmarked national debts.

三、思路和建议
III. Conceptions and Recommendations

2．大力支持国有能源企业开拓海外能源合作市场

从实际情况看，政府应当在统筹、支持国有企业海外能源合作业务方面采取必要的政策措施，除了协调三大油公司的海外业务、在其对外投资审批手续和程序上给予特殊支持以外，政府财政还可以从财务管理、投资风险基金、税收抵免优惠等方面给予特殊的财政支持。

2. Vigorously promote state-owned energy enterprises to develop an overseas energy cooperative market.

The government should:

- Coordinate the overseas business of the three large oil enterprises and specially facilitate their approval systems and procedures.
- Provide special fiscal supports for financial management, investment risk funds, and taxation deduction incentives.

三、思路和建议
III. Conceptions and Recommendations

3．积极支持煤炭及传统能源产业的发展。

要进一步调整煤炭资源税政策，扩大资源税的调节作用；要运用税收政策、企业财务政策，促进煤炭安全生产。

3. Vigorously support the development of traditional energy industries.

- Coal resource tax measures should be further adjusted.
- The adjusting role of the resource tax instrument should be reinforced.
- Taxation policies and corporate financial regulations should be utilized to promote production safety.

三、思路和建议
III. Conceptions and Recommendations

（四）支持能源研发与科技创新的财税政策建议

1．增加政府能源研发预算投入
2．要为企业用于能源研发的银行贷款提供财政贴息
3．运用税收优惠政策支持能源研发

iv. Fiscal policy recommendations to support energy R&D and technological innovations

1. Increase budgetary investments in energy R&D activities.
2. Provide interest discounts for bank loans for enterprises' energy R&D activities.
3. Use tax incentives to support energy R&D.

三、思路和建议
III. Conceptions and Recommendations

（五）改革中央与地方在能源公共财政和税收体制方面的思路和建议

1．国家通过确定有关能源开采最低标准的基础上，将扩大开采或回采比例所征收的税收或费用全额返还当地政府，以此抑制常规化石能源基地存在的短期行为和浪费行为。

2．不分所有制，鼓励技术水平高、开采和生产效率高的大中型企业兼并技术水平低的小型企业，在税收政策上限制浪费资源的小型企业过快发展。

v. Suggestions on reforming the central-local fiscal system for energy development

1. Based on the minimum standards on energy exploitation set by the state, to minimize the short-term behaviors and wastes evidenced at normal fossil energy bases, the central government should rebate the tax revenues or fee charges from raising exploiting or retraction rates to local governments.

2. Large and medium-sized enterprises with advanced technologies and high exploiting and producing efficiency should be encouraged by taxation incentives, so as to prevent highly energy-consuming small-sized enterprises from developing too fast.

三、思路和建议
III. Conceptions and Recommendations

3．对将来可能实行的有关逆向限制政策所出台的税收（如碳税、能源税等），作为中央政府固定收入，或使中央政府在税收分享中占较大比重，增强中央政府在能源生产、消费、节能等方面的调控能力。

3. Tax revenues from negative restrictive measures (carbon tax, energy tax and etc.) should be retained as central government revenues, or shared with the local government.

The central government should take a majority of the revenues, so as to reinforce the central government's control over energy production, consumption, and economization.

Fiscal Instruments for Pollution Control: Attractions, Limitations, and Strategies

污染控制财政措施：优势、缺陷和策略

Lawrence H. Goulder
Stanford University
斯坦福大学

Important to recognize attractions and limitations of fiscal instruments.

- Benefits and costs for the nation as a whole
- Potential winners, losers, and associated political challenges

认识到财政手段的优势与缺陷非常重要。

- 国家整体利益与成本
- 潜在受益者、受害者及有关政治上的挑战

Fiscal Approaches to Environmental Protection
环境保护的财政措施

A. Taxes on:
- emissions or effluent releases (pollution levy)
- goods or services associated with pollution (gasoline tax)

B. Tax Credits for:
- Clean energy purchases by consumers (installing insulation)
- Use of clean energy production methods (electricity from renewable sources)
- Investments in cleaner production equipment (better methane capture from natural gas pipelines)

C. Subsidies to research and development of new, clean technologies

D. Policy Packages:
- Green tax reform: using environmental taxes to finance cuts in ordinary income or sales taxes
- Linked environmental policies: using emissions taxes to pay for B or C above.

A. 税收：
- 空气污染物和废水排放（污染税收）
- 对造成污染的商品或服务征税（汽油税）

B. 减税优惠：
- 消费者购买清洁能源（安装隔热层）
- 利用清洁能源生产方式（可再生能源发电）
- 投资环保生产设备（从天然气管道收集泄漏甲烷）

C. 补贴：对研发新型环保技术进行补贴

D. 政策方案：
- 绿色税收改革：利用环境税补偿一般所得税或营业税的减少
- 关与环保政策联系起来：利用排污税支付上述 B 或 C。

Questions
问题

1. What are the potential attractions and limitations of fiscal instruments?
2. Which types of fiscal instruments are best?
   -- “Carrots”?
   -- “Sticks”?
   -- A Combination?
3. Do fiscal instruments make conventional regulation (direct controls) unnecessary?
4. How extensively are fiscal instruments used in various countries?
5. Is it worthwhile for China to expand use of these instruments now? Or does the “Environmental Kuznets Curve” imply it is better to wait until a higher per-capita income level is reached?

1. 财政手段有哪些潜在优势与缺陷？
2. 哪些类型的财政手段是最好的？
   -- “胡萝卜政策”？
   -- “大棒政策”？
   -- 两种政策相结合？
3. 财政手段是否意味着不再需要进行常规调控（直接控制）？
4. 财政手段在不同国家的推广程度如何？
5. 中国是否有必要现在就推广这些手段？“环境库兹涅茨曲线”是否意味着最好还是等到人均收入达到更高水平后再推广？

Fiscal Approaches to Environmental Protection
环境保护财政措施

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"sticks"

"carrots"

A. 税收：
- 空气污染物和废水排放（污染税收）
- 对造成污染的商品或服务征税（汽油税）

B. 减税优惠：
- 消费者购买清洁能源（安装隔热层）
- 利用清洁能源生产方式（可再生能源发电）
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"大棒政策"

"胡萝卜政策"

1. What are the potential attractions and limitations of fiscal instruments?
1. 财政手段有哪些潜在优势与缺陷？

Attractions:

1. **Cost-effectiveness**
   - *Helps assure that pollution-reductions will be made where they can be achieved most cheaply*
   - *Direct regulation generally cannot assure this -- regulators have insufficient information*
2. **Innovation incentives**
   - *Sustained rewards from discovering cleaner methods*
3. **Efficient source of revenue**
   - *Allows for socially beneficial "green tax reform" -- taxing "bads" allows for lower taxes on "goods"*

优势：

1. 成本效益
   - *有助于确保以最低的成本降低污染*
   - *直接法规通常无法确保这一点 —— 监管人员缺乏信息*
2. 激励创新
   - *不断激励更环保技术方法的发现*
3. 收入来源 的有效利用
   - *可有利于社会的"绿色税收改革" —— 对"不好的"收税，对"好的"提供税收优惠*

1. What are the potential attractions and limitations of fiscal instruments? (*continued*)
1. 财政手段有哪些潜在优势与缺陷？（续）

缺陷：

1. Larger share of policy cost falls on polluting facilities
   - *This can be overcome through partial exemptions*
2. Greater visibility of policy cost
3. The quantity of pollution is uncertain
   - *but the cost of abatement is clearer*

Taxes on emissions or fuels

4. Drain on public revenue (compete with other revenue needs; enlarge public deficits)
   - *(in U.S., this is significant obstacle to increased Federal support for R&D)*
   - *Partial solution to this problem: environmental policy linkage. Use emissions tax revenue to finance these subsidies.*

Tax-credits and R&D subsidies

缺陷:

1. 污染设施承担较多的政策成本
   - *可以通过部分免税来克服*
2. 政策成本更加透明
3. 污染量不确定
   - *但减污成本非常明确*

排污税或燃料税

4. 消耗公共收入（与其他收入需要存在冲突；增加公共赤字）
   - *(在美国，这是联邦加大研发支持力度的主要障碍)*
   - *以下方案可部分解决这一问题：环境政策相联系。利用排污税收入为这些提供资金补贴*

减税优惠和研发补贴

2. Which types of fiscal instruments are best?
-- "Carrots"? -- "Sticks"? -- A Combination?
2. 哪些类型的财政手段是最好的？
-- "胡萝卜政策"？ -- "大棒政策"？ -- 两种政策结合？

Excluding the sticks is politically expedient in U.S. (perhaps in China as well) -- But it is economically wasteful

- Emissions taxes focus most directly with problem of environmental externalities ("pollution market failure")
- Government subsidies to R&D focus most directly on problem of insufficient incentives to innovate ("innovation market failure")

The least-cost approach to environmental protection and clean energy involves both types of policies (carrots and sticks).

- Goulder and Schneider (1999): achieving 15% reduction in U.S. carbon emissions is 10 times more costly if achieved solely through R&D subsidies

在美国，遏制使用大棒政策在政治上有利（在中国或许也是如此）—— 但在经济上非常浪费

- 排污税主要直接针对环境外部效应问题（"污染市场失灵"）
- 政府对研发进行补贴主要直接针对缺乏创新激励（"创新市场失灵"）

结合使用这两种政策（胡萝卜政策与大棒政策）是保护环境和促进环保能源使用成本最低的方式。

- Goulder 和 Schneider (1999)：美国碳排放量减少 15% 所需的成本要高10倍，如果单独采用研发补贴。

3. Do fiscal instruments make conventional regulation unnecessary?
3. 财政手段是否意味着不再需要进行常规调控？

Emissions taxes can remove need for some direct controls, particularly if introduced "upstream"

- For example, a carbon tax, if imposed on suppliers of primary fuels, would encourage electric power generators to switch to cleaner fuel sources (hydro power, wind power, etc.) or to lightly taxed fuels (natural gas). No need for direct fuel-switching requirements.

But several types of economic activity are not easily addressed through fiscal instruments. Examples:

- Mobile-source emissions (cars, planes)
- Non-point agricultural sources

In these cases, monitoring emissions is very costly or impossible. Direct controls (efficiency standards, mandated technologies) are better.

采取征收排污税后将不再需某些直接控制，尤其是在"上游"引入时。

- 例如，如果对供应商提供的初级燃料征收碳税，将鼓励发电商改用更清洁的燃料源（水能、风能等）或征税较少的其他燃料（天然气）。这样就没有必要直接要求更换燃料。

但有些经济活动很难通过财政手段来解决。例如：

- 移动排污源（汽车、飞机）
- 农业非点源

在这些情况下，排污监控成本非常高甚至根本无法监控。直接控制（能效标准、强制性技术）会更加有效。

In Sum
总结

The most cost-effective promotion of environmental protection (including clean energy) involves:

- Combination of taxes (or tax-breaks) and R&D subsidies
- Combination of fiscal approaches and direct controls

Many fiscal approaches suffer a political disadvantage. But some disadvantages can be reduced or eliminated through judicious policy design (inframarginal exemptions, policy-linkage)

A. Taxes on Pollution

B. Tax Credits for clean production or consumption

C. Subsidies to R&D

D. Policy Packages (linked policies)

E. Direct Controls

促进环境保护（包括清洁能源）最具成本效益的方法是：

- 将税收（或减税）与研发补贴相结合
- 将财政手段与直接控制相结合

许多财政手段在政治方面存在缺陷。但有些缺陷可以通过合理地制定政策（超边际免税、政策关联）来减轻甚至消除

A. 征收污染税

B. 对清洁生产或消费提供减税优惠

C. 对研发进行补贴

D. 政策方案组合（相关政策）

E. 直接控制

4.How extensively are fiscal instruments used?
4. 财政手段的推广程度如何？

Table 1:

Contributions of Environment-Related Taxes to Overall Tax Revenues for OECD Countries in 1997.

Source: OECD

Country	Environment-Related Tax Revenue (millions of US dollars)	Total Tax Revenue (millions of US dollars)	GDP (billions of US dollars)	Environment-Related Tax Revenue as Percent of Total Tax Revenue	Environment-Related Tax Revenue as Percent of GDP
Austria	4,865	91,297	206.7	5.33	2.35
Belgium	5,715	111,411	243.6	5.13	2.35
Canada	13,242	236,225	640.0	5.61	2.07
Czech Republic	1,501	20,460	53.0	7.33	2.83
Denmark	7,780	84,233	168.4	9.24	4.62
Finland	3,963	56,526	122.5	7.01	3.23
France	30,156	635,746	1,406.0	4.74	2.14
Germany	46,382	782,305	2,114.5	5.93	2.19
Greece	4,746	40,504	120.0	11.72	3.95
Hungary	1,292	17,868	45.8	7.23	2.82
Iceland		2,377			
Ireland	2,381	25,772	78.5	9.24	3.03
Italy	37,790	515,237	1,159.5	7.33	3.26
Japan	71,388	1,202,355	4,195.3	5.94	1.70
Korea	13,333	101,880	476.9	13.09	2.80
Luxembourg	504	7,303	17.5	6.89	2.88
Mexico		67,763			
Netherlands	13,668	158,109	376.7	8.64	3.63
New Zealand	1,108	23,553	64.9	4.70	1.71
Norway	5,570	65,676	155.0	8.48	3.59
Poland	2,350	55,936	143.2	4.20	1.64
Portugal	3,670	34,919	104.3	10.51	3.52
Spain	11,964	188,355	558.6	6.35	2.14
Sweden	7,276	122,252	237.5	5.95	3.06
Switzerland	5,020	86,729	256.3	5.79	1.96
Turkey	5,846	53,007	190.2	11.03	3.07
United Kingdom	38,247	464,383	1,315.7	8.24	2.91
United States	77,333	2,299,136	8,121.0	3.36	0.95
Total	417,090	7,551,318	22,571.6	5.52	1.85

Table 1:

Contributions of Environment-Related Taxes to Overall Tax Revenues for OECD Countries in 1997.

Source: OECD

表 1：

1997 年经济合作与发展组织各国中与环境有关的税收对总税收的贡献。

资料来源：经济合作与发展组织

国家	与环境有关的税收（百万美元）	总税收（百万美元）	国内生产总值（十亿美元）	与环境有关的税收占总税收的百分比	与环境有关的税收占国内生产总值的百分比
奥地利	4, 865	91, 297	206. 7	5. 33	2. 35
比利时	5, 715	111, 411	243. 6	5. 13	2. 35
加拿大	13, 242	236, 225	640. 0	5. 61	2. 07
捷克共和国	1, 501	20, 460	53. 0	7. 33	2. 83
丹麦	7, 780	84, 223	168. 4	9. 24	4. 62
芬兰	3, 963	56, 526	122. 5	7. 01	3. 23
法国	30, 156	635, 746	1, 406. 0	4. 74	2. 14
德国	46, 382	782, 305	2, 114. 5	5. 93	2. 19
希腊	4, 746	40, 504	120. 0	11. 72	3. 95
匈牙利	1, 292	17, 868	45. 8	7. 23	2. 82
冰岛		2, 377			
爱尔兰	2, 381	25, 772	78. 5	9. 24	3. 03
意大利	37, 790	515, 237	1, 159. 5	7. 33	3. 26
日本	71, 388	1, 202, 355	4, 195. 3	5. 94	1. 70
韩国	13, 333	101, 880	476. 9	13. 09	2. 80
卢森堡	504	7, 303	17. 5	6. 89	2. 88
墨西哥		67, 763			
荷兰	13, 668	158, 109	376. 7	8. 64	3. 63
挪威	5, 570	65, 676	155. 0	8. 48	3. 59
波兰	2, 350	55, 936	143. 2	4. 20	1. 64
葡萄牙	3, 670	34, 919	104. 3	10. 51	3. 52
西班牙	11, 964	188, 355	558. 6	6. 35	2. 14
瑞典	7, 276	122, 252	237. 5	5. 95	3. 06
瑞士	5, 020	86, 729	256. 3	5. 79	1. 96
土耳其	5, 846	53, 007	190. 2	11. 03	3. 07
英国	38, 247	464, 383	1, 315. 7	8. 24	2. 91
美国	77, 333	2, 299, 136	8, 121. 0	3. 36	0. 95
合计	417, 090	7, 551, 318	22, 571	5. 52	1. 85

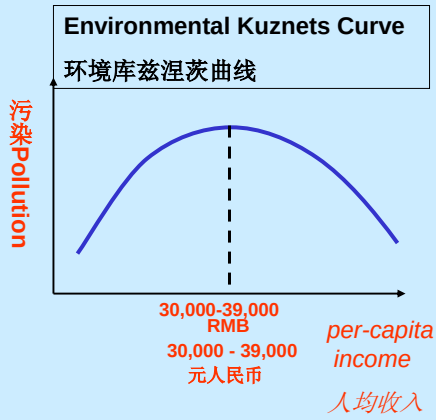
5. Is it worthwhile to use these instruments now?
5. 是否有必要现在就推广这些手段？

Cross-country comparisons suggest that a nation's environmental quality begins to improve when its per-capita income reaches ~$7000-$9000 (30,000-39,000 RMB).

Does this imply it's best for China to wait until per-capita income reaches this level before aggressively addressing pollution?

多国对照研究表明，一个国家的环境质量会在人均收入达到 7000 到 9000 美元（相当于 30,000 到 39,000 元人民币）后开始提高。

这是否意味着中国最好还是等到人均收入达到这一水平后再集中力量解决污染问题？



5. Is it worthwhile to use these instruments now? (*continued*)
5.是否有必要现在就推广这些手段？（*续*）

Two arguments against waiting:

1. **The "inevitable" inventing of clean technologies will occur later than what is best for society**
   - **Innovation market failure: The private reward from invention efforts falls short of the social benefit. Consequently, private markets provide insufficient incentives to invent and innovate.**
   - **Tilted playing field: In absence of policies to deal with pollution externalities, conventional, "dirty" production processes can be employed at costs below their full social cost. As a result, new, clean technologies face an inefficiently large cost-challenge.**
     - **Example: in U.S., the market penetration of clean, hybrid cars is made more difficult because gasoline taxes are relatively low, and cost of using conventional cars is therefore low as well.**

反对等待的两个论点：

1. 迟早会发明的新型技术将不能在最佳时期顺应社会需求
   - 创新市场失灵：发明工作的私人回报低于社会利益导致私有化市场不能有力地刺激发明和创新。
   - 不公平竞争：如果缺乏处理污染外部效应问题的政策，采用容易造成污染的传统生产流程的成本将低于其社会总成本。从而造成新型环保技术面临巨大的成本挑战。
     - 例如在美国，混合型动力环保汽车的市场渗透非常困难，因为汽油价格相对较低，从而使驾驶常规汽车的成本也会较低。

5. Is it worthwhile to use these instruments now? (*continued*)
5. 是否有必要现在就推广这些手段？（*续*）

2. **A "waiting" nation will suffer excessive environmental damage during the time-interval from now until the arrival of the clean technology**

   Economic analysis indicates that, at all points in time, social welfare is enhanced if fiscal policies can help bring prices of environmentally damaging activities closer to their full social cost (or if direct regulation can cause producers and consumers to act as if they faced such prices).

2. 从现在开始到环保技术出现之前的这段时间内，推迟推广这些手段的国家环境将受到严重损害

   经济分析表明，无论在任何时候，如果财政政策能够促使损害环境的活动的成本接近其社会总成本（或如果直接调控能够使生产商与消费者采取行动，如同他们面临此价格时一样），都可以提高社会福利。

5. Is it worthwhile to use these instruments now? (*continued*)

5. 是否有必要现在就推广这些手段？（*续*）

Implications for China:

- **Taxes on emissions and tax-credits for pollution-reduction**

  China's current levy rates are below the efficiency-maximizing rates (marginal environmental damages). Higher rates can produce environmental benefits in excess of regulatory costs.

- **R&D support**

对中国的启示：

- 征收排污税和降低污染的减税优惠

  中国目前的污染收费低于效率最大化的费率（边际环境损害）。较高费率带来的环境收益可以高于调控成本。

- 研发支持

Table 2: Science Development Indicators

Country	1987-1997 R&D Expenditure as % of GNP	1987-1997 No. of Scientists Engaged in R&D per Million	1987-1997 No. of Technicians Engaged in R&D per Million	1997 No. of Patent Applications per Million
Australia	1.80	3357	797	2342
Denmark	1.95	3259	2644	14076
Finland	2.78	2799	1996	12709
France	2.25	2659	2873	1681
Germany	2.41	2831	1472	1889
Japan	2.80	4909	827	3182
Spain	0.90	1305	343	2137
Sweden	3.76	3826	3166	9482
United Kingdom	1.95	2448	1017	2192
United States	2.63	3676	-	2342
Mid-Income Countries	2.00	2662	14439	5815
China	0.66 (1.31 in 2003)	454	233	43

Table 2: Science Development Indicators
表 2：科学发展指标

国家	1987 - 1997 年研发费用占国内生产总值的百分比	1987 - 1997 年每百万人口中从事研发的科学家的人数	1987 - 1997 年每百万人口中从事研发的科学家的人数	1997 年每百万人口专利申请数量
澳大利亚	1.80	3357	797	2342
丹麦	1.95	3259	2644	14076
芬兰	2.78	2799	1996	12709
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美国	2.63	3676	-	2342
中等收入国家	2.00	2662	14439	5815
中国	0.66(2003 年为 1.31)	454	233	43

5. Is it worthwhile to use these instruments now? (*continued*)
5. 是否有必要现在就推广这些手段？*(续)*

Implications for China:

- **Taxes on emissions and tax-credits for pollution-reduction**

  China's current levy rates are below the efficiency-maximizing rates (marginal environmental damages). Higher rates can produce environmental benefits in excess of regulatory costs.

- **R&D support**

  China's share of GDP devoted to R&D is fairly low relative to other nations (but growing significantly). Studies of social return to R&D suggest increased commitment would produce social net benefits. Nature of R&D support is as important as expenditure level.

对中国的启示：

征收排污税和降低污染的减税优惠

中国目前的污染收费低于效率最大化的费率（边际环境损害）。较高费率带来的环境收益可以高于调控成本。

- **研发支持**

与其他国家相比，研发投入占中国国内生产总值的比例还非常低。对研发的社会回报研究表明，加大研发投入将产生社会净收益。研发支持制度与支出水平同样重要。

5. Is it worthwhile to use these instruments now? (*continued*)
5. 是否有必要现在就推广这些手段？（*续*）

Thus, the existence of an "Environmental Kuznets Curve" does not imply it's best for China to postpone vigorous environmental protection:

- benefits of speeding up the arrival of newly invented, clean technologies (via R&D support as well as emissions policies) are likely to exceed the social costs
- in the interim, benefits from reducing pollution now (via fiscal instruments or direct controls) are likely to exceed the social costs.

"环境库兹涅茨曲线"并不意味着中国最好推迟采取强有力的环境保护措施：

- 加速新型环保技术的出现（通过研发支持以及排污政策）带来的利益很有可能会超过社会成本
- 在这段时间内，立即采取降低污染的措施（通过财政手段或直接控制）带来的利益很有可能会超过社会成本。

6.Conclusions
6.结论

1. Fiscal instruments can help bring prices in line with social costs → bring better balance of environmental and other goals.
2. Fiscal instruments offer several attractions relative to direct controls
   - Cost-effectiveness
   - Innovation incentives
   - Efficient revenue source
3. Key drawback of these instruments: larger share of policy cost falls on polluting facilities.
   - But fiscal instruments can be designed in a way that avoids this problem.

1. 财政手段有助于促使价格符合社会成本 → 更好地平衡环境与其他目标。
2. 与直接控制相比，财政手段具有以下优势
   - 成本效率好
   - 激励创新
   - 有效的**收入来源**
3. 这些手段的主要缺陷：使污染设施承担更多的政策成本。
   - 但合理制定财政手段可以避免这一问题。

6.Conclusions *(continued)*
6.结论（*续*）

4. Achieving environmental goals at lowest cost requires a mix of approaches
   - Both emissions-oriented policies and technology-push policies (to address two types of market failure)
   - Both fiscal instruments and direct controls

5. The presence of an "Environmental Kuznets Curve" does not offer justification for China's postponing significant action to reduce pollution or encourage cleaner energy use.
   - Raising pollution levy rates closer to marginal environmental damages can yield social net benefits
   - Increasing commitment to R&D (and changing the incentive structure) can also may provide overall social welfare gains.

4. 要以最低成本实现环境目标需要结合使用多种手段
   - 结合使用以排污为导向的政策和技术推动政策（解决两种类型的市场失灵）
   - 结合使用财政手段和直接控制

5. "环境库兹涅茨曲线"并不意味着中国应推迟在降低污染或鼓励使用环保能源方面采取强有力的措施。
   - 将污染税率提高到接近边际环境损害成本有助于实现社会净收益
   - 增加研发投入（同时改进激励制度结构）也有助于提高整体社会福利。