全球能源安全智库论坛2013年会

GLOBAL FORUM ON ENERGY SECURITY 2013

主办 SPONSORED BY

中国社会科学院

CHINESE ACADEMY OF SOCIAL SCIENCES

共同主办 **Co-organized By:**

中国社会科学院数量经济与技术经济研究所
Institute of Quantitative & Technical Economics (IQTE), CASS
美国全球安全分析研究所
Institute for the Analysis of Global Security (IAGS)
中国电力传媒集团
China Power Media Group (CPMG)
美国能源安全理事会
United States Energy Security Council (ESC)
中国社会科学院中国循环经济与环境评估预测研究中心
Center for Studies on China's Circular Economy and Environment (CSCCEE)
北京师范大学新兴市场研究院
Emerging Markets Institute, Beijing Normal University (EMI)

协助承办:
北京特驰能源科技有限公司
北京世纪盛邦商务服务有限责任公司

2013 年 8 月 10-11 日

北京

全球能源安全智库论坛简介

全球能源安全智库论坛由中国社会科学院数量经济与技术经济研究所与美国全球安全分析研究所共同发起的年度性国际论坛。论坛宗旨为推动全球智库在能源安全方面的研究与学术交流，传播可持续发展的理念，促进全球能源安全合作与政策协调。

Global Forum on Energy Security is co-initiated by Institute of Quantitative and Technical Economics (IQTE) at Chinese Academy of Social Sciences and Institute for the Analysis of Global Security (IAGS). The target of the forum is to promote research and academic exchanges on energy security among think tanks, to spread the idea of sustainable development, and to facilitate global coorperation on energy.

各国智库在促进全球能源市场的治理上负有重要的思想库、智囊团责任。中国社会科学院数量经济与技术经济研究所、中国电力传媒集团、中国循环经济与环境评估预测研究中心在有关部门支持下，联合美国能源安全理事会、美国全球安全分析研究所、北京师范大学新兴市场研究院等国内外机构共同主办全球能源安全智库论坛 2013 年会

The Global Forum on Energy Security 2013 is co-organized by Institute of Quantitative & Technical Economics (IQTE) at Chinese Academy of Social Sciences, United States Energy Security Council (ESC), Institute for the Analysis of Global Security (IAGS) of USA, Center for Studies on China's Circular Economy and Environment (CSCCEE), and invite top experts and speakers from top think tanks and responsible firms. The conference focuses on energy security and global energy market regulation, new technology and its perspective, as well as the potential and development route of unconventional oil & gas resources. Valuable policy recommendations will be reported to central government.

联系方式:

秘书长(Secretary-General)：刘强 (Dr. Qiang Liu)

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论坛主席团（Co-chairs）：

李　平，中国社会科学院数量经济与技术经济研究所所长
Ping Li, Director, Institute of Quantitative & Technical Economics, CASS

鲁夫特，全球安全分析研究所所长，美国能源安全理事会高级顾问
Gal Luft，Co-Director, Institute for the Analysis of Global Security, and Senior Adviser, United States Energy Security Council

齐建国，中国社科院数量经济与技术经济研究所副所长
Jianguo Qi, Associate Director, Institute of Quantitative & Technical Economics, CASS

胡必亮，北京师范大学新兴市场研究院院长
Biliang Hu, Director, Emerging Markets Institute, Beijing Normal University

白俭成，中国电力传媒集团董事长、党委书记
Jiancheng Bai, Chairman of China Power Media Group

.

刘　强，中国社科院数量经济与技术经济研究所能源室副主任
Liu Qiang Deputy Director, Energy Economics Division, Institute of Quantitative & Technical Economics, CASS

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秘书长：刘强
Secretary-General：Dr. Qiang Liu

通知【2013】190号

关于做好"全球能源安全智库论坛（2013年会）"宣传报道的通知

人民日报、新华社、光明日报、经济日报、中央人民广播电台、中央电视台、中国国际广播电台、中国日报、中国新闻社：

8月10日至11日，中国社会科学院数量经济与技术经济研究所联合美国能源安全理事会、美国全球安全分析研究所等单位在北京共同举办"全球能源安全智库论坛（2013年会）"。根据我部领导意见，请各媒体配合做好有关宣传报道。

1．8月10日，论坛开幕，请新华社播发消息通稿，人民日报等中央各报次日刊发新华社稿或自采稿，中央人民广播电台、中央电视台当晚新闻节目播出报道。

2．请人民日报、光明日报、经济日报刊发报道，介绍论坛成果，反映与会专家对全球能源安全治理、非常规油气、电力与电网安全、新能源发展等问题的见解，宣传论坛表达出的我国和平开发能源、高效利用能源的战略姿态。请中央人民广播电台经

济之声、中央电视台财经频道采访参会嘉宾，制作播出一期专题节目。

3、请中央外宣媒体结合各自特点，做好有关宣传报道。请人民网、新华网、中国网络电视台、中国经济网结合论坛情况，组织在线访谈，并转载相关报道。

联系人：论坛秘书长刘 [illegible]

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中宣部新闻局 甘启畅 63095071

中宣部新闻局

2015年7月25日

全球能源安全智库论坛

2013 年会

议 程

主 办

中国社会科学院

共同主办

中国社会科学院数量经济与技术经济研究所

美国全球安全分析研究所

中国电力传媒集团

美国能源安全理事会

中国社会科学院中国循环经济与环境评估预测研究中心

北京师范大学新兴市场研究院

协助承办

北京特驰能源科技有限公司

北京世纪盛邦商务服务有限责任公司

2013 年 8 月 10-11 日

北京

一、本次论坛背景

能源安全是全球共同关注的重大课题。中国长期致力“推动能源生产和消费革命，控制能源消费总量，加强节能降耗，支持节能低碳产业和新能源、可再生能源发展，确保国家能源安全”，“倡导综合安全、共同安全、合作安全的理念”。

通过新兴技术发现新能源，开拓非常规能源，是提高能源安全的重要途径。近年来，世界各国在可再生能源和非常规油气资源方面取得了巨大的进步。风电、光伏发电的快速增长为世界提供了大量的清洁能源，页岩气革命也使世界油气市场开启了新的篇章。尽管 2012 年以来中国新能源行业遭遇严冬，大批新能源企业面临危机。但是，我们仍然相信，通过积极研发新技术、拓展新的应用领域，中国新能源企业与行业将战胜困难，迎来更好的发展前景。事实证明，新兴能源技术为促进人类物质文明提供了无限的可能性。只要我们继续坚持以人为本、互利共赢的发展理念，有限的地球资源仍然可以支持我们享有无限精彩的科技成果与工业文明。

能源拜自然之赐，技术创新来自人类智慧。能源资源有限，智慧资源无限。以邻为壑必将加剧冲突，智慧与合作才是全球能源安全的基石。没有智慧的投入，我们就无法突破资源的有限性；没有合作，世界将永无宁日。智慧的合作，是全球能源合作的重点。

各国智库在促进全球能源市场的治理上负有重要的思想库、智囊团责任。中国社会科学院数量经济与技术经济研究所、中国电力传媒集团、中国循环经济与环境评估预测研究中心在有关部门支持下，联合美国能源安全理事会、美国全球安全分析研究所、北京师范大学中国能源与战略资源研究中心等国内外机构共同

主办全球能源安全智库论坛 2013 年会。论坛将邀请来自中美两国政府能源领域官员和国际知名智库的多名专家学者，就全球能源安全与市场治理、电力安全、非常规油气/页岩气发展、煤炭市场、智能电网与能源新技术的作用与发展方向等重要议题进行深入研讨，并向参会各国政府提交本次论坛的研讨成果。

二、论坛议题

主议题

全球能源安全治理

分议题

☼非常规油气发展前景及其影响

☼中国能源前景与改革

☼新能源与可再生能源

三、会议时间

2013 年 8 月 10－11 日（星期六、日）

上午：9:00～12:00　　下午：13:30～16:30

其中 12:00～13:30 为午餐时间。

四、会议地点

中国社会科学院学术报告厅

（北京建国门内大街 5 号社科院科研大楼 1 层）

五、组织机构

论坛主席团：

李　平　　中国社会科学院数量经济与技术经济研究所所长

齐建国　　中国社科院数量经济与技术经济研究所副所长

鲁夫特　　美国全球安全分析研究所所长 (IAGS)

胡必亮　　北京师范大学新兴市场研究院院长

白俭成　　中国电力传媒集团董事长、党委书记

刘　强　　中国社科院数量经济与技术经济研究所能源室副

主任

论坛秘书长:

刘　强

论坛副秘书长:

韩胜军、姜晓澜、杨彤、刘双艳、孙旭红、吕成、居翠凤

六、会场语言

会场中、英文同声传译

七、会议议程

8 月 10 日 (星期六)

08:30-8:55 报到注册

开幕式

主持人：李平

09:00-09:05　开场介绍

李平，中国社会科学院数量经济与技术经济研究所所长

09:05-09:15　中国社会科学院领导致辞

李扬，中国社会科学院副院长

09:15-09:25　中国国家能源局领导致辞

杨　昆　中国国家能源局总工程师

主题演讲

09:25-09:45　中美共同维护全球能源安全的政策选择

艾博特（Robert Ivy），美国能源部中国办公室主任

09:45-10:15　页岩革命与能源安全

田中伸男（Nobuo Tanaka）　国际能源署前署长、日本能源经济研究所全球能源安全专家

10:15-10:30　互动交流

茶歇

10:30-10:50

主议题演讲：全球能源安全治理

主持人：何德旭，中国社科院数量经济与技术经济研究所副所长

10:50-11:10 亚太地区的美中双头领导机制

赵全胜，美利坚大学亚洲研究所所长

11:10-11:30　中国新能源发展的新起点

李　平，中国社会科学院数量经济与技术经济研究所所长

11:30-11:50　美国能源转换与其对中国的影响

鲁夫特 美国全球安全分析研究所所长、美国能源安全理事会顾问

11:50-12:10　世界能源安全治理的中国因素与全球合作

刘强,中国社会科学院数量经济与技术经济研究所能源研究室副主任

12:10-12:20　互动交流

12:30-13:30 午餐（社会科学院餐厅）

主议题演讲：中国能源前景与改革

主持人：白俭成

13:30-13:50　中国能源需求前景展望

姜克隽　国家发改委能源所能源分析和市场分析研究中心主任

13:50-14:10　页岩气革命对中国能源改革的启示

涂建军，美国卡耐基国际和平基金会中国能源与气候项目主任、高级研究员

14:10-14:30　透过电力看经济

胡兆光，国家电网能源研究院首席专家、副院长

14:30-14:40　互动交流

茶歇

14:40-15:00

分议题演讲：非常规油气

主持人：鲁夫特

15:00-15:20　全球能源转型的机遇与挑战

陈卫东，中国海洋石油总公司能源经济研究院首席能源研究员

15:20-15:40　中国进入天然气时代

彼得·伊万，GE 公司全球战略与规划部主任

15:40-16:00　中国的甲醇燃料和甲醇汽车

和晓驰，全国醇醚燃料及醇醚清洁汽车专业委员会副会长

16:00-16:20　互动交流

8 月 11 日（星期日）

分议题演讲：新能源与可再生能源

主持人：李雪松，中国社会科学院数量经济与技术经济研究所副所长

9:00-9:20　替代运输燃料与全球能源安全-以色列的战略选择

马腾·维尔奈，以色列国驻华大使

9:20-9:40　中国农村能源的解决途径

齐建国，中国社会科学院数量经济与技术经济研究所副所长

9:40-10:00　中国运输系统的能源安全平衡与污染挑战

辛焰，能源基金会高级项目专家

10:00-10:10　互动交流

茶歇

10:10-10:30

主持人：齐建国，中国社会科学院数量经济与技术经济研究所副所长

10:30-10:50　中国生物能源产业发展前景

孟海波，农业部规划设计研究院能源环保研究所副所长

10:40-11:00　中国电动汽车产业

王韬，卡耐基－清华全球政策中心

11:10-11:30　替代能源与碳捕集技术的进展

范英，中国科学院能源与环境政策研究中心主任

11:30-11:40　互动交流

11:40-12:00　会议总结

刘强，中国社会科学院数量经济与技术经济研究所能源研究室副主任

12:00-13:00 **午餐（社会科学院餐厅）**

八、拟邀能源领域嘉宾

国家能源局石油与天然气司、新能源与可再生能源司、国际合作司领导；美国、德国、巴西、以色列驻华大使馆相关官员；国际能源企业、国内能源领域各大央企、地方性大型能源企业；国内著名新能源企业、技术及设备供应商；国内外能源领域科研机构和高校的领导及专家学者。

九、拟邀参会媒体

新华社、人民日报、中央电视台、经济日报、中国能源报、人民网、中国电力报、中国电力新闻网、21 世纪经济报道、大公报等 20 多家通讯社、报纸、电视、广播、网络等各类媒体。

十、会务联系方式

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秘书处

电话：010-85195705，传真：010-65137561

Global Forum on Energy Security 2013

AGENDA

August 10-11，2013

Beijing，China

Sponsored by

Chinese Academy of Social Sciences

Co-organized by

Institute of Quantitative & Technical Economics (IQTE), CASS

Institute for the Analysis of Global Security (IAGS)

China Power Media Group (CPMG)

United States Energy Security Council (ESC)

Center for Studies on China's Circular Economy and Environment (CSCCEE)

Emerging Market Institute at Beijing Normal University (EMI)

1. Introduction

Energy security is one of the most concerned issues in the world, especially to China. The Report of 18th National Congress of CPC put forward that China is going to promote the revolution of energy production and consumption, to control total energy consumption, to enhance energy conservation and support the development of low-carbon industries as well as renewable energy, and thus to guarantee energy security of the state. President Xi Jinping said at Boao Forum this year that China stresses the idea of synthetic and collaborative common security.

Renewable and unconventional energy have made great progresses in recent years, and contribute a lot to global energy security, owing to fast technological innovation. The successful examples include wind power, photovoltaic power, and shale gas. Although renewable energy industry of China has met some troubles since the beginning of 2012, many firms confronting big problems, we are still confident that they will make a breakthrough by hardworking, further innovation of technology and finding new market both domestic and abroad. The amazing development of shale gas in USA has shown us the significant contribution of technology innovation and sound market settings. Many facts have proved that emerging energy technologies, including conventional, unconventional fossil, and renewable ones, could provide indefinite possibilities of a more economical, more sustainable and more peacefully globe.

Although traditional energy resources coming from the nature is limited, technological innovations from human intelligence can make boundless possibilities. Collaboration of human intelligence may give us a more secure global energy system. In each country, think tanks play an important role in both domestic and global affairs through policy studying and recommendation. It will be very meaningful to promote the communication and coordination among think tanks relating energy security policy.

The **Global Forum on Energy Security 2013** is co-organized by Institute of Quantitative & Technical Economics (IQTE) at Chinese Academy of Social Sciences, United States Energy Security Council (ESC), Institute for the Analysis of Global Security (IAGS) of USA, Center for Studies on China's Circular Economy and Environment (CSCCEE), and will invite top experts and speakers from top think tanks and responsible firms. The forum will focus on energy security and global energy market regulation, as well as new technology and its perspective, the potential and development route of unconventional oil & gas resources. We will also report effective policy recommendations to governments.

2. Topic

Main topic:

Global Structure of Energy Security

Sub-topics:

☼Perspective of Un-conventional Oil and Gas and Its Impacts

☼China's Energy Outlook and Reform
☼Renewable Energy

3. Time

9：00～16：30, Aug 10. 2013
9：00～12：30, Aug 11. 2013

4. Location

No.1 Conference Hall, Chinese Academy of Social Sciences (CASS)
No.5, Jianguomennei Street, Beijing, China

5. Organizing Committee

Co-chairs：

Li Ping *Director, Institute of Quantitative & Technical Economics, CASS*
Gal Luft *Co-Director, Institute for the Analysis of Global Security, and Senior Adviser, United States Energy Security Council*
Bai Jiancheng *Chairman of China Power Media Group*
Qi Jianguo, *Associate Director, Institute of Quantitative & Technical Economics, CASS*
Hu Biliang *Director, Emerging Markets Institute, Beijing Normal University*
Liu Qiang *Deputy Director, Energy Economics Division, Institute of Quantitative & Technical Economics, CASS*

Secretary-General：

Dr. Liu Qiang

6. Languages

The working languages of the conference are Chinese and English with simultaneous interpreting.

7. INITIAL AGENDA

August 10 (Saturday)

08:30-08:55 CHECK IN/REGISTRATION

OPENING CEREMONY

Chair: *Mr. Li Ping*

09:00-09:05 OPENING REMARKS

Mr. Li Ping, Director, Institute of Quantitative & Technical Economics, Chinese Academy of Social Sciences (CASS)

09:05-09:15 WELCOME SPEECH

Mr. Li Yang, Vice President, Chinese Academy of Social Sciences

09:15-09:25 Speech by Leader from NEA of China

Mr. Yang Kun, Chief Engineer, National Energy Administration, China

KEYNOTE SPEECHES

09:25-09:45 Speech by Leader from DOE of USA

Mr. Robert Ivy, Executive Director of the China Office, Department of Energy, USA

09:45-10:15 Shale Revolution and Energy Security

Mr. Nobuo Tanaka, Former Director of IEA, Global associate for Energy Security at the Institute of Energy Economics

10:15-10:30 Discussion

10:30-10:50

COFFEE BREAK

PRESENSATIONS ON MAIN TOPIC: GLOBAL ENERGY SECURITY

Chair: *Professor He Dexu, Associate Director, Institute of Quantitative & Technical Economics, CASS*

10:50-11:10 A U. S.-China Dual-Leadership in Asia-Pacific

Professor Quansheng Zhao, Director of Asia Institute at American University

11:10-11:30 A New Start of China's New Energy Industry

Professor Li Ping, Director, Institute of Quantitative & Technical Economics, CASS

11:30-11:50 US energy transition and its implications for China

Mr. Gal Luft, Co-Director, Institute for the Analysis of Global Security, Senior Adviser, United States Energy Security Council

11:50-12:10 The Role of China in Global Energy Security and Collaboration

Dr. Liu Qiang, Deputy Director, Energy Economics Division, Institute of Quantitative & Technical Economics, CASS

12:10-12:20 Discussion

12:30-13:30

Lunch at the Dining Hall of CASS

PRESENSATIONS ON MAIN TOPIC: CHINA'S ENERGY OUTLOOK AND REFORM

Chair: *Mr. Bai Jiancheng, GM of China Power Media Group*

13:30-13:50 Outlook of China's Energy Consumption

Jiang Kejun , Director, Center for Energy and Market Analysis, Institute of Energy, NDRC

13:50-14:10 Shale Gas Revolution and China's Energy Reform

Dr. Kevin J. Tu, Director & Senior Associate, China Energy & Climate Program Carnegie Endowment for International Peace

14:10-14:30 Power and How Powerful is China's Economy

Mr. Hu Zhaoguang, Vice President and chief economist, Energy Research Institute, State Grid of China

14:30-14:40 Discussion

14:40-15:00

COFFEE BREAK

PRESENSATIONS ON MAIN TOPIC: UNCONVENTIONAL OIL&GAS

Chair: *Mr. Gal Luft, Co-Director, Institute for the Analysis of Global Security, Senior Adviser*

15:00-15:20 Global Energy Transition: Opportunity and Challenge

Mr. Chen Weidong, Chief Energy Researcher, CNOOC Institute of Energy Economics Research

15:20-15:40 China - Age of Gas

Mr. Peter Evans, Director, Global Strategy and Planning of GE

15:40-16:00 Methanol Fuel and Vehicle in China

Mr. He Xiaochi, Vice President,Chinese specialized committee of alcohol ether fuel and vehicle

16:00-16:20 Discussion

August 11 (Sunday)

PRESENSATIONS ON SUB-TOPIC: RENEWABLE ENERGY

Chair: *Professor Li Xuesong, Associate Directot, Institute of Quantitative & Technical Economics, CASS*

09:00-09:20 Alternative Fuels for Transportation and Global Energy Security - Israel's Strategy

Mr. Matan Vilnai, Ambassador in China of State of Israel

9:20-9:40 Clean and Economic Energy for Chinese Rural Areas

Qi Jianguo, Associate Director, Institute of Quantitative & Technical Economics, CASS

9:40-10:00 Balancing Energy Security and Pollution Challenges in China's Transportation System

Ms. Xin Yan, Senior Program Associate at the Energy Foundation

10:00-10:10 Discussion

10:10-10:30

COFFEE BREAK

Chair: *Professor Qi Jianguo, Associate Directot, Institute of Quantitative & Technical Economics, CASS*

10:30-10:50 Perspective of Bio-energy Industry in China

Dr. Meng Haibo, Associate Director, Energy and Environment Protection Institution at Academy of Planning and Design of Chinese Ministry of Agriculture

10:50-11:10 China's Electric Vehicle Policy

Dr. Wang Tao, Researcher, Carnegie-Tsinghua Center for Global Policy

11:10-11:30 Progresses of Substitute Energy and CCS Technology

Fan Ying, Director, Management Science and Engineering Center, Chinese Academy of Sciences; and Director, Energy and Environmental Policy Research Center

11:30-11:40 Discussion

11:40-12:00 Conference Wrap-up

Dr. Liu Qiang, Deputy Director, Energy Economics Division, Institute of Quantitative & Technical Economics, CASS

12:00-13:00

Lunch at the Dining Hall of CASS

8. Contact

If you want to have more information, please contact us at:

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推动全球合作 保障能源安全

——在全球能源安全智库论坛上的讲话

李 扬

中国社会科学院 副院长

2013 年 8 月 10 日

尊敬的各位来宾，女士们，先生们：

大家早上好！

首先代表中国社会科学院对这样一次会议的召开表示热烈的祝贺！对来自国内外的专家们表示衷心的感谢和热烈的欢迎！

今年已经是我第二次出席全球能源安全智库论坛。去年的首届年会上，与会专家就全球能源安全与低碳发展进行了深入的讨论，我也与美国能源部中国办公室主任范旭先生等专家有很深入的交流。今年的论坛规模更大，参会人员更多，美国能源安全理事会也派代表出席，中央电视台、《人民日报》、《华尔街日报》等重要媒体都来参会报导，说明大家对能源安全这一问题更加关心、更加重视了，这是一个好现象。

当前世界经济形势比较复杂，各经济体之间并不平衡。发达经济体的复苏出现分化，美国经济持续复苏，但是欧洲仍陷于衰退，日本经济前景存在很大的不确定性，新兴经济体增长放缓，资本外流和汇率波动的风险加剧，全球有效需求不足，世界经济进入了深度转型的

调整期，但尚未形成新的增长点。在刚刚结束的中美战略经济对话中，中美双方同意加强宏观经济政策的协调，在促进各自的改革与发展同时，推动国际合作，为促进世界经济复苏和增长做出贡献。

中美之间有着越来越深入的能源合作。本次中美战略经济对话达成的三项共识中，有两项涉及到能源：气候合作与能源合作。在能源合作方面，中国决定继续投资美国页岩气项目。在气候变化方面，中美达成了五项具体共识，包括减少重型车辆排量、节能环保建筑等方面。我认为，中美在共同管理全球流动性过剩方面也有很大的合作空间。而全球流动性的管理，是维护石油价格稳定的基础。此外，中美在国际政治、军事等领域的合作也日益加深。因此，我相信，中美之间的全面合作，将为构建全球能源安全体系打下良好的基础。

能源安全是关系到世界各国人民福祉的重大课题。能源安全不止是一个国家的问题，更是一个全球的问题，只有共同安全才是真正的安全。中国与世界各国，包括重要的能源出口国和能源进口国开展了广泛的合作，共同维护国际能源安全秩序。在世界已经充分全球化的今天，只有全面提升各国之间的合作水平，才能实现广泛的共赢，才能最大程度地提升各国人民的福祉。

中国政府高度重视能源安全问题。推动绿色发展，通过低碳技术应用，发展循环经济，实现绿色发展，是中国政府保障能源安全、实现可持续发展的基本国策之一。中国为此付出了巨大的努力。“十一五”期间，我国以能源消费年均 6.6%的增速支撑了国民经济年均 11.2%的增速，能源消费弹性系数由“十五”时期的 1.04 下降到 0.59。

全国单位国内生产总值能耗下降 19.1%，节能 6.3 亿吨标准煤，减少二氧化碳排放约 15 亿吨。取得这样成绩是非常能源可贵的。

中国政府于 2009 年 11 月郑重宣布了到 2020 年控制温室气体排放行动目标，其中包括二氧化碳排放强度比 2005 年下降 40-45%的目标。2010 年，中国在五省八市启动了低碳试点工作，探索符合中国国情的低碳发展模式。我国的“十二五”规划《纲要》中提出到 2015 年单位国内生产总值二氧化碳排放比 2010 年降低 17%、非化石能源占一次能源比重达到 11.4%约束性指标，并提出“合理控制能源消费总量”、“建立完善温室气体排放统计核算制度，逐步建立碳排放交易市场”。中国将采取切实行动，确保上述目标的实现。

中国在“十五”和“十一五”期间实现了经济的高速增长，但是近两年中国经济增幅趋于平缓，这是结构调整的必然现象，中国不会出现硬着陆。应该看到，经济增速放缓也为我们实现经济结构调整提供了机会。总体来看，未来相当长一段时间，由于经济仍然保持较快增长，中国的能源需求还会合理的增加，但我们不会靠无约束地增加能源消费和排放温室气体来实现经济发展。我们将把应对气候变化作为国家重大战略纳入国民经济和社会发展中长期规划，大力发展以低碳排放、循环利用为内涵的绿色经济，逐步建立以低碳排放为特征的工业、建筑、交通体系，加快形成科技含量高、资源消耗少、经济和环境效益好的国民经济结构。

中国社会科学院作为党中央和国务院重要的思想库和智囊团，一向重视全球能源安全方面的理论与政策研究，在中国社会科学院 36

个研究所中至少有 3 个研究所研究能源问题，其中数量经济与技术经济研究所是我院十分有特色、实力很强的的研究机构，他们在经济模型、能源与环境、技术经济理论与方法、信息化等方面有一批有学术造诣和潜力的研究团队，数量经济和技术经济研究所创办的全球能源安全论坛是对我院在能源安全研究领域的一个重要国际性交流平台，希望你们越办越好，为中国和世界能源安全研究贡献力量。

女士们、先生们，中国社会科学院和美国全球安全分析研究所都是本国重要的智库和政策研究机构，在推动中美两国之间的战略合作方面都发挥了着重要的政策咨询作用，这种智库之间的交流具有十分重要的意义，希望诸位专家畅所欲言，为中国、为全球能源安全合作多提建设性意见。

最后，预祝本次会议取得圆满成功，祝在座的各位来宾特别是来自国外的朋友们在北京生活愉快，身体健康。

谢谢！

保障能源安全 服务全球经济

——在《全球能源安全智库论坛 2013 年会》上的讲话

杨昆

国家能源局总工程师

各位来宾，女士们，先生们：

能源安全是世界与中国经济稳定发展的的重要基础。中国与世界各国，包括重要的能源出口国和能源进口国开展了广泛的合作，共同维护国际能源安全秩序。在世界已经充分全球化的今天，只有全面提升各国之间的合作水平，才能实现广泛的共赢，才能最大程度地提升各国人民的福祉。

中国政府高度重视能源安全问题。推动绿色发展，通过低碳技术应用，发展循环经济，实现绿色发展是中国政府保障能源安全、实现可持续发展的重要政策。中国为此付出了巨大的努力。“十一五”期间经过全国上下共同努力，实现了“十一五”规划纲要确定的节能减排约束性指标。我国以能源消费年均 6.6%的增速支撑了国民经济年均 11.2%的增速。能源消费弹性系数由“十五”时期的 1.04 下降到 0.59。全国单位国内生产总值能耗下降 19.1%，节能 6.3 亿吨标准煤，减少二氧化碳排放约 15 亿吨。

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间，中国的能源需求还会合理增长，但我们不会靠无约束地增加能源消费和排放温室气体来实现经济发展。

中国政府重视与世界各国尤其是主要能源消费国的合作。7 月 11 日闭幕的第五轮中美战略与经济对话上，中美双方达成的三个重要共识中有两项与能源有关，即气候合作与能源合作。在能源合作方面，中国决定继续投资美国页岩气项目。在气候变化方面，中美达成了五项具体共识，包括减少重型车辆排量、节能环保建筑等方面。

在传统能源领域，中国既重视石油天然气供应安全，也重视电力与电网安全。石油天然气方面，中国通过加强与世界各国的合作，在维护全球市场基本稳定的基础上努力保障中国石油天然气进口的安全、顺畅。在电力领域，中国从优化电网/电源的布局、加强局部薄弱电网建设、实施电网差异化设计和改造、积极推进新技术新装备的应用等方面入手，不断提升电网的整体防灾能力，防范电网大面积停电风险。

中国高度重视替代能源的发展。在可再生能源领域，中国是光伏发电和风电增长最为迅速的国家。到 2012 年底,中国并网风电装机容量达到 6300 万千瓦,年发电量 1008 亿千瓦时,发电量占全国总发电量的 2%;全国并网光伏发电约 700 万千瓦,年发电量 39 亿千瓦时。尽管遇到电力消纳等问题，中国发展新能源产业的目标和信念是坚定不移的,要更加注重新能源发展的品质,从注重发展速度向速度和质量并重的方式转变,从注重集中式开发向集中与分散并进的方式转变,从注重风能、太阳能资源条件向资源和电力市场条件兼顾的方式转变,统筹可

再生能源资源和消纳市场,优化开发布局,促进可再生能源健康可持续发展。

同时，中国也高度重视页岩气革命带来的新变化。我们已经制定了《页岩气发展规划（2011-2015 年)》，力争让页岩气成为提升中国能源安全水平的一个新的契机，也为全球能源安全做出贡献。

中国将把应对气候变化作为国家重大战略纳入国民经济和社会发展中长期规划，大力发展以低碳排放、循环利用为内涵的绿色经济，逐步建立以低碳排放为特征的工业、建筑、交通体系，加快形成科技含量高、资源消耗少、经济和环境效益好的国民经济结构。

女士们，先生们，

推动全球能源安全不仅是各国政府的事情，更是各智库和有关研究机构的重要职责。中国社会科学院和美国全球安全分析研究所都是本国重要的智库和政策研究机构，在推动中美两国之间的战略合作方面都发挥着重要的政策咨询作用。这种智库之间的交流具有十分重要的意义，希望诸位专家畅所欲言，为全球能源安全合作多提建设性意见，并向本国政府传递本次论坛的研讨成果。

最后，预祝本次会议取得圆满成功，也祝愿在座的各位来宾和朋友身体健康，生活愉快！

谢谢！

中国社会科学院数量经济与技术经济研究所
Institute of Quantitative & Technical Economics
IQTE, CASS

全球能源安全——框架与建议

Global Energy Security: Concept, Risks and Suggestions

全球能源安全智库论坛 2013 年会

Global Forum on Energy Security 2013

August 10-11，2013

Beijing，China

摘要：本报告为中国社会科学院数量经济与技术经济研究所为全球能源安全智库论坛 2013 年会准备的主题报告。通过对能源安全的概念、风险来源和外部性风险的分析，提出了建立全球能源安全治理机制的原则和一些建议。报告认为，在加强全球合作的基础上，有效整合几个具有发展潜力的区域能源市场将有助于推动全球能源市场的良性发展。从基础条件看，东北亚、东南亚、中亚和北太平洋两岸具备发展区域性能源市场的条件。

Abstract: This paper is prepared for Global Forum on Energy Security 2013 held at Beijing on August, 2013. This report put forward some principles and suggestions to global energy security mechanism, based on the perspectives on the risk analysis and external impacts of energy price fluctuation risk. It will be helpful to integrate some regional energy markets with sound economic conditions and potentials, such as Northeast Asia, Southeast Asia, Central Asia, and Trans-North-Pacific Areas.

1. 全球能源安全问题的提出与其根源

1. Concept and Origin of Global Energy Security

1.1 能源安全的定义

1.1 Concept of Energy Security

能源安全有多种定义。本报告认为，能源安全可以定位为消费者和经济部门在所有时间能够以支付得起的价格获得充分能源供应的能力，同时不会对环境造成不可接受的或不可逆转的负面影响。也就是说，能源安全有三个层次的要求：

There are various concepts of energy security. we are to define energy security as the availability of energy at all times in various forms, in sufficient quantities and at affordable prices, without unacceptable or irreversible impact on the economy and the environment. This means that energy security contains three category:

A. 稳定的供给。即能够在总量上满足消费者和经济部门在每一个时点的消费需求。

A. Reliable supply. The system can provide the amount which consumers and industrial sectors' require at any time point.

B. 合理的能源价格，保证消费者能够消费得起所需要的各种能源形式，包括燃油、燃气、电力等，并且能源价格作为国民经济的基础性价格，不能对下游产业造成过大的成本压力。

B. Appropriate price level. The consumers may afford energy they need. As energy price is the base price of the whole economy, it should not harm those downstream industries.

C. 能源的勘探、开发、生产、转换、运输和消费环节不能对环境产生不可接受或者不可逆转的负面影响。所为不可逆转是指在一个比较长的时期内即使停止与能源生产和消费有关的活动也不能恢复或接近恢复原有的状态。

C. There should not be any unacceptable and irresistible negative impact to society and environment during the process of exploration, development, production, transmission and utilization.

综合这三个方面的要求，与乔治-布什政府提出的可靠的、支付得起的、环境友好的能源政策基本一致。

According to these three requirements, the concept in this paper is familiar with the frame issued by George W. Bush Administration, i.e., Reliable, Affordable, and Environmentally Sound Energy.

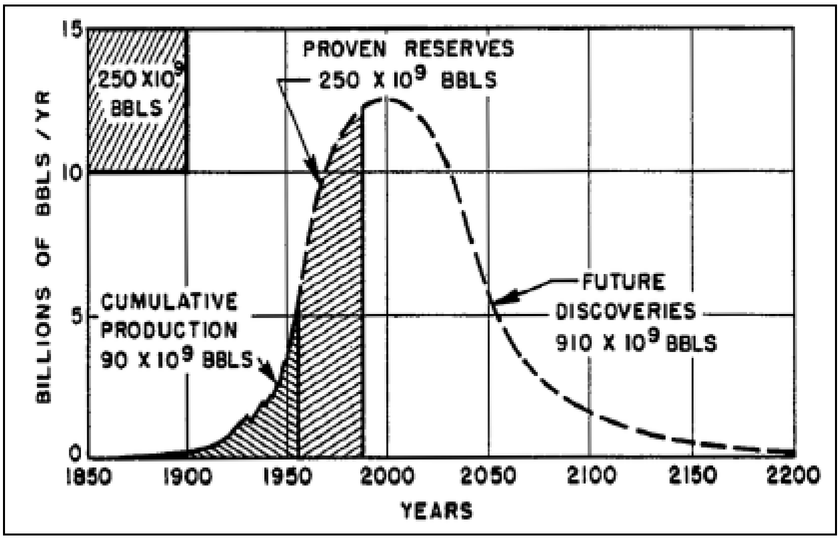
1.2 资源分布不平衡是能源安全焦虑的来源

1.2 Imbalance of Resources Distribution is the Source of Security Anxiety

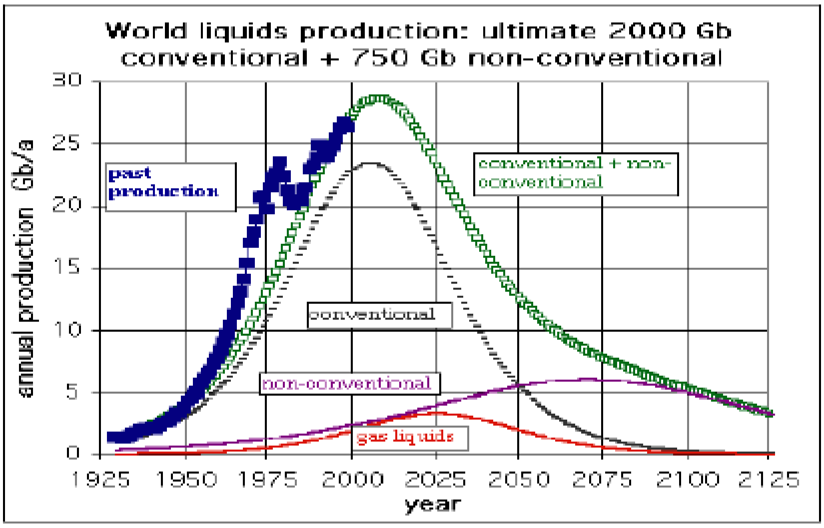
导致能源安全焦虑的根本原因在于两点：传统化石能源资源的有限性，和分布的不均衡性。一开始，我们都认为，化石能源很快就会耗竭，因此替代能源的缺乏将导致严重的能源供给问题。

Two points cause energy security anxiety: the non-sustainable of traditional fossil energy, and the imbalance of it's distribution. At the beginning, people think fossil energy will be exhausted very quickly, and thus will cause serious trouble when the day coming.

The original Hubbert curve for the US-lower 48



The Early Global Hubbert Curve from ASPO (2000)

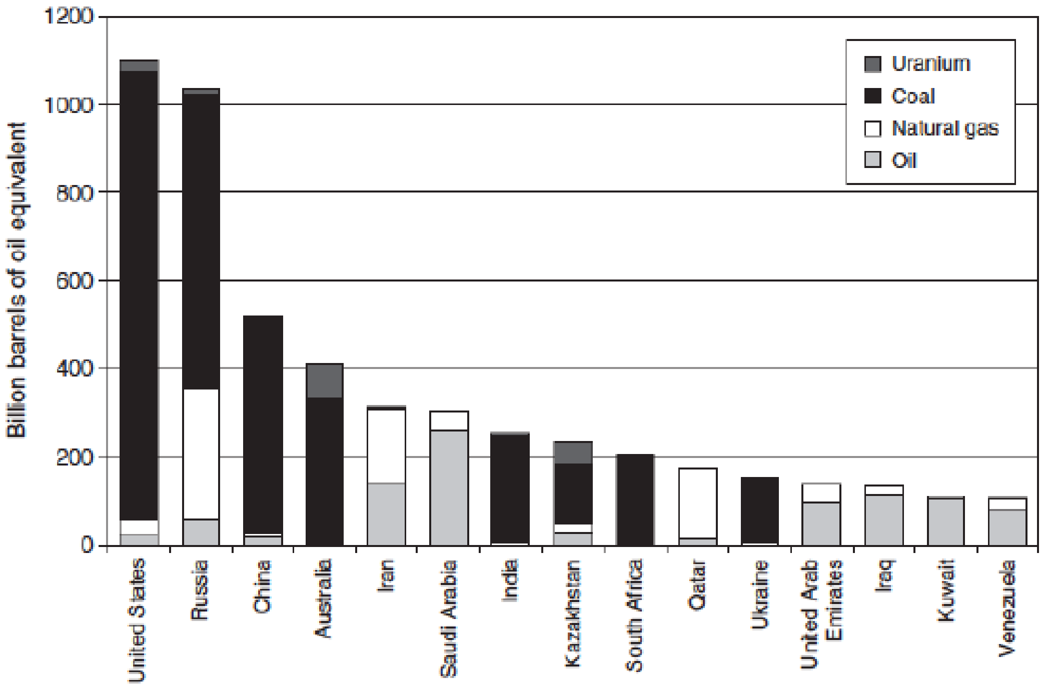


来源：Patrick Criqui and Sylvain Rossiaud，2010.

尽管从地理分布看，传统能源资源分布的集中度比较高——前 6 位国家拥有 80%的石油资源，前 13 位国家拥有 80%的天然气资源，前 6 位国家拥有 80%的煤炭资源，前 6 位国家拥有 80%的铀资源——这样的集中度会不会导致这些国家联合行动对消费国进行利益压榨？正是这种担心构成了全球能源安全问题的来源。如果我们从全球所有的化石能源储量看，能源资源储量在全球范围内的不均衡性并没那么差。亚太地区虽然石油资源较少，但是有丰富的煤炭资源。此外，还有核能资源可资利用。

The distribution of traditional energy resources, including coal, natural gas, and uranium, is equally consolidated. Eighty percent of the world‘s oil can be found in nine countries that have only 5 percent of the world population, 80 percent of the world's natural gas is in 13 countries, and 80 percent of the world's coal is in six countries. Many of the same countries are among the six that control more than 80 percent of the world's uranium resources (Brown and Sovacool, 2011). Will these countries like to suppress those energy-net-consuming ones by their power? This worry is turned into the security anxiety. But if we look at the distribution in the sight of total energy, the landscape does not look so imbalanced. Although there is fewer oil and gas resources in Asia and Pacific area, there are more coal resource than other areas. Furthermore, there are also uranium ore resources can be utilized.

Global Distribution of Energy Reserves



(Source: Brown and Sovacool, 2011)

由于石油在现代能源中的支配性地位，各国政府和公众都对石油资源分布的不平衡性视为对能源安全的重大挑战。二战之后的多次地缘政治冲突都是围绕着中东这一富藏石油的地区展开。1973－74 年和 1979－80 年两次石油危机及其引发的全球性经济危机都与对石油供应中断带来的恐慌有关。

As oil has the dominant role in modern energy industry, various countries and public take the imbalance of oil reserve distribution as the main challenge of energy security. So many conflicts happened around mid-east, the oil reserve concentrated area after WWII. The two oil crisis during 1973-74 Yom Kippur War and 1979-80 Iranian Revolution which caused serious global economic crisis connected with this kind of anxiety.

Distribution of proved oil reserves in 1992, 2002 and 2012

Percentage

来源：BP Statistical Review of World Energy，June 2013。

世界石油探明资源分布在 2012 年之后出现的一个重大变化，那就是西半球的探明储量有了明显的增长。加拿大的油砂资源、美国新增的石油探明储量和委内瑞拉重油资源的重新计算，导致美洲在世界石油资源探明储量中的比重有了明显的上升，北美地区所占比重从 2002 年的 8.3%上升到 2012 年 8.4%（注意这是在总储量从 13215 亿桶上升到 16689 亿桶的背景下），而中南美洲的比重则从 2002 年的 7.6%上升到 2012 年的 19.7%。相应的中东地区的比重则从 2002 年的 56.1%下降到 2012 年 48.4%。这种变化有助于缓解对中东地区不稳定带来的能源安全风险的担忧，但是中东地区的基础性作用仍是不可动摇的。

The distribution of verified oil reserves changed a lot in 2012, the data in west hemisphere rised. By the re-accounting of Canadian oil sand resource, new-added American oil reserves and Venezuela's heavy oil reserve, the share of west sphere was raised obviously. The share was raised from 8.3% in 2002 to 8.4% in 2012, meanwhile the share of Mid-east dropped from 56.1% in 2002to 48.4% in 2012. But, the dominance of Mid-east will not change.

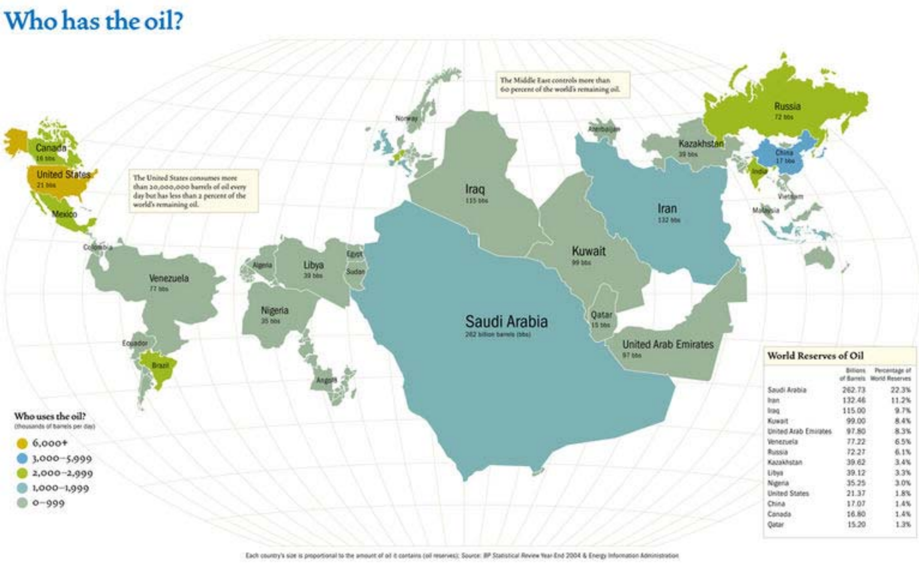
1.3 能源安全是全球的共同安全，单独行动无法解决问题

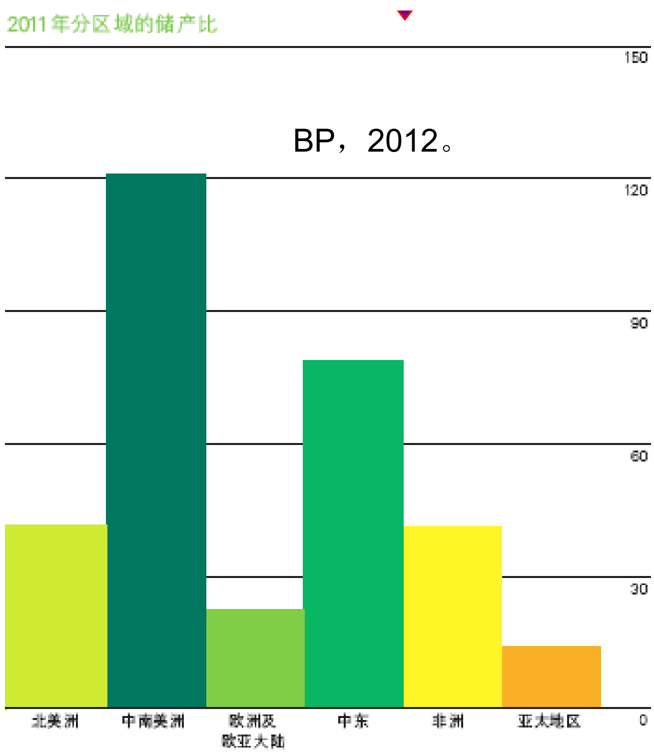
1.3 The Key of Global Energy Security Is Common Security

在历史上，随着化石能源在现代经济中的决定性地位的显现，一些国家为争夺能源资源而不惜动用战争手段。法国与德国之间为争夺煤炭产区的控制权，不仅引发了普法战争，甚至引发了第一次和第二次欧战并扩展为两次世界大战；德国入侵前苏联的根本目的也是为争夺高加索油田，日本发动太平洋战争为的是夺取中南亚的石油资源；二战后中东四次战争、两伊战争、海湾战争等都与争夺能源资源和能源通道的控制权有直接的关系。

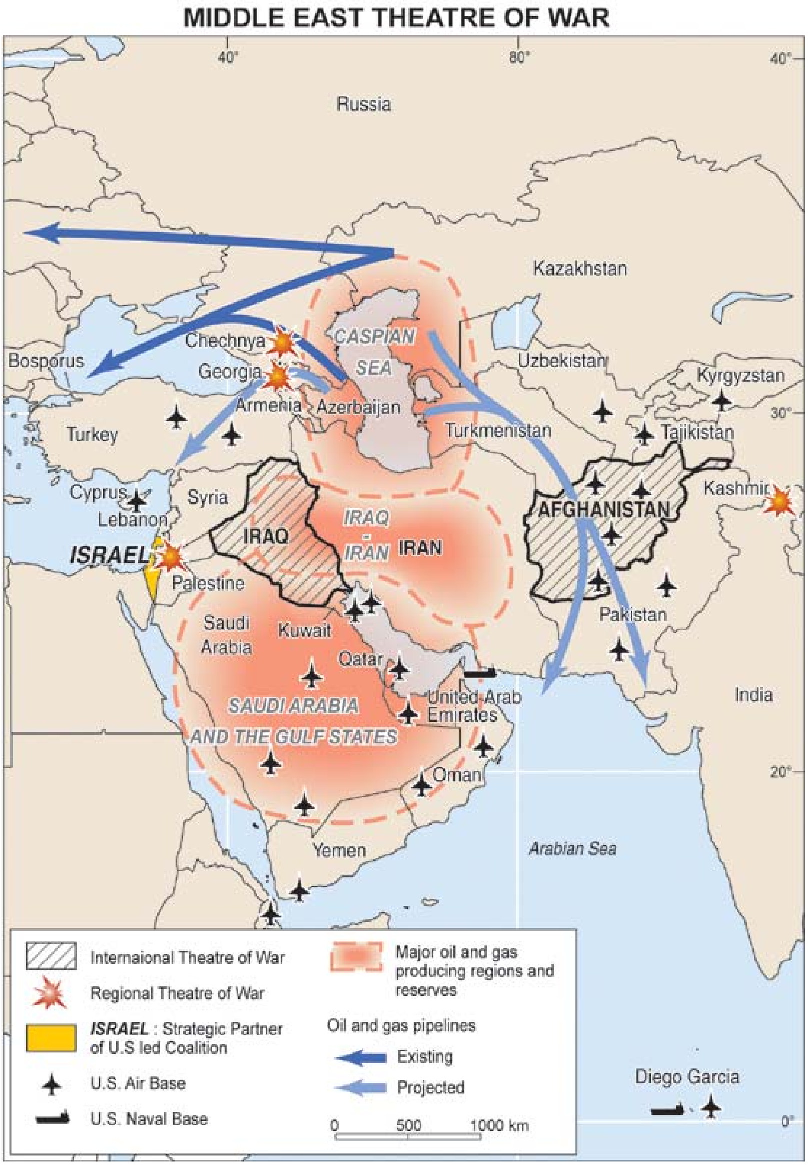
In history, accompanying with appearance of modern energy, some countries began to fight for the control of energy resources. The typical example was the Franco-Prussian War and the subsequent series of war. The key points of fighting during WWII were also the control of oil resources in

Caucasus and Southeast Asia. And the four Mid-east wars, Iran-Iraq war, Gulf War are all related to the control of oil.





普法战争 Oil Painting of Franco-Prussian War



来源：http://www.payvand.com/news/08/sep/1038.html.

为应对各自所谓的能源安全问题，不同国家都采取了一些措施。美国自乔治-布什总统以来，致力于减少对中东石油的依赖，更多地转向从美洲和非洲进口石油，同时发展生物乙醇、页岩气等替代燃料。

All countries take some measures to improve situation of energy security. Similarly, the focus on energy security in countries that are struggling to meet their energy requirements is quite distinct. United States endeavors to energy independence since the beginning of George W. Bush Administration, and begin to develop substitute energy such as ethanol, shale gas, wind power.

日本在国内几乎没有传统化石能源资源的背景下，自上世纪 70 年代第一次石油危机开始就致力于分散其进口来源。日本通过进口来源分散化、贸易与投资、与产油国建立合作关系等措施来保障自身的能源供应。

Japan has pursued an energy security strategy of diversification, trade, and investment, as well as selective engagement with neighboring Asian countries to jointly develop energy resources and offset Japan‘s stark scarcity of domestic reserves.

中国自 1993 年成为石油净进口国之后，由于 2008 年成为煤炭的净进口国，从而被迫地自力更生转向依赖国际市场。2012 年，中国石油对外依存度达到 58%。在这种情况下，中国的能源外交政策选择也日益国际化，如投资海外油气资源，加深中东、非洲、俄罗斯、中亚地区产油国的合作，并开始关注能源运输通道的安全。

China has become a net importer of oil after 1993 and of coal since 2008. China, for example, has viewed energy security as an ability to rapidly adjust to their new dependence on global markets and engage in energy diplomacy, shifting from its former commitments to self-reliance and sufficiency to a new desire to build a well-off society. China‘s current approach to energy security entails buying stakes in foreign oil fields, militarily protecting vulnerable shipping lanes.

但是，过度追求自身安全而以邻为壑的单边主义政策并没有带来安全，相反却给全球各国带来灾难。因此，我们可以说，能源安全是一个全球性的问题，没有全球能源安全，就没有单个国家的安全。

However, the excessive pursuit of their own safety and thy-neighbor policy of unilateralism does not bring security, on the contrary gave countries around the world to bring disaster. Therefore, we can say that energy security is a global issue, no collaboration, no security at all.

2. 全球能源安全的真正风险仍然是人为因素

2. The Real Risk Is Still from Human Behavior

两次石油危机的经历表明，能源安全的风险的根源仍然是人为因素所导致。从能源资源总量来看，世界能源安全问题更多地是来自因为分布不均衡带来的对能源供应国的不放心，或者说，这是一种典型的安全悖论：由于相互之间的不信任而导致各自采取利己主义的单边行动，并由此产生了进一步的安全风险。因此，能源安全是全球共同面临的问题。能源安全是一个全球化的交叉概念，没有一个国家可以脱离世界来保障自己的全部能源供给。解决全球能源安全的关键还是在于相互之间的沟通、信任与合作，而不是谋求与国外能源供应脱钩，寻求自身的安全。全球能源安全的合作治理机制是解决这一问题的关键。

Experience during the two oil crises shows that, energy security risk come from human behavior. World energy security problems are more often caused by uneven distribution. So this is a typical security paradox: as the mutual distrust lead to unilateral actions, and resulting further risks. Therefore, energy security is a common issue facing the world. It has a global meaning that no country can protect itself, disregarding other countries. Solutions to global energy security lie in mutual communication, trust and cooperation, rather than to seek decoupling with foreign energy supply.

尽管从理论上讲，化石能源一定是可耗竭的，但是目前来看，石油、煤炭、天然气等传统化石能源还没有表现出显著的产量下滑迹象，而深海油气、非常规油气资源的逐渐发现和投入商业化生产，显示出投资与技术突破对于保障能源供给还有很大的空间。因此，可以说，未来 20－30 年左右的时间内，传统能源资源储量还不至于成为能源安全的瓶颈。

Although in theory, depletion of fossil energy can not be avoidable, but for now, oil, coal, natural gas have not shown significant signs of decline in production, while the deep-sea oil and gas, unconventional oil and gas resources were gradually discovered and put into commercial production. This illustrates that investment and technological breakthroughs can do a lot to improve energy supply. Therefore, we can say that the next 20-30 years or so, reserves of traditional energy will not become a bottleneck of energy security.

能源安全风险可以分为三种类型：

Energy security risks can be divided into three types：

技术性风险。是指由于能源系统本身的脆弱性或者技术性操作失误所带来的风险，比如自然灾害、人为操作失误或者内部故障所引起的能源系统失效或崩溃的风险。比如多次飓风对墨西哥湾采油平台的破坏性影响，2008 年中国南方冻

雨灾害造成电力供应中断，供给或者需求侧的突发剧烈变化引起电网崩溃，石油钻井或者海上平台的漏油、爆炸等，都属于技术性风险。2003 年美国和加拿大部分地区的大停电、2011 年 3 月 11 日海啸导致日本福岛核电站事故也属于这种风险。

Technical risk. This type of risk is due to the vulnerability of the energy system itself or the technical risks of operational failures, such as natural disasters, human error or malfunction, these may cause energy system failure or collapse. Examples include oil platform devastating in Gulf of Mexico during hurricane attacks, and grid interrupt in southern China caused by freezing rain in 2008, oil spills, platform explosions, etc. Blackout in some areas of United States and Canada in 2003, Fukushima nuclear power plant accident caused by tsunami on March 11, 2011 Japan also belong to this type.

2005年卡特里娜飓风
Hurricane Katrina,2005

2008年中国南方的冻雨灾害
Ice storm, Southern China, 2008

2003年美加大停电主要城市受影响人数
Power Failure in USA and Canada, 2003

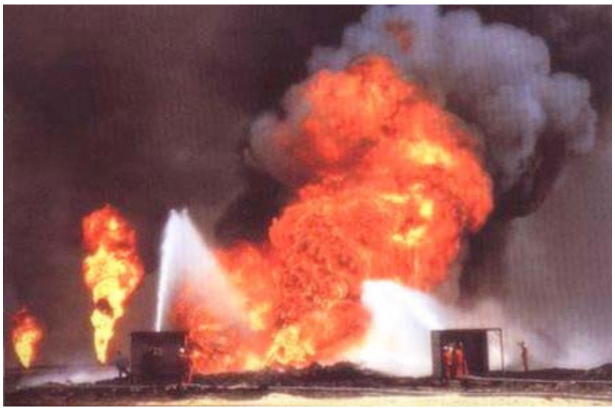
城市 CITY	受影响人数 POP AFFECTED
纽约市 NY	8,000,000
多伦多 Toronto	5,600,000
底特律 Detroit	951,000
渥太华 Ottawa	820,000
汉米尔顿 Hamilton	680,000
克利夫兰 Cleveland	478,000
托莱多 Toledo	314,000
温索尔 Windsor	208,000

战争与蓄意破坏风险。由战争、区域冲突、犯罪或其他人为故意行为直接或

间接导致的能源生产、输送与消费设施的破坏，都会导致能源安全风险。比如海湾战争期间伊拉克军队放火焚烧科威特的油井，尼日利亚部族武装对石油输送管线的袭击等等，都会导致能源供给的局部中断。

War and sabotage risks. Wars, conflicts, crimes, or other deliberately human behaviors will lead to damage the process of energy production, transport and consumption facilities For example the Iraqi army fire-setting to Kuwait's oil wells during the Gulf War, Nigeria tribal army attacks on oil pipelines, etc., would lead to a partial disruption of energy supply.

海湾战争中伊拉克军队焚烧科威特油井
Gulf War, 1991



Explosion of oil pipeline in Nigeria after attack

环境风险。现代能源工业在勘探、开发、生产、输送、消费过程中必然要产生一定的环境影响，比如自然景观的改变、矿物开采过程的污染、石油冶炼与燃煤发电产生的废物排放、燃油消耗过程中的废气排放、水电站对河流生态的影响等等。尽管能源生产与使用不可避免地会产生环境影响，但是我们要避免的是那种不可逆地和不可接受的环境影响，比如对生存环境的根本性破坏，生物物种的灭绝，水环境、大气环境和土地污染。

Environmental risks. The exploration, development, production, transportation, consumption process of modern energy industry is bound to have some environmental impacts, such as changes in the natural landscape, emission of pollutant. But we hope to avoid that kind of irreversible and unacceptable environmental impacts, such as the destruction of living setting of humankind, species extinction, water and air pollution.

2010年BP公司墨西哥湾污染事故，海水中油污浓度相当于可乐中焦糖的浓度
Oil Spill, Mexico Bay, 2010. oil density in sea water is the same caramel in Cocacola.

内蒙古的露天煤矿
Opencast coal mine，Inn Mongolia, China

如果仔细分析这三类风险，我们就会发现，所有的风险最终来源与人为因素。即使是自然灾害引起的能源系统风险，也是由于系统设计中的漏洞造成的，或者是对可能发生的自然灾害风险缺乏预防性措施，或者是由于发生灾害后处理不当造成二次灾害。最典型的例子是 2011 年 3 月的日本福岛核事故。事后的《福岛核电站事故调查报告》指出，福岛核电站处于一种脆弱的状态，既没有保证能抗地震，也没有保证能抵御海啸。一些本应未雨绸缪的事情，比如考虑因地震和海啸受灾的可能性、应对大幅超出安全设计基准事故的措施以及保障居民安全的措施等，东京电力公司和原子能安全委员会等都没有去做。其他人为破坏、冲突与战争、恐怖袭击、石油禁运等导致的能源安全问题，无疑更是人为因素所致。

If we analyze these three types of risk carefully, we may find the ultimate source of all of the risks is human factors. Even the energy system collapses caused by natural disasters, they are because of the systematic design flaw, or the lack of preventive measures for natural disaster risk. Sometimes, improper handling in disaster situations will cause secondary disasters. The most typical example is the Fukushima nuclear accident. Fukushima Nuclear Power Plant Accident Investigation Report shouw that the nuclear power plant was in a fragile state, neither guaranteed to withstand earthquakes, nor guaranteed to tsunamis. Some means that should take precautions, such as the earthquake and tsunami disaster. But Tokyo Power Company and the Nuclear Safety

Commission did not act properly. Other kinds of deliberately destruction, conflicts and wars, terrorist attacks, oil embargoes, are no doubt human factors.

因此，要想解决全球能源安全问题，重要的仍然是规范人的行为、组织的行为和国家的行为。只有在全球治理的框架下，约束各方的行为模式，才可能换来持久的、保护所有人利益的能源安全。比如在西非尼日尔河三角洲的跨国石油公司，如果不能带来当地居民生活质量的改善，它必然就要面对来自部落居民和当地各种组织的威胁，也就无法长期地有效利用西非石油资源改善美国的能源安全形势。同样的情况也适用于中国石油集团公司在苏丹的情形。

Therefore, in order to solve global energy security issues, it is important to regulate human, organizational and States' conducts. Only in the context of global governance, there may be a sustainable energy security, protecting interests of all. For example, in Niger Delta of West Africa, multinational oil companies have to face hostile acts from local people if they can not improve the life quality of local residents. The same situation also may apply to CNPC's situation in Sudan.

3. 关注能源价格带来的外部性风险

3. Focus on External Risk of Energy Price

3.1 经济性风险

3.1 Economic Risks

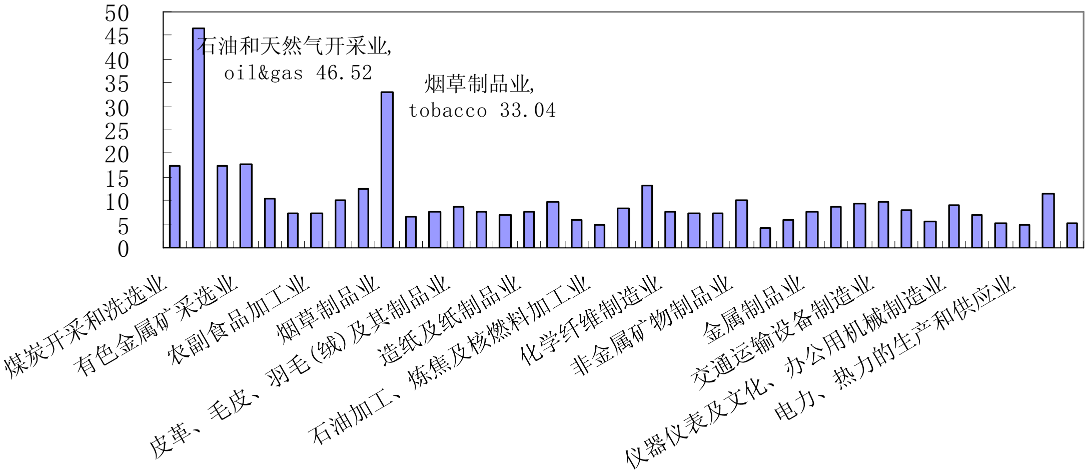
由能源市场波动带来的经济性风险往往受到能源安全话题的掩盖。实际上，真正意义上的能源供给中断从来没有在和平时期发生过，而能源市场波动带来的经济性风险却时时存在。由于能源价格构成了国民经济运行的基础，因此能源价格的剧烈波动往往成为经济周期变化的一个肇因。

Risks from fluctuations in energy market are often masked by the topic of energy security. In fact, the true sense of the energy supply interruption never occurred in peacetime, while energy market volatility of the economic risk always exists. As energy prices constitute the basis of the whole economy, volatility of energy prices often causes a change in economic cycle.

对能源进口国来说，如果能源价格超过了正常的水平，那么就会造成下游工业的利润空间大幅度减少，并因而扭曲了经济资源配置格局，甚至扼杀了制造业的创新与发展能力，并给消费者带来较高的生活成本。而对于能源出口国来说，较高的能源价格会带来大量的货币流入，并带动本币的升值和利息率的提高以及较高的劳动成本和物价水平，同样也会使其他工业的发展失去动力，因为任何其他工业都无法提供像能源工业那样高的利润率，这也就是经济学上的“荷兰病”。

To energy importing countries, if energy prices higher than normal level, it will significantly reduce profit margins of downstream industries, and thus distort the deployment of economic resources, stifling innovation and development of manufacturing sectors, giving consumers a higher cost of living. For those energy-exporting countries, higher energy prices will bring money net inflows, and promote the appreciation of currency and rise interest rate increase as well as labor costs and price levels. Other industries will also lose their vitality, as they are unable to provide profit margins as high as energy sectors, this is the so-called Dutch disease.

中国工业成本费用利润率
profit rate to cost in China (2010, %)



Hamilton (2011)总结了石油价格波动与美国经济周期之间的关系。结论是很显著的，石油价格的剧烈波动与美国经济周期之间存在着很强的联系。尽管这一关系是不对称的，即石油价格快速上涨会引起经济的衰退，但是石油价格的快速下跌却不会引起经济的繁荣。

Hamilton (2011) summed up the relationship between oil price volatility and U.S. economic cycle. Conclusion is very significant, there is a strong link between them. Although this relationship is asymmetric, ie, the rapid rise in oil prices will cause a recession, but the rapid decline in oil prices will not lead to economic prosperity.

3.2 国际性风险

3.2 International Risks

能源安全表现在能源资源垄断及由此产生的巨大经济力量的集中，赋予了国际上某些集团超常的力量，可以在地缘政治上和非传统安全领域发挥更大的作用。美国关于 9－11 恐怖袭击的调查表明，基地组织活动资金的最终来源有很大一部分来自石油美元。

Huge economic profit from energy resources monopoly may give enormous power to some blocs, and thus make them have a big potential in non-traditional security fields. Officially survey of USA on 9-11 terrorist attacks showed that the funding of al-Qaeda activities mainly came from a large part of petrodollar.

由于石油价格在事实上与美元的挂钩，而美元又是全球货币体系的基础，因此石油价格的剧烈波动很可能引发全球的市场动荡，并可能引发全球性的经济危机。2008 年爆发的世界金融危机，其前兆就是 2007 年的高企的石油价格（达到 147 美元/桶的历史高位）。

In fact, as oil price is pegged to U.S. dollar which is the basis of global monetary system, so volatility of oil price is likely to lead to global market turmoil, and may trigger a global economic crisis. The world financial crisis since 2008, also has a precursor of is high oil price in mid-2007 (up to $147/barrel record high).

石油价格与美国经济周期的关系研究综述

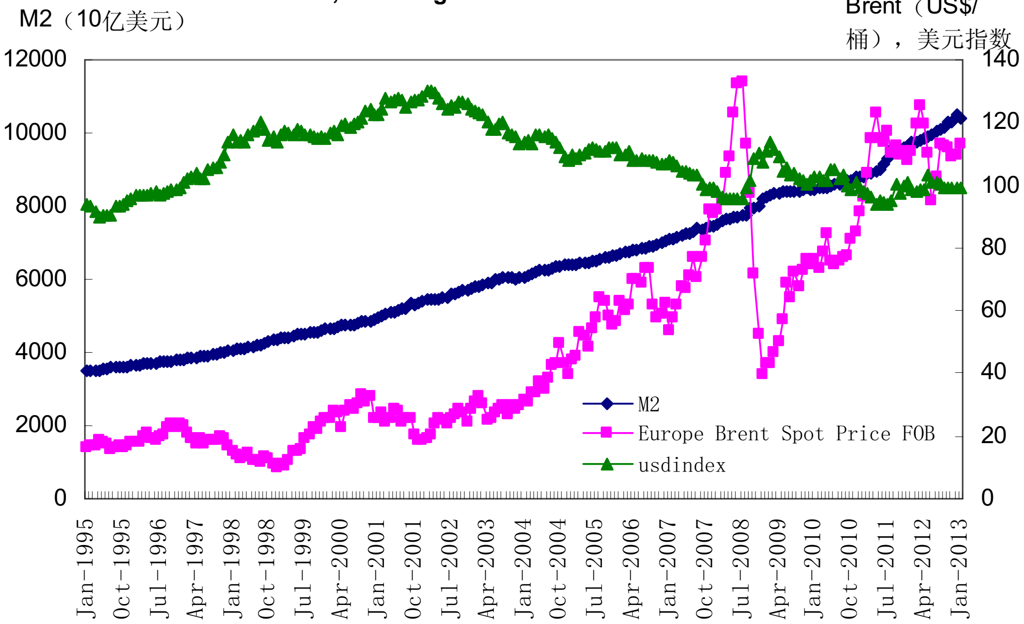
Relationship between Oil Price and American Economic Circle

Gasoline shortages	Price increase	Price controls	Key factors	Business cycle peak
Nov 47- Dec 47	Nov 47-Jan 48 (37%)	no (threatened)	strong demand, supply constraints	Nov 48
May 52	Jun 53 (10%)	yes	strike, controls lifted	Jul 53
Nov 56-Dec 56 (Europe)	Jan 57-Feb 57 (9%)	yes (Europe)	Suez Crisis	Aug 57
none	none	no	---	Apr 60
none	Feb 69 (7%) Nov 70 (8%)	no	strike, strong demand, supply constraints	Dec 69
Jun 73 Dec 73- Mar 74	Apr 73-Sep 73 (16%) Nov 73-Feb 74 (51%)	yes	strong demand, supply constraints, OAPEC embargo	Nov 73
May 79-Jul 79	May 79-Jan 80 (57%)	yes	Iranian revolution	Jan 80
none	Nov 80-Feb 81 (45%)	yes	Iran-Iraq War, controls lifted	Jul 81
none	Aug 90-Oct 90 (93%)	no	Gulf War I	Jul 90
none	Dec 99-Nov 00 (38%)	no	strong demand	Mar 01
none	Nov 02-Mar 03 (28%)	no	Venezuela unrest, Gulf War II	none
none	Feb 07-Jun 08 (145%)	no	strong demand, stagnant supply	Dec 07

Source：Hamilton (2011).

油价、美元汇率与M2

Oil Price, Exchange Rate of Dollar and M2 of US

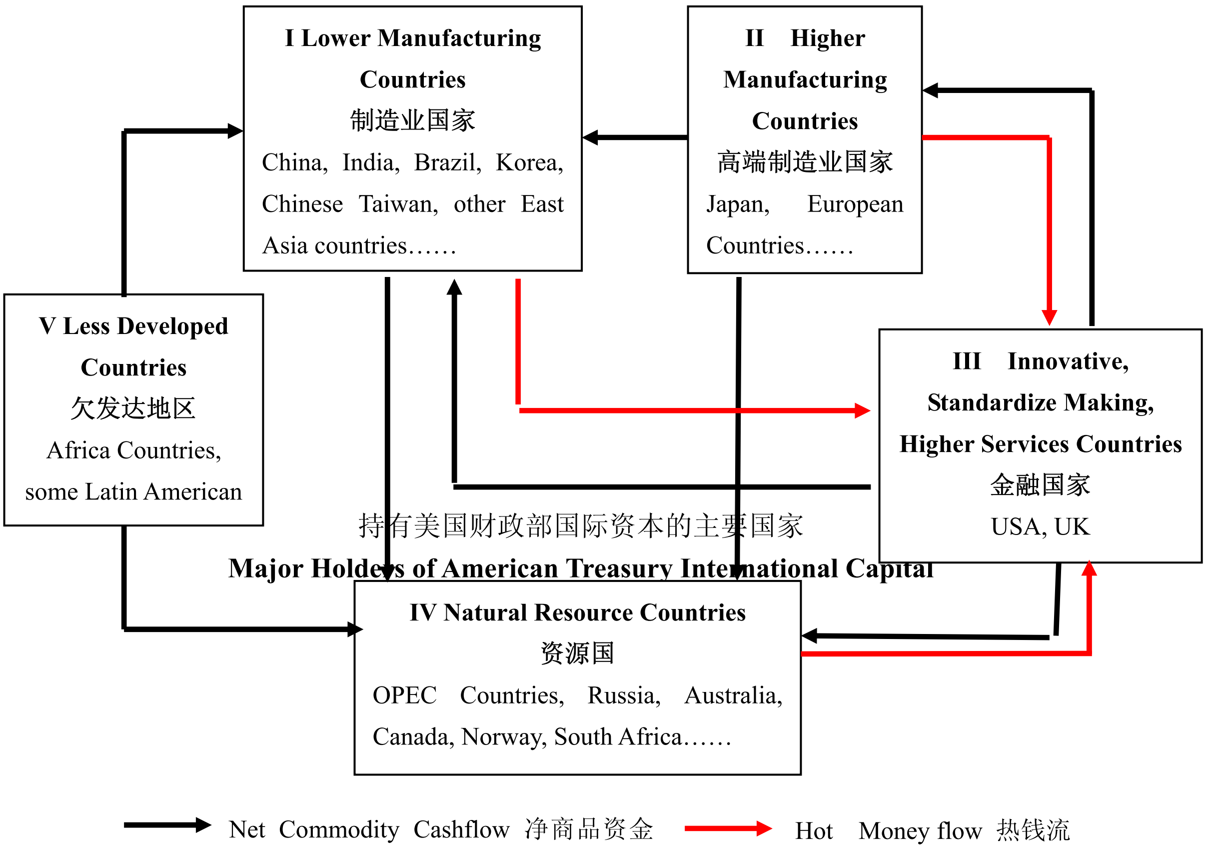


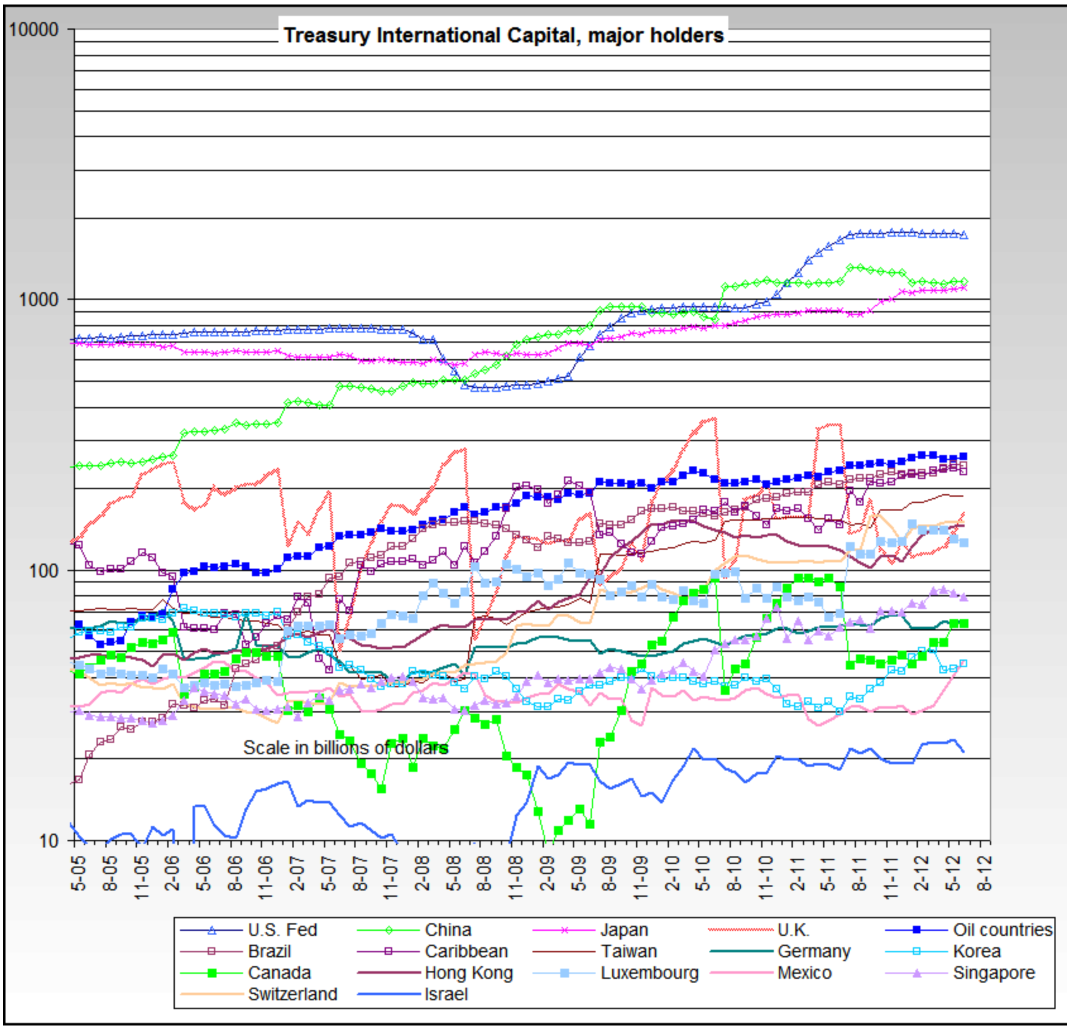
以美元的石油定价权作为基础的货币体系，使世界经济构成了一个物质流与资金流相互配合的统一体。需要进口石油国家必需出口制造业商品来换取美元，出口石油的国家获得美元然后用来购买其他商品。因此，石油价格就成为了在全球进行利益分配的基础工具。

Global money system based on dollar pricing of oil links the world as an integrated utility of material and capital flow with each other. Oil-importing countries need to export manufactured goods in exchange for U.S. dollars, while oil exporting countries received U.S. dollars and then used to buy other commodities. Therefore, the price of oil has become a fundamental tool for the distribution of benefits in the world.

全球物质与资金流动

GloabalGoods and Money Flow

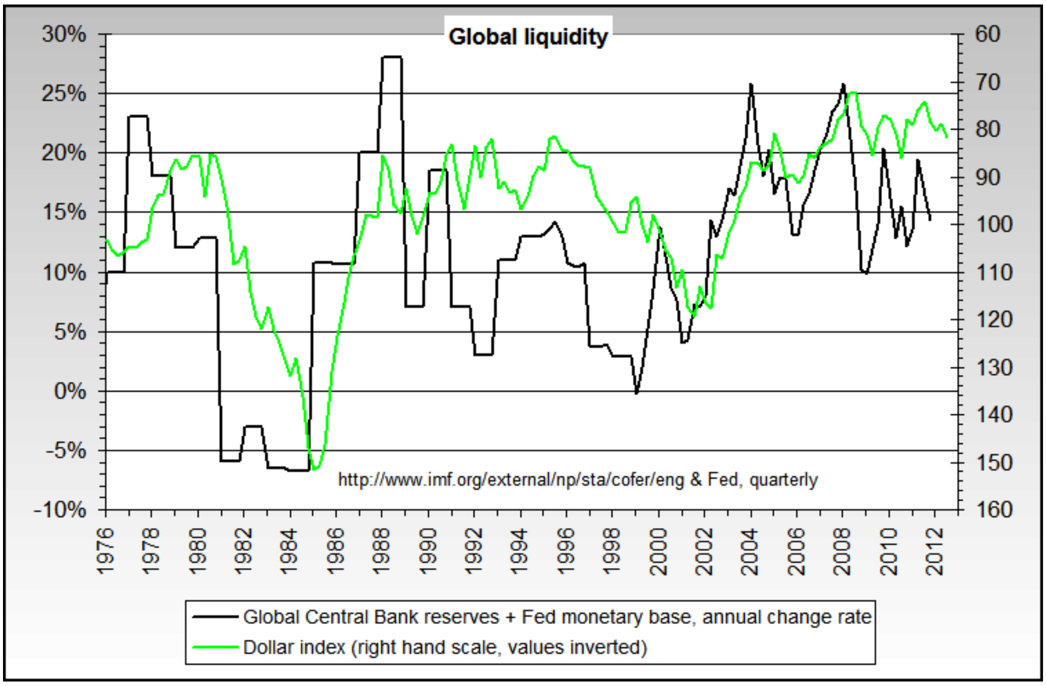


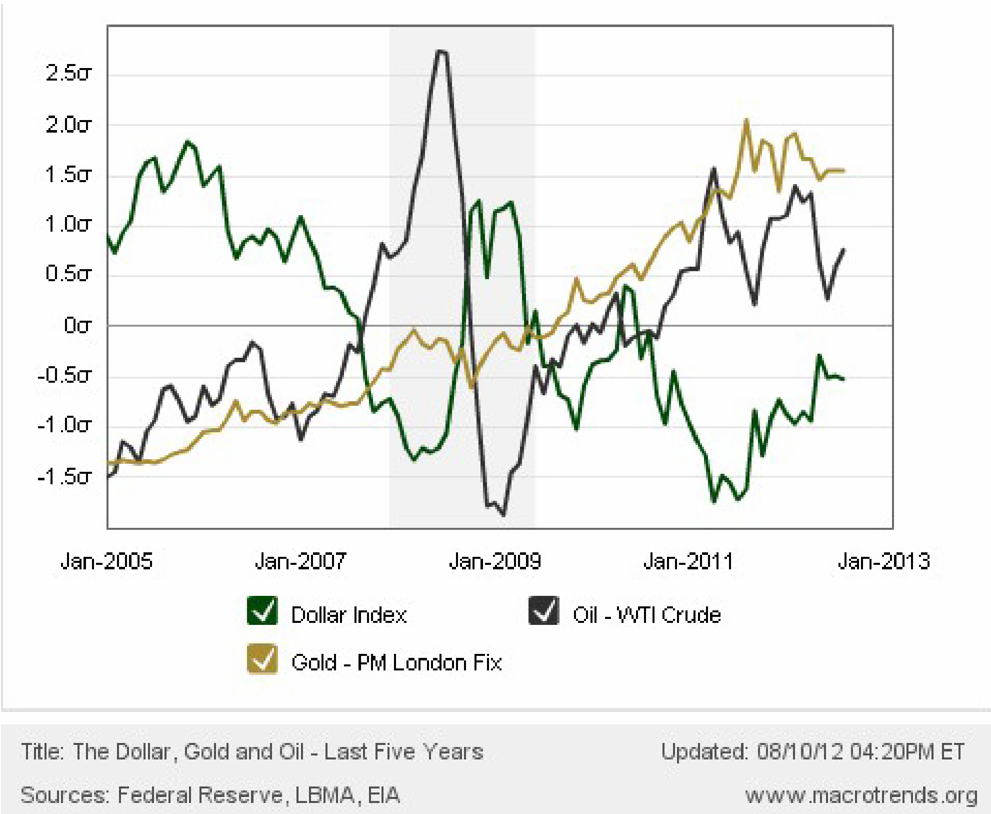


Source：http://nowandfutures.com/key_stats.html#tic

石油价格的基础是全球货币流动性尤其是美元的流动性。因此，控制全球流动性的快速增长，是有效抑制国际石油价格剧烈波动，实现全球经济平稳运行的关键。这是能源消费大国尤其是中国、美国、日本、欧盟等经济体的重要责任。

The base of oil price is the liquidity of US dollar. Therefore, controlling of growth of global liquidity is the key to control oil price and to keep a sound pace of world economy. This is especially the important responsibility of energy consuming countries, such as China, USA, Japan, EU.





4. 全球能源安全治理机制的原则

4. Principles of Global Energy Security Governance

4.1 普遍服务原则

4.1 The Principle of Universal Service

能源服务是现代文明社会的基础之一。经济发展如果不能给让全体居民享受现代化的物质文明与精神文明，就不能称之为现代化。因此，能源安全不是限制经济发展和能源消费的理由，那种人为中国、印度等人口大国冲击国际能源市场的看法从理论上讲是不公平的。各国人民都拥有享受现代文明成果的权力，无论是气候谈判还是能源合作都不应该导致限制经济发展的结果发生。发达国家和联合国应帮助发展中国家和地区建立基本的能源服务，通过基础能源服务改善落后地区的医疗卫生、教育和生存条件，使之逐渐脱离贫困，接受现代文明成果。

Energy service is one of the foundations of modern civilized society. If we can not provide all residents a sound life-style, the society can not be called modern. Therefore, energy security is not the excuse to limit economic development and energy consumption to some countries or some specialized people, such as China, India and other populous country, because that unfair. All peoples have the right to enjoy modern civilization, any climate negotiations or energy cooperation should not result in such restrictions. Developed countries and international organizations such as United Nations should help developing countries and regions to establish basic energy service system to improve health, education and living conditions.

4.2 利益公平原则

4.2 Principle of Fairness

公平是稳定和安全的基础。不仅在能源生产国和消费国之间，在能源生产企业和消费者之间，能源企业与受影响的人群之间，也都要实现公平。实现公平的工具在于能源价格。当能源价格过低时，供给会出现不足，比如美国对内石油价格剪刀差的时期；石油价格过高的话，消费者的能源账单会高到影响影响生活的程度，会让贫穷国家的居民享受不到基本的能源服务。那么合理的价格应该满足什么条件呢？首先，它需要满足能源企业正常的利润水平；其次，由于能源勘探投资有一定的风险性，投资额也很大，因此，能源价格需要超出社会平均利润率的一定水平来平衡投资的风险因素。但是，如果能源行业的利润率大大超过了平均风险投资利润率的话，显然就不是合理的价格了。此时，前面所说的对内和对外两种问题就会显现。

Fairness is the basis for stability and security. It should cover not only between energy producing and consuming countries, but also between producers and consumers, between energy companies and affected population. When energy prices are too low, there will be insufficient supply, such as the situation during domestic oil price controlling in 1970’s USA. If oil price is too high, consumers' energy bills will be high enough to affect the quality of life. So what is a reasonable price which satisfies each side? First, it needs to meet the normal profit level; Secondly, as there are risks while exploration, and investment being also large, the prices need to go beyond a certain level of average profit margin to balance investment risks. However, if the margin is much higher than average profit level, it is obviously not reasonable. At this point, the mentioned both internal and external problems will rise.

这种利益公平原则，要求在能源出口国和进口国之间实现利益的平衡。能源出口国不应利用自身的优势，谋求过高的收益。但是事实上，有些能源出口国往往禁受不住这种诱惑。俄罗斯与白俄罗斯、乌克兰之间的天然气价格之争无疑就是一个例子。

The principle of fairness, requires balance between energy exporting and importing countries. Exporting countries should not exploit their own advantages to seek over-high returns. But in fact, some countries are often unable to weather the temptation. Gas price disputation between Russia and Belarus, Ukraine is undoubtedly one example.

另外，由于化石能源为不可再生资源，能源价格也要体现出对资源保护和替代能源技术创新的鼓励。但是，如果以单纯提高价格的做法来实现能源资源保护，则从经济上侵犯了消费者的利益，而给能源企业带来了不应有的超额利润。在实践中，可以通过税收的发生提高能源消费的成本，而把通过税收手段筹集的资金再用于资源保护和鼓励创新上。

In addition, as fossil fuels are non-renewable, energy prices should reflect the need of conservation and encouragement of technology innovation on alternative energy. However, if we simply raise prices, there must be a violation to consumers, while energy companies obtain excess profits. In practices, governments cmay increase tax costs on energy consumption, and use this fund to conservation and innovation encouragement.

4.3 合作原则

4.3 Principle of Cooperation

合作原则应该是建立全球能源安全治理体系的基础。在走向全球合作的道路上，在冲突思维的长期引导下，走过很多弯路。冷战时期苏联集团试图建立起围绕自己的能源体系，中东国家把石油供应作为维护民族利益的武器。OPEC 这一组织在很多时候也把石油出口国的利益置于全球利益之上，而企图维护一个较高价位。近些年俄罗斯试图控制中亚天然气资源的管道与交易的企图，也不是一种符合合作原则的行为。

Principle of cooperation is the foundation of global energy security governance system. In the way to this goal, international society has many lessons. During Cold War period, the Soviet bloc tried to build their own energy system, Middle-East countries used oil supplies as a weapon to safeguard their national interests. OPEC in many cases love to maintain a relatively high price. In recent years Russia's attempts to control natural gas pipeline and transactions in Central Asian, are also examples violating this principles.

5. 加强全球能源安全的若干建议

5. Some Suggestions on Global Energy Security

5.1 充分发挥国际能源署等国际组织的作用

5.1 To Strengthen the Role International Energy Agency

国际能源署（IEA）作为主要能源消费国的政策协调机构，在维护全球能源市场稳定中发挥了重要的作用。该机构从 1974 年成立以来三次动用战略储备，包括 1991 年海湾战争期间、2005 年卡特里娜飓风袭击墨西哥湾期间、2011 年利比亚内乱期间，都取得了较好的稳定市场的效果。目前中国已经成为世界最大的能源消费国，应该择机加入国际能源署，充分发挥自身的作用。

International Energy Agency (IEA) as a major energy consumer policy coordination mechanism has played an important role. Three times of strategic petroleum reserves use from its inception in 1974, including the 1991 Gulf War, in 2005 during Hurricane Katrina hitting the Gulf of Mexico, in 2011 during the civil unrest in Libya, have achieved good effects to stabilize the market. As the world's largest energy consumer, China should participate this collaboration organization when properly.

5.2 推动区域性能源消费市场的进一步融合

5.2 To Promote the Integration of Some Regional Energy Markets

北美地区和欧盟地区是区域经济融合发展最好的案例。区域融合发展为区域性能源市场的融合提供了良好的基础。北美电网、北美天然气网络、欧洲电力网络的融合，大大改善了区域内的能源系统安全状况。

North America and European Union are nice examples of regional economic integration. Regional integration provides a good foundation to the development of regional energy markets. The integrations in North American power grid, North American natural gas networks, European electricity network, have greatly improved energy system security.

北美和欧盟的融合发展经验值得其他地区学习。根据区域经济结构和能源要素禀赋，本报告建议推动以下几个区域性能源市场的建立。

North America and EU's integration experiences are worthy to learn for other areas. According to regional economic structure and energy factor endowments, this report recommends the following regional markets to promote regional energy market integration.

5.2.1 东北亚区域能源市场

5.2.1 Northeast Asian energy Market

东北亚地区涵盖中国东北和环渤海地区、俄罗斯远东地区、朝鲜、韩国、日本，是世界上少数经济增长潜力巨大的地区。这一地区能源资源丰富，中国东北（包括内蒙古东部）和俄罗斯远东地区蕴藏丰富的石油、煤炭、天然气资源，电力网络发达；除朝鲜外各地区的工业经济基础良好，劳动力丰富。这一地区也是联合国力图推动的经济融合发展区域之一。如果能够实现俄罗斯远东地区、中国东北和环渤海地区、朝鲜韩国的电网互联，和石油天然气融合市场，未来将很可

能形成一个人口和经济总量不亚于欧盟的新的经济增长极。同时也将大大改善这一地区的能源安全形势。

Source: http://www.iglesianicristowebsite.com/Pages/5a-global-expansion.html

Northeast Asia including Northeast China and Bohai region, the Russian Far East, DPRK, ROK, Japan, is one of the few areas with enormous potential for economic growth. This region has rich energy resources, sound electricity network and abundant labor, and good industrial economic foundation except NPRK. United Nations also trY to promote economic integration in this region. If grid interconnection and oil & gas market integration can be done among Russian Far East, Northeast China and the Bohai circle, NPRK, there maybe a new economic growth pole bigger than EU in population and economy, and will also greatly improve the region's energy security situation.

5.2.2 东南亚区域能源市场

5.2.2 Southeast Asian Regional Energy Market

东南亚地区涵盖中国华南与西南地区，中南半岛以及印度尼西亚和菲律宾。这一地区人口众多，油气资源丰富。但是单个地区的能源体系都比较薄弱。中国的华南地区工业基础好但能源资源较为贫乏，中国西南地区、湄公河流域和缅甸水能资源丰富但是基础设施条件较差，马来西亚、印度尼西亚、文莱虽然油气资源丰富但是没有良好的配套工业体系。如果这一地区能以中国华南地区为龙头，辅以其他地区丰富的能源资源，将会大大推动区域经济的发展。随着中国与东盟关系的日渐改善，未来应抓住机遇推动这一区域能源市场的建立和发展。

Southeast Asia area including south and southwest region of China, Indochina peninsula, Indonesia and the Philippines, has large population and rich hydrocarbon resources. However, energy systems are relatively weak. southern China's industrial base is good but has relatively poor energy resources; southwestern China region, the Mekong River area and Myanmar has abundant hydropower resource but poor infrastructure; Malaysia, Indonesia, Brunei are although rich in oil and gas resources, but have not a sound supporting industrial system. If this area can be leaded by south China, supplemented by rich energy resource in the region, regional economic development will be greatly promoted. With China-ASEAN relations improving, the future of this region should seize the opportunity to promote the establishment and development of integrated energy markets.

Source: http://www.iglesianicristowebsite.com/Pages/5a-global-expansion.html

5.2.3 中亚区域能源市场

5.2.3 Central Asia Regional Energy Market

广义的中亚地区涵盖中国新疆、哈萨克斯坦、土库曼斯坦、吉尔吉斯斯坦、乌兹别克斯坦、塔吉克斯坦、阿塞拜疆、格鲁吉亚、亚美尼亚、阿富汗等广大地域。这一地区能源资源丰富，但是经济基础尚不完善。伴随着中国经济的快速发展，对中亚地区能源资源的需求迅速增长。如果只是把中亚的石油天然气向中国内地输送，成本很高，对当地经济拉动有限。如果能够通过上海合作组织等区域性合作机制，推动中亚地区经济、能源、社会的协调发展，将为世界开辟出一个新的经济增长极。

Central Asia in generalized conception, including China's Xinjiang, Kazakhstan, Turkmenistan, Kyrgyzstan, Uzbekistan, Tajikistan, Azerbaijan, Georgia, Armenia, Afghanistan, is a vast area. This region has rich energy resources, but does not have a sound economic system yet. Along with China's rapid economic development, Central Asia's energy resources begin to flow eastward. But remote distance has decrease the cost advantage. If regional cooperation mechanism such as Shanghai Cooperation Organization can promote the Central Asian regional economic, energy, social development, there may open up a new economic growth pole of the world.

为实现这一目标，应快速完善这一区域内的基础设施网络。首先是能源通道的畅通，包括建设跨越里海的阿塞拜疆－土库曼斯坦油气管线，和阿塞拜疆向西通往地中海的油气管线，从而实现里海两岸能源基础网络的互联，打通向东和向西两个方向的能源外送通道。此外，中亚地区的电力网络也可以逐步实现互联，通过大电网来改善能源安全条件。

To achieve this goal, infrastructure networks should be priorities. The first may be the energy outward network, including trans-Caspian Sea oil & gas pipeline from Azerbaijan to Turkmenistan, and Azerbaijan's oil and gas westward pipeline to Mediterranean which link both sides of the Caspian energy, open up energy flow in both directions. In addition, grid in Central Asia may also be gradually interconnected, this bigger grid may improve energy security conditions obviously.

5.2.4 北太平洋能源市场

5.2.4 North Pacific Energy Market

美国实现页岩气革命之后，北美地区的能源形势大大改善。美国、加拿大、墨西哥三国加总后的能源供给能力不仅可以满足区域内需求，而且可以实现较大规模的出口。而北太平洋西岸的中国、日本、韩国都是能源进口需求的大户。因此，北太平洋两岸完全有条件建设一个大规模的区域能源市场，这样即可以为北美地区的能源生产潜力找到出口，也大为丰富东亚地区的能源进口来源，可以有效地改善能源安全形势。

United States and total North America have a better energy security situation than before since the revolution of shale gas. Total capability of North America can not only meet its own demand, but also can export. Across the North Pacific, China, Japan and South Korea are all big energy consumers. Therefore, both sides of the North Pacific are perfectly placed to build a large-scale regional energy market, in this case, the potential of energy production in North America can have an exit, while East Asia countries can effectively improve their energy security situation.

5.3 推动能源技术的国际合作

5.3 To Promote International Cooperation In Energy Technology

既想享受现代生活方式，又要保护环境，那么惟一的选择就是通过现代技术手段来提高能源效率。发达国家在能源技术和推动技术创新的市场机制建设上有丰富的经验，应推动发达国家向欠发达国家和地区转让有关能源技术，并帮助这些国家和地区建立鼓励技术创新的市场环境。具体的技术体系包括产业节能减排技术、车辆节能减排技术、节能建筑设计技术、智能电网与智能社区技术、废弃物能量清洁回收技术、安全核电技术、离网分布式能源生产与应用技术、非常规油气开发与生产技术、深海油气开采技术，等等。

The unique option is to improve energy efficiency if we love both comfortable life-style and sound environment. Developed countries have extensive experiences in energy technology and the market mechanisms. There may be large space to cooperate in technology transfer and to help developing countries to encourage technological innovation and market regulation. Suggestions including those technology related with industrial energy saving, less emission vehicle, energy efficient and eco-building design, smart grid and smart community, energy recovery from municipal waste, safe nuclear power, off-grid distributed energy production and application, unconventional oil and gas exploration and production, off-shore oil and gas exploration, and so on.

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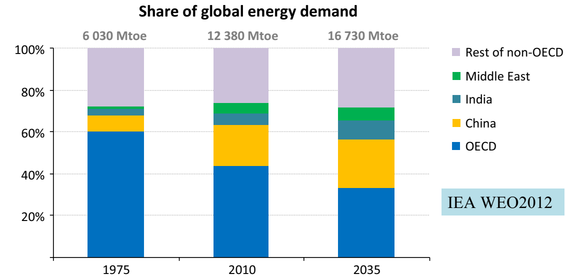
The Shale Revolution and Energy Security

August 10th, 2013 Beijing
Global Forum on Energy Security 2013

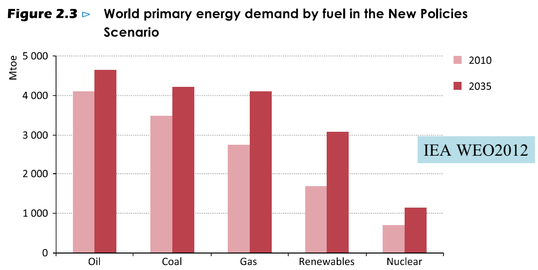
Nobuo TANAKA
Former Executive Director of the IEA
Global Associate of Energy Security and Sustainability, IEEJ

Emerging economies steer energy markets



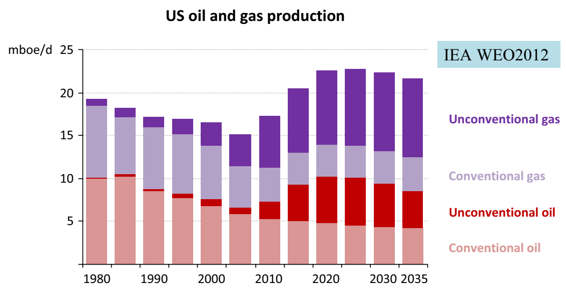
Global energy demand rises by over one-third in the period to 2035, underpinned by rising living standards in China, India & the Middle East

We will still be in the Fossil Fuel economy.



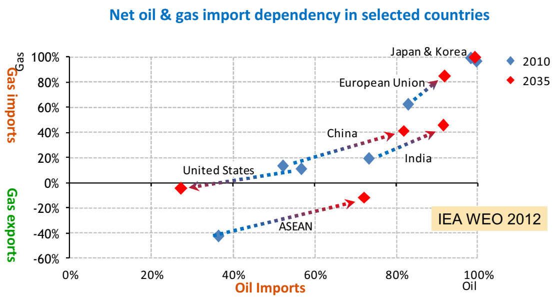
Renewables increases by 80%, Nuclear by 60%. But Fossil Fuels continue to be major sources of energy, though their share drops from 81% to 75% in 2035.

A United States oil & gas transformation



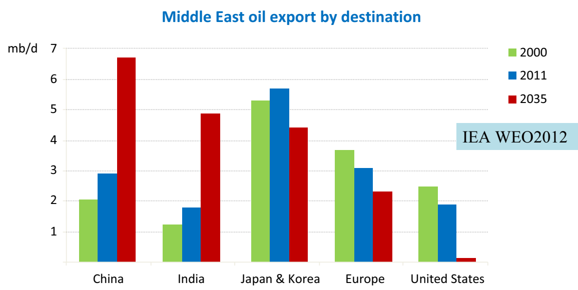
The surge in unconventional oil & gas production has implications well beyond the United States

Different trends in oil & gas import ; US is a single winner.



While dependence on imported oil & gas rises in many countries, the United States swims against the tide

North American Energy Independence and Middle East oil to Asia: a new Energy Silk Road



By 2035, almost 90% of Middle Eastern oil exports go to Asia; North America's emergence as a net exporter accelerates the eastward shift in trade

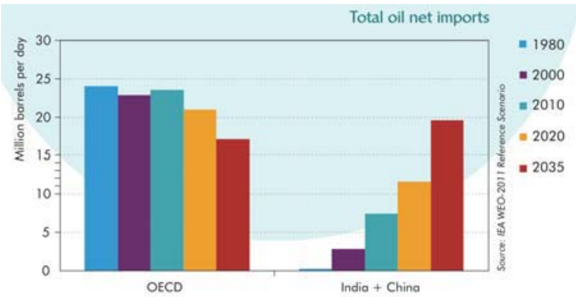
China's Import Transit Routes

USDOD China Report 2013

A Time of Unprecedented Uncertainties.

- Growing Asian economies will shape the global energy future – where will their policy decisions lead us ?

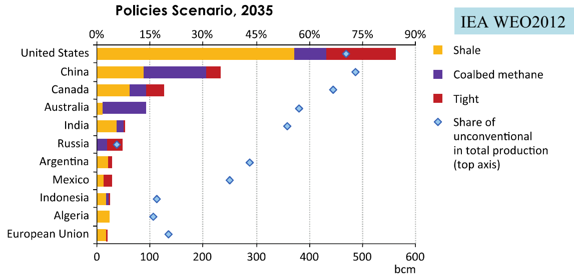
Will China and India join the IEA?



Golden Age for Natural Gas?

Figure 4.5 ▷ Unconventional gas production in leading countries in the New Policies Scenario, 2035

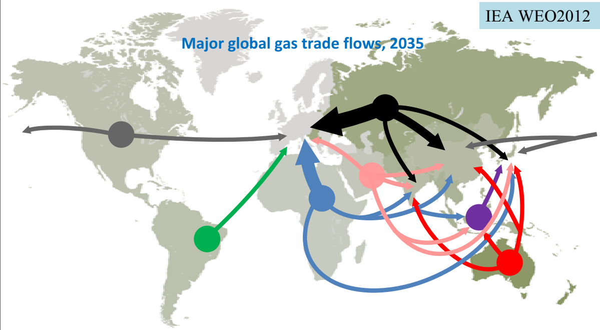
IEA WEO2012



Technically recoverable resources amount to 790tcm or more than 230 years of production at current rates.

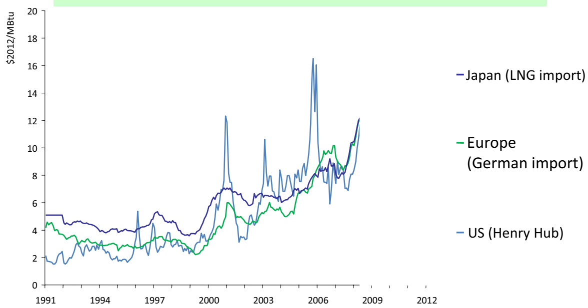
Natural gas: towards a globalised market

IEA WEO2012



Rising supplies of unconventional gas & LNG help to diversify trade flows, putting pressure on conventional gas suppliers & oil-linked pricing mechanisms

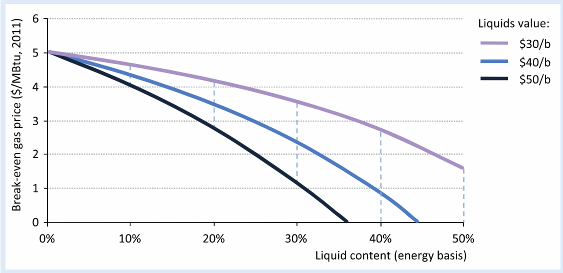
LNG pricing : a competitiveness burden on Asian economies



Developing a Natural Gas Trading Hub in Asia (2013 by IEA)

The higher the oil price goes, the lower the gas price becomes.

Figure 4.7 ▷ Relationship between break-even price (gas price needed to recover well costs) and the liquid content of the gas produced



Golden Rules for a Golden Age of Gas

The "Golden Rules" are principles that can allow governments, industry & other stakeholders to address these environmental & social impacts:

1. Measure, disclose & engage
2. Watch where you drill
3. Isolate well & prevent leaks
4. Treat water responsibly
5. Eliminate venting, minimise flaring & other emissions
6. Be ready to think big
7. Ensure a consistently high level of environmental performance

They are "Golden Rules" because their application can ensure operators have a "social license to operate", paving the way for a golden age of gas.
But Cost of gas production will increase by 7%.

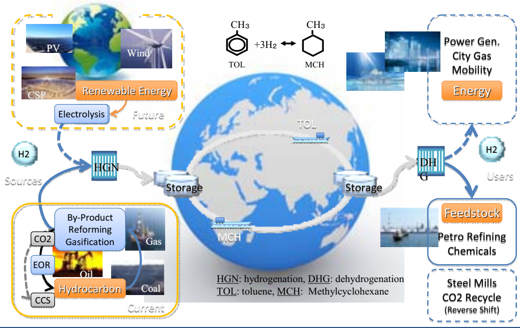
Methane Hydrate, Next unconventional ?

An Energy Coup for Japan: 'Flammable Ice'

Photo by JOGMEC

Introduction - Chiyoda's Hydrogen Supply Chain Outlook

- Chiyoda established a complete system which enables economic H2 storage and transportation.
- MCH, an H2 carrier, stays in a liquid state under ambient conditions anywhere.

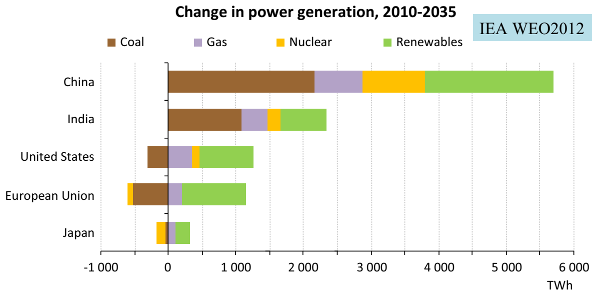


- H2 Supply of a 0.1-0.2mmtpa LNG equivalent scale (M.E. to Japan) could be feasible.

CHIYODA CORPORATION

A power shift to emerging economies

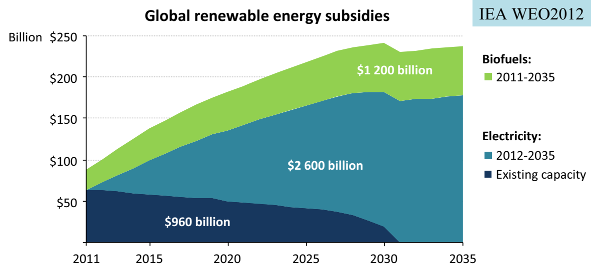
IEA WEO2012



The need for electricity in emerging economies drives a 70% increase in worldwide demand, with renewables accounting for half of new global capacity

The multiple benefits of renewables come at a cost

IEA WEO2012

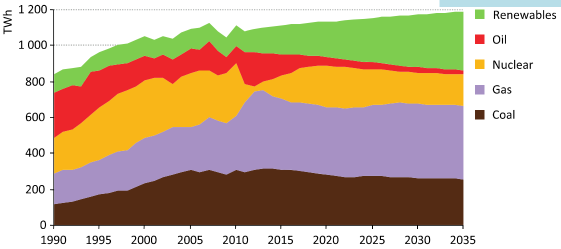


Renewable subsidies were $88 billion in 2011; over half the $4.8 trillion required to 2035 has been committed to existing projects or is needed to meet 2020 targets

Japan's Power Sector: Renewables, gas and energy efficiency leading the charge

Figure 6.13 ▷ Japan electricity generation by source in the New Policies Scenario

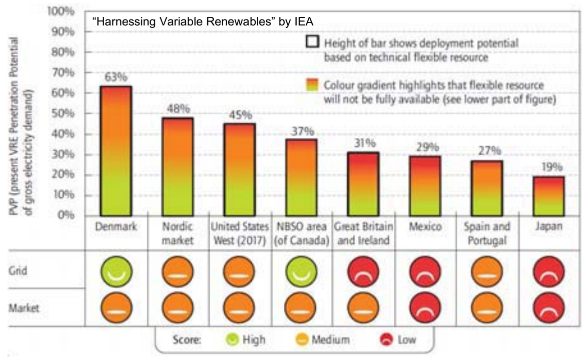
IEA WEO2012



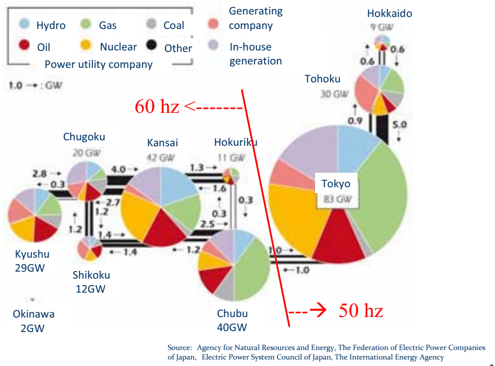
A decline in nuclear is compensated by a 3-fold increase in electricity from renewables, a continued high reliance on LNG imports & improvements in efficiency

Not only Feed-in-tariffs but Grid integration !

Snapshot of present penetration potentials



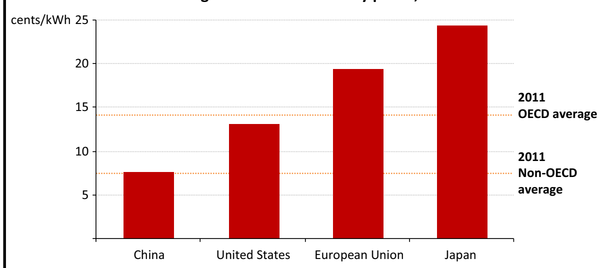
Power grid in Japan



Wide variations in the price of power

IEA WEO2012

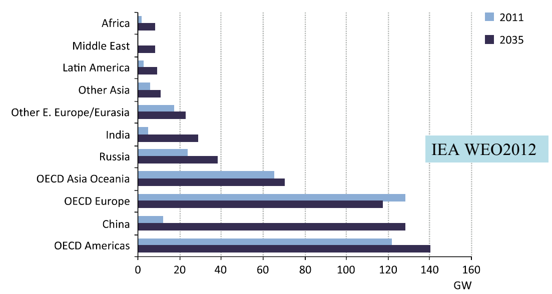
Average household electricity prices, 2035



Electricity prices are set to increase with the highest prices persisting in the European Union & Japan, well above those in China & the United States

Nuclear Power in World Energy Outlook 2012

Figure 6.7 ▷ Nuclear power capacity by region in the New Policies Scenario



IEA WEO2012

In aggregate, world nuclear capacity reaches 580GW in 2035, 50GW lower from 2011 WEO. Production rises from 2756TWh to 4370TWh, almost 60% increase, though the share in total generation falls from 13% to 12%.

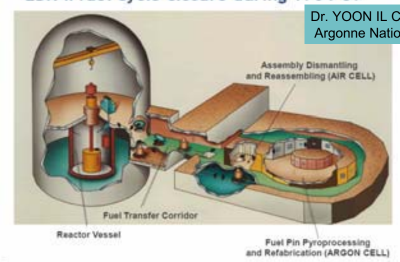
Lessons of the Fukushima

- Lessons to be Shared
  - Think about the unthinkable; Tsunami and Station Black Out. Large scale Blackout. Change total mind set for "Safety".
  - Prepare for the severe accidents by defense in depth, common cause failure & compound disasters.
  - Clarify why it happened only to Fukushima Daiichi and NOT to other sites.
- Safety Principles
  - Fukushima accident was caused by human error and should have been avoided. (Parliament Investigation Commission report)
  - International Cooperation : A nuclear accident anywhere is an accident everywhere.
  - Independent Regulatory authority ; Transparency and Trust, "Back Fitting" of regulation
- Secured supply of Electricity
  - Power station location
  - Strengthened interconnection of grid lines
- Once disaster has happened, Recovery from disaster is at least as important as preparing for it.
  - FEMA like organization and training of the nuclear emergency staff including the self defense force ; integration of safety and security.
- New Technology. New type of Reactors such as Integral Fast Reactor.

Time for G4 Reactors: Integral Fast Reactor and Pyroprocessing

Pyroprocessing was used to demonstrate the EBR-II fuel cycle closure during 1964-69

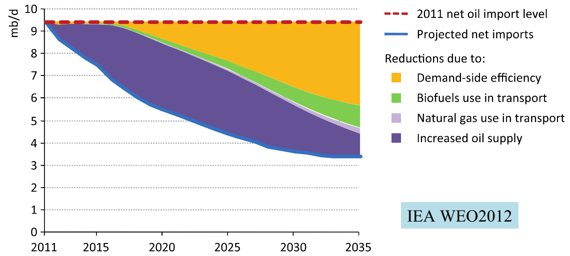
Dr. YOON IL CHANG
Argonne National Laboratory



IFR has features as Inexhaustible Energy Supply ,Inherent Passive Safety ,Long-term Waste Management Solution , Proliferation-Resistance , Economic Fuel Cycle Closure.
High level waste reduces radioactivity in 300 years while LWR spent fuel takes 100,000 years.

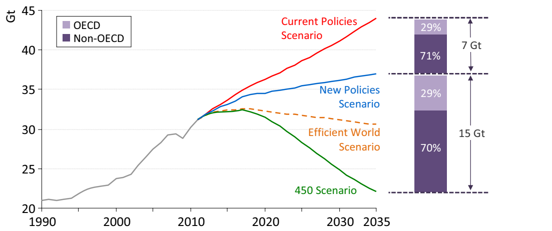
A half of US Energy Independence comes from Energy Efficiency

Figure 2.17 ▷ **Reductions in net oil imports in the United States by source in the New Policies Scenario**



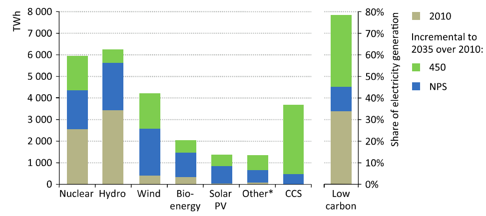
IEA WEO2012

Global energy-related CO_2 emissions by scenario



CO_2 emissions rise to 44.1 Gt in the Current Policies & 37 Gt in New Policies Scenario by 2035. Efficient World & 450 Scenarios see levels of 30.5 Gt & 22.1 Gt respectively

Figure 8.6 ▷ **Electricity generation from low-carbon technologies and share by scenario, 2010 and 2035**

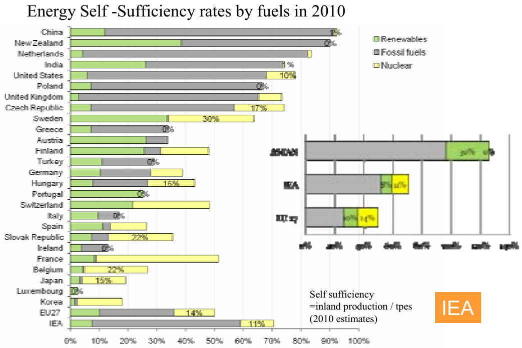


* Other includes geothermal, concentrating solar power and marine.
Note: 450 = 450 Scenario; NPS = New Policies Scenario.

Can we build 16 GW of nuclear power plants a year?
\+ Can we build 60 GW of wind power plants a year? (2010 = 198 GW)
\+ Can we build 50 GW of Solar PV capacities a year? (2010 = 38GW)

Diversity and Connectivity for Energy Security

Energy Self -Sufficiency rates by fuels in 2010



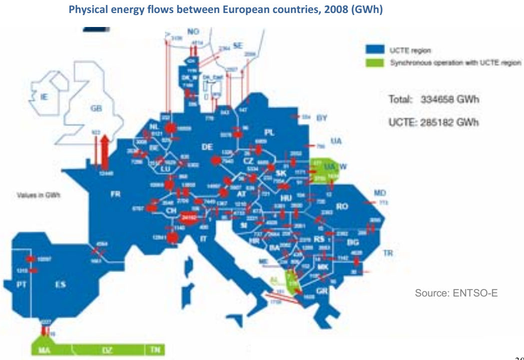
Self sufficiency
=inland production / tpes
(2010 estimates)

IEA

Nuclear is an important option for countries with limited indigenous energy resources .
EU is aiming at Collective Energy Security by power grid and pipeline connections.

Power Grid Connection in Europe

Physical energy flows between European countries, 2008 (GWh)

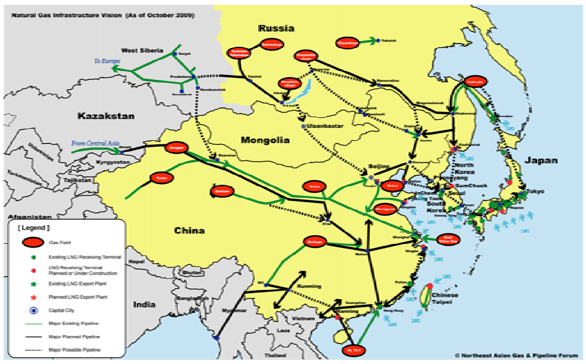


Source: ENTSO-E

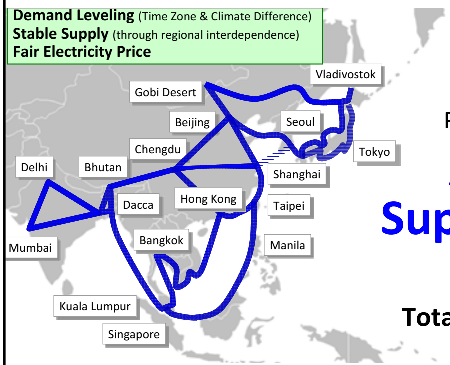
Connecting MENA and Europe: " Desertec" as visionary “Energy for Peace"

Source: DESRETEC Foundation

New concepts for North East Asia Gas & Pipeline Infrastructure



Energy for Peace in Asia. A New Asian Vision?



Phase 3

Asia Super Grid

Total 36,000km

Presentation by Mr. Masayoshi SON

Conclusions

Comprehensive Energy Security Policies for Asia

- The Shale Gas Revolution changes the global energy market. Golden Age of Natural Gas will come with golden rules including sustainability requirements and a new pricing formula. Russia remains as a key player with pipelines and LNG facilities. LNG exports from North America including Alaska may be a game-changer.
- Energy Security for the 21st Century must be Collective and Comprehensive Electricity Supply Security under sustainability constraints. EU`s connectivity approach can be a model especially for Asia. Contingency Plan is needed for imminent Iranian Crisis. China and India should join the IEA.
- Nuclear Power will continue to play a major role in the world. Japan’s role after Fukushima is to share the lessons learned for safer Nuclear Power deployment in Asia and elsewhere.
- For Coal and to a lesser extent for Gas to remain the backbone of power supply, CCS readiness & highly efficient power plants are needed.
- New technologies help; Hydrogen economy, Methane-hydrate , Super-conductivity grid., EVs, Smart Grids, Storage, 4G Reactors like Integral Fast Reactor, etc.

U.S.-China Energy Cooperation: Path to a Clean Energy Future

U.S. Department of Energy

August 10, 2013

Outline

- ❑ Energy and Climate Change
- ❑ Comparison of U.S. and China’s Energy Mix
- ❑ U.S.-China Shared Energy Goals & Targets
- ❑ Energy Supply and Demand - Drivers and Challenges
- ❑ Key Areas of Cooperation
- ❑ Crosscutting Bilateral and Multilateral Cooperation

U.S. DEPARTMENT OF ENERGY

Energy and Climate Change

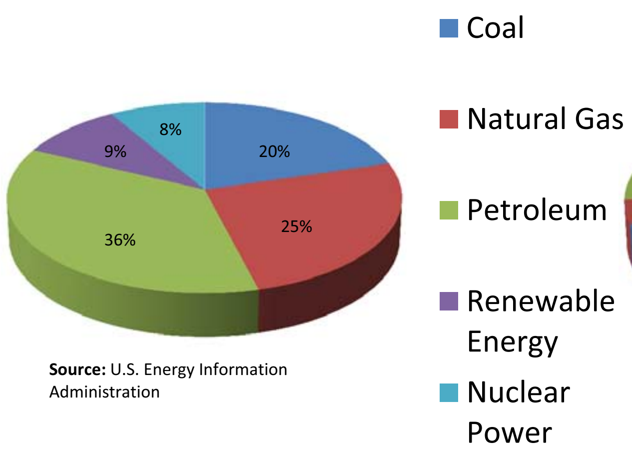
- Changing climate
  - The problem is not going away
  - Two degree threshold at high risk

- Increasing energy demand
  - China is the largest emitter of greenhouse gases, accounting for over 20% of all emissions
    - The U.S. and China combined are responsible for 40% of the word's greenhouse gas
  - Coal continues to dominate China's energy mix
  - China is the largest energy user in the world and energy use doubled between 2000 and 2007
    - China and the U.S. together consume almost 40% of the world's energy
      - ✓ The U.S. consumes more energy per capita…
      - ✓ …but China's economy is more energy-intensive

Comparison of U.S. & China's Energy Mix

U.S. Energy Mix

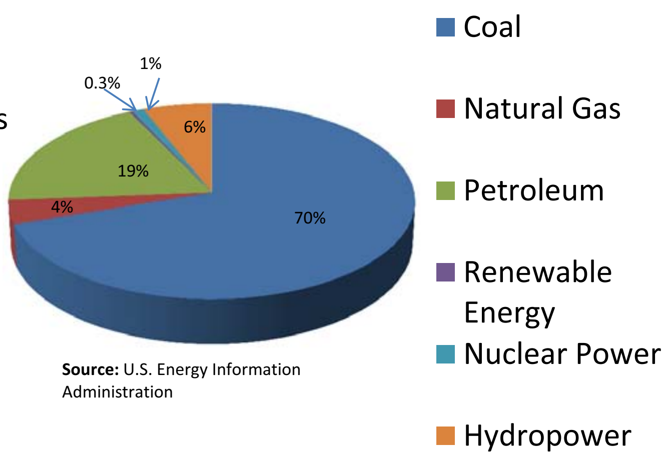
Total energy consumption in U.S., by type, 2011



Source: U.S. Energy Information Administration

China's Energy Mix

Total energy consumption in China, by type, 2009



Source: U.S. Energy Information Administration

U.S. & China Shared Energy Goals

- **Strengthen Energy Security**
  - Diversify energy mix
  - Reduce dependence on traditional fossil fuel
  - Improve energy intensity
- **Promote Economic Growth**
  - Accelerate energy innovations through R&D
  - Deploy clean energy technologies
  - Grow international clean energy trade
- **Reduce Emissions**
  - Pursue new and renewable sources of energy
  - Promote clean and efficient use of fossil fuels
  - Improve environment through a lower carbon foot print and reduced criteria air pollutants

U.S. DEPARTMENT OF ENERGY

U.S. Energy Goals

President Obama's Targets

- By 2020: Make commercial and industrial facilities 20% more efficient
  - Homes, businesses and factories buildings currently account for 70% of the U.S. energy consumption
- By 2025: Raise average fuel economy to 54.5 miles per gallon
- By 2035: Generate 80% of U.S. electricity from clean energy sources
  - Renewable energy, nuclear power, efficient natural gas, and clean coal
  - Currently 40% of the U.S. electricity comes from clean energy source

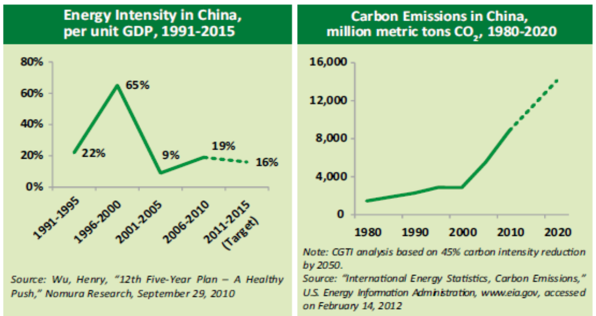
U.S. DEPARTMENT OF ENERGY

China's 12th Five Year Plan

Key Targets

- By 2015:
  - Non-fossil energy will rise to 11.4 percent in the national total primary energy consumption
  - Non-fossil energy will rise to 30 percent installed generating capacity
  - Energy consumption per unit of GDP will drop by 16 percent from 2010
  - CO2 emission per unit of GDP will decrease by 17 percent from 2010

- By 2020:
  - Non-fossil energy will account for 15 percent of its total primary energy consumption
    - More than half will come from hydropower
  - CO2 emission per unit of GDP will be 40-45 percent lower than in 2005



Source: The China Greentech Report, 2012

U.S. DEPARTMENT OF ENERGY

Energy Supply and Demand

U.S. DEPARTMENT OF ENERGY

U.S.-China Energy Cooperation

- Targets both energy supply and demand
- Enabled by common goals and drivers
- Cooperation mostly based on public-private partnership
  - Industry forum model
- Different approaches and strengths complement each other
  - U.S. innovation
  - China providing a good test bed for new technologies

U.S. DEPARTMENT OF ENERGY

Clean Energy Cooperation

- In November 2009, President Obama and President Hu announced seven new joint U.S.-China clean energy initiatives

U.S. DEPARTMENT OF ENERGY

Bilateral Clean Energy Initiatives

- ❑ Shale Gas Initiative
- ❑ 21st Century Coal
- ❑ Electric Vehicles Initiative
- ❑ Energy Efficiency Action Plan
- ❑ Renewable Energy Partnership
- ❑ Clean Energy Research Center
- ❑ Energy Cooperation Program

U.S. DEPARTMENT OF ENERGY

U.S.-China Cooperation on Clean Energy

SUPPLY

- ❑ Develop new and renewable energy
  - Nuclear
  - Wind, Solar, Hydropower
  - Biofuels
- ❑ Promote clean development of fossil fuels
  - Clean coal and thermal power
  - Conventional and unconventional oil and gas

CROSSCUTTING

- ❑ Strengthen cooperation on crosscutting issues
- ❑ Support bilateral and multilateral forums on clean energy
- ❑ Support energy policy dialogue
- ❑ Develop eco-cities and support eco-partnerships

DEMAND

- ❑ Promote energy conservation
  - Industrial
  - Building
  - Vehicles

U.S. DEPARTMENT OF ENERGY

Promote Energy Conservation

- Strengthen energy conservation in industry
  - Top 1000 enterprises program
  - University Alliance for Industrial Energy Efficiency
  - Labeling and standards development
- Promote energy efficiency at the building and city level
  - Selection of U.S. and Chinese demo cities and workshops on eco-cities certification, planning, design, and best practices
- Push forward energy conservation in transportation
  - Joint electric vehicle standards development and demonstrations
  - Development of a joint technical roadmap to identify R&D needs as well as issues related to electric vehicle manufacture, deployment, and use

U.S. DEPARTMENT OF ENERGY

Develop New and Renewable Energy

- Effectively develop and use wind and solar power
  - Renewable energy road-mapping and deployment
  - Grid modernization
  - Standards development
- Develop and utilize biofuels
  - Advance second generation biofuels

U.S. DEPARTMENT OF ENERGY

Develop Nuclear Energy Safely

- Develop nuclear power in a safe and efficient way
  - Promote Generation III+ and Generation IV nuclear reactor technology
  - Advocate for nuclear safety
  - Collaborate on nuclear fuel cycle R&D

Promote Cleaner Fossil Fuels

- Develop and utilize conventional and unconventional oil and gas resources
  - Gov-to-gov exchanges and public-private partnerships
  - Training on shale gas development
- Develop coal industry safely and efficiently and deploy clean coal technologies
  - R&D collaboration on CCS technologies and CO_2 usage
  - Focus on coal gasification, coal-to-liquids, coal-to-chemicals technologies
  - Demonstration projects with U.S. and Chinese industries

U.S.-China Clean Energy Research Center

- First of its kind joint clean energy R&D center, bringing together teams of U.S. and Chinese scientists and engineers
- $150 million financial support over five years
  - Equal contributions between U.S. and China
  - Half of U.S. portion from private sector
  - U.S. portion only funds U.S. researchers
- IPR Model: intellectual property management and sharing arrangements have been rigorously negotiated , involving U.S. private sector participants
- Areas of focus chosen to maximize U.S. learning and address China's growing demand for energy

U.S.–CHINA CLEAN ENERGY RESEARCH CENTER
中美清洁能源联合研究中心

U.S. DEPARTMENT OF ENERGY

Energy Cooperation Program

- Public-private partnership to leverage private sector resources for clean energy projects
- Helps U.S. member companies to enter Chinese market, expanding U.S. export opportunities
- 24 founding member U.S. companies work on cooperation projects; now over 40 members
- Organized into working groups including:
  - Renewable energy
  - Smart grid
  - Clean transportation
  - Green building and building energy efficiency
  - Clean coal
  - Combined heat and power
  - Industrial energy efficiency
  - Energy financing and investment
  - Nuclear Power
  - Shale gas

ECP
中美能源合作项目
US CHINA Energy Cooperation Program

U.S. DEPARTMENT OF ENERGY

Bilateral and Multilateral Cooperation

- Strengthen cooperation on bilateral endeavors that cut across energy areas, strengthening the breadth and depth of cooperation
  - U.S. China Energy Policy Dialogue
  - Ten Year Framework
  - Eco Partnerships
  - Strategic and Economic Dialogue
- Support multilateral clean energy forums
  - Carbon Sequestration Leadership Forum
  - International Framework for Nuclear Energy Cooperation
  - Generation IV International Forum
  - Clean Energy Ministerial
  - International Partnership for Energy Efficiency Cooperation

U.S. DEPARTMENT OF ENERGY

Further Information

- U.S. Department of Energy website
  http://www.energy.gov

- National Nuclear Security Administration website
  http://www.nnsa.doe.gov

- DOE China website
  http://beijing.usembassy-china.org.cn/doe.html

U.S. DEPARTMENT OF ENERGY

Fuel Choices Initiative

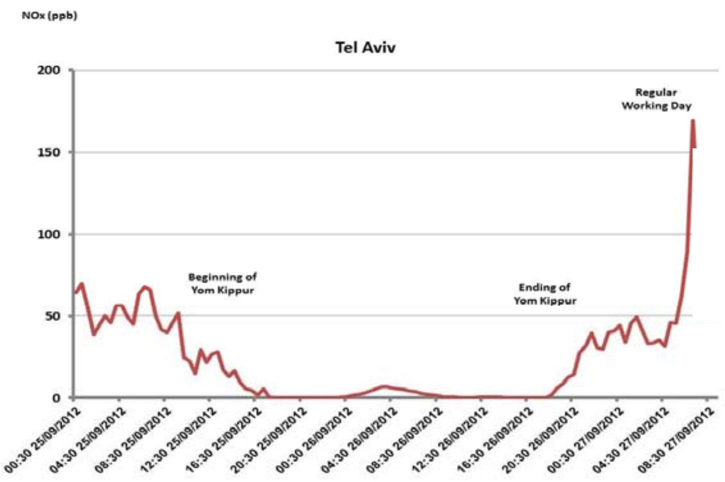
Prime Minister's Office

Reducing Dependence on Oil in Transportation

FREEDOM TO CHOOSE THE WAY WE MOVE

Fuel Choices Initiative

NOx Emission – Tel Aviv, Yom Kippur 2012



FREEDOM TO CHOOSE THE WAY WE MOVE

Fuel Choices Initiative

Prime Minister's Office

Our Mission

To serve as a catalyst for the reduction of global dependence on crude oil by establishing Israel as a center of knowledge and industry in the field of fuel alternatives for transportation.

FREEDOM TO CHOOSE THE WAY WE MOVE

Fuel Choices Initiative

Strategy

1. *Turn Israel into a **center of knowledge** and industrial best practices in the field of fuel alternatives.*
2. *Reduce the share of oil in Israel's transportation sector by **60% by 2025**, while supporting **green growth** and becoming a show case to the world.*
3. *Raising the world's **awareness of alternative fuels**. Building global coalition of partners to speed up innovation.*

FREEDOM TO CHOOSE THE WAY WE MOVE

Center of Knowledge and Best Practice

Fuel Choices Administration Under the Prime Minister's Office

Global Partnerships with Leading Players

Local Regulation & Incentives

Supporting Pilots

Venture Capital Co-Investment

Research Centers & Grants

Research → Industrial R&D → Start ups → Pilot → Scale Up

FREEDOM TO CHOOSE THE WAY WE MOVE

Israel National Research Center for Electrochemical Propulsion (INREP)

BIU, TAU, Technion, AUC

The Challenge: improved energy storage & integration into mobility platforms

Applied research and production is focused on:

- *Hydrogen Storage Systems*
- *Metal Air Batteries*
- *Battery Management Systems*
- *Lithium Batteries*
- *Super Capacitors*
- *Fuel Cells*

Phinergy

FREEDOM TO CHOOSE THE WAY WE MOVE

Pilots and Demonstrations

Electric Urban Public Transportation

Full electric buses

Super-capacitor based Electric Urban Public Transportation (EUPT)

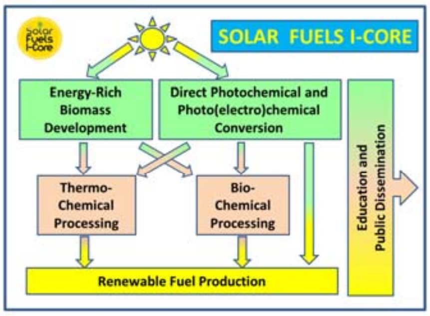
The Solar Fuels
Israeli Center of Research Excellence

Solar Fuels I-Core

Challenge: Generate clean, efficient energy from renewable sources.

focused on:

- *Bio mass Conversion*
- *Photo (electro) Chemical Conversion*
- *Sugar 2 Ethanol*
- *Energy Rich Biomass*
- *Renewable Fuels Production*



FREEDOM TO CHOOSE THE WAY WE MOVE

Agro - Energy Research (Vulcani Center)

Challenge: Generate clean, efficient energy from renewable sources.

focused on:

- *New varieties of energy plants*
- *New machinery for harvest of new crops*
- *Procedures for post harvest processes and production of bio-fuels*
- *Development of other new local technologies*

FREEDOM TO CHOOSE THE WAY WE MOVE

Fuel Choices Initiative

Prime Minister's Office

Global Challenge

Local Research and Innovation

International Collaboration

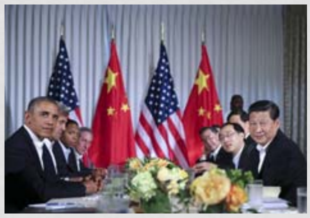
FREEDOM TO CHOOSE THE WAY WE MOVE

A U. S.-CHINA DUAL-LEADERSHIP IN ASIA-PACIFIC

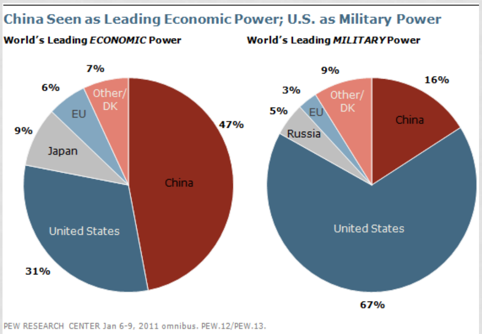
QUANSHENG ZHAO | AMERICAN UNIVERSITY| ZHAO@AMERICAN.EDU

THE EMERGING DUAL LEADERSHIP STRUCTURE IN THE ASIA-PACIFIC

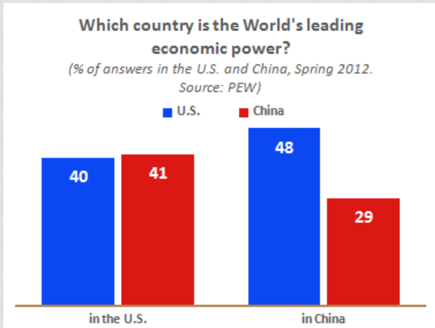
- The U.S. as an existing hegemon and military/security leader
- China as a newly emerged regional economic leader
- A new type of great power relations



US OPINION OF LEADING POWERS



CHINA/US OPINION OF LEADING POWERS



POWER TRANSITION THEORY IN INTERNATIONAL RELATIONS

- Relationship between rising power and existing dominant power
  - How the dominant power deals with the rising power is the key to either a peaceful transition, or a violent war dynamic.
- Key element- degree of satisfaction the rising power has with the existing international system
  - Probability of conflict is greatest when the relationship can be characterized as "the zone of contention and probable war"

RISING POWER VS. EXISTING HEGEMON

- Historical Rising Powers-
  - Japan- challenged China's dominance (Meiji period – WWII)
  - Germany- challenged UK dominance
  - USSR rising (after WWII)
  - United States- challenged UK dominance
- Robert Kagan-

"the most successful management of a rising power in a modern era was Britain's appeasement of the United States in the late nineteenth century, when the British effectively ceded the entire Western hemisphere (except Canada) to the expansive Americans."

WHAT CHARACTERISTICS DESCRIBE A COUNTRY IN A LEADERSHIP POSITION?

International leadership—not self-appointed, nor elected

- Powerful
- Rule making
- A leader in international organizations (e.g. World Bank, United Nations)
- Provides public goods
- Occupies a high moral position

COOPERATION AND THE DUAL LEADERSHIP STRUCTURE

- Cooperation is key to successful Dual Leadership
  - A deliberate changing of behavior contingent on changes in the other party's behavior
  - Increases rewards for each party
  - Not the same as harmony (where no deliberate change in behavior is necessary)
- Examples:
  - Post Cold War security community among capitalist powers
  - US led military/financial coalition in war on Iraq

THE RISE OF CHINA

- Economic
  - No. 2 Economy in the world; passed Japan in 2010
  - GDP rising (1980-2011)- 10% average annual growth
    - compared to the U.S. average annual GDP growth of 2.6%
  - World's largest creditor- mainland China owns 22.2% of all foreign owned U.S. Treasury Securities (Apr. 2012).

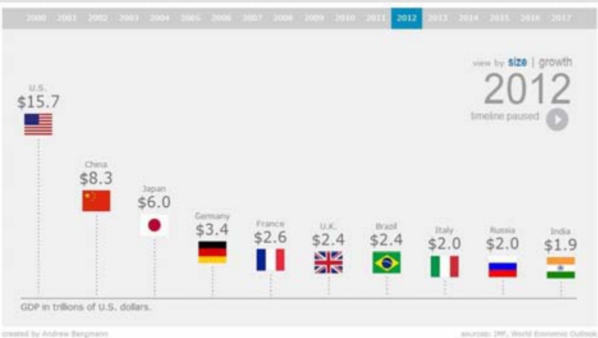
Sources: World Bank; U.S Department of the Treasury

TOP 10 WORLD ECONOMIES BY GDP (2012)

Rank	Country	GDP (Nominal, US$ Millions)
1	United States	15,094,025
2	China	7,298,147
3	Japan	5,869,471
4	Germany	3,577,031
5	France	2,776,324
6	Brazil	2,492,908
7	United Kingdom	2,417,570
8	Italy	2,198,730
9	Russia	1,850,401
10	Canada	1,736,869

Source: International Monetary Fund

TOP 10 WORLD ECONOMIES BY GDP (2012)



CHINA AS AN IMPORTANT WORLD TRADING PARTNER

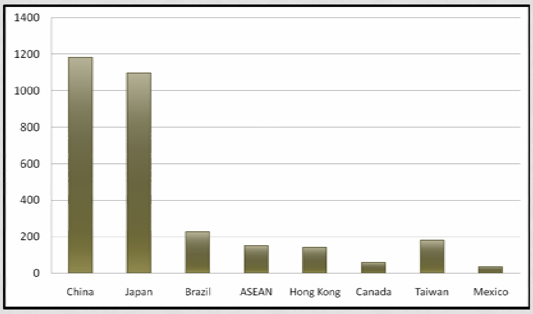
- Growing Asian Regionalism- East Asia, Southeast Asia, Oceania, South Asia Countries
- Reliance on China as a trading partner
- China as an economic engine for recovery-
  - World GDP growth largely depends on China's GDP growth and investments

MAJOR PARTNERS IN INTERNATIONAL TRADE (2011)

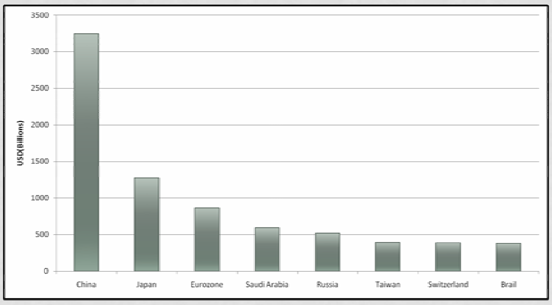
Country	No.1	No.2	No.3	No.4	No.5	No.6	No.7
China	EU	USA	Hong Kong	ASEAN	Japan	S. Korea	India
USA	Canada	China	Mexico	Japan	Germany	UK	S. Korea
EU	USA	China	Russia	Switzerland	Norway	Turkey	Japan
India	UAE	China	USA	Saudi Arabia	Switzerlan d	Hong Kong	Germany
Hong Kong	China	USA	Japan	Taiwan	Singapore	S. Korea	India
Australia	China	Japan	USA	South Korea	Singapore	UK	New Zealand
Japan	China	USA	S. Korea	Australia	Taiwan	Thailand	Saudi Arabia
ASEAN (2010)	China	EU	Japan	USA	S. Korea	India	Australia
S. Korea (2009)	China	Japan	USA	Saudi Arabia	Hong Kong	Australia	Singapore
Canada (2009)	USA	China	UK	Mexico	Japan	Germany	S. Korea
Mexico (2009)	USA	China	Brazil	Japan	Germany	Chile	S. Korea

Source: United States Census Bureau, National Bureau of Statistics of China, Department of Commerce, Government of India, European Commission, Trade and Industry Department, Government of Hong Kong, ASEAN Web, Department of Foreign Affairs and Trade, Australian Government, Japan External Trade Organization, etc.

US TREASURY SECURITY HOLDINGS BY COUNTRY (USD BILLIONS, 2012)



FOREIGN RESERVES BY COUNTRY (USD BILLIONS, 2012)



REGIONAL INFLUENCE

- Dependence on China economically
  - FDI into China on the rise
  - China's Investments- important for all countries in East Asia, Southeast Asia, etc.
  - Top trading partner to Japan, South Korea, EU, U.S., Singapore, Hong Kong, Taiwan, Australia, and others

CHINA'S FREE TRADE AGREEMENTS

- Mainland and Hong Kong Closer Economic Partnership Arrangement (CEPA) - 2003
- Mainland and Macau Closer Economic Partnership Arrangement (CEPA) – 2003
- Thailand-China Free Trade Agreement – 2003
  Chile-China Free Trade Agreement – 2005
- Pakistan Free Trade Agreement - 2007
- New Zealand-China Free Trade Agreement - 2008
- Singapore-China Free Trade Agreement - 2008
- Peru-China Free Trade Agreement – 2009
- Taiwan Economic Cooperation Framework Agreement (ECFA) - 2010
- ASEAN-China Free Trade Area (ACFTA)- 2010
- Costa Rica–China Free Trade Agreement - 2011

FDI INFLOW IN COUNTRIES ACROSS ASIA-PACIFIC 2011 (USD BILLIONS)

Rank	Country	Volume
1	USA	227
2	China	124
3	Hong Kong	83
4	Canada	41
5	Singapore	64
6	Australia	36
7	India	32

Sources: UNCTAD

FDI OUTFLOW IN COUNTRIES ACROSS ASIA-PACIFIC 2011 (USD BILLIONS)

Rank	Country	Volume
1	USA	397
2	Japan	114
3	Hong Kong	81
4	China	65
5	Canada	50
7	S. Korea	20
8	Australia	20

Sources: UNCTAD

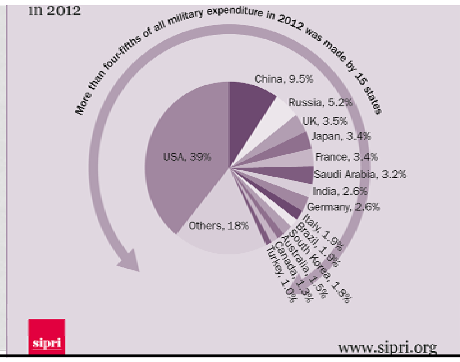
CHINA IN THE DEVELOPING WORLD

- Increased Investment and Aid Programs in Africa
- Always Win-Win: China leading investor in African infrastructure and resources projects
- Surpassed the World Bank's Loans total
  - 2009-2010: China's Investment in Africa totaled $110 Billion; Exceeds the record $100 Billion lent out by the World Bank

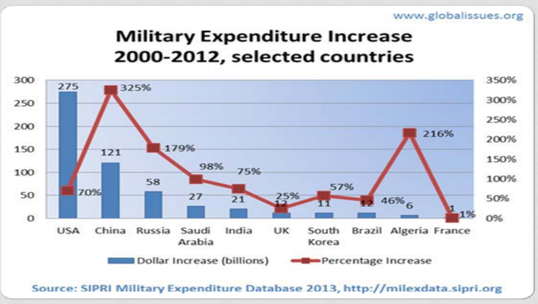
U.S. STILL THE LEADING POWER IN MILITARY/SECURITY DIMENSION

- U.S. spends more annually on defense and military technology than any other country. ($909.3 billion in 2012 – in constant $U.S.)
- U.S. is responsible for 44.1% of world total military expenditures, distantly followed by the China (7.3%), France (3.9%), UK (3.7%), and Russia (3.4%)
- U.S. is still the leading supplier of military arms worldwide.

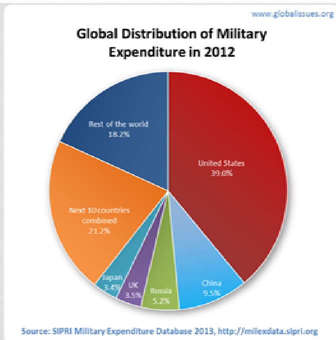
COUNTRIWS WITH THE HIGHEST MILITARY EXPENDITURE IN 2012



GLOBAL MILITARY EXPENDITURES 2000-2012



GLOBAL MILITARY DISTRIBUTION (IN CURRENT $U.S.)



U.S. MILITARY PARTNERS

- U.S. also controls most international organizations/institutions related to military and security in the Asia-Pacific
  - U.S. led bilateral security institutions
    - US-Japan Security Alliance
    - US-South Korea Military Alliance
  - Military Partnerships between the U.S. and Asian countries (Philippines, Australia, New Zealand, Thailand, India, Pakistan, Singapore)

U.S. MILITARY EXERCISES

- South Korea
  - Ulchi Focus Lens
    - Computerized defense of S. Korea from N. Korea
  - Operation Team Spirit
    - Periodically from 1976 to 1997
  - 2010
    - Invincible Spirit
    - North Korean naval deterrence
    - Anti-submarine exercises; 11-day warn deterrent exercise; Scheduled drills following Yeonpyeong shellings
  - 2011-2012
    - Continued practicing of annual military exercises despite threat of North Korean retaliation

U.S. MILITARY EXERCISES (CONT.)

- Japan
  - Over 100 joint exercises annually
  - 2009
    - Peace-09 naval exercise (China included)
  - 2010
    - Naval exercises following Yeonpyeong shellings
    - Keen Sword Exercises (50th anniversary of US-Japan alliance)

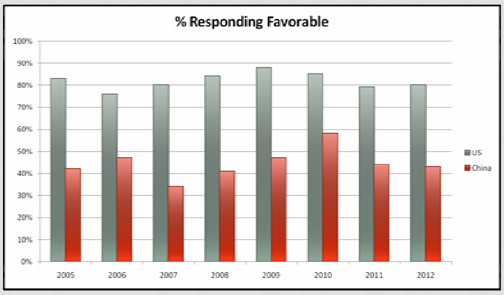
CHINESE MILITARY PARTNERS

- China has fewer military partners than the U.S.
  - Shanghai Cooperative Organization (SCO)
    - China and Russia as leaders of Central Asia
  - North Korea Six Party Talks
    - U.S. and China as leaders
  - Close Relations
    - Pakistan
    - Burma

GAP IN POLITICAL INFLUENCE

- "Smart power"
- US advantages:
  - Adjusts its foreign policy to reflect a high moral stance
  - Leads news media to guide public opinion
  - Strengthens international credibility to maintain alliance relationships
  - Constant debate over domestic/foreign policy → ability to self correct

INTERNATIONAL PUBLIC OPINION



Source: Pew Research Center

ASIA'S REGIONAL INSTITUTIONS

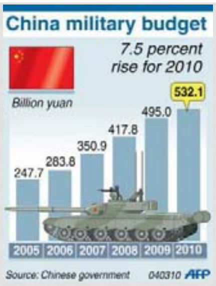
- Primarily four categories:
  - (1) U.S.-led institutions- Security institutions (i.e. the US-Japan alliance, US-South Korea alliance)
  - (2) China-led institutions- Economic institutions (i.e. SCO, FTAs)
  - (3) U.S.-China Co-leaders- Six Party Talks
  - (4) U.S.-China Co-participants- APEC, ASEAN Regional Forum, East Asian Summit

CHINA CATCHING UP

- The U.S. still dominating power-
  - Dominant Military/Security Leader
  - Still Surpasses China Economically- GNP, GDP, GDP per capita, etc.
- China Closing the Gap
  - Catching up to the U.S. Economically
  - Developing Military and Defense Technology

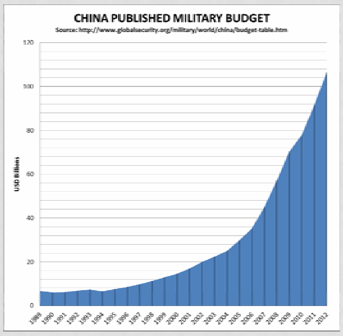
CHINA'S INCREASED EMPHASIS ON DEFENSE

- Number 2 in military expenditures globally
- China's Military Budget over the past 30 years-
  - 1978-1988- up 3.5% annually
  - 1989-1999- up 14.5% annually
  - 2000-2012- up 15.9% annually



Source: France24 International News, quoted from the Chinese government,

CHINA'S MILITARY BUDGET (U.S. BILLIONS)



CHINA'S "PEACEFUL RISE"

- China claims growth with peaceful intentions
  - West and neighbors' suspicions intact
  - Soft power a "sore spot" in China's global influence
- Damage to China's core interests
  - Has listed Taiwan, Tibet and Xinjiang as core interests
    - West's public opinion reflects misunderstanding
    - Sympathy for Chinese political opposition

STRENGTHS AND WEAKNESSES

- China
  - Economically stronger
  - Politically and militarily weaker
- United States
  - Political and militarily stronger
  - Economically weaker

"3 C'S"—POSITIVE DEVELOPMENT

- Necessities for peaceful dual structure
  - *Coordination*
  - *Cooperation*
  - *Compromise*

"3 C'S"–NEGATIVE DEVELOPMENT

- Preconditions for divided dual structure
  - *Competition*
  - *Conflict*
  - *Confrontation*

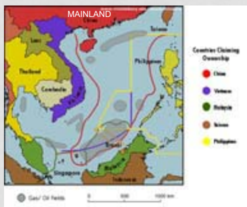
CO-MANAGEMENT OF HOT SPOTS

- Hot Spots for Conflict:
  - Korea Peninsula- explicit co-management
    - Six Party Talks
  - Taiwan Strait- implicit co-management

AREAS FOR POTENTIAL CONFLICT

- Security
  - South China Sea: bilateral and multilateral talks
  - East China Sea: China-Japan (and the U.S.?)
  - Central Asia: SCO
- Economic
  - Trade Balance
  - RMB

Conflict in the South China Sea



CHINA & US IN ENERGY--FACTS

- China overtook the United States as the top energy user in 2009.
- China's goal to be producing 6.5 billion cubic metres (bcm) a year of its own gas by 2015 and up to 100 bcm by 2020.
- China's potential shale gas reserves in the Sichuan, Tarim and Ordos basins outstrip those of the US.
- China brought in 25% of the worldwide investments in solar, 37% of those in wind and 47% of other types of renewable energy, from small hydropower to geothermal.
- China's increasing dependence on Middle East Oil

ENERGY COMPETITIONS

- Top two energy consumers, oil investors and carbon emitting nations.
- US concerns about lagging behind China in clean technology—possible clean technology race? No consensus in the US side.
- Oil: China's relation with "Pariahs" (Iran, Sudan,Venezuela)
- US blamed China's "Mercantilist"-- control the oil area through state-owned companies.
- Geopolitical influence: China's investment in middle east and Africa. Increasing power?
- Disagreement over the responsibility of climate change.

ENERGY COOPERATION

- U.S.-China Strategic and Economic Dialogue
- New energy and climate dialogue
- Nuclear energy
- Unconventional energy resources such as shale gas
- Ten Year Framework for Cooperation on Energy and Environment signed in 2008.
- Government incentive programs

ZERO-SUM GAME?

- ‘One up and one down’?
  - Offensive Realism perspective- strategic environment is a zero-sum game
  - Little room for shared power, especially militaristic
  - China as a threat to the U.S.
- John Mearsheimer- “The most dangerous scenario the United States might face in the early twenty-first century is one in which China becomes a potential hegemon in Northeast Asia. China and the United States are destined to be adversaries as China’s power grows.”
  - The Tragedy of Great Power Politics (New York: W.W. Norton 2001), 401 and 4.

OR WIN-WIN?

- ‘Win-win’ situation?
  - China’s rise could be good for both the U.S. and for China
  - Interdependency theory- as long as relations between major powers can be managed, conflict is not inevitable
  - Globalization and regional integration= greater economic interdependence.

CURRENT COOPERATION

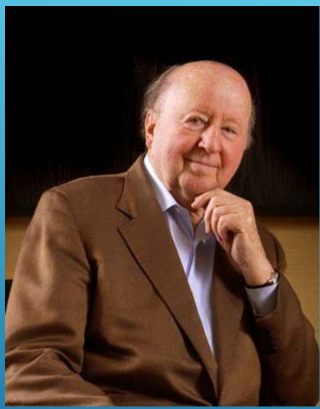
- China- U.S. Strategic Economic Dialogue
  - Began in 2006: Twice per year, Beijing and Washington
  - Economic interdependence
- Frequent Summits and State visits
  - Mutual Visits: Obama and Xi Jinping (2009 & 2013)
  - Biden visits China, Xi Jinping (2011 & 2012 respectively)

FUTURE DIRECTIONS

- Dual Leadership Structure is positive so far
- Inclusive to other powers in the region?
  - Japan, Russia and the two Koreas
- The Six Party Talks might be institutionalized?
  - Major contributors are the important powers in the region
- Expand Existing Institutions and Alliances
  - For Example-
    - 2+2 Talks (U.S. + Japan) could be the 2+2+2 Talks (U.S. + Japan + China)?

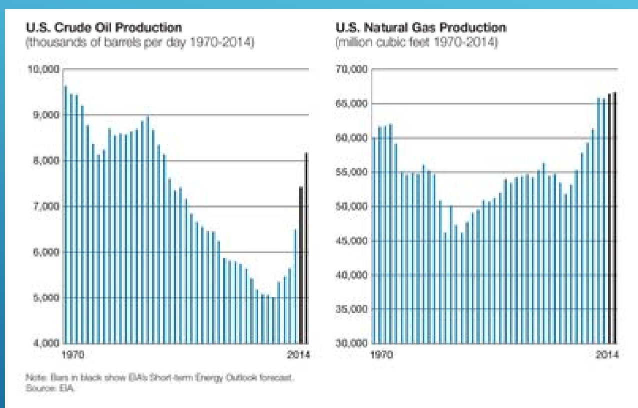
US Energy Transformation
Implications for China

Dr. Gal Luft
Co-director, Institute for the Analysis of Global Security
Senior Adviser United States Energy Security Council
www.usesc.org

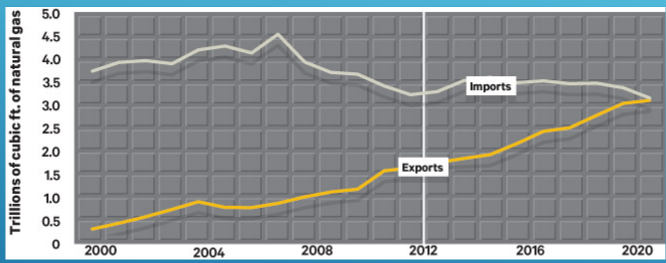


George P. Mitchell
The father of fracking
1919-2013

The fracking factor

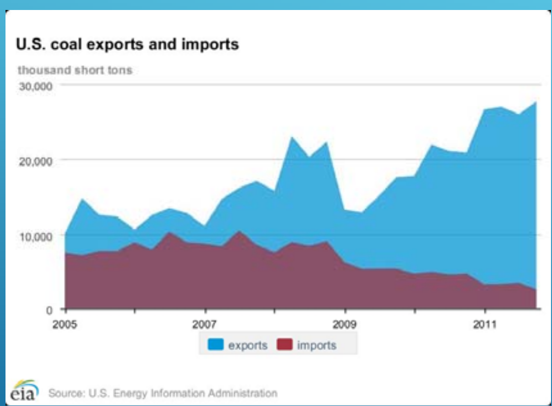


THE US IS ON ITS WAY TO BECOME A GAS EXPORTER



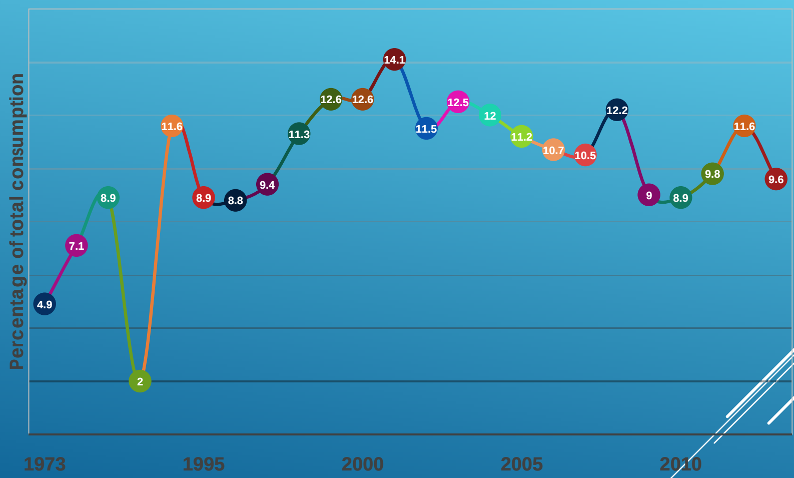
The eight pending U.S. LNG export projects, if approved, could provide a total of 120 million tons of gas/year, compared to the world LNG leader Qatar's production capacity of 77 million tons/year.

THE US HAS BECOME A MAJOR COAL EXPORTER

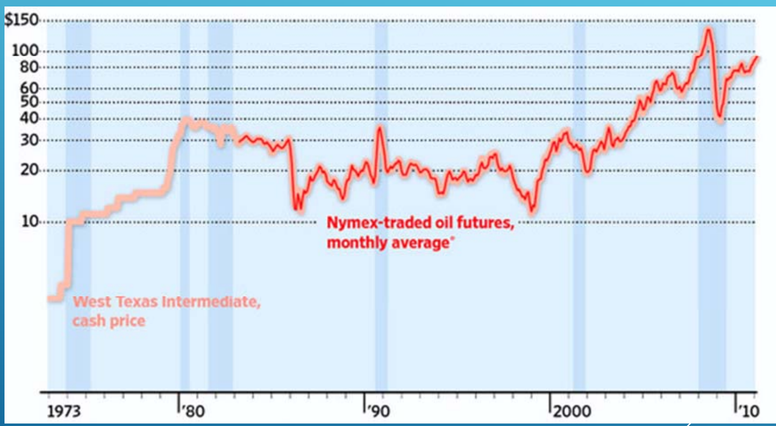


WILL THE US PULL OUT OF THE MIDDLE EAST?

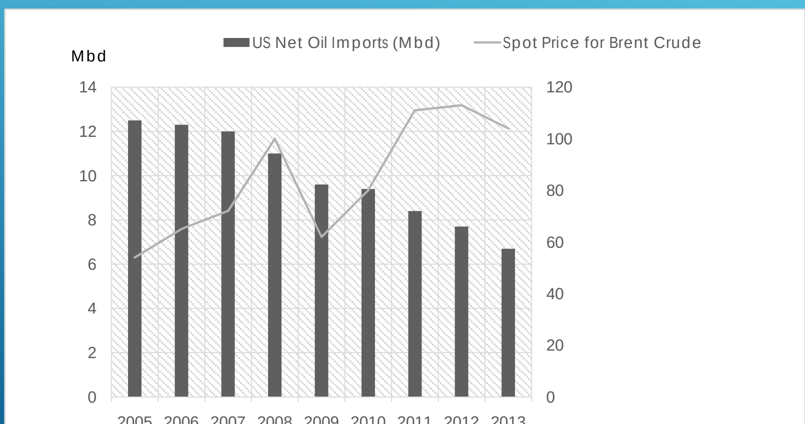
OIL IMPORTS FROM THE PERSIAN GULF 1973 - 2013 AS PERCENTAGE OF OVERALL US CONSUMPTION



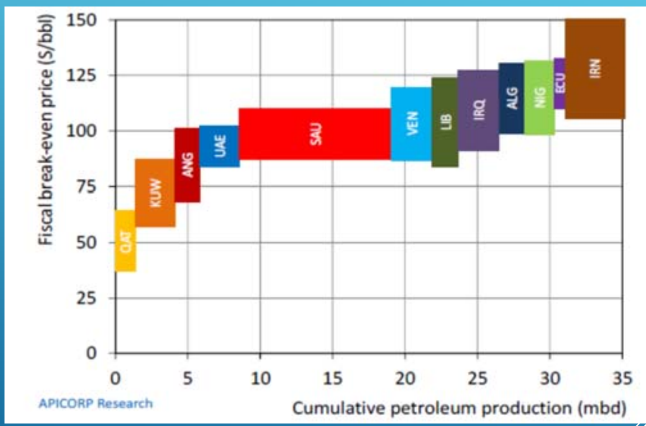
OIL SPIKES AND ECONOMIC RECESSIONS



THE ENERGY SECURITY PARADOX



BREAKEVEN PRICE FOR OPEC MEMBERS



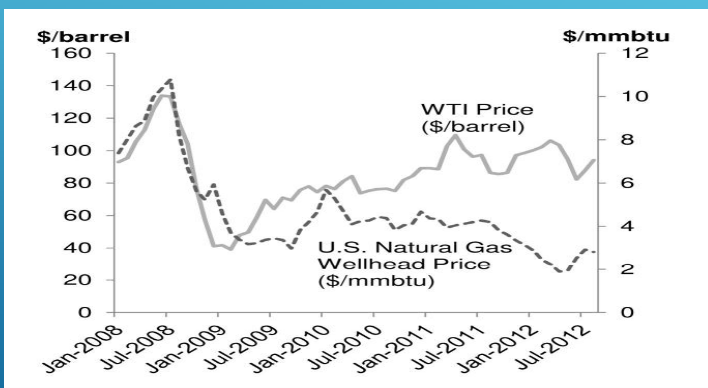
WHY OPEC MATTERS

	1973	2013
World population	4 billion	7 billion
Number of automobiles	250 million	1 billion
World GDP	$5 trillion	$70 trillion
Global oil demand	55 mbd	88 mbd
OPEC production	30 mbd	30 mbd
Share of global supply	54%	33%
Price per barrel (2012 $)	$13	$100

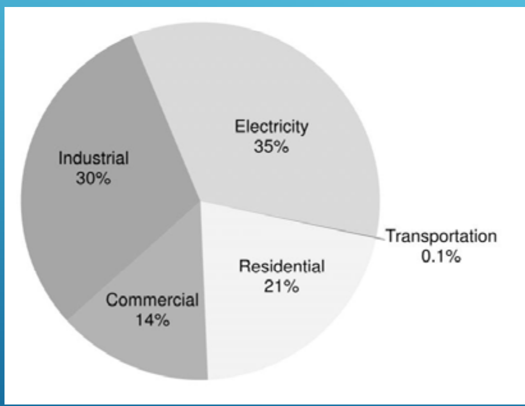
SAUDI ARABIA'S FISCAL BREAKEVEN OIL PRICE

Year	2005	2010	2015	2020	2025	2030
Oil production (mbd)	9.4	8.2	9.3	10	10.7	11.5
Oil exports (mbd)	7.5	5.8	6.3	6	5.6	4.9
Domestic consumption (mbd)	1.9	2.4	3.1	3.9	5.1	6.5
Total revenues (SR billion)	564	735	843	961	1,108	1,120
Total expenditures (SR billion)	346	627	893	1,147	1,620	2,453
Balance	218	109	-50	-186	-512	-1,334
Saudi Arabia Monetary Agency's net foreign assets	564	1,652	1,958	1,331	375	375
Domestic debt	475	167	167	167	949	5,889
Breakeven oil price	$30.3	$71.6	$90.7	$118.5	$175.1	$321.7

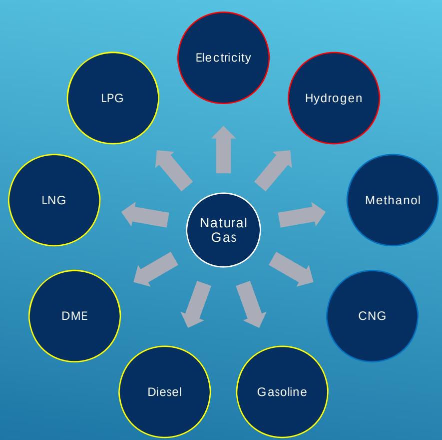
OIL VS NATURAL GAS PRICES



NATURAL GAS DEMAND BY SECTOR



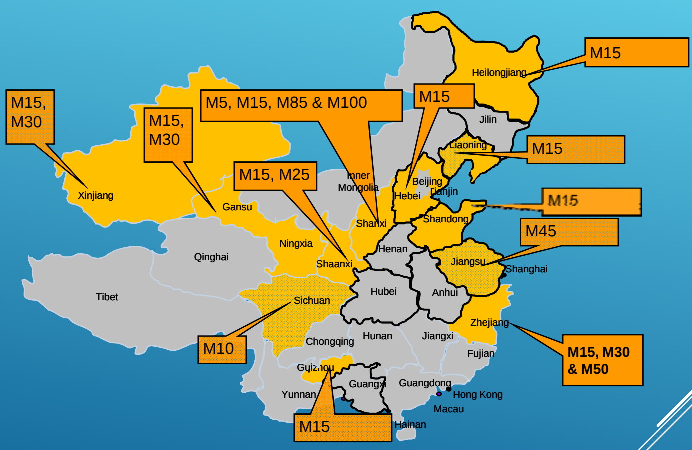
NATURAL GAS USES IN TRANSPORTATION



MARKET PENETRATION OF ELECTRIC VEHICLES

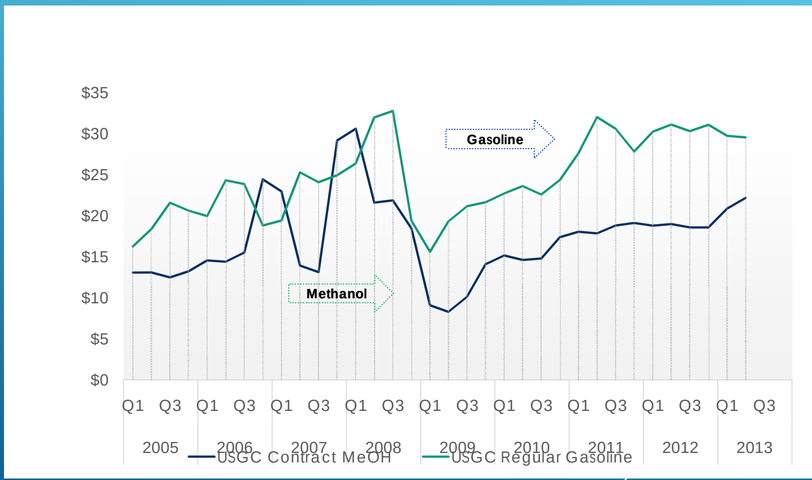
Study	Projection
U.S. National Academy of Sciences (2010)	3% of sales by 2015 and 15% by 2035
Credit Suisse (2009)	7.9% of sales by 2030
US Energy Information Administration (2011)	1.8% of sales in 2020 and 3.8% by 2035
IHS Global Insight (2010)	20% of sales in 2030
Roland Berger Strategy Consultants (2012)	2.2%-8.2% of sales by 2020
The Boston Consulting Group, (2010)	5% of sales by 2020
Deloitte, (2010)	3.1% of sales by 2020

METHANOL PROLIFERATION IN CHINA

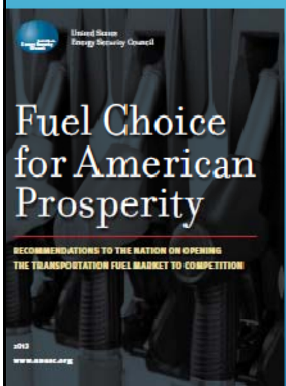


Source: Methanex, China PDRC's, Shanxi Methanol office

METHANOL VS GASOLINE $/MMBTU



USESC RECOMMENDATION



Form a U.S.-China-Brazil Alcohol Fuels Initiative to advance cooperation of the three major alcohol producing countries in all matters related to alcohol fuel blending and to engage with other countries who are planning to introduce alcohol fuels programs.
Activities under the alcohol fuels initiative will include joint standards and development, joint pilots and demonstrations, joint technical roadmaps, fueling infrastructure development, environmental studies, public awareness and engagement.
The initiative can be expanded to include other countries with robust alcohol fuels programs.

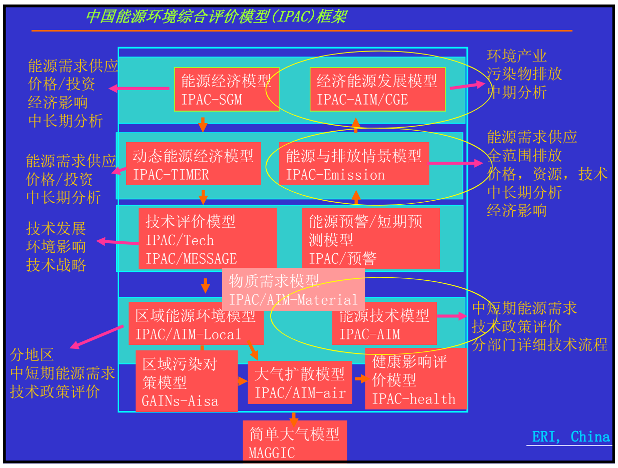
2025年之前实现CO2排放峰值

能源预测与煤炭消费总量控制

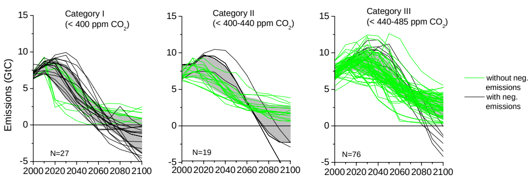
姜克隽

发改委能源研究所
kjiang@eri.org.cn

ERI, China

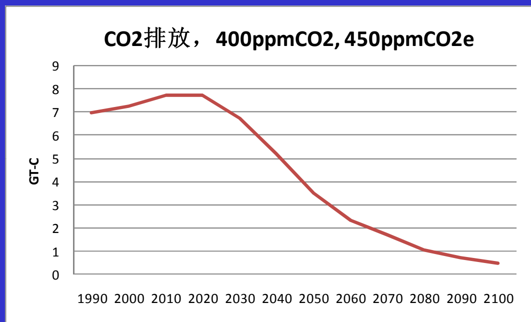


Keyword: Transition – mitigation to reach some climate change targets

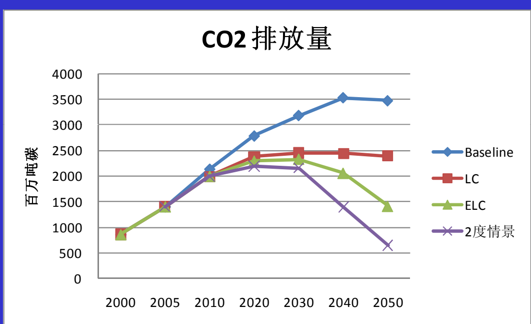


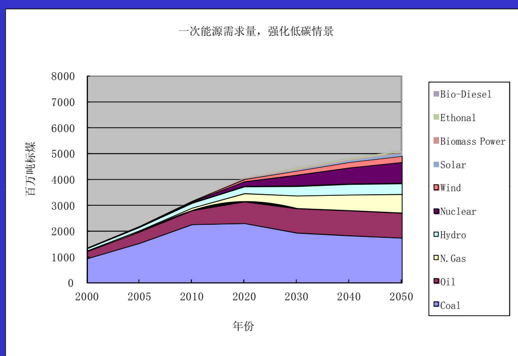
ipcc

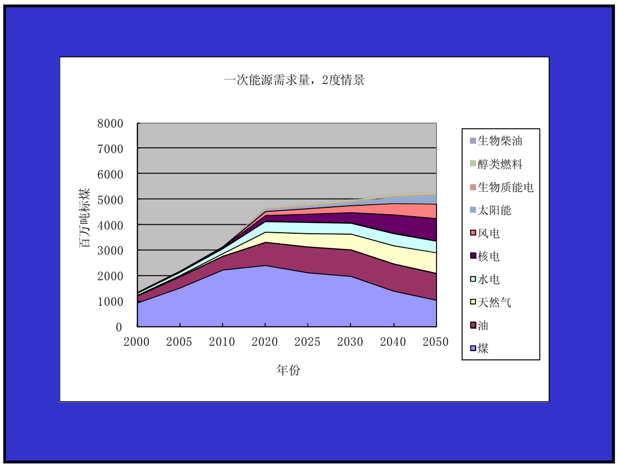
2度目标，IPAC情景，最为推迟实现全球峰值的情景

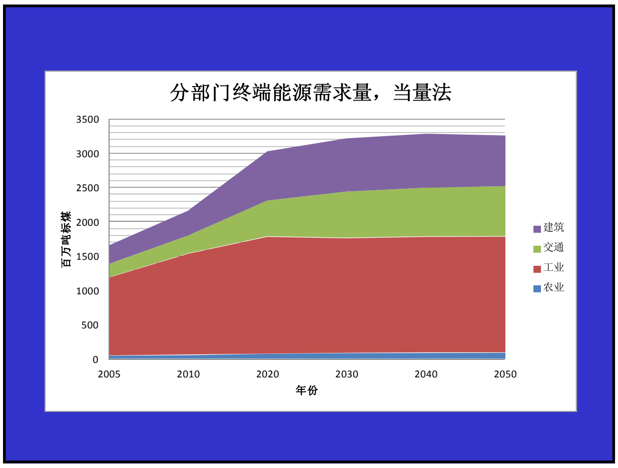


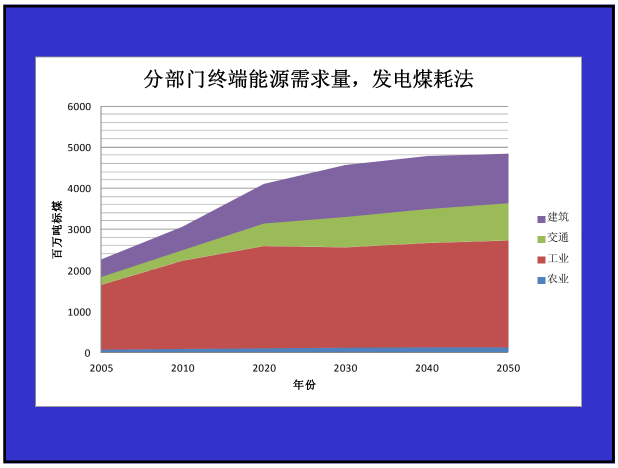
强化低碳情景： 2050年回到2005年排放水平上， 2度情景，2020年之后发生变化，2025年之前达到峰值。 目前正在利用模型研究2度情景的可行性






一次能源需求量，2度情景
百万吨标煤
8000
7000
6000
5000
4000
3000
2000
1000
0
2000 2005 2010 2020 2025 2030 2040 2050
年份
生物柴油
醇类燃料
生物质能电
太阳能
风电
核电
水电
天然气
油
煤


分部门终端能源需求量，当量法
百万吨标煤
3500
3000
2500
2000
1500
1000
500
0
2005 2010 2020 2030 2040 2050
年份
建筑
交通
工业
农业


分部门终端能源需求量，发电煤耗法
百万吨标煤
6000
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4000
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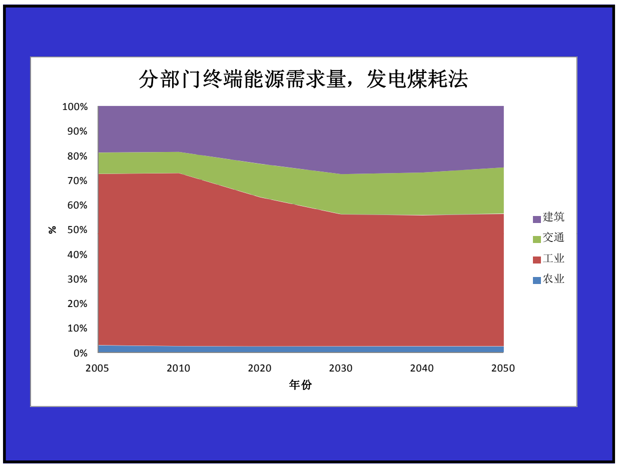
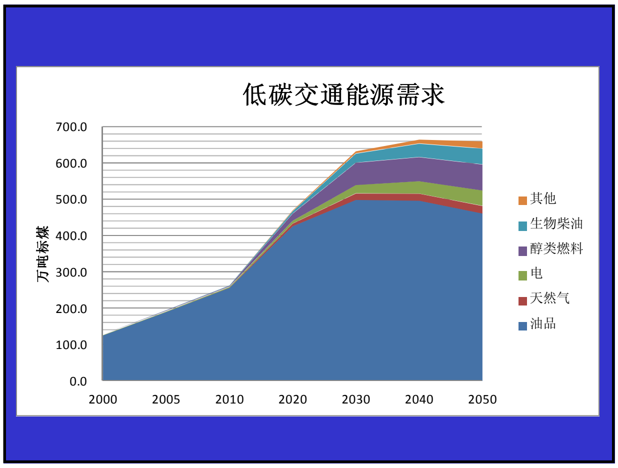
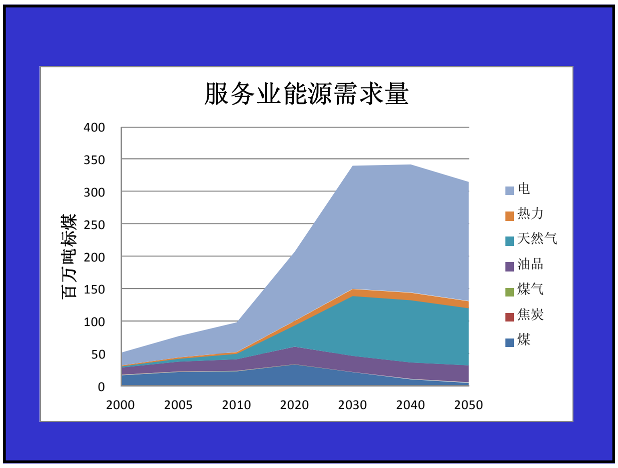
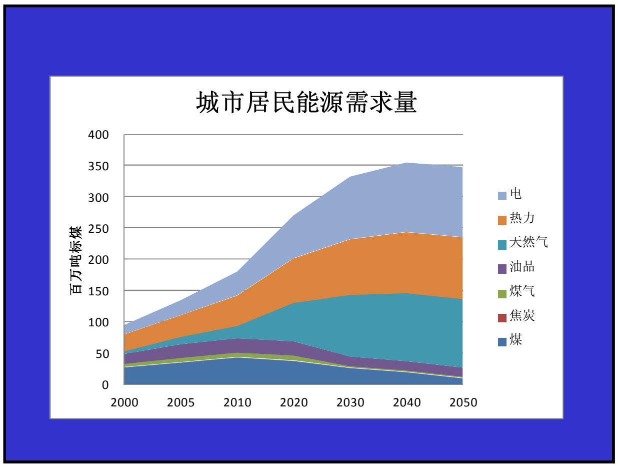
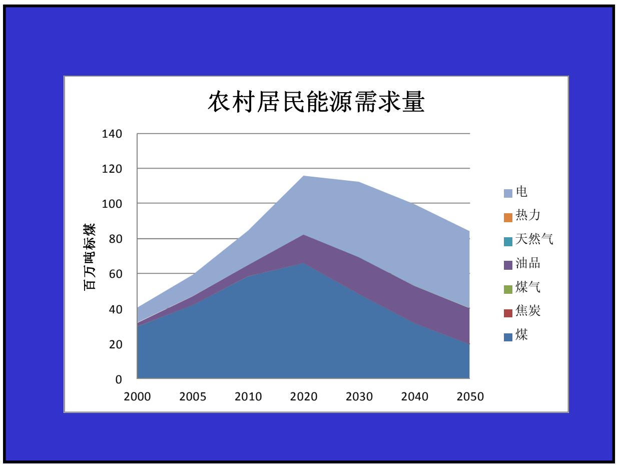
2005 2010 2020 2030 2040 2050
年份
建筑
交通
工业
农业

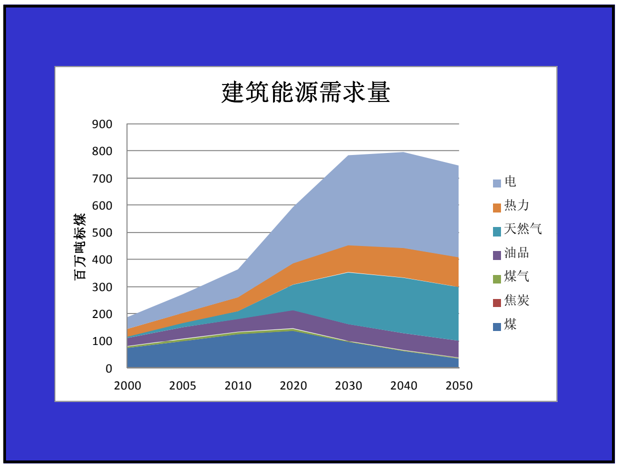

分部门终端能源需求量，发电煤耗法
%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2005 2010 2020 2030 2040 2050
年份
建筑
交通
工业
农业

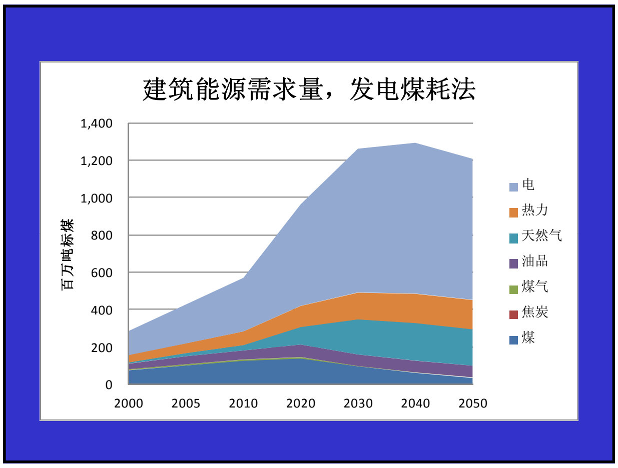

低碳交通能源需求
万吨标煤
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
2000 2005 2010 2020 2030 2040 2050
其他
生物柴油
醇类燃料
电
天然气
油品

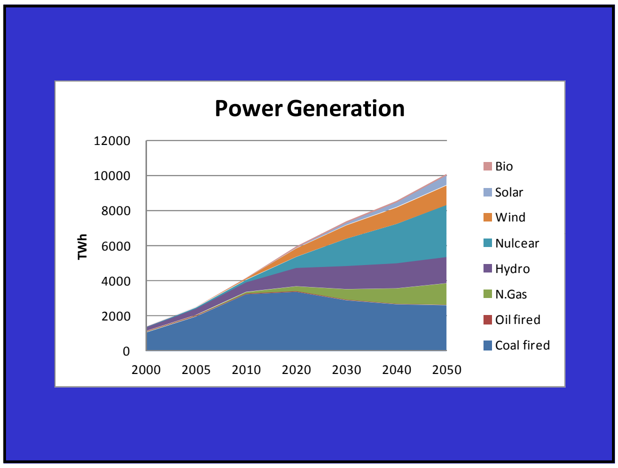

服务业能源需求量
百万吨标煤
400
350
300
250
200
150
100
50
0
2000 2005 2010 2020 2030 2040 2050
电
热力
天然气
油品
煤气
焦炭
煤

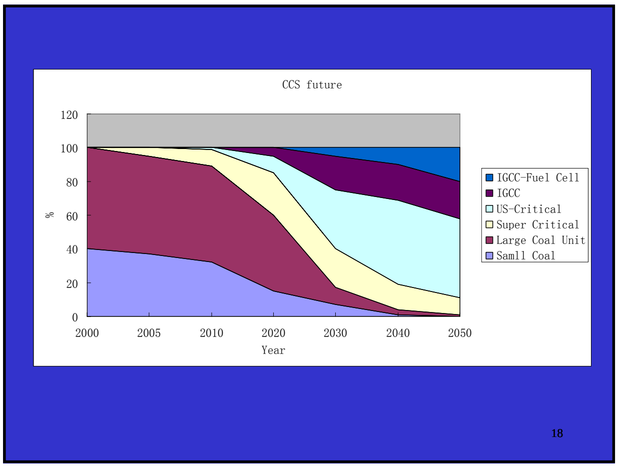

城市居民能源需求量
百万吨标煤
400
350
300
250
200
150
100
50
0
2000
2005
2010
2020
2030
2040
2050
电
热力
天然气
油品
煤气
焦炭
煤

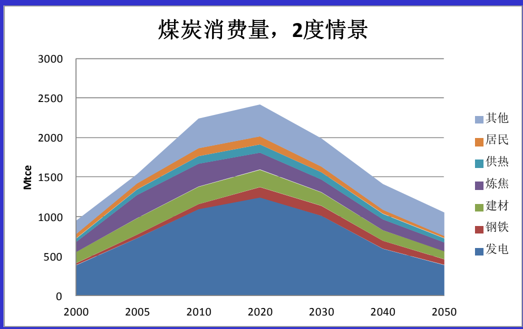

农村居民能源需求量
百万吨标煤
140
120
100
80
60
40
20
0
2000
2005
2010
2020
2030
2040
2050
电
热力
天然气
油品
煤气
焦炭
煤

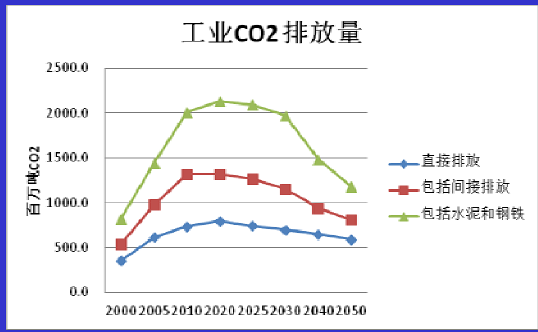

建筑能源需求量
百万吨标煤
900
800
700
600
500
400
300
200
100
0
2000
2005
2010
2020
2030
2040
2050
电
热力
天然气
油品
煤气
焦炭
煤


建筑能源需求量，发电煤耗法
百万吨标煤
1,400
1,200
1,000
800
600
400
200
0
2000
2005
2010
2020
2030
2040
2050
电
热力
天然气
油品
煤气
焦炭
煤


Power Generation
TWh
12000
10000
8000
6000
4000
2000
0
2000
2005
2010
2020
2030
2040
2050
Bio
Solar
Wind
Nulcear
Hydro
N.Gas
Oil fired
Coal fired


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
Saml1 Coal
18





温室气体减排和能源系统

- 能源活动的温室气体排放占据全部排放的70%左右。
- 温室气体减排成为对能源系统产生重大影响的最为核心的因素
- 分析未来能源发展，必须要分析温室气体减排的约束

实现峰值的主要因素

调整经济结构: 肯定调整了，已经开始，更多是被动的

强化节能：节能技术已经很成熟，一些技术进展迅速

可再生能源： 发展速度快速，到2020年可以成为新增能源需求的重要组成部分

核电： 仍然具有大规模发展的潜力

CCS： 争论存在，技术不断进展，***需要战略确认***

低碳生活方式和消费：已经为公众所接受，但是不让人满意

中国的责任：我们必须要做，全球2度升温目标的要求。2011年中国能源和水泥CO2排放占全球28.4%。

高耗能产品产量研究方法

过去两年中，模型组花了大量精力分析

- 行业研究数据
- CGE模型研究方法：钢铁，水泥
- 实物量投入产出分析方法：分析我国的需求，包括国内和出口需求，衣、食、住、行、进出口、设备、消费品、基础设施（道路、铁路、机场、建筑、大坝等）
- 基本 结论：主要高耗能产品产量在2013-2015年达到峰值

天然气规划

- 2015年天然气2600亿立方米
- 预计2030年达到4500亿立方米
- 相当于新增2015年新增能源1.6亿吨标煤（考虑效率的话，2.2亿吨），2020年新增能源4.8亿吨

可再生能源可以有巨大发展潜力

可再生能源和核电的发展为进一步减排温室气体提供大量机会。按照目前展望，2050年风电装机会达到4-5亿千瓦字左右，核电4到5亿千瓦，水电4到5亿千瓦，太阳能3到5亿千瓦，占据发电装机容量的55%以上。与基准情景相比，2030年减排贡献会在2到3亿吨碳，2050年3到8亿吨碳

目前看来, 可再生能源可以发展的更快, 2020年风电2亿-3亿千瓦, 太阳能发电2000万-8000万千瓦。如果达到高值，可再生能源发电量达到1.8万亿kWh，核电5800亿kWh，占2020年发电量32-35%左右。

2013年1月24日，国家能源局宣布2015年PV的装机目标从2000万千瓦提高到3500万千瓦

2013年能源工作会议决定2013年新增风电装机1800万千瓦

可再生能源可以有巨大发展潜力

2012年11月份，国家电网宣布6MW以下PV将免费接入电网，个人家庭PV也包括在内

2011年初, 风机成本下降到3200元/kW, 光伏发电为15000元/kW

如果考虑天然气发电和核电增长，电力部门有可能在2020年实现CO2排放峰值

全球大规模减排可以促进我国经济发展：到2012年中国技术竞争性已经在全球处于领先

- 在大部分的低碳相关技术方面, 技术水平中国已经处于世界领先
- 将是未来我国出口增长的主要因素
- 欧盟、美国已经感到威胁: 双反, 印度也将加入
- 中国越来越重要, 中国的选择会对全球的未来走向产生重大影响: 核电, 电动汽车, 可再生能源, 高铁等
- 全球的主要技术来自于少数几个国家和地区，因此未来国际合作这些国家和地区很重要：美国、欧盟、中国、日本、韩国、澳大利亚等

GDP快速发展,可以支持我国实现大幅度减排需要的资金

2005年： 18.3万亿
2010年：40.3 万亿， 年均增长10.9%， 现价年均增长16.7%
预计
2015年：75万亿

2018年：105万亿， 折合美元16.6万亿（汇率6.3元=1美元）， 人均1.2 万美元

2020年：131万亿

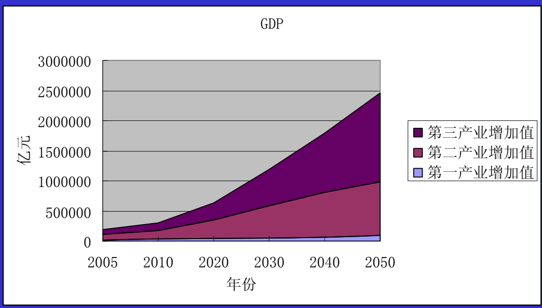
2010年到2020年累计新增 GDP450万亿， 累计GDP860万亿

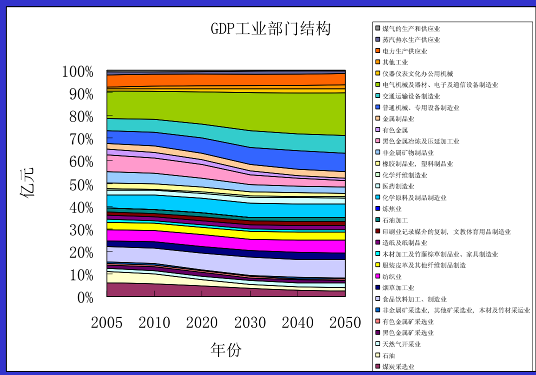
可以为可再生能源、新能源、低碳行业提供更大量投资

- 是我国的支持发展的行业，因此对其投资应该高于其他行业
- 2010年公布2010年到2020年将为新能源行业提供5万亿的投入， 现在看来可以提供20万亿的投入
- 可再生能源和新能源技术成本明显下降

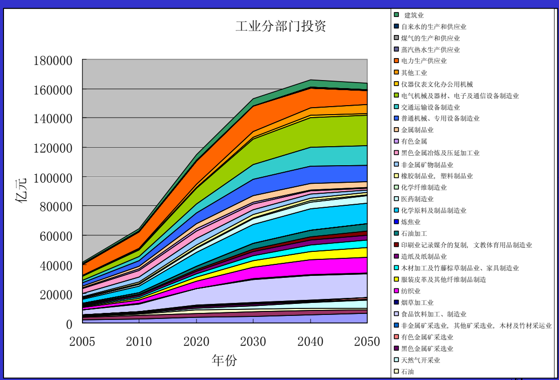
2020年图景

- 天然气: 3600-4600亿立方米，相当于7-9亿吨煤，如果考虑效率，9-12亿吨煤，和2013年相比新增4-6亿吨煤，和6-9亿吨煤
- 风力发电：2.5-3亿千瓦，光伏1亿千瓦，水电3.3亿，核电6000-8000万千瓦，相当于新增5亿吨标煤
- 基本满足2020年之前新增能源需求
- 2020年和2013年相比煤炭消费下降3-8亿吨





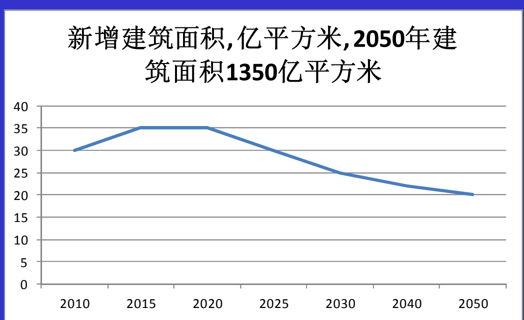
Investment by industrial sectors

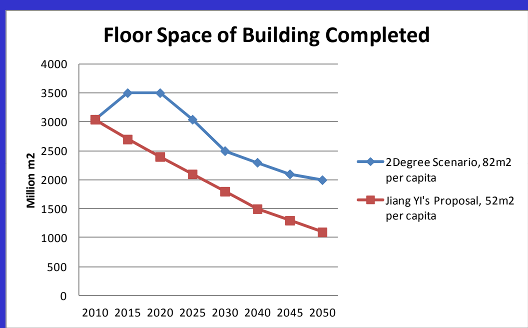


主要高耗能行业发展，2020年之后实现转折

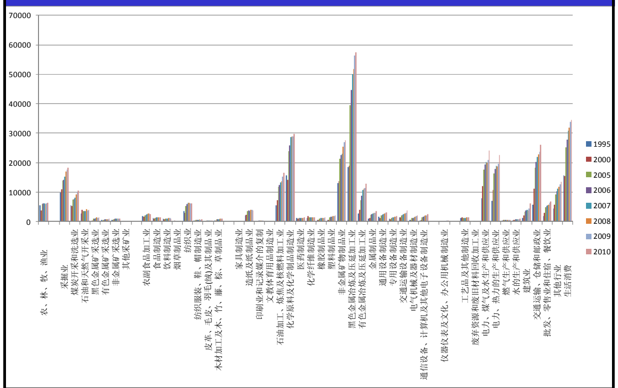
	单位	2005年	2010	2011	2012	2020年	2030年	2040年	2050年
粗钢	亿吨	3.55	6.27	6.83	7.17	6.1	5.7	4.4	3.6
水泥	亿吨	10.6	18.68	20.63	22	16	16	12	9
玻璃	亿重量箱	3.99	5.8	7.38	7.14	6.5	6.9	6.7	5.8
铜	万吨	260	479	518	560	700	700	650	460
电解铝	万吨	851	1695	1806	1966	1600	1600	1500	1200
铅锌	万吨	510		521	969	720	700	650	550
纯碱	万吨	1467		2303	2382.545	2300	2450	2350	2200
烧碱	万吨	1264		2466	2698	2400	2500	2500	2400
纸和纸板	万吨	6205	9270	9930	10500	11000	11500	12000	12000
化肥	万吨	5220		6027		6100	6100	6100	6100
乙烯	万吨	756		1527	1487	3400	3600	3600	3300
合成氨	万吨	4630		5069	5423.83	5000	5000	5000	4500
电石	万吨	850		1737		1000	800	700	400

根据2011年之前的发展速度， 现在看来2012-2015年就可以实现峰值， 2012年的数字，已经显示出这种趋势





分部门能源消费量，工业占据2000-2010年新增能源的70%，五个高耗能工业部门占据49%



2013年发电展望

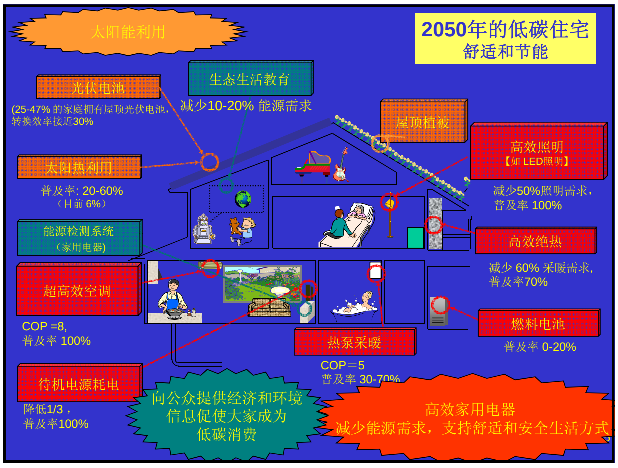
	装机	发电小时	发电量
	万千瓦		亿度
风电	1800	2000	360
光伏	1000	1300	130
水电	2100	3500	735
生物质能	200	5000	100
核电	600	7300	438
天然气	1500	4500	675
合计	7200		2438

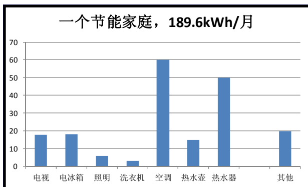
工业部门，主要产品单耗，低碳情景，2025年-2030年达到当时世界先进水平

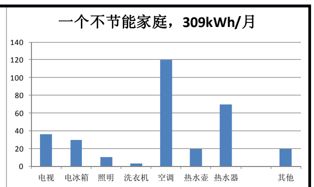
产品	单位	2005	2020	2030	2040	2050
钢铁	Kgce/t	760	650	564	554	545
水泥	Kgce/t	132	101	86	81	77
玻璃	Kgce/重量箱	24	18	14.5	13.8	13.1
砖瓦	Kgce/万块	685	466	433	421	408
合成氨	Kgce/t	1645	1328	1189	1141	1096
乙烯	Kgce/t	1092	796	713	693	672
纯碱	Kgce/t	340	310	290	284	279
烧碱	Kgce/t	1410	990	890	868	851
电石	Kgce/t	1482	1304	1215	1201	1193
铜	Kgce/t	1273	1063	931	877	827
铝	kWh/t	14320	12870	12170	11923	11877
造纸	Kgce/t	1047	840	761	721	686
火电	Gce/kWh	350	305	287	274	264

城市居民参数: 2030之前达到目前发达国家生活水平
在实现大康生活水平情况下，可以比发达国家现在的人均生活能耗低很多

服务	单位	服务 2020	2030	2050
居民户数，百万户		288	336	380
采暖比例		42%	44%	48%
采暖强度指数，2000=1		1.35	1.5	1.6
采暖时间指数，2000=1		1.33	1.36	1.4
50%采暖节能建筑比例		20%	45%	65%
百户空调拥有量		130	180	260
空调强度指数，2000=1		1.3	1.4	1.6
空调利用时间指数，2000=1		1.6	1.8	2.2
冰箱拥有率	每百户	100	120	130
冰箱平均容量	升	250	310	390
冰箱效率		0.8kWh/天	0.8kWh/天	0.7kWh/天
洗衣机拥有率		100	100	100
每周洗衣机利用次数		5．4	8	8
电视机拥有率		180	220	290
电视机平均功率		320W	300W	280
每台电视机每天观看时间		3.5	3.2	2.9
照明节能灯普及率		100%	100%	100%
每户照明灯数（40W荧光灯标准照度）	个	14	21	27
热水器拥有率		100%	100%	100%
太阳能热水器拥有率		18%	25%	33%
百户电炊具拥有率		130	140	260
电炊具每天利用时间		12 分钟	30 分钟	50 分钟
其他家电容量		1500W	1800W	2300W
其他家电每天利用时间		50 分钟	80 分钟	100 分钟





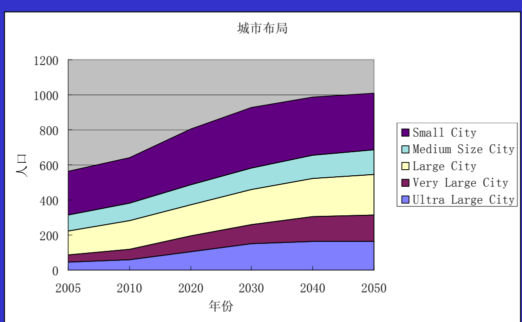


	Hours	W	kWh/Day	Days	每月电耗
电视	4	160	0.64	330	17.6
电冰箱			0.6	30	18
照明	5	40	0.2	30	6
洗衣机			0.1	30	3
空调	8	500	4	15	60
热水壶	0.5	1000	0.5	30	15
热水器	1	2000	2	25	50
其他	1	1000	1	20	20
					189.6

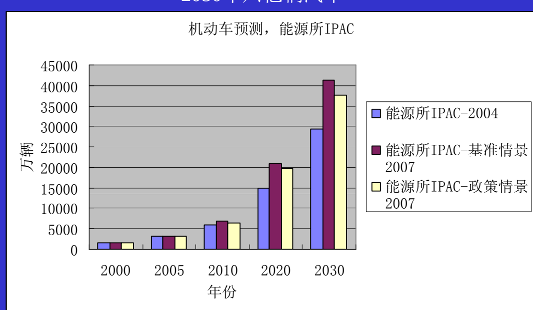
	Hours	W	kWh/Day	Days	每月电耗
电视	4	330	1.32	330	36.3
电冰箱			1	30	30
照明	5	70	0.35	30	10.5
洗衣机			0.1	30	3
空调	8	1000	8	15	120
热水壶	0.5	1300	0.65	30	19.5
热水器	1	2800	2.8	25	70
其他	1	1000	1	20	20
					309.3

交通部门，低碳情景

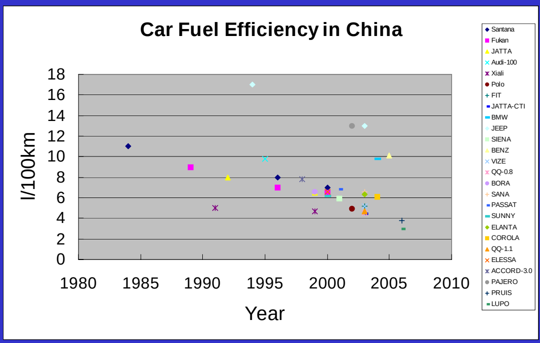
		2005	2010	2020	2030	2040	2050
每百户私人汽车保有量	城市	3.37	14	36	65	77	78
	农村	0.08	0.2	8	38	70	90
私人汽车年行驶里程		9500	9500	9300	8550	8100	7220
私人小轿车发动机平均容量		1.7	1.6	1.6	1.6	1.5	1.4
小轿车百公里油耗		9.2	8.9	7.1	5.5	4.1	3.3
城市轨道公共交通客运周转量比重		0.011	0.016	0.025	0.052	0.13	0.26
生物燃料占燃油的比例		1.10%	1.30%	4.1%	7.70%	12%	13%
电动汽车占小汽车比例		0%	0.12%	3.2%	8.90%	17.4%	28.7%
氢燃料汽车比例		0%	0%	0.80%	3.70%	16.70%	27.50%



2050年六亿辆汽车



排放标准达到国六，城市机动车达到国际水平不会加重本地污染，但需要强化政策支持，控制出行



中国如何做到低碳排放

- CCS技术成为中国进一步减排的重要技术。
- 2050年中国仍然消费18亿吨煤炭，CCS必须使用
- CCS将是一个长期技术，负排放技术
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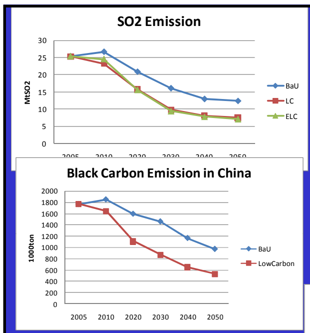
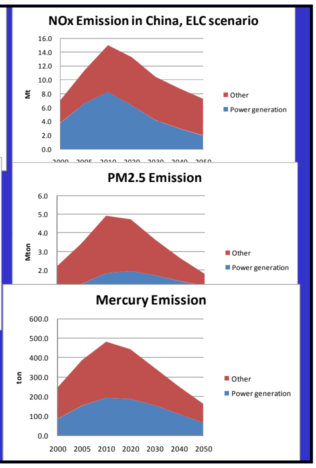


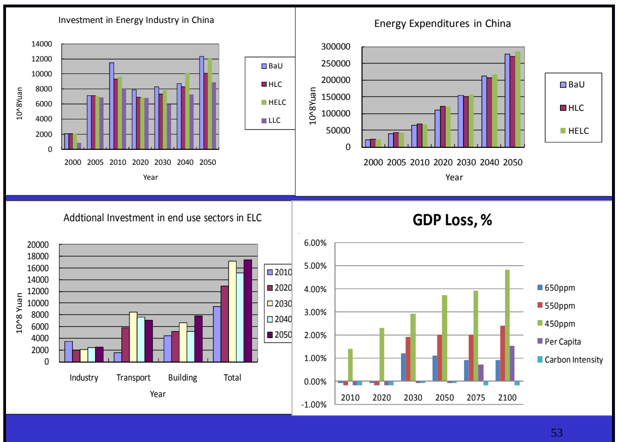


减排CO2与减排本地污染非常一致

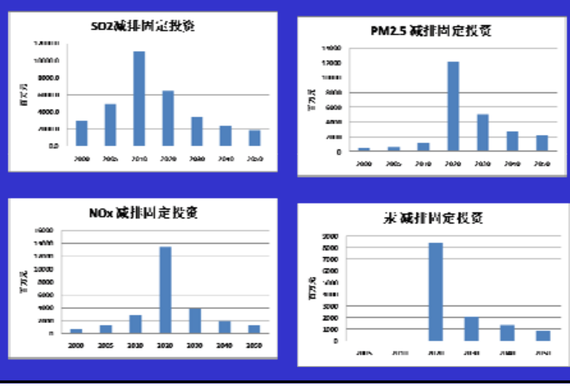
贡献生态文明建设
美丽中国

By 2020, Wind 200GW to 250GW, Solar 50WG

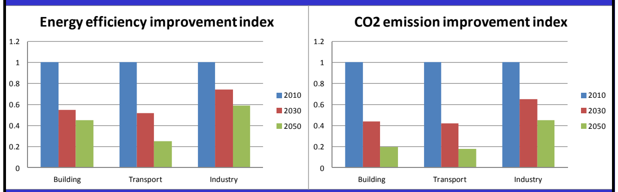
Price: US$38000
Subsidy: US$15000(Shanghai), no need to apply number plate(cost US$10000)
US$18000(Beijing), no need to apply number plate(By Oct. 2012, 1.1 million people apply for 20000number plates per month),



Fixed Investment for Pollution Control, million yuan

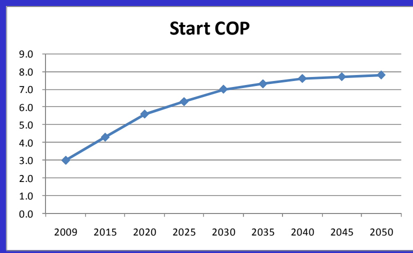


What is the role of technologies in the mitigation?



Policy roadmap: Super high efficiency air conditioner

- Efficiency Standard: COP, MEPS
- Government Planning
- Subsidy



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四、影响电动汽车发展的主要制约因素分析

4. Analysis Major Constraints Factors

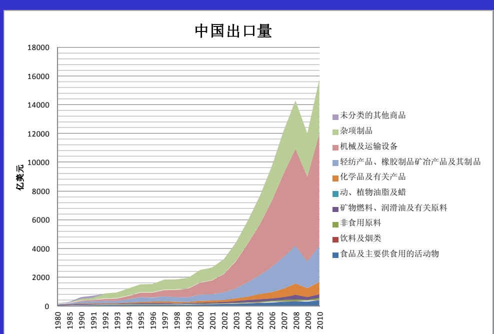
- 3.3 电动汽车实现经济性的趋势分析 Trend Analysis on EVs

电动汽车与先进汽油和柴油车成本变化趋势分析					
	2006-2010	2011-2015	2016-2020	2021-2025	2026-2030
电动汽车EVs					
电池充满电时总容量kWh	16	24	48	80	112
电力销售价格（元/kWh）	0.48	0.60	0.75	0.94	1.18
单位里程耗电量（kWh/km）	0.18	0.13	0.08	0.08	0.07
单位里程耗电费用（yuan/km）	0.09	0.08	0.06	0.08	0.08
电动汽车燃料成本（yuan/car）	43200	39067	30104	37694	41299
单位电池容量成本(USD/kWh)	750	375	130	75	30
EVs车电池组成本(yuan/car)	80400	60300	41808	40200	22512
电池组寿命（年）	3.6	5	11	22	22
电池组更换次数（set/year)	4.1	2.8	1.4	0.7	0.7
EVs全寿期电池成本（yuan/car）	413256	226728	99503	67938	38045
EVs全寿期电耗和电池总成本（yuan/car）	456456	265795	129607	105632	79345
每年费用（yuan/car）	30430	17720	8640	7042	5290
先进汽油汽车ICE					
汽油销售价格（yuan/liter)	6.6	8.5	10.2	11.0	11.8
柴油销售价格（yuan/liter)	6.4	8.3	9.9	10.6	11.4
单位里程耗汽油（L/km）	0.050	0.039	0.031	0.024	0.020
单位里程耗柴油（L/km）	0.047	0.038	0.030	0.024	0.020
全寿期行驶里程（km)	500000	500000	500000	500000	500000
先进汽油车燃料成本（yuan/car）	165000	167550	158356	133574	117738
先进柴油车燃料成本（yuan/car）	150400	155333	149317	128100	114170
每年费用	11000	11170	10557	8905	7849
比较（EVs年费用－ICE年费用）	291456	98245	-28749	-27941	-38394

中国的关键低碳技术 28种关键技术

No.	部门	技术	描述	注
1	工业技术	高效设备	先进高效锅炉、窑炉，高效工艺设备，高效电机，余热回收技术	大量市场化，但需要新型先进技术
2		新型水泥、钢铁制造技术		
3		CCS	水泥、钢铁、化工行业	
4	交通	超高效柴油汽车	先进柴油混合动力	
5		先进电动汽车		
6		燃料电池汽车		
7		高效飞机	30%以上能效提高	
8		生物燃料飞机		
9	建筑	超高效空调	COP〉7	
10		LED照明		
11		户用可再生能源	太阳光伏/风能/热水器/采暖	
12		热泵		已经成熟
13		高绝热建筑		已经成熟
14		高效电器		2020年之前成熟
15	发电	IGCC/多联产	效率大于55%	
16		IGCC/燃料电池	效率大于60%	
17		陆地风电		Mature
18		近海风力田		Mature before 2020
19		太阳光伏发电		
20		太阳能热发电		
21		先进核电技术		
22		先进NGCC	效率大于65%	
23		生物质能IGCC		
24		CCS		
25	替代燃料	纤维素乙醇		
26		生物柴油	汽车、船舶、飞机	
27	电网	智能电网		
28	循环利用技术		可回收建材，低耗材	

历年出口货物分类金额



近两年中国技术进步和技术出口

- 风机和太阳能光伏技术：基本自主产权，常规技术水平世界领先
- 工业制造技术：普遍世界领先，燃煤发电，水泥生产设备，钢铁生产设备，环保设备等。
- 2011年，水泥装备出口占全球市场45%，水泥厂设计服务占85%
- 2012年预计出口2300万千瓦发电装备，占全球新增燃煤电站的40-80%，不包括中国
- 2011年机电出口占全国出口比重大于50%
- 2012年5月中国风电技术出口欧洲

- 近期美国欧盟，以及印度对中国低碳技术的贸易壁垒间接说明我国技术在全球的竞争性

明确的强有力的气候变化政策，可以大力促进我国在全球的技术竞争性，实现我国国家创新战略的实现
没有这样的战略信号，我的下一代新技术非常让人担心

- 40%光电效率的PV在我国没有研究，美国和日本已经研制出来
- 低碳建筑相关技术在我国还非常缺乏
- 新的工业生产工艺和技术，我国关注还很不够
- 总体来讲，现有已经看到市场的低碳技术，我国已经领先，但是下一代低碳技术，在我国还很薄弱，就是因为我国减排政策滞后

结论，90%信度

- 由于这几年高耗能工业快速发展，高耗能工业很可能在12五期间实现产量峰值，中国能源需求增长速度将明显放慢
- 考虑可再生能源、核电、天然气发展，以及技术进步，我国在2020年到2025年实现排放峰值有不小的可能性
- 也是我国的可持续发展的迫切需要
- 经济规模足以支持低碳发展
- 新的技术，如CCS，有可能使我们走得更远
- 2050年关闭2亿千瓦燃煤装机可能性存在

未来气候变化的战略

- 大规模促进低碳发展，制定强有力的减排目标
- 对于先进省市，2015年-2020年实现排放峰值（北京2015年）
- 全面的低碳战略，目前土地利用/农业基本没有行动
- 国际合作更加积极主动，和欧盟一起起到引领作用
- 促进全球的低碳发展，为中国技术扩大市场
- 我国的谈判对策要全面转变立场，进入积极推动全球减排的阶段，助力我国成为全球社会经济环境发展的引领者

我国发展需要更加良好的环境：中国引领全球气候变化

- 未来10年中国将有10-20万亿国外投资，中国经济和国际融合将发生明显变化，需要良好国际环境
- 中国技术创新需要更多机会和国际环境
- 全面促进国内可持续发展：低碳和其他环境问题的协同
- 创立更好的国际形象

IPAC模型组研究人员

姜克隽，胡秀莲，庄幸，苗韧，安琪，贺晨旻，刘嘉，朱松丽，刘强，高霁，杨蕾，魏珣，黄丽雅，徐向阳，张树伟

2009年我国主要产品产量几占世界的比例

一、基础工业数据：

1、 粗钢产量：5.68亿吨，占世界份额的46.6%，超过第2-第20名的总和；
2、 钢材产量：6.96亿吨；
3、 水泥产量：16.3亿吨，超过世界份额的50%；
4、电解铝产量：1285万吨，达到世界份额的60%；
5、精炼铜产量；413万吨，达到世界份额的25%；进口430万吨，消费铜超过800万吨，达到世界精铜产量的50%；
6、 煤炭产量：30.50亿吨，占世界份额的45%；
7、 原油产量：1.89亿吨；进口2.04亿吨，消费量占世界份额 的11%；
8、 乙烯产量：1066万吨，世界第二（第一的是美国，与老美还有差距），当量消费2200万吨，自给率约为50%；
9、 化肥产量：6600万吨，占世界份额的35%；
10、 塑料产量：4479.3万吨；

二、基础设施数据：

1、新增装机容量8970万千瓦，总装机容量达到8.6亿千瓦（美国为10亿千瓦）；
2、新建高速公路4719公里，总里程达到6.5万公里（美国9万公里），09年新开工1.6万公里；
3、新增公路通车里程9.8万公里（含高速），农村公路新改建里程38.1万公里；
4、铁路投产新线5557公里，其中客运专线2319公里；投产复线4129公里；营业总里程达8.6万公里（仅次于美国）；09年新开工1.2万公里；

2011年我国主要产品产量几占世界的比例

一、基础工业数据：

1、　粗钢产量：6.95亿吨，全球15.3亿吨，占世界份额的45.5%，出口4000多万吨；

3、　水泥产量：20.85亿吨，超过世界份额的60%；

2009年我国主要产品产量几占世界的比例

三、工业产品数据：

1、　汽车产量1379万辆，占世界份额的25%，世界第一；

2、　造船完工量4243万载重吨，占世界份额的34.8%；新接订单2600万载重吨，占世界份额的61.6%；

手持订单18817万载重吨，占世界份额的38.5%；

3、　微机产量1.82亿台，占世界份额的60%；

4、　彩电产量9899万台，占世界份额的48%；

5、　冰箱产量5930万台，占世界份额的60%；

6、　空调产量8078万台，占世界份额的70%；

7、洗衣机产量4935万台，占世界份额的40%；

8、微波炉产量6038万台，占世界份额的70%；

9、　手机产量6.19亿部，占世界份额的50%；

四、轻工产品：

1、纱产量2393.5万吨，占世界份额的46%；

2、布产量740亿米；

3、化纤产量2730万吨，占世界份额的57%；

其他：

黄金产量：313.98吨，世界第一；

玻璃产量：5.8亿重量箱，占世界份额的50%；

中国如何做到低碳排放

可再生能源和核电的发展为进一步减排温室气体提供大量机会。按照目前展望，2050年风电装机会达到4-5亿千瓦字左右，核电4到5亿千瓦，水电4到5亿千瓦，太阳能3到5亿千瓦，占据发电装机容量的55%以上。与基准情景相比，2030年减排贡献会在2到3亿吨碳，2050年3到8亿吨碳

目前看来, 可再生能源可以发展的更快, 2020年风电2亿-3亿千瓦, 太阳能发电2000万-8000万千瓦。如果达到高值，可再生能源发电量达到1.8万亿kWh，核电5800亿kWh，占2020年发电量32-35%左右。

2011年初, 风机成本下降到3200元/kW, 光伏发电为15000元/kW

如果考虑天然气发电增长，电力部门有可能在2020年实现CO2排放峰值

2011年全球光伏发展

2011年，全球新增太阳能发电装机容量约2800万千瓦，同比新增1100万千瓦，相当于2009年底以前全球太阳能累计装机容量。至2011年底，全球太阳能发电累计装机容量达到6900万千瓦，与2006年底全球累计风电装机规模相当。

欧洲仍是全球太阳能发电市场的重点地区。2011年，欧盟27国新增太阳能发电装机约2100万千瓦，占全球太阳能发电新增装机的75%。其中，意大利新增900万千瓦，居世界第一；德国新增750万千瓦，法国和英国分别为150万千瓦和70万千瓦。

此外，美国和日本的太阳能发电市场保持稳定增长，2011年分别新增装机容量160万千瓦和110万千瓦；印度等新兴市场处于大规模发展前期阶段，年新增装机容量达到30万千瓦。中国2011年新增太阳能发电装机容量约220万千瓦，当年新增量位居世界第三，占全球太阳能发电新增装机的7%左右。

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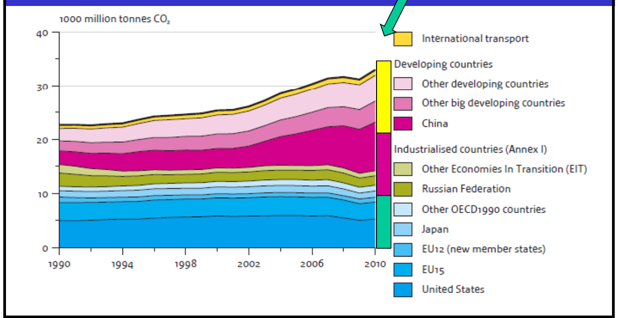
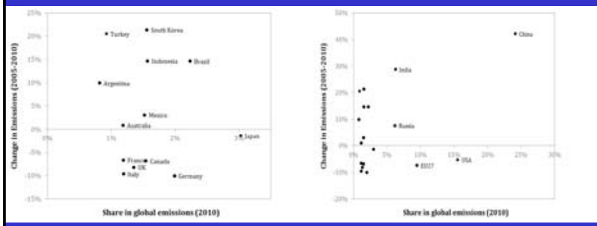
天津泰达在埃及苏伊士运河经济开发区：10平方公里

全球能源活动和水泥生产CO2 排放量
Global CO2 emission from energy and cement manufacture

2020 emission



主要国家占世界排放的比例,以及2005年到2010年的变化



欧盟碳贸易： 航空

- 支持欧盟纳入航空碳贸易
- 这是一个长期趋势
- 免费份额： 欧盟/美国86%，中国/发展中国家115%
- 另外专门额度预留给发展中国家航空公司
- 每张机票价格上涨2-4欧元（现有欧盟价格）
- 促进中国航空公司领先
- 不加入有可能影响上座率（低碳消费）

- 现在看来中国是在欧盟航空碳贸易中唯一的一个损失者

IAMC Members IAMC 成员

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University of Oldenburg
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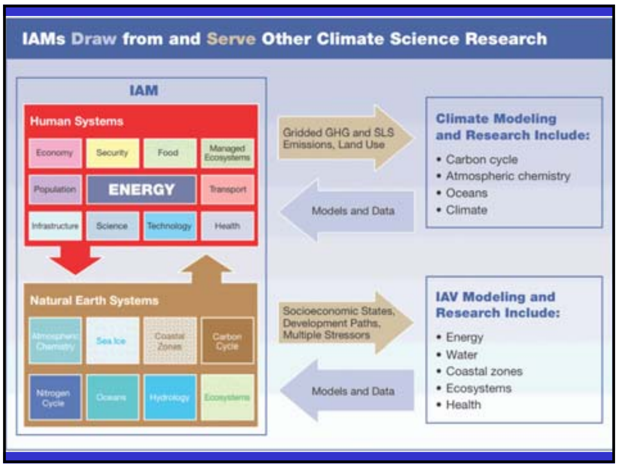
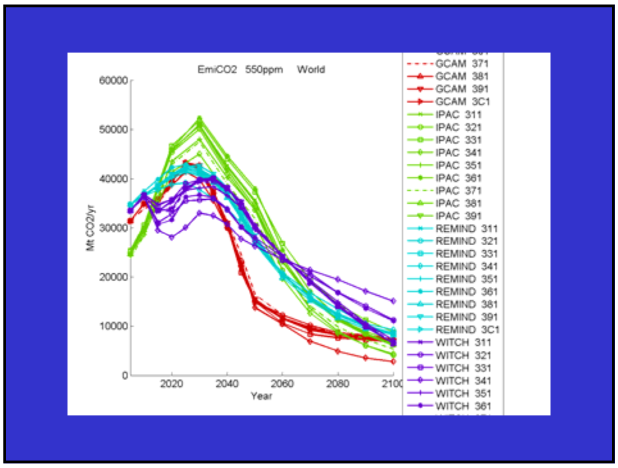
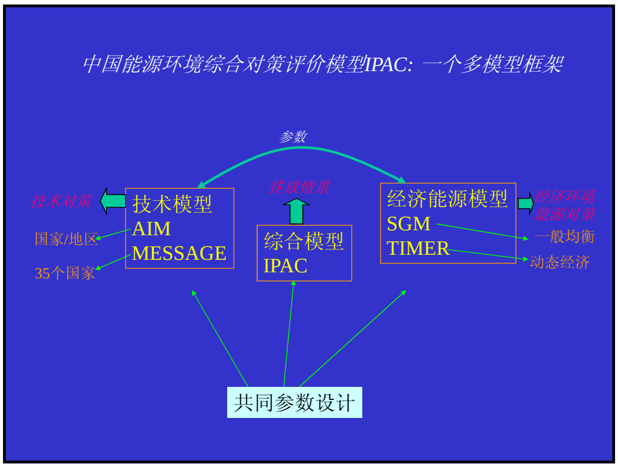
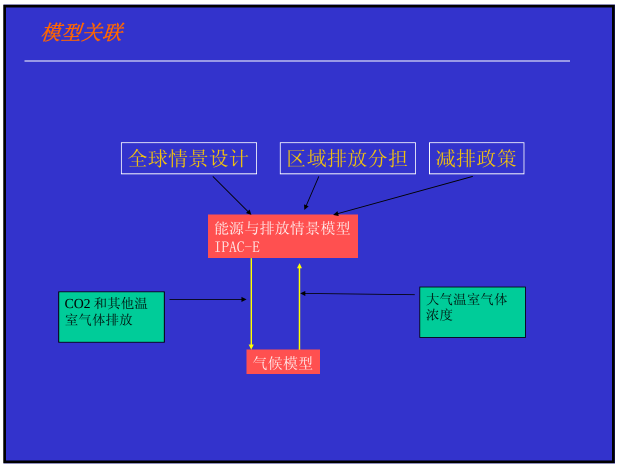
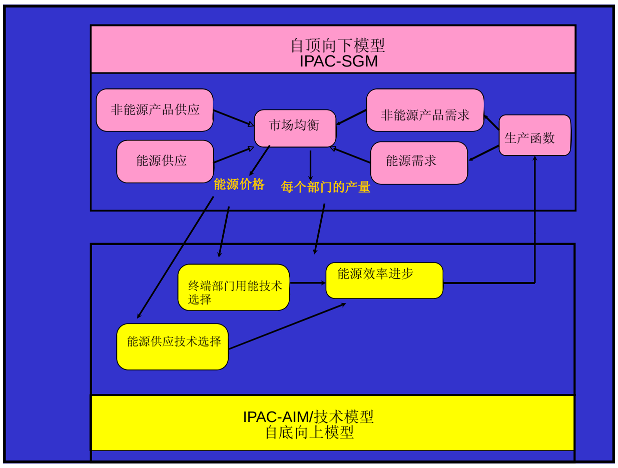
VTT
World Bank

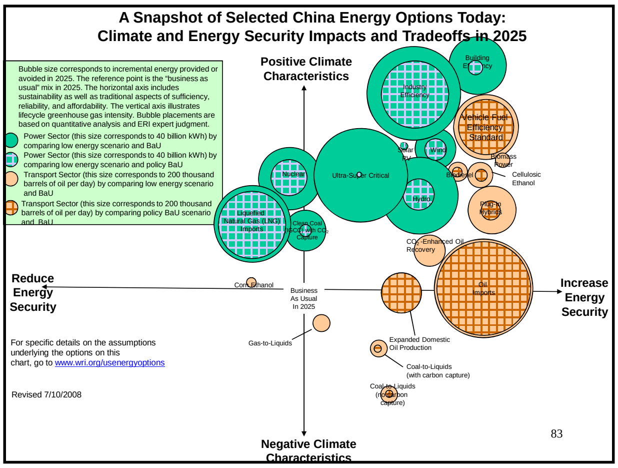


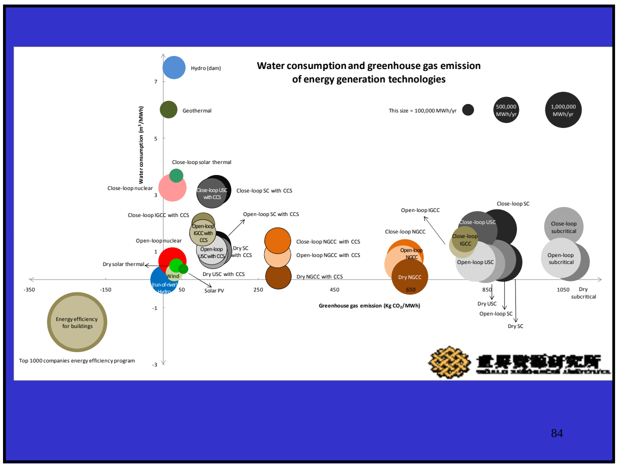

EmiCO2 550ppm World
Mt CO2/yr
Year
GCAM 371
GCAM 381
GCAM 391
GCAM 3C1
IPAC 311
IPAC 321
IPAC 331
IPAC 341
IPAC 351
IPAC 361
IPAC 371
IPAC 381
IPAC 391
REMIND 311
REMIND 321
REMIND 331
REMIND 341
REMIND 351
REMIND 361
REMIND 381
REMIND 391
REMIND 3C1
WITCH 311
WITCH 321
WITCH 331
WITCH 341
WITCH 351
WITCH 361

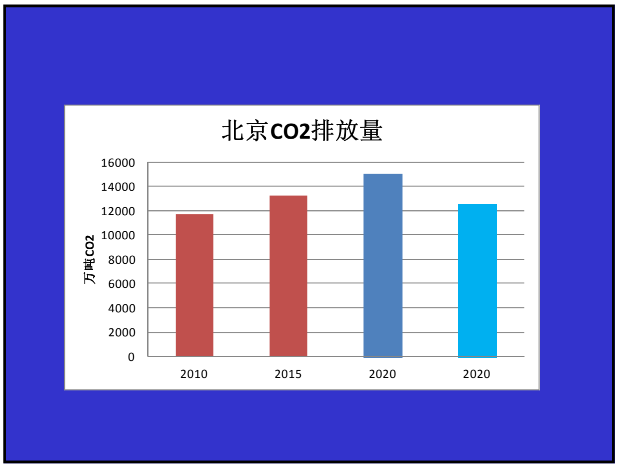

中国能源环境综合对策评价模型IPAC：一个多模型框架
参数
技术对策
国家/地区
35个国家
技术模型
AIM
MESSAGE
排放情景
综合模型
IPAC
经济能源模型
SGM
TIMER
经济环境
能源对策
一般均衡
动态经济
共同参数设计


模型关联
全球情景设计
区域排放分担
减排政策
能源与排放情景模型
IPAC-E
CO2 和其他温室气体排放
大气温室气体浓度
气候模型

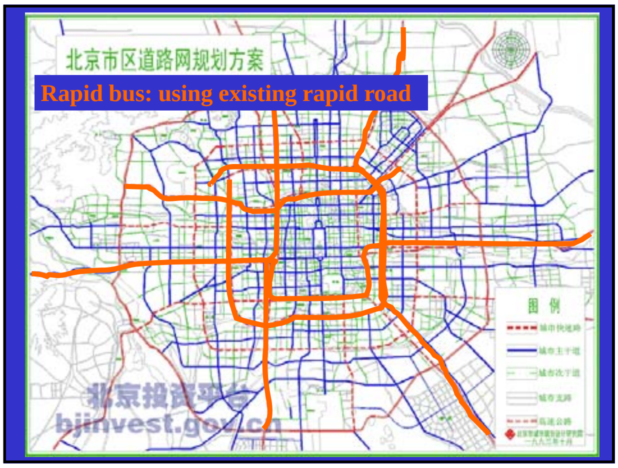

自顶向下模型
IPAC-SGM
非能源产品供应
市场均衡
非能源产品需求
生产函数
能源供应
能源需求
能源价格
每个部门的产量
终端部门用能技术选择
能源效率进步
能源供应技术选择
IPAC-AIM/技术模型
自底向上模型


A Snapshot of Selected China Energy Options Today:
Climate and Energy Security Impacts and Tradeoffs in 2025
Bubble size corresponds to incremental energy provided or avoided in 2025. The reference point is the "business as usual" mix in 2025. The horizontal axis includes sustainability as well as traditional aspects of sufficiency, reliability, and affordability. The vertical axis illustrates lifecycle greenhouse gas intensity. Bubble placements are based on quantitative analysis and ERI expert judgment.
Power Sector (this size corresponds to 40 billion kWh) by comparing low energy scenario and BaU
Power Sector (this size corresponds to 40 billion kWh) by comparing low energy scenario and policy BaU
Transport Sector (this size corresponds to 200 thousand barrels of oil per day) by comparing low energy scenario and BaU
Transport Sector (this size corresponds to 200 thousand barrels of oil per day) by comparing policy BaU scenario and BaU
Positive Climate Characteristics
Negative Climate Characteristics
Reduce Energy Security
Increase Energy Security
Industry Efficiency
Vehicle Fuel Efficiency Standard
Nuclear
Ultra-Super Critical
Wind
Biomass Power
Biodiesel
Cellulosic Ethanol
Hydro
Plug-In Hybrids
Liquefied Natural Gas (LNG) Imports
Clean Coal (IGCC) with CO2 Capture
CO2 -Enhanced Oil Recovery
Oil Imports
Corn Ethanol
Business As Usual In 2025
Gas-to-Liquids
Expanded Domestic Oil Production
Coal-to-Liquids (with carbon capture)
For specific details on the assumptions underlying the options on this chart, go to www.wri.org/usenergyoptions
Revised 7/10/2008
83


Water consumption and greenhouse gas emission of energy generation technologies
Water consumption (m3/MWh)
Greenhouse gas emission (Kg CO2/MWh)
Hydro (dam)
Geothermal
This size = 100,000 MWh/yr
500,000 MWh/yr
1,000,000 MWh/yr
Close-loop solar thermal
Close-loop nuclear
Close-loop USC with CCS
Close-loop SC with CCS
Close-loop IGCC with CCS
Open-loop SC with CCS
Open-loop IGCC with CCS
Open-loop nuclear
Open-loop USC with CCS
Dry SC with CCS
Dry solar thermal
Wind
(run-of-river) Hydro
Dry USC with CCS
Solar PV
Close-loop NGCC with CCS
Open-loop NGCC with CCS
Dry NGCC with CCS
Open-loop IGCC
Close-loop NGCC
Open-loop NGCC
Dry NGCC
Close-loop SC
Close-loop USC
Close-loop IGCC
Open-loop USC
Close-loop subcritical
Open-loop subcritical
Dry subcritical
Dry USC
Open-loop SC
Dry SC
Energy efficiency for buildings
Top 1000 companies energy efficiency program
84


北京CO2排放量
16000
14000
12000
10000
8000
6000
4000
2000
0
万吨CO2
2010
2015
2020
2020


Stockholm: bicycle is coming back


北京市区道路网规划方案
Rapid bus: using existing rapid road
图 例


POWER_BOX by Baosteel
2kW wind
10kW Solar PV

近期进行中研究

- GAINs-Aisa模型
- MESSAGE技术评价模型
- GTEM模型：中澳气候变化合作
- IEA中国2030年能源展望
- IPCC全球情景开发
- 循环经济评价模型
- 北京能源环境对策研究
- 清洁煤发展情景和技术评价
- 全球石油需求和市场分析
- 燃油税实施研究
- 能源税设计和实施研究
- 能源预警模型开发
- 短期能源模型开发(3个月-2年)

近期进行中研究（续）

- IPAC-CGE模型开发
- 节约优先情景研究
- 世行能源情景研究
- 2050低碳发展情景
- 2050低碳社会研究
- 海南省能源规划
- 20%节能目标行业分解
- 进出口产品能源含量分析
- 消费品能源含量/污染物分析
- 煤炭/天然气外部性成本分析
- 主要产品碳含量国际对比
- 部门方法在中国的应用分析
- 2010年后气候变化国际机制研究

近期进行中研究（续）

- 碳税实施机制研究(税务总局)
- 贵阳能源规划
- 区域发展和气候变化政策
- 全球能源转型途径研究
- 全球强化减排途径和成本研究
- 碳交易在电力部门可行性研究
- 中澳碳交易专家对话
- 大唐高井电厂NGCC CHP CCS示范项目研究
- 天津碳交易机制研究
- 建筑部门实现强化减排情景研究
- 交通部门实现强化减排情景研究
- 建筑部门实现强化减排机制顶层设计
- 综合评价模型复杂性机理研究（973课题）
- 大气排放互动性研究（973课题）

页岩气革命对中国能源改革的启示
Shale Gas Revolution and China's Energy Reform

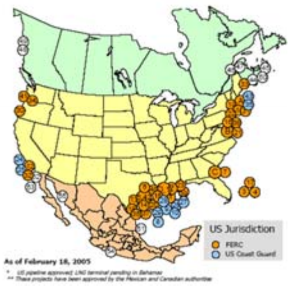
Kevin Jianjun Tu 涂建军



全球能源安全智库论坛 Global Forum on Energy Security
中国北京 Beijing China
August 10-11, 2013

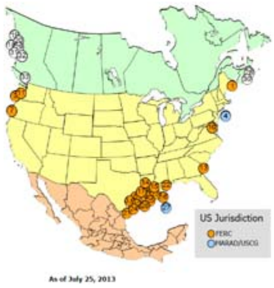
LNG Trade in U.S.: 2005 vs. 2013

LNG Receiving Terminals



February 2005

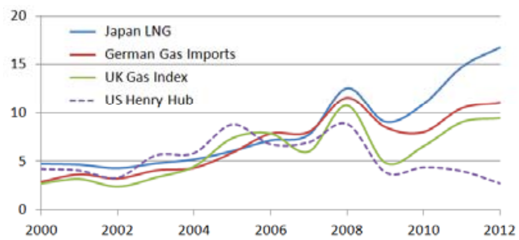
LNG Exporting Projects



July 2013

Price Implications of Shale Gas Revolution

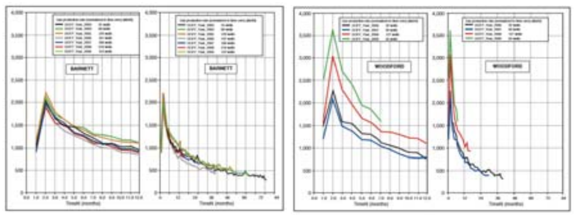
Gas Price ($/MMBtu)



Source: BP

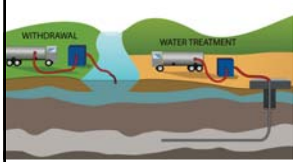
Uncertainty: Production Decline

Barnett First Year and Total Production Rate **Woodford**



Source: The American Oil & Gas Reporter

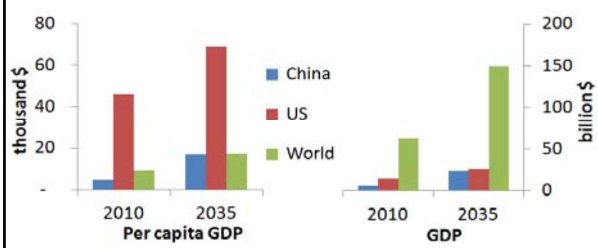
Shale Gas Development in U.S.: Environmental Issues



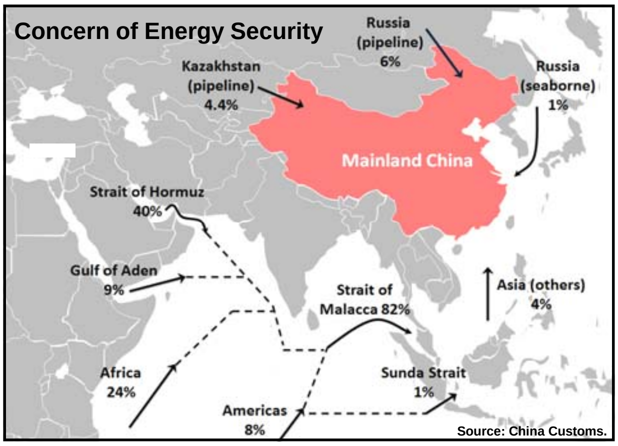
- Prevent well water contamination
- Handling flow back water
- Disclosure of fracturing chemicals
- Minimizing fugitive emissions
- Pad drilling

Source: Vikram Rao (2012) Shale Gas: The Promise and the Peril.

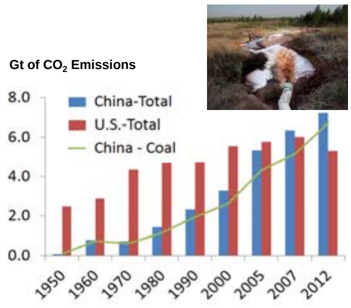
China: A Hybrid Economy at Crossroad



Source: World Bank, IEA, own estimation



Environmental Constraints



Source: US EIA, NBS, ERI, IEA, own estimation.

Shale Gas Potential in China

- Resource is an uncertainty
- Technology is not a big concern in the long run
  - Horizontal drilling
  - Hydraulic fracking
  - Optimization: micro-seismic monitoring
- Geological conditions lead to unique challenges
  - Seismic activities
  - Water availabilities
- Above ground institutional settings

Discussion

- What is energy reform?
- Long-term energy & climate strategy
- Redefining energy security
- Market-oriented instruments that are compatible with China’s national circumstance

Thank You Very Much !

非常感谢！

www.weibo.com/tujianjun

Review The Economy Through Electricity

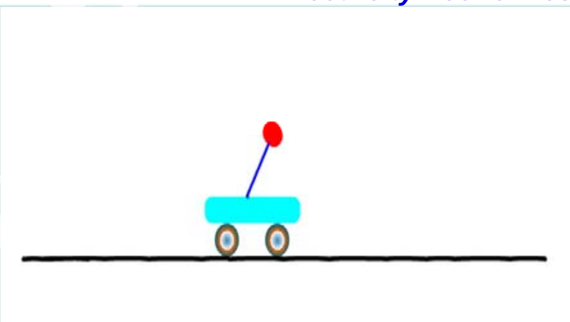
Zhaoguang Hu
State Grid Energy Research Institute
2013.8.10

Is the energy structure sustainable?

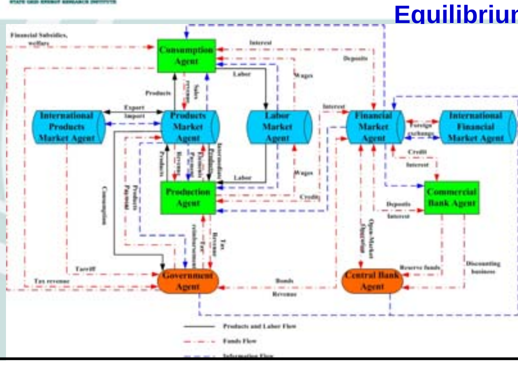
What bout China's Economy?

What is reasonable electricity growth

Intelligent Laboratory for Electricity Economics



Intelligent Agent Response Equilibrium

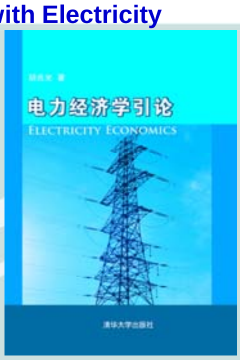


Electricity Economics: Production Functions with Electricity

- Electricity economics
- = electricity supply economics
  + electricity demand economics

⇩

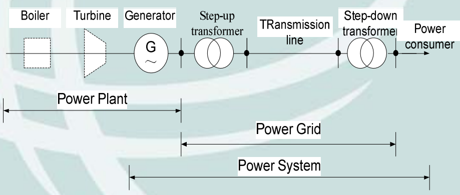
- Production functions with electricity



$Q = AL^\alpha K^\beta$

The Cobb-Douglas production function

$$Q = AL^\alpha K^\beta$$



Production Functions with Electricity

Necessity
accuracy
accessibility
representativeness

E is positive correlated with other production factors

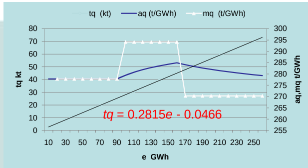
Electricity has the following characteristics:
1) necessity - electricity is required for almost any type of production
2) representativeness - as a productive input, electricity consumption in proportion to the other production inputs.
3) accuracy - electricity consumption is a physical quantity which can be read from meters. Electricity consumption data is objective.
4) accessibility - a smart meter can provide us with the electricity consumption per hour (or per 15 minutes) from the electrical equipment or the production.

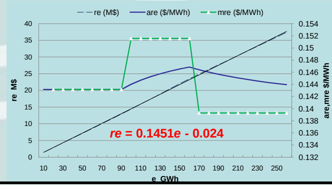
Firms production

production factors
(x,y,z,)

e

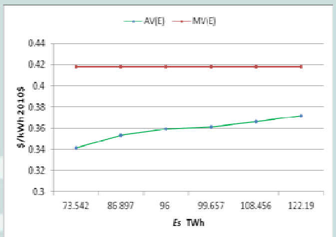
tq, re





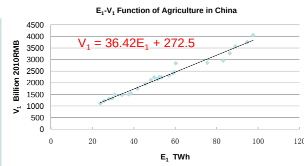
Sectoral production

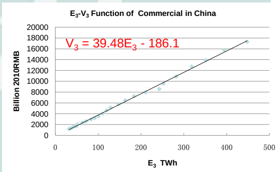
- The cement production in 2005 was 1.069 billion tons. The electricity consumption was 73.542 TWh.
- The cement production in 2010 was 1.88 billion tons. Here, electricity consumption was 122.19 TWh.
- cement production function with electricity:
- $Q = 0.017Es - 0.2309$
- $V = 0.4183Es - 5.6704$

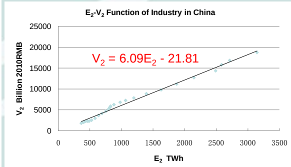


E-V function for Industries in China

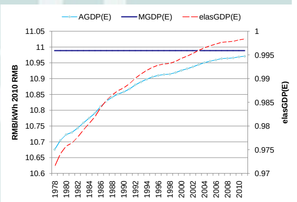
- Electricity use E
- Value added V
- 3 Industries: primary secondary and tertiary

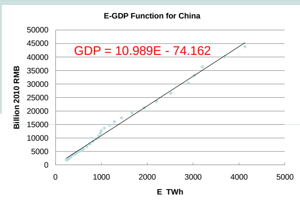






E-GDP function in China

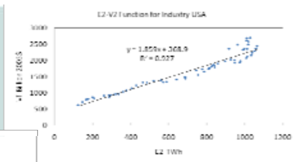


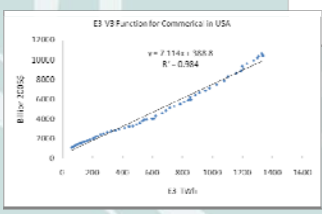


E-V function for the U.S. in 2005$

$V_2 = 1.859E_2 + 368.9$

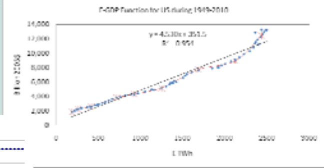
$V_3 = 7.114E_3 + 388.8$

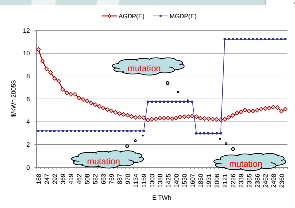




E-GDP function for the U.S. in 2005$

GDP = 4.53E + 351.5

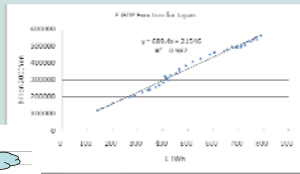


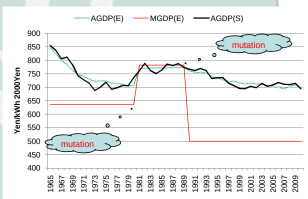


- Gene characteristics:
- Replication
- Mutation
- Evolution
- Uniqueness

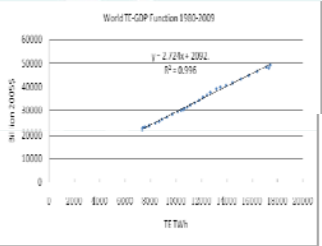
E-GDP function Japan in 2000Yen

GDP = 689.4E + 21546





World E-GDP function in 2005$



GDP = 2.724E + 2092

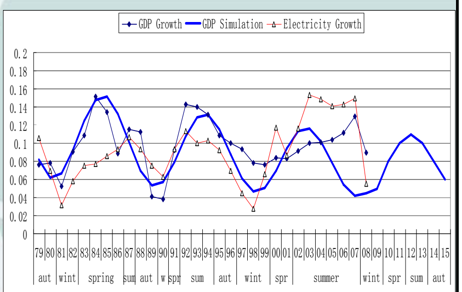
Economic stages

Development Stage		Per Capita Income (in 1982 US Dollars)	Per Capita Income (in 2008 US Dollars)
Primary products stage		260—364	
		364—728	710-1420
Industrialization stage	Early	728—1456	1420-2841
	Middle	1456—2912	2841-5682
	Late	2912—5460	5682-10654
Developed economy stage		5460—8736	10654-17046
		8736—13104	17046-25569

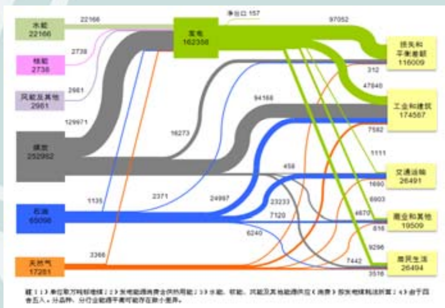
Development Stage		Per Capita Electricity Consumption	Per Capita Residential Electricity Consumption
Stage of primary commodity		<300	<20
Industrialization stage	Early	300—1000	20—80
	Middle	1000—2400	80—240
	Late	2400—4500	240—810
Stage of industrialization completion		4500—5000	810—900
Developed economic stage	Early	5000—6000	900—1500
	Middle	6000—8000	1500—2400
	Late	>8000	>2400

9 years economic cycle in China

- Forecasted power shortage during 2003-2006
- Showed the economic winter in 2008-2009

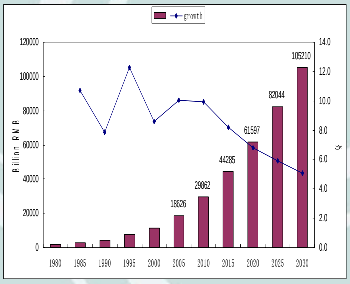


Energy flow in China 2011

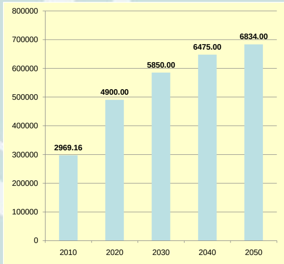


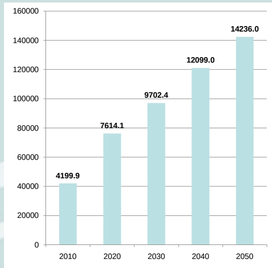
Outlook of economic growth in China

2005RMB

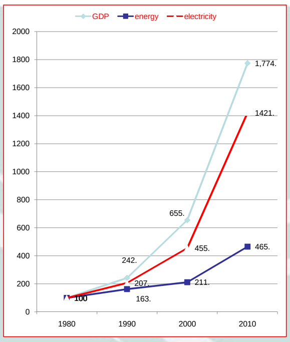


Energy-Electricity Demand Mtce TWh

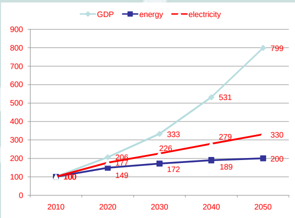




Economy-energy-electricity growth

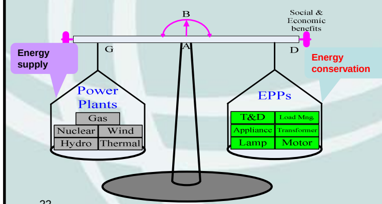


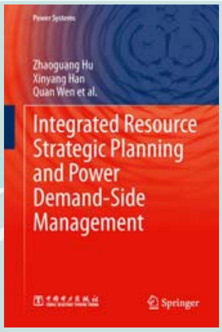
1980-2010:
energy elasticity coefficient: 0.523
electricity elasticity: 0.919
2010-2050:
energy elasticity coefficient: 0.327
electricity elasticity: 0.581



Integrated Resource Strategic Planning and Power Demand-Side Management

IRSP is a national strategic plan to get the greatest energy saving on both demand and supply sides.





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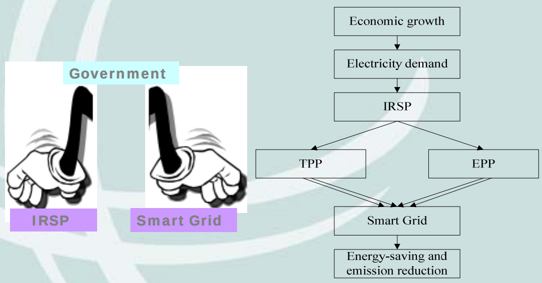
IRSP for China

	2020	2030	2012
Generation capacity (GW)	1935.94	2812.77	1144.91
hydro	350	520	248.90
coal-fired	1075.94	1139	758.11
nuclear	60	160	12.57
wind	220	400.30	60.83
gas	70	189.47	38.27
solar	160	364	3.28
Efficiency Power Plant	197.65	414.44	
lamp	37.65	20	
motor	30	120	
transformer	30	120	
frequency	20	80	
appliance	20	51.44	
interrupt	60	22.99	
(TWh) saving	388.3	525.6	
(Mtec) coal saving	1280.79	1733.68	
CO2(Mt)Co2 saving	3163.63	4283.5	

The Model of Low-carbon-electricity



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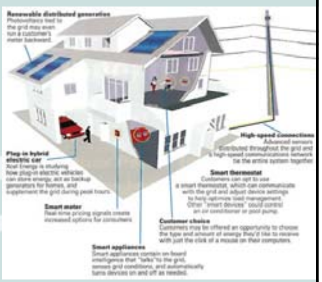
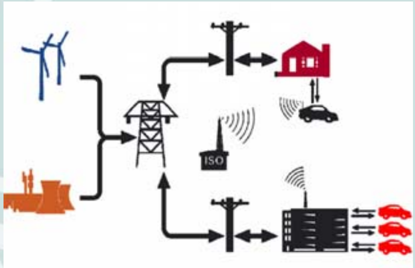
Smart Grid

Smart grids offer the prospect of delivering electricity in a low carbon future more efficiently and more reliably, intelligently integrating the actions of all participants in the system.



EV recharge with Smart Grid



Electric Vehicle Technology

Smart Grid will improve the development of electric vehicles, and reduce our dependence on importing oil.

- China's oil dependency has more than 56%.With the rise of car ownership, fuel consumption will increase.
- Smart Grid is able to effectively meet the power requirements of electric vehicles. In 2020, quantity of China's electric vehicles will 5 million, and reduce 7.1 million tons of gasoline consumption.

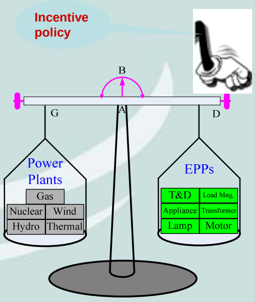
Wellinghoff, Chairman FERC: 500BUDS investment on Smart Grid

Oettinger, Member of European Commission: 260BEuro

IRSP for Policy Study

IRSP is a tool of policy study for the government to promote EPP through:

1.EPP funding
2.Tariff studies
3. Resource tax
4. Carbon tax
5. ……



Smart Grid Pilot projects

1. demonstration projects 29 cities in China smart residential district for leading consumer to save energy and peak load
2. electric vehicle charging station
3. integrating distributed generation
4. 2010 Shanghai Expo demonstration

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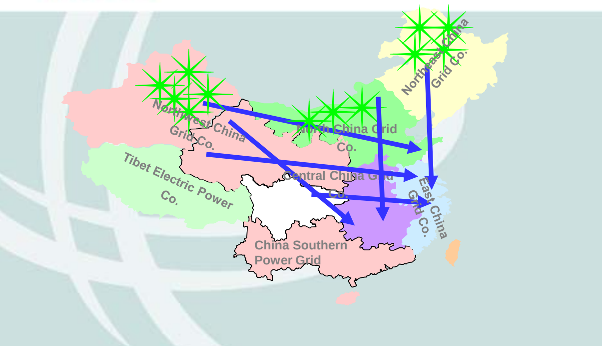
国网能源研究院

Smart Grid : UHV transmission lines



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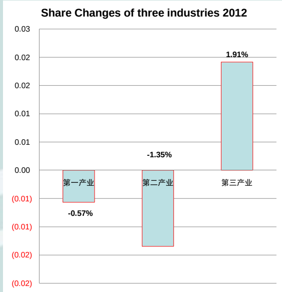
The Change of Economic Structure

- Electricity growth 5.5% in 2012,
- primary industry growth 0%,
- secondary 3.9%,
- tertiary 11.5%。
- The share of Value added in GDP changed:
- primary industry decreased 0.57%,
- secondary decreased 1.35%,
- tertiary increased1.91%。
- By production function with electricity
- $V_1 = 36.42E_1 + 272.5$
- $V_2 = 6.09E_2 - 21.81$
- $V_3 = 39.48E_3 - 186.1$
- (2010 RMB)



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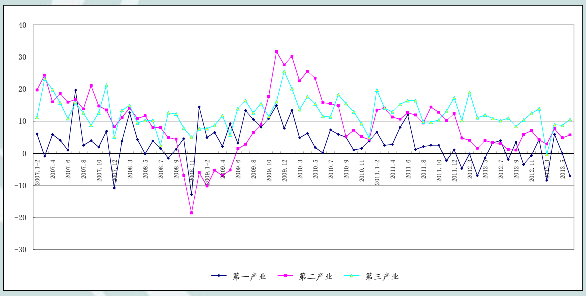
Is Investment useful to promote economy?



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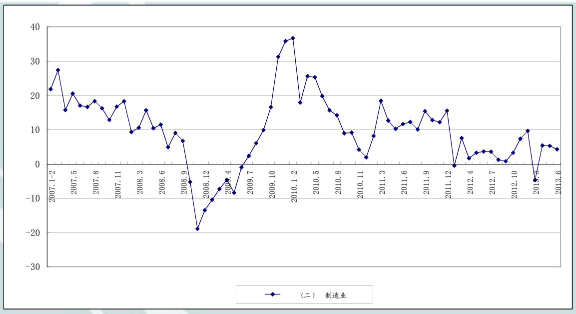
Excess Capacity in Industry



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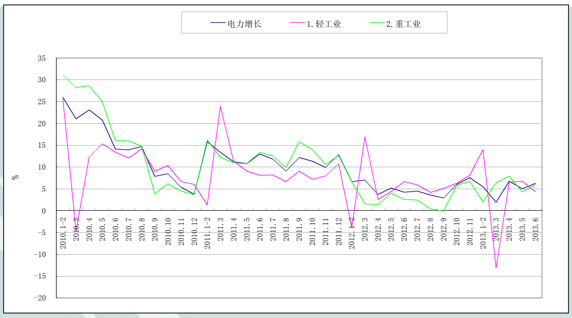
Light and Heavy Industry



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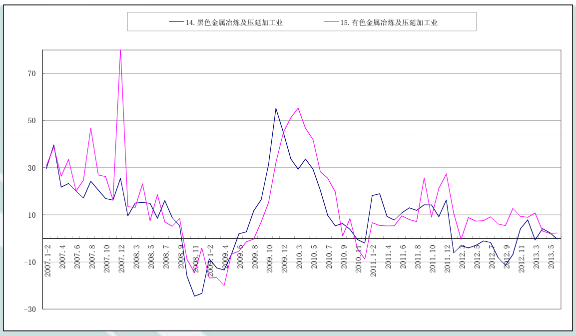
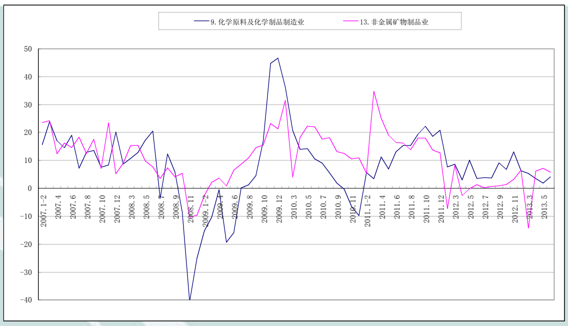
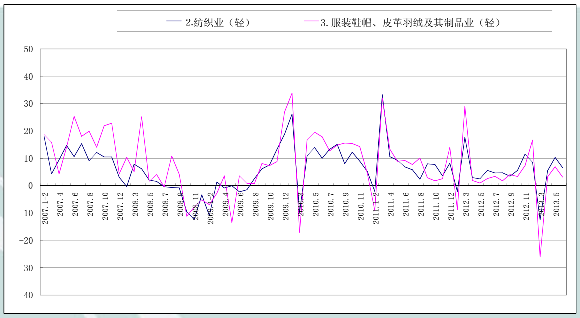
Steel and non-ferrous metal



Chemical and non-metallic



Textile and leather GROWTH

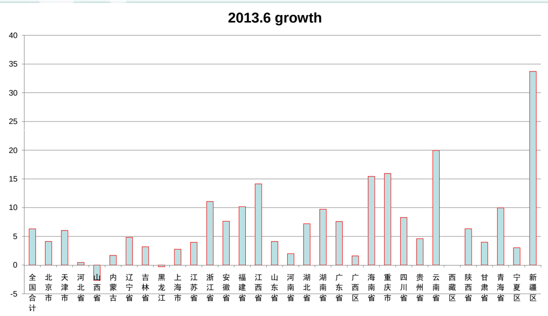


Commercial GROWTH

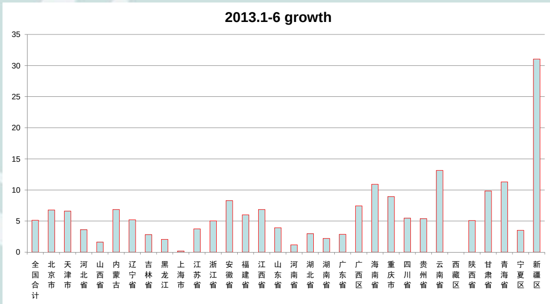
Electricity growth

2013.6	Growth in June (±%)	First 6 months growth (±%)
Total electricity demand	6.30	5.14
A、three industries	5.94	5.32
Primary	-7.11	-0.77
Secondary	5.73	4.88
Tertiary	10.53	9.26
B、residential	9.32	3.89
city	10.79	3.52
farmer	7.50	4.37

Electricity growth



Electricity growth



Scenario Analysis of Employment

Scena	E2 growth %	E3 growth %	Increased L2 Million	Increased L3 Million	Total increase labor million
1	3	9. 6	3. 36	10. 92	14. 28
2	3. 2	9. 4	3. 59	10. 69	14. 28
3	3. 4	9. 2	3. 81	104. 67	14. 28
4	3. 6	9	4. 04	10. 24	14. 28
5	3. 8	8. 8	4. 26	10. 02	14. 29
6	4	8. 6	4. 48	9. 80	14. 28

E2 growth 4.88%, E3 growth 9.26%。Increase labors 7.6084 million first 6 months 2013。It is achievable to 14.28 million jobs increased in 2013

The labor position per kWh in tertiary is 8.39 times higher than secondary. The marginal is 6.54 times. Average value added per kWh in tertiary is 6.42 times higher than secondary, and marginal is 6.48 times.

Thank you!

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全球能源转型的机遇与挑战

陈卫东

首席能源研究员
中国海洋石油总公司能源经济研究院

目 录

一、全球进入新的能源转型期

1. 由薪柴转向煤炭推动了工业革命
   - 蒸汽机的发明
   - 机械能、电能成为主要动力来源替代了人力、畜力、水力和风力
   - 英国成为“日不落”帝国

一、全球进入新的能源转型期

2. 煤炭转向石油，人类跨入工业时代
   - 汽车为标志的现代工业体系建成
   - 冷战结束、经济全球化、美国一极主导世界
   - 石油贸易全球化、期货化
   - Online转向Offline （管道气、LNG）

一、全球进入新的能源转型期

3. 当前，全球能源进入了新的转型期
   - 传统高碳能源消费快速增长，环境承载能力接近极限
   - 人类进入信息时代，资讯不对称的阻碍迅速消解
   - 全球化使地球村变小，文明间的冲突加剧，同时，国家间的相互依赖前所未有

二、能源转型的几个明显特征

1. 消费主体转移，新的生产大国崛起
   - 从发达国家转向发展中国家
   - 传统能源出口国向消费大国转型
   - 制度障碍减弱，资金、技术、人才流动加速，造就了新的能源生产大国

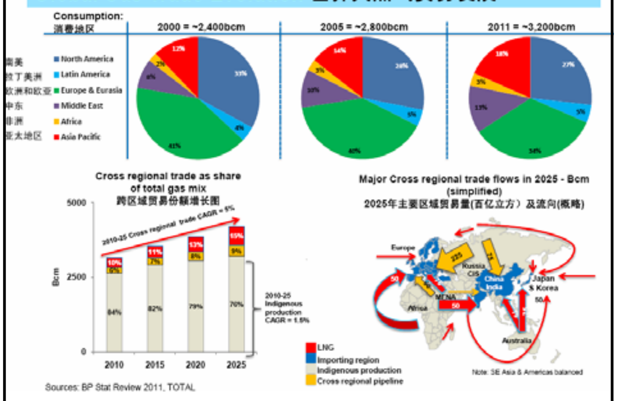
二、能源转型的几个明显特征

2. 煤炭、石油等高碳能源向天然气为桥梁的低碳多元能源转型
   - 高浓度能源向低浓度能源转移
   - 离散、不持续能源的比重增加
   - 资源贫矿具有了商业开采价值

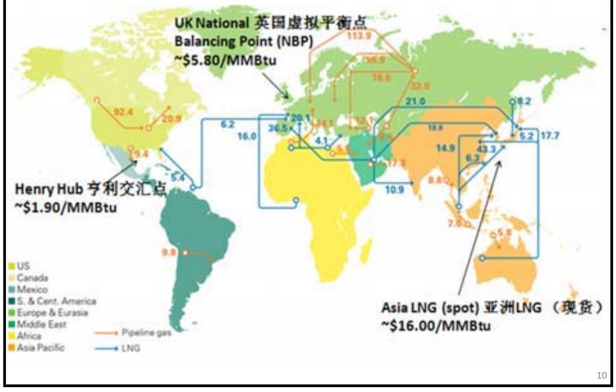
专题：把握天然气

- 进口气看LNG
- 全球各地气价差异大，美国最平、日本（亚洲）最贵、欧洲居间
- LNG供应量快速增长，价格威胁管道气
- 借鉴石油现货市场形成的历史经验
- 全球LNG现货市场正在形成，意义重大
- 参加多哈第21届世界石油大会有感——埃克森美孚和壳牌公司在卡塔尔的成功经验：利用LNG和GTL科技重返中东，获得丰厚回报
- 早日避免“中国资本往哪走，哪里就要‘抖三抖’”、“中国买什么什么贵，卖什么什么便宜”

Global Gas Trade Evolution 世界天然气贸易发展



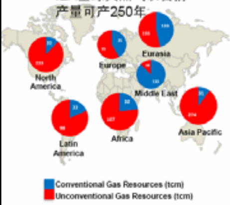
全球天然气交易路径和价格 （2012年4月）



Why Gas? 为何选择天然气？

ABUNDANT 储量充分

- Abundant global gas resources: ~250 years reserves at current production (IEA) IEA全球天然气以目前产量可产250年



Sources: DECC, IEA, TOTAL

ACCEPTABLE 可接受性

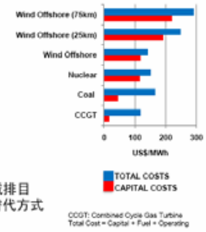
- CCGT: gas-fired power compared to coal: 相对煤电
  - 40% more energy efficient / 能效高40%
  - Emits 50-70% less CO2 / 排放低50-70%
  - CCS retrofit at similar cost per MWh / CO2 CCS成本相当
  - Better complements with wind power /比风电互补更好
- Replacing coal with gas for electricity generation is cheapest and fastest way to meet CO2 reduction targets /实现减排目标，最快最经济的煤电替代方式

CCS: Carbon Capture & Storage

Natural Gas = AAA

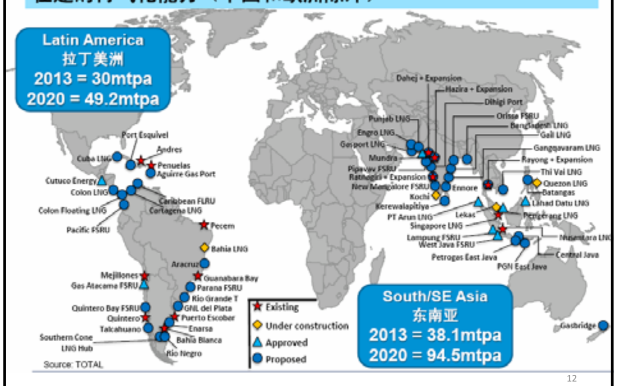
AFFORDABLE 经济性

- CCGT cheapest to build / 燃气发电最经济
- Similar operating cost to coal and nuclear / 运行成本与煤和核电相当



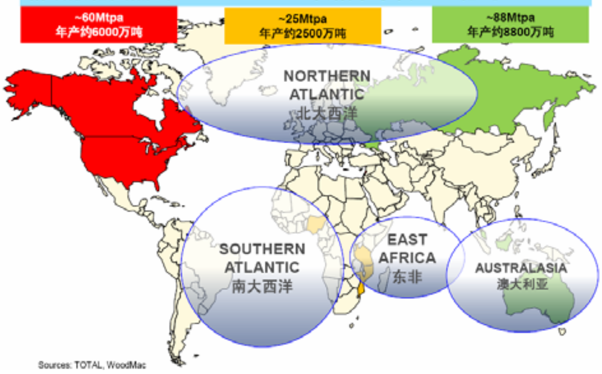
CCGT: Combined Cycle Gas Turbine
Total Cost = Capital + Fuel + Operating

Regas Capacity Build-Up (Beyond China & Europe) 在建的再气化能力（中国和欧洲除外）



Existing and Potential LNG Export Projects
现存的和潜在的液化天然气出口项目

Consensus New LNG: ~170Mtpa between 2015 – 2020
新增液化天然气：2015至2020年期间约年产1.7亿吨



二、能源转型的几个明显特征

3. 常规油气向非常规油气转移
   - 美国页岩气革命强烈的示范效应
   - 美洲石油“新中东”形成
   - 中国非常规油气酝酿突破？

三、能源转型的三个推动力

1. 经济全球化 + 市场经济 + 自由贸易
   发展中国家改革开放成效显著
2. 技术创新加速，技术转移成本降低
3. 低碳道德化正被广泛接受

四、能源转型带来的新挑战

1. 全球能源治理格局转型的挑战
   - 现有的治理平台：IEA和OPEC是主体
   - 以石油供需平衡与价格稳定为目标
   - 美元计价体系和全球金融投机体系有可能形成风险转嫁的工具

四、能源转型带来的新挑战

2. 减排谈判与WTO谈判都停滞在多哈
   - 国家责任与义务的争论
   - 发达国家对历史的责任与现实投资收益的计较
   - 发展中国家发展目标与成本的计较
   - 补贴争执与基础设施投资能力的制约

四、能源转型带来的新挑战

3. 低碳道德化概念与现实实践的巨大差距
   - 不同国家处于不同的发展阶段，发展目标不同
   - 不同行业、不同企业利益再分配的矛盾
     石油长期价格不敏感、垄断利益最大化
     能源安全观念分歧难以弥合
   - 国家利益 / 拯救地球、利益虚实 / 长远的计算不同

五、能源转型带来的机遇

1. 传统能源供给增长快于需求增长，消费主体的话语能力增强
2. 非常规油气与可再生能源可容纳更多投资和投资主体，让更多企业和资本可以进入
3. 非常规能源、可再生能源对成本非常敏感，技术进步成为重要竞争因素，有利于打破原有的垄断格局

五、能源转型带来的机遇

4. 制度选择比资源禀赋更重要，有利于促进行业投资环境的改革
5. 雾霾月痛苦的揭示了中国经济发展模式和能源结构的不可持续性，必须改革
6. 建设美好家园、实现中国梦没有重大的能源结构改变是不可能实现的

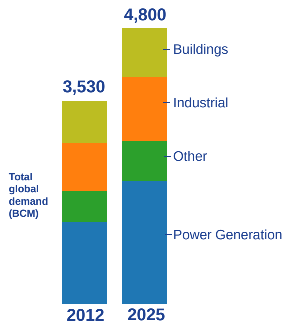
The Age of Gas
Harnessing China's Shale Gas

Global Forum on Energy Security 2013 |
August 10-11, 2013 Beijing

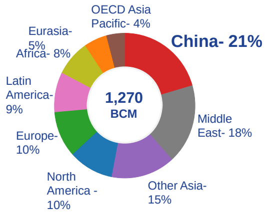
Peter Evans
Director
Global Strategy & Analytics
General Electric

imagination at work

Global natural gas growth outlook



Growth in Demand, 2012-2025



Source: GE Global Strategy & Analytics, 2013

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Harnessing China's Shale Gas
Value of developing domestic gas resources

National competitiveness
- Building interconnected systems to leverage domestic resources
- Significant opportunities exist for gas to harness new network synergies to support new levels of national competitiveness

Environmental sustainability
- Harnessing network synergies can lower environmental externalities
- Increasing share of gas and renewable generation and will decrease the overall water intensity of the power sector
- Fugitive emissions

Resilience
- Disruptions and costs to energy infrastructure are on the rise
- Investment in resilient-sustainable infrastructure

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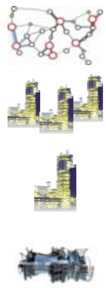
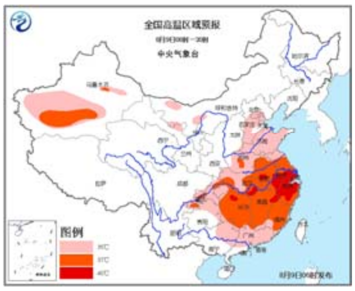
Building energy system resilience
How to **minimize disruption** + quickly **restore** basic functions

1. Diversification
2. Intelligence
3. Couple / decouple
4. Pooling/ coordination
5. Redundancy



Networks
Fleets
Facilities
Machines

China'S current heat wave
Record breaking temperatures this summer



Source: China Meteorological Administration, August 9, 2013

Heat alerts issued for nine provinces including Anhui, Jiangsu, Hunan, Hubei, Shanghai and Chongqing.

Shanghai experienced the hottest July in 140 years.

Drought conditions are growing in parts of Guizhou, Chongqing, Hunan, Jiangxi and Zhejiang provinces.

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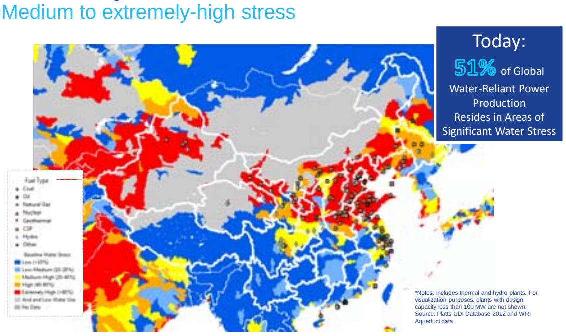
China's generation units with water stress*
Medium to extremely-high stress



*Notes: Includes thermal and hydro plants. For visualization purposes, plants with design capacity less than 100 MW are not shown. Source: Platts UDI Database 2012 and WRI Aqueduct data

More than 2,600 units are in areas of medium to extremely-high water stress

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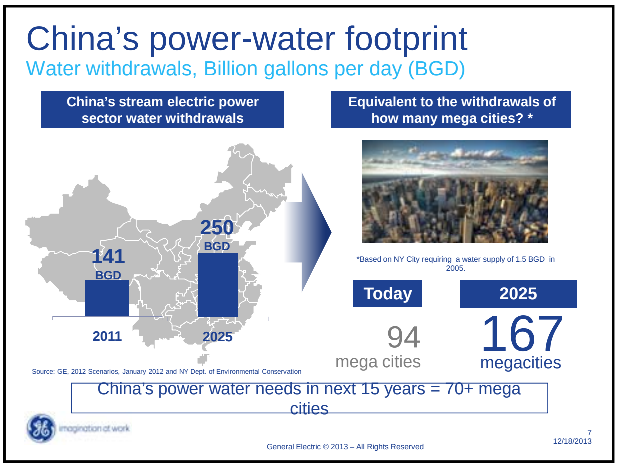

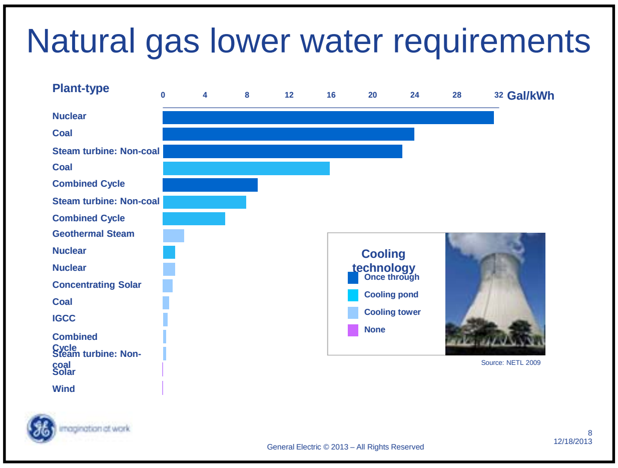

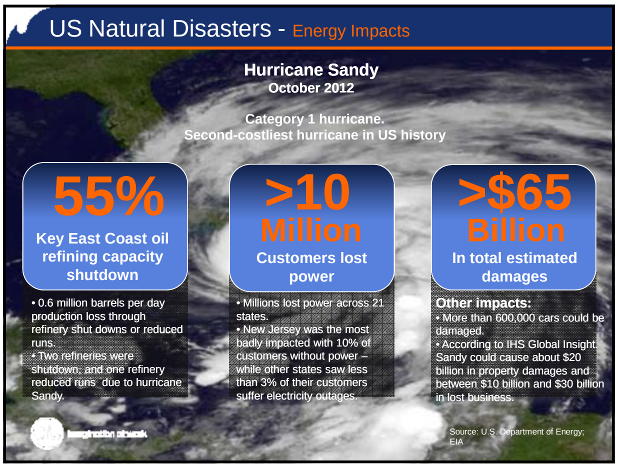

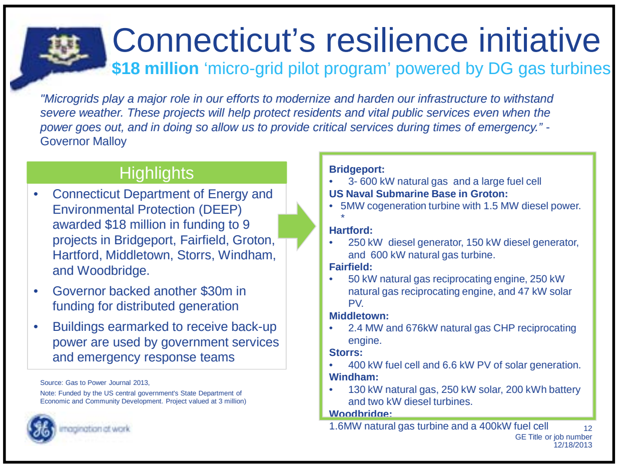

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Call to Action

Pres. Obama Climate Action Plan

Georgetown University, June 25, 2013

"We've got to build smarter, more resilient infrastructure that can protect our homes and businesses, and withstand more powerful storms."

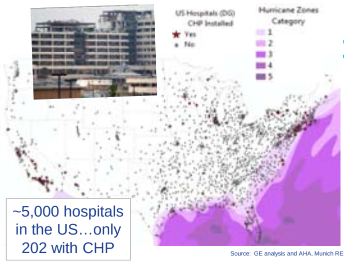
- Distributed power for resilient infrastructure
- $8B in loan guarantees announced for "innovative" energy efficiency
- Ease of spending federal funding on increasing community resiliency
- Ensure hospitals can withstand climate impacts

Resilience in the Health Sector …

- ***building on lessons from pilot projects underway in 16 states***

US hospital vulnerability

Hurricane risks and their impact on hospitals



~5,000 hospitals in the US…only 202 with CHP

Source: GE analysis and AHA, Munich RE

1,450 Number of hospitals exposed to hurricanes from 2002-2011*

$9.2 Revenue losses for a typical 800 bed hospital (in millions of dollars per day)**

78% Percentage of power outages associated with hurricanes that typically last >24 hours

*Hospitals with 100 miles of a hurricane track
**Based on FEMA study of Hurricane Ike

Distributed power can support resilient-sustainable infrastructure

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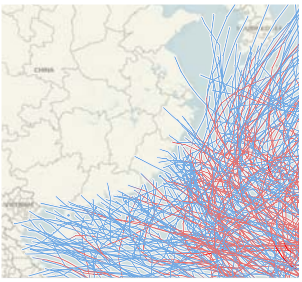
China's typhoon exposure

Typhoon tracks since 1980, 50 knots or higher



Source: Platts UDI Database 2012, Munich Re NatCat data

China's coastal provinces are regularly subjected to Typhoons.

Ash dams at thermal power plants have been known to break causing damage to farmland, villages and rivers.

At present more than 800 unit power plants representing 116 GW exposed to Category 3 and higher Typhoons.

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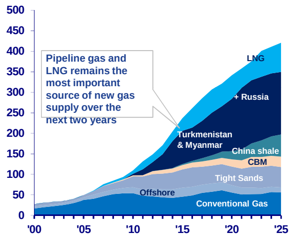
China gas outlook to 2025

Multiple supply options … but new pipelines remain critical for growth

China gas supply by source

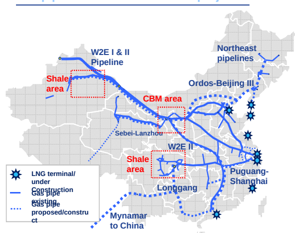
Bcm per year – Baseline



Source: GE Fuel COE, Revised March 2013

China natural gas pipelines

Gas pipelines and selected new projects



Source: GE China region

Source: GE Fuel COE, Revised March 2013

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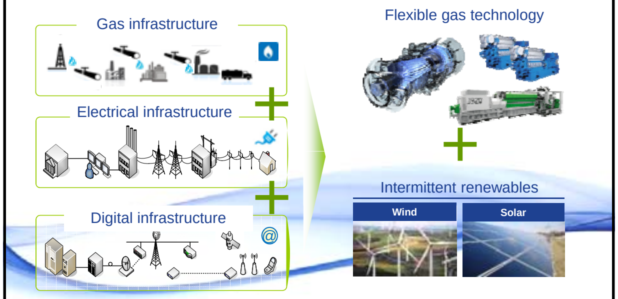
Energy network integration

Expanding and connecting related infrastructure networks



Joining capabilities for a more resilient-sustainable future

imagination at work

Strategies for security and resilience

Proactive vs. reactive approaches

Reactive Response	Proactive Investment
Upfront investment: • None or business as usual **Costs** • More damage • Longer power outages • Slower recovery • Limited efficiency gains	**Upfront investment:** • Natural gas grid invest. • Intelligence/automation • Distributed power (e.g. CHP) **Benefits** • Reduced damage • Faster recovery • Efficiency gains

Source: GE Global Strategy & Analytics, 2013

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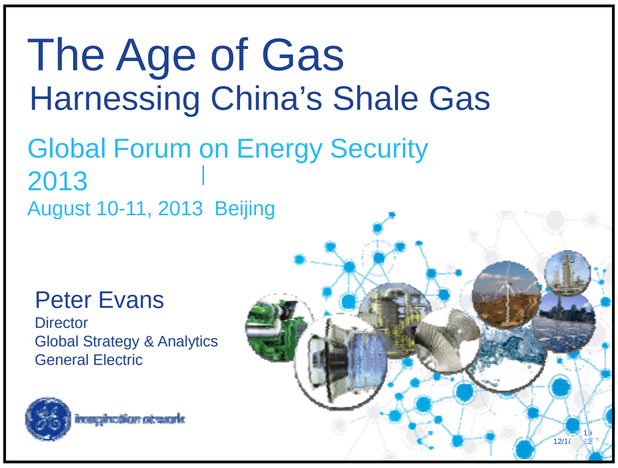

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绿色能源、智慧发展

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中国社会科学院数量经济与技术经济研究所

2013年6月

能源的绿色环保要和安全、普遍服务并重，不能以牺牲发展来限制能源消费

2003年美加大停电主要城市受影响人数

城市 CITY	受影响人数 POP AFFECTED
纽约市 NY	8,000,000
多伦多Toronto	5,600,000
底特律Detroit	951,000
渥太华Ottawa	820,000
汉米尔顿 Hamilton	680,000
克利夫兰 Cleveland	478,000
托莱多Toledo	314,000
温莎尔Windsor	208,000

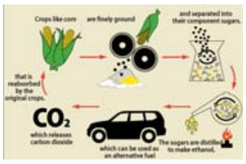
能源的环境影响

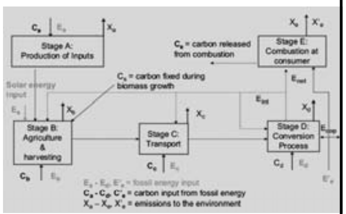
Fukushima Nuclear Power Plant Disaster, 2011

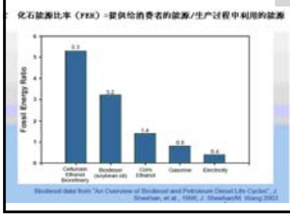
Oil Spill, Mexico Bay,2010

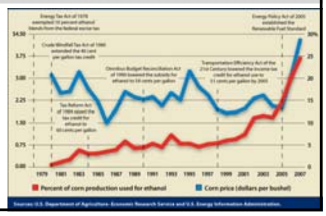
煤矿开采引起的滑坡，山西保德，2006

从全生命周期看，新能源也不一定是完全环境友好的









所有的光伏组件都有镉排放

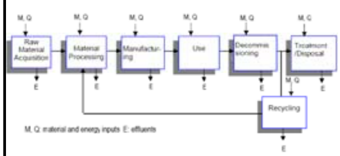
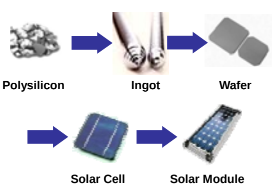
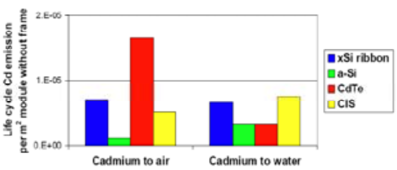
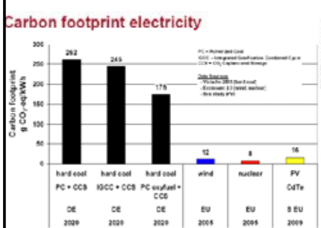


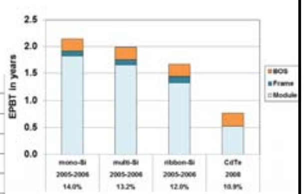
Figure 1: Flow of the life-cycle stages, energy, materials, and effluents for PV systems





但是，从温室气体排放等指标看，新能源仍然具有环境优势

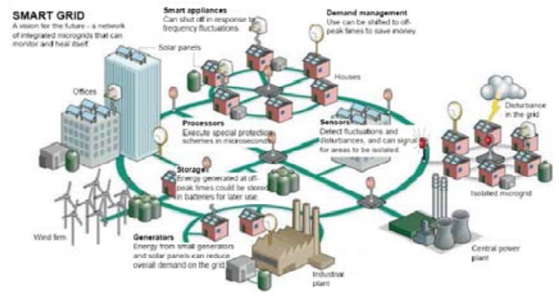




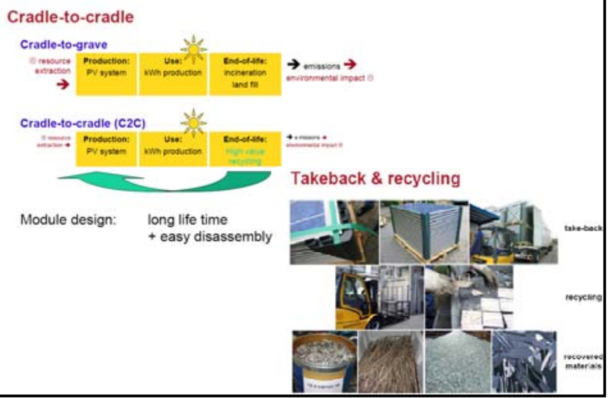
Energy payback time (EPBT) of rooftop mounted PV systems estimated from the currently available LCI data for European production and installation.

绿色能源的第一个关键取决于智能化：灵活性、可自调节

Smart-grid power system
Source: Smart Grid 2030 Associates, SG2030™ Smart Grid Portfolios

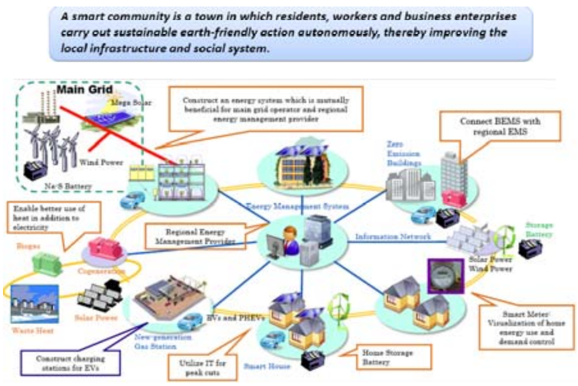


绿色能源的第二个关键是环境管理：循环经济



智能社区：分布式单元与系统化连接

- 现代社会是一个复杂系统，能源、环境问题与人的行为和社会活动紧密相关。
- 智能电网作为现代能源社会的发展方向，必需与社区活动模式互相适应，才能实现节能和环境目标。因此，需要建立新型的社会系统，以实现电能、热能的最有效利用，这就是智能社区（smart community）。



Resource：NEDO, Smart Community: A New Frontier for Future Sustainable Growth, 2012

智能式发展的八项指导原则

原则 1

紧凑而方便的邻里社区

原则 2

可选择多种方便的出行方式

原则 3

与自然生态系统和谐相处

原则 4

更为绿色、智能和廉价的建筑与基础设施

原则 5

提供多种形式的住房

原则 6

工作地点紧邻居住地点

原则 7

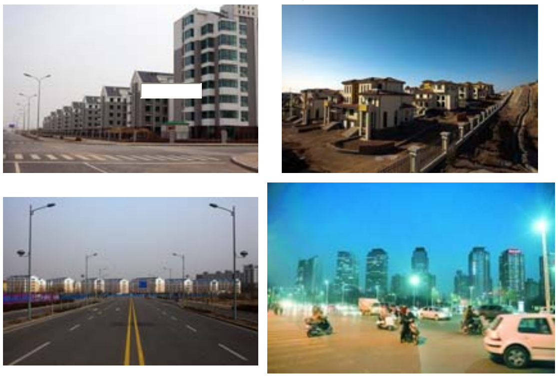
惬意的本地社区生活模式

原则 8

尊重个体意见

中国城市的铺张浪费

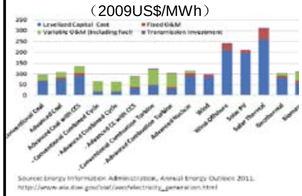
鬼 城

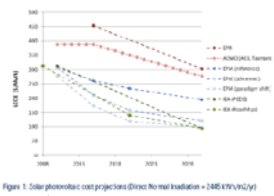


智能式政策

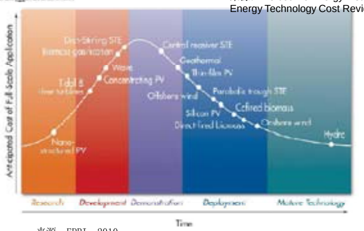
- 战略新兴产业都有一定的技术风险，适度扶持。
- 政策应尊重市场规律，慎防过度补贴。

2016年的新能源电力LCOE估计（2009US$/MWh）



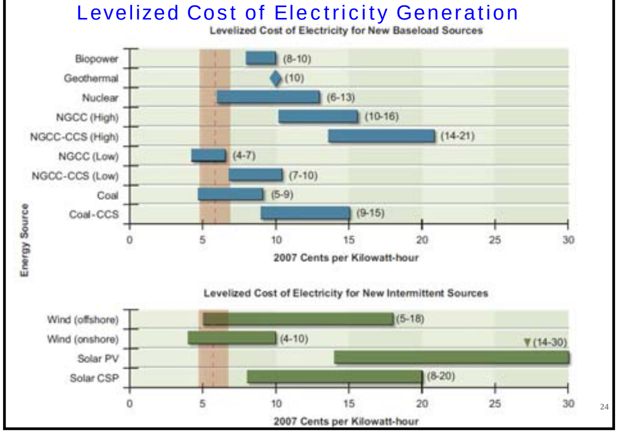


来源：Melbourne Energy Institute, Renewable Energy Technology Cost Review. March 2011.



来源：EPRI，2010。

Levelized Cost of Electricity Generation



主要观点

- 能源的绿色环保要和安全、普遍服务并重，不能以牺牲发展来限制能源消费。
- 各种能源形式，都不可避免地产生环境影响。
- 能源是否绿色要从全生命周期来判定。
- 绿色能源的关键取决于智能化与环境管理。
- 政策智能化：政策应尊重市场规律，慎防过度补贴。

•谢谢！

•THANKS

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加速适用生物质能源技术开发，消除农村能源贫困的建议

数量经济与技术经济研究所　齐建国　蔡跃洲

能源是提升人民生活水平的重要物质支撑。能源消费在农村居民生活消费中占有很重要的地位。很多地区的农村居民由于能源消费负担造成日常生活困难，并且导致“乱砍滥伐”，造成农村地区生态破坏严重。能源消费负担正在成为城乡生活质量差距的重要原因之一。目前，我国农村居民人均生活能源消费水平仅为城镇居民的 60%左右，随着农村居民收入水平不断提高，能源消费水平也必将不断上升，近几年农村能源消费中煤炭、液化气等商品性化石能源的比重正在逐年提高。如果将农村居民能源消费全面引向依靠煤炭、液化气等化石能源的道路，必然对国家能源供给安全、温室气体减排、生态环境保护带来更大压力。

一、农村能源贫困问题正在导致生态灾难

我国农村仍拥有 7 亿左右人口，根据《中国能源统计年鉴》（2010）公布的数据，2010 年农村人均生活能源消费仅为 190 千克标煤/年。如果农村年人均生活能源消费水平增加 100 千克标煤（仍低于城镇居民水平），每年将多消费 7000 万吨标准煤，相当于 2010 年全国生活用能消费总量的约 18%，与我国 2010 年 8000 多万吨的煤炭净进口量也大体相当。如果农村居民增加的能源消费全部用化石能源供给，每年大约增加排放 2 亿吨的二氧化碳、154 万吨二氧化硫以及大量的固体废弃物。随着农村居民的生活水平日益提高，农民家庭人均能源消费量也在上升，并且，增加的能源消费主要依靠化石能源供给。收入越高的农村地区传统生物质能源消费比例越下降，过去作为家庭能源的大量秸秆被随地焚烧，造成严重的季节性环境污染。与此同时，在较为贫穷的农村地区，家庭能源消费仍然是生活支出的沉重负担，这一方面造成大量生物质能源浪费，另一方面无效地增加温室气体排放，同时还增加了化石能源供需矛盾，推升能源价格水平。

我国广大农村地区拥有丰富的生物质能源资源，总量约折合 50 亿吨标准煤，相当于我国 2010 年全年能源总消费（32.5 亿吨标准煤）的 1.5 倍以上。生物质能源是可再生能源，也是实现自然碳循环的重要基础。但是，在大多数贫困地区，由于生物质能源利用技术极为落后，大多数农民仍然沿用传统的锅灶设施利用生物质能源，效率极低。不仅浪费费了大量宝贵的生物质能源资源，又使农民能源消费成本过高造成巨大生活压力。由于缺乏购买化石能源的支付能力，较为贫困地区的农民长期依靠砍伐薪炭林甚至是用材林、挖草根解决生活用能源。在一部分贫困地区，由于长期大量对生物质资源进行低效率的掠夺性利用，造成山体植被破坏殆尽，水土严重流失，沙漠化和石墨化泛滥，正在向着可怕的生态危机转变。

二、生物质能源高效利用实用技术是解决农村能源贫困的根本出路

造成农村能源贫困和生态灾难，生物质能源高效利用技术不能广泛应用的根本原因，是各级政府对研究开发先进实用的农村生物质能源利用技术重视不够，未能有效推广已经成功开发的先进实用生物质能源利用技术体系。虽然近几年国家在农村户用沼气领域投入了巨额资金，修建了大量户用沼气池，使生物质能源

沼气化利用取得了一定成绩，但由于农村居民家庭的人口结构和生活方式的变化，户用沼气的效果并不理想。50%以上的户用沼气没有充分发挥作用。

因此，应该尽快转变解决农村能源问题的思路，推广更先进适用的生物质能源开发与利用技术体系。针对农村居民居住分散、缺乏公共基础设施、收入水平不高、家庭小型化，农村养殖业规模化集中导致家庭养殖业萎缩等特点，应大力研究开发、推广利用适合农村生活和生产方式的生物质能源高效利用实用新技术，充分利用生物质能源资源，全面提高可再生能源利用效率，降低农民家庭能源消费成本。既可以减轻农村居民能源消费负担，缓解农村能源贫困，更能够减轻国家化石能源供给压力，节约宝贵的碳汇资源，涵养生态资源，为温室气体减排做出贡献。

1、加紧对现有生物质能源利用技术进行优化筛选

目前国家支持的农村生物质能源利用技术路线五花八门，技术效率差别巨大，国家扶持资金使用效率堪忧。国家花费大量资金支持的农村户用沼气利用效率不高，尤其是在北方地区，冬季产气极少，再加上农民家庭小型化，年青一代不搞家庭养殖，导致沼气池原料不足，约有一半以上的户用沼气池被废弃。

国家投巨资扶持的一些大中型沼气池项目，由于没有统一的技术标准，各种规格和形式的设备设施随意建设，结果是在北方大多数地区的沼气池由于气温低，冬季不能正常产气。一些大型沼气池为了能在冬天产气，不得不烧锅炉为其加温，结果是生产的沼气能源远没有烧掉的煤炭能源多，造成能源负产出的局面，造成巨大的资金和能源双重浪费。

近几年，市场上出现了大量所谓新型柴灶炉、气化炉等产品，其技术水平良莠不齐，多数产品技术不过关，使用性能不高，农民买了大呼上当，造成了“坑农害农”的不良影响。

还有一些在“低碳经济”和“节能减排”旗帜下得到各级政府大量资金资助的秸秆气化、碳化、液化技术，更是五花八门，效率差别巨大，但真正形成具有经济效益，有效解决农村居民用能的成功项目不多。特别是各级政府盲目资助的一批生物质能源发电项目，多数因各种原因无法正常运转，长期处于亏损甚至是闲置状态。

根据上述状况，当务之急是，由国家有关部门组织科研力量，加紧对五花八门的生物质能源利用技术进行优化筛选，选择技术效率高、经济效益好、适合农村居民生活特点的实用高效技术，制定统一的技术标准，由国家集中力量，投入资金，扎扎实实有序推广，减少国家优惠扶持政策的盲目性，防止浪费资源。

2、运用“后现代思维”加大对生物质能源高效利用技术的研究与开发

由于不具备像新一代信息化等高技术那样的主流工业化和信息化新技术特征，农村生物质能源利用技术的研究与开发似乎难登“大雅之堂”，不仅研究开发机构少，而且获得资金支持也较为困难。因此，长期以来，农村生物质能源新技术的研究与开发进展不大。**要从根本上解决农村居民的生活现代化，必须首先实现农村居民用能的现代化。**特别需要提出的是，必须扬弃现代化中复杂机械技术体系和化石能源相结合的技术路线，要以适合农村特征的传统实用技术和高技术相结合，基于生态环境保护的“后现代思维”，以解决农民低成本高效利用生物质能为目标，指导生物质能源技术的研究与开发。

例如，河北森蔚电气科技有限公司等已经成功研究开发出了比传统炉灶秸秆燃烧效率高几倍，以秸秆、薪柴、杂草、树枝枯叶等为燃料的新型“家具式”高效气化炉灶技术设备，并已经过清华大学国家实验室鉴定。该项技术不仅成本比

户用沼气低，而且其能源利用效率比户用沼气效率更高，应用简单方便、清洁卫生，适合所有农户和城乡结合部低层楼房居民做饭和取暖使用。

再比如，河北省滦县中誉佳美思再生能源有限公司开发的方便、高效、清洁、低成本的秸秆和其他生物质能源利用技术设备，可以充分利用各种农作物秸秆、薪柴和林业剩余物作为农村居民用能，既适合农民家庭使用、又适合农村地区机关、学校等企事业单位使用，可以实现多家多户联合使用一台套设备的规模化生物质能源利用模式。使“家家烧柴，户户冒烟”转向通过生物质能源集中供给系统，与利用煤气、天然气、液化石油气、煤炭相比，原料成本低廉，可以采用与城市管道燃气完全相同的输送方法，以自然村或居民小区为单位，用一台或多台设备，建秸秆供气站，建设规模可大可小，每个小学、中学、乡镇企业、机关都可以根据自己的能源需求规模和周边生物质资源情况，建立能源微网。利用这种系列设备的制造的燃气成本（秸秆费+电费+设备折旧费）每立方米仅 0.1 元左右，每平方米建筑冬季取暖费用仅 7 元左右。非常适合广大农村地区推广。

我国农村以能源为目的，每年消费秸秆大约 3.4 亿吨，折合标准煤约 1.6 亿吨；每年消费薪柴为 1.8 亿吨，折合标准煤 0.9 亿吨。如果全面推广这样的技术设备，可使现有的秸秆和薪柴等生物质能源利用效率提高 2-3 倍，相当于节约 3 亿吨以上标准煤，减少温室气体排放 7 亿多吨；可使农民减少能源消费支出 50%以上。特别是这一类实用新型生物质能源利用技术的推广应用，可以大大减少贫困地区农民对薪炭林和用材林的砍伐破坏，使植被得到恢复和保护，具有巨大的经济效益和生态效益。

三、若干政策建议

党的十八大报告中指出，建设生态文明，是关系人民福祉、关乎民族未来的长远大计。面对资源约束趋紧、环境污染严重、生态系统退化的严峻形势，必须树立尊重自然、顺应自然、保护自然的生态文明理念，把生态文明建设放在突出地位，融入经济建设、政治建设、文化建设、社会建设各方面和全过程，努力建设美丽中国，实现中华民族永续发展。着力推进绿色发展、循环发展、低碳发展，形成节约资源和保护环境的空间格局、产业结构、生产方式、生活方式，从源头上扭转生态环境恶化趋势，为人民创造良好生产生活环境，为全球生态安全作出贡献。并提出我国到 2020 年要全面建成小康社会。没有农村能源的现代化和生态化，就根本谈不上生态文明建设，上述目标将是空话。因此，建议在未来发展中，把提高生物质能源利用效率，解决农村能源贫困和生态文明建设紧紧融合在一起，提升到“五位一体”的发展布局高度来对待。

1、在国家“十二五”科技支撑计划执行中，设立农村生物质能源高效利用技术研发与推广专项。要从生态文明建设、国家能源安全、应对气候变化和消除农村能源贫困的高度看待农村能源问题。“十二五”期间，要在国家科技支撑计划中列专项对农村生物质能源先进实用技术进行研究与开发，在全国三分之一以上农村地区，特别是贫困地区广泛推广高效生物质能源利用技术。

2、由国家发改委、财政部、科技部、农业部联合组织专家队伍，设立专项课题，对生物质能源利用的诸多技术路线进行评估优选，在优选的基础上制定国家标准，制定专项技术目录，设立农村能源专项基金，进行有针对性的高强度扶持和推广扩散。

3、在国家扶贫基金中，列农村生物质能源扶贫专项，在经过专家深入论证

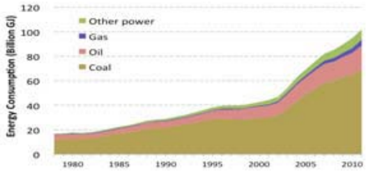
的基础上，选择先进高效技术体系，在先行试点示范的基础上，在贫困地区免费推广普及。

Xin Yan, Senior Program Associate, Energy Foundation

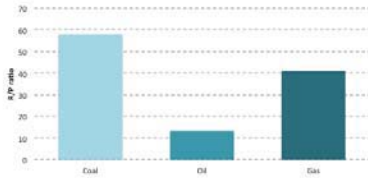
Balance Energy Security and Pollution Challenges In China's Transportation System

Growing Energy demand V.S. Energy Scarcity

Energy Consumption Trend in China



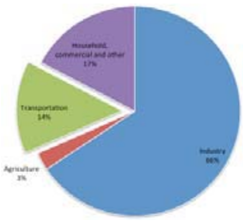
Coal, Oil and Gas Reserve/Production Ratio in China



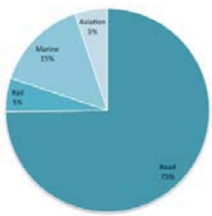
Source:
1 China Energy Statistics Yearbook
2 Wang Q.Y.

Transportation contributes to 14% energy consumption and 60% oil consumption in China

Energy Consumption Share by Sectors



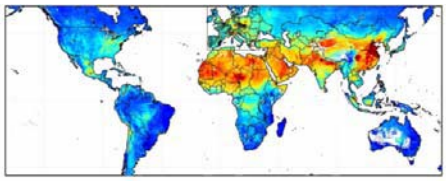
Transportation Energy Consumption Share



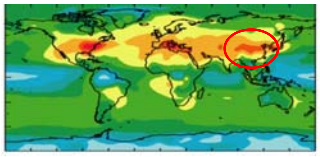
Oil Consumption Share

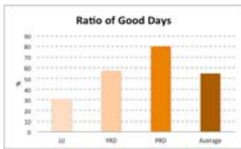
Source:
1 Wang Q.Y.
2 Mao B.H. Beijing Jiaotong University

Highest PM2.5 and O_3 concentration in the world

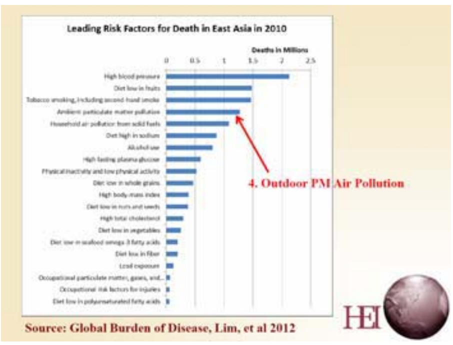


Source:
1 Tsinghua University
2 Ministry of Environmental Protection



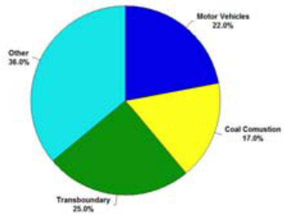


Large number of premature mortality attributed to air pollution

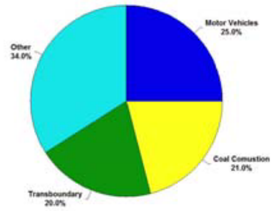


Vehicle – A significant source for PM2.5, NOx and VOC in Urban Area

Beijing $PM_{2.5}$ Sources



Shanghai $PM_{2.5}$ Sources

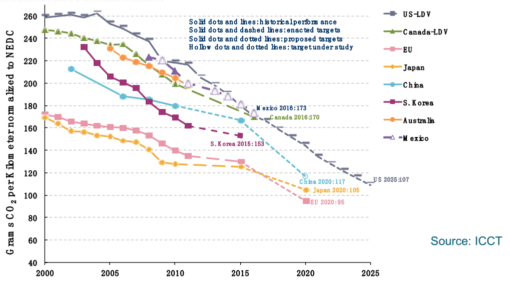


Source:
1 BJ EPB
2 SH EPB

China's efforts – Fuel Economy Program

	2005	2006	2007	2008	2009	2010	2011	2012	2013
LD Passenger Car	Phase I			Phase II				Phase III	
LD Commercial Car				Phase I			Phase II		
HD Commercial Car*									Draft
Motorcycle					Phase I				
Rural vehicle				Phase I					

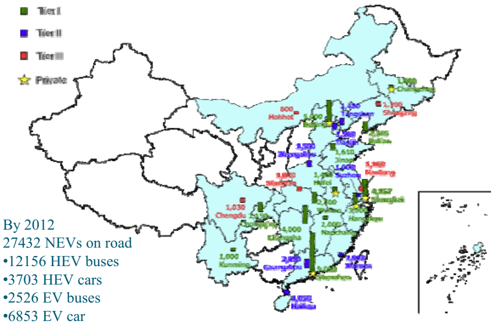
*Industrial Standards enforced in 2012



Source: ICCT

[1] China's target reflects gasoline vehicles only. The target may be lower after new energy vehicles are considered.
[2] US, Canada, and Mexico light-duty vehicles include light-commercial vehicles.

China's efforts – NEV Program



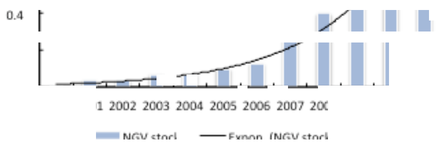
By 2012
27432 NEVs on road
•12156 HEV buses
•3703 HEV cars
•2526 EV buses
•6853 EV car
•2194 other NEVs

Source:
1 Gong Huiming, Energy Foundation
2 Society of Automotive Engineers of China

China's efforts – Programs to promote alternative fuels

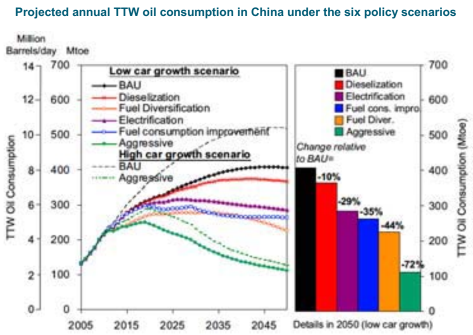
NGV growth in China

Annual growth rate：
•Global 23%
•Asia-Pacific 38%
•China 46%



Source: : International Association for Natural Gas Vehicles

Energy saving potential by different technology options



Source: Huo, H., et al.

China's efforts – 1999-2010, very strong control program on vehicles & fuels (1)

Vehicle Emissions Standards Enforcement Timetable

车型 \ 年份		2006	2007	2008	2009	2010	2011
轻型汽车	压燃式		国II			国III	
	点燃式		国II		国III		国IV
	气体点燃式		国II		国III		国IV
重型汽车	压燃式		国II			国III	
	点燃式			国II			国III
	气体点燃式		国II		国III		国IV
摩托车	两轮和轻便摩托车			国II			国III
	三轮摩托车			国II			国III
低速汽车		无控制要求	国I			国II	
非道路移动机械用柴油机		无控制要求			国I		国II
非道路移动机械用小型点燃式发动机				无控制要求			国I

Source: Annual Report of Vehicle Emissions Control in China

China's efforts – 1999-2010, very strong control program on vehicles & fuels (2)

Gasoline Sulfur Limits (parts per million)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
China	1,500		1,000		800				500				150				50			10
Beijing	1,500		800		500			150			50						10			
Shanghai	1,500			800				500							50					10
Guangzhou	1,500			800				500		150					50					10
Europe	500			150				50							10					

Diesel Sulfur Limits (parts per million)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
China	> 2000						2,000							350				50		10
Beijing	> 2000		2000			500		350			50						10			
Shanghai	> 2000					2000									50					10
Guangzhou	> 2000			2000				500		350					50					10
Europe	500			350				50							10					

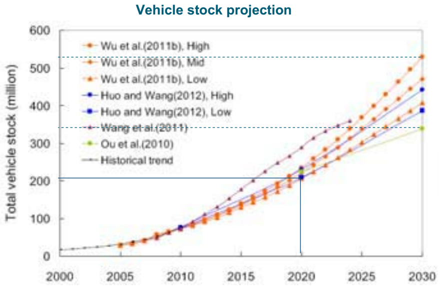
By the end of the 11th-five year plan:

➢Vehicle population increased by 250% ;

➢Vehicle emissions increased only by 1.6%-11.9%

Source:
1 ICCT
2 State Council Circular

Challenges-increasing vehicle stock



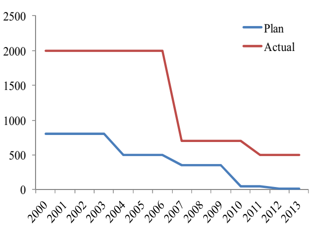
Fast increase of vehicle population: will reach 210-240 million units in 2020, and 410-530 million units in 2030 !

Source: Wu Y., et al.

Challenges - Very Rapid Growth is Forecast for both passenger and freight traffic

Challenges-High sulfur diesel fuel

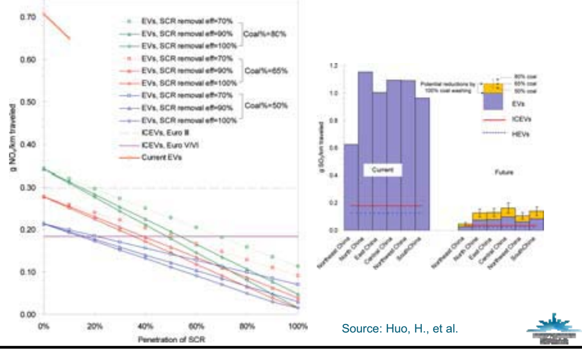
Twice delayed the truck standards because the fuel quality



Challenges- Life cycle assessment of alternative fuel vehicles

Fuel-cycle NOx emissions of EVs compared to those of gasoline ICEVs and HEVs in China

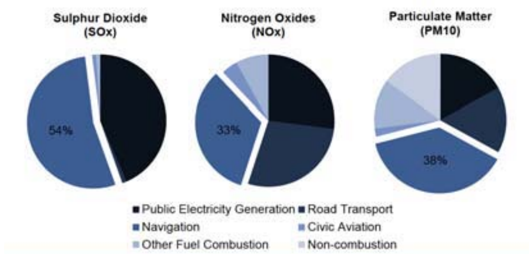
Fuel-cycle SO_2 emissions of EVs compared to those of gasoline ICEVs and HEVs in China



Source: Huo, H., et al.

Challenges – non-road vehicle missions

Shipping has become the biggest source of SOx, NOx, and PM10 in Hong Kong...



Source: Environmental Protection Department, HKSAR Government

Summary

- Energy security drives stricter programs on vehicle emissions and energy consumption
- Road transportation is and will remain a dominant source for energy consumption and pollutants emissions in transportation sector
- More efforts need to be put on emerging non-road mobile sources
- Clean fuels (especially clean diesel) enable technologies that address both fuel economy improvement and emissions control
- Balance the alternative fuel vehicle and its environmental impacts

ENERGY FOUNDATION
能源基金会

Building a sustainable future

Thank You!

生物质能源

与低碳经济

孟海波 研究员/博士
农业部规划设计研究院 能源环保研究所
2013年8月·北京

生物质能源与低碳经济

- 背 景
- 生物质能源与低碳经济
- 思 考

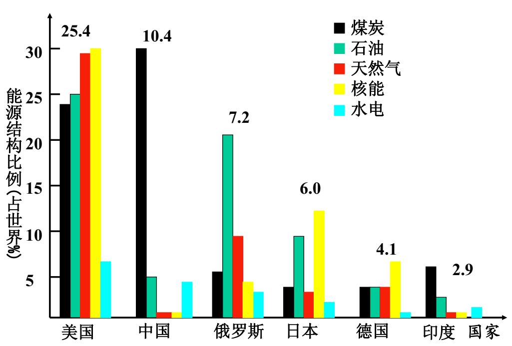
背景—碳与高碳经济

- **碳-**“碳汇(库)”[C sink (pool)]、“碳排放“(C emission)和“碳循环”(C cycling) “碳中性”(Cneutral)、“碳封存”(C sequestration)、“碳足迹”(Cfootprint)等
- **碳经济-**“碳税”(C tax)、“碳交易”(C- certificate trading)、“零碳排放能源技术”(C-free energy technology)
- **高碳经济-**大量使用和依靠煤和石油(含天然气)的经济；注定要排放巨量的CO_2, 还有SO_2, 和氮氧化合物等其他温室气体, 是不可持续的。

背景—典型的高碳经济

- **高能耗不可持续**
  - 1980~2000 年间, 我国能源需求与GDP 之间的弹性系数为0.43。十一五超过了1.0，到2020 年, 届时的年能耗将超出50 亿t 标准煤， 能源安全受到严重威胁。
  - 我国大气中70%的CO_2、90%的SO_2 以及67%的NO*x*, 还有一半以上的总悬浮颗粒均来自煤炭
- **重要成因**
  - 依赖基建投资、加工外贸，大量消耗能源和资源，并大量排放温室气体

背景—能量消耗前六名的国家



问题与途径

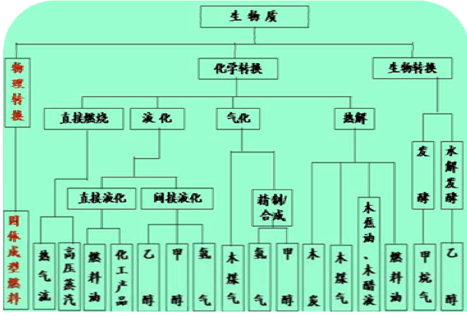
- □ 对化石能源过度依赖，造成了两个日益突出问题
- ◆ 环境污染日益严重
- ◆ 现存的化石燃料储量日趋减少
- □ 解决途径
- ◆ 节约使用能源；
- ◆ 开发利用新能源或可再生能源

生物质能源应运而生

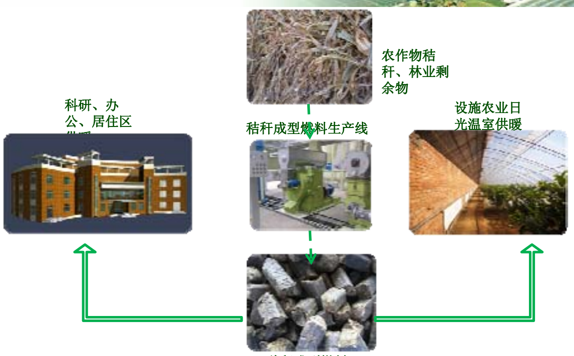
生物质能源

◆利用农作物秸秆、树木、其它植物及其残体、畜禽粪便、有机废弃物为原料，经加工转化生产的一种清洁可再生能源。主要包括生物质发电、可燃气（如沼气）、生物质成型燃料、生物液体燃料以及生物炭等

生物质能源技术路线与产品



生物质成型燃料利用



沼气利用

沼气发电、提纯压缩后供燃气，替代天然气

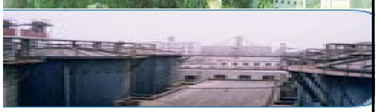
生物液体燃料

◆燃料乙醇的主要原料：
- 粮食（玉米）
- 薯类（木薯）、甜高粱茎秆
- 甘蔗
- 农作物秸秆等

◆生物柴油的主要原料：
- 林木种子：小桐子、黄连木
- 地沟油

液体燃料—生物乙醇利用

◆吉林燃料乙醇
◆河南天冠
◆黑龙江华润
◆安徽丰原
◆广西北海（木薯乙醇）



液体燃料—生物柴油利用

生物质能源是典型的低碳燃料

◆大气环境造成的影响而言，生物质能有两大基本特点:

- 燃烧时获单位能量所产生的温室气体量，只有化石能源的1/8 左右;
- 从生物质能的全生命过程(Life cycle, 指从植物的种植到最终被焚烧)来讲, 生物质能温室气体"投"、"产"平衡，是所谓"碳中性"

生物质能源的低碳性

◆生物质能源（燃料乙醇和沼气），是应用碳原子远少于烃类的醇、烷类，不但热效率高，而且在使用中空气污染物(如SO_2)和悬浮颗粒(TSP)的排放量很低。

- 如燃料生物乙醇的CO_2 排放量只有汽油的1/8，而生物柴油只有柴油的1/2。

◆对节能减排和推行低碳经济作出积极的贡献

沼气的特殊温室气体减排效应

◆ 沼气燃料的温室气体排放因子远低于煤和石油，分别为748 g/kg的 CO_2 和0.023 g/kg的CH_4; 而煤炭则分别高达2 280 g/kgCO_2 和2.92g/kgCH_4。

◆ 1990~2010 年, 中国沼气累计提供了相当于2.84×10^7t标煤的能量, 相当于减排7.3 亿t温室气体当量。按照沼气发展规划, 到2020年将达到年产约600 亿m^3 沼气, 可相应减排温室气体当量1.2亿t。届时，全年全国温室气体排量将达40 亿t, 沼气可做3%的直接减排贡献。

生物质成型燃料减排效应

◆ 生物质成型燃料的燃烧利用是将植物光合作用固定的大气中的CO_2再释放到大气之中，形成区域循环，也是零排放，1吨秸秆成型燃料可替代0.5吨标煤，减排CO_2 1.3吨，按照可再生能源中长期发展规划，到2020年，年利用量达到5000万吨，则减排6500万吨;

◆ 与煤炭比较，还可以减少SO_2、颗粒物PM2.5排放，应对雾霾天气

两点思考

◆农业和农村能够增加化石能消耗及增排污染物和温室气体，反之加以开发利用，也能为节能减排做出很大贡献;

◆高碳经济转为低碳经济，节能减排一定要有新思路和新的着力点，生物质能源不失为一条新路径。

谢 谢！

CARNEGIE-TSINGHUA
CENTER FOR GLOBAL POLICY

中国电动汽车发展
- 转向快车道

王韬| 2013年10月23日
常驻学者，能源和环境项目

关于清华-卡内基全球政策中心

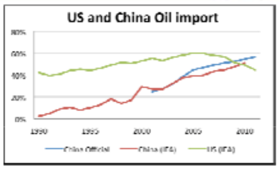
- 卡内基国际和平基金会于1910年成立，并于2010年和清华大学国际关系学系共同建立了清华-卡内基全球政策中心。
- 致力于成为“全球性智库”，总部位于华盛顿，另外5个分部分别设立在3个大洲。在2013年，印度中心也计划成立。
- 基金会是一个私人，非营利性的组织，致力于增进国与国之间的合作关系。中心的工作无党派性，以取得实效为目的。
- 能源和环境项目的目标是：1、提高相互理解 2、加强合作 3、为能源和环境政策提供独立且有建设性的政策分析。

概述

- 世界各国促进电动汽车发展的措施
- 中国、德国和美国的政策比较
- 中国电动汽车试点城市的经验
- 政策建议

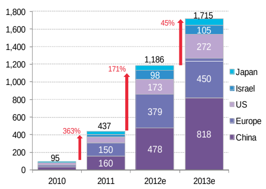
电动汽车在中国发展的好处

- 能源安全
- 环境保护
- 气候变化减缓
- 工业增长 (汽车行业的跨越发展)

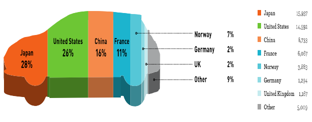


电动汽车的国际发展

公共电动汽车基础设施的总投资, 2010-13e ($百万)



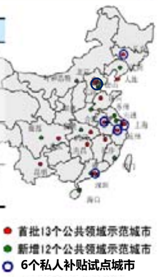
全球电动汽车销售额, 2012 (单元)



- 来源：彭博新能源经济资讯
- 来源：国际能源机构

中国试点城市

批次	时间	数量	城市
第一批	2009年1月	13	上海、深圳、长春、大连、北京、重庆、武汉、合肥、杭州、长沙、济南、昆明、南昌
第二批	2010年6月	7	广州、海口、唐山、天津、厦门、苏州、郑州
第三批	2010年9月	5	成都、沈阳、襄樊、呼和浩特、南通



2010年6月，6个私人补贴试点城市：

北京、深圳、上海、杭州、合肥、长春

摘自中国电动汽车政策和产业规划，徐长明，国家信息中心

政策比较：
目标和计划

		中国	德国	美国
目标	截至 2015	500,000纯电动车(BEV)及混合动力汽车（PHEV）	N/A	截至 2015年100万辆纯电动车，后宣布放弃
	截至 2020	截至2020年 5 百万纯电动车和 混合动力汽车by 和$160 亿的投资	(欧盟) 截至2020年5 百万纯电动车和 50亿R&D 基金	
	2020后	N/A	截至2030年6 百万纯电动车和 混合动力汽车截至2050年城市建立声电网络	N/A
产业发展计划		电动汽车科技发展“十二五”专项规划	国家电动汽车发展计划， 包括 电池、电驱动、电网	美国复苏和再投资法案（09）- 电池
		节能和新能源汽车产业发展规划2012-2020	示范项目和旗舰项目	美国清洁能源和安全法案（09）- 智能电网技术
				电动汽车随处和工作地的充电挑战 - 充电站

政策比较：
鼓励措施

	中国	德国	美国
鼓励机制	购买补贴	汽车免路税	汽车和充电站的税收抵免
	免费用电	公司轿车税费	免费停车
	限购豁免（？）	特殊的停车位和行车线	免费上牌
	免费安装充电极	使用公交优先道的权利	高乘载优先车道的使用权
		零排放 （碳交易）	零排放 （碳交易）
其他方法	出租车和公交车车队的集中采购	公共采购计划	
		低利率的银行信贷	车队平均油耗标准
		可互换车牌	保险
			电力公司
			汽车经销商

政策比较:
销售量

	中国	德国	美国
2012年电动汽车销售量	12,800 纯电动汽车 & 混合动力汽车 (11,400 纯电动汽车)	少于 3,000 纯电动汽车 & 混合动力汽车	53,000 纯动力汽车 & 473,000 混合动力汽车
汽车总销售量	1930万	6 百万	1450万
比例	0.06%	少于 0.1%	0.3% 纯动力汽车 3.3% 混合动力汽车

试点城市所得经验

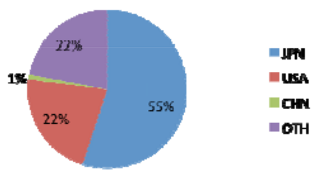
- 创新能力不足导致创新能力与技术上的差距
- 目前缺乏动力让中国汽车制造商专注于电动汽车的技术发展
- 缺乏必要的基础设施和激励促使人们在日常生活中使用电动汽车而非传统汽车
- 过分依赖补贴，缺乏合适的商业模式

2013年9月最新的电动汽车补贴政策

- 政府重点加大政府机关、公共机构、公交等领域
- 这些补贴将在2014年减少10%，在2015年减少20%。以此鼓励生产商逐渐降低汽车的价格。
- 此外，30%新购的市政用车必须是电动的
- 更重要的，推广应用的车辆中的30%必须来自外地品牌，以此防止地方贸易保护主义。

政策建议:
向国际先进的汽车制造商开放国内电动汽车市场

锂电池专利注册总数

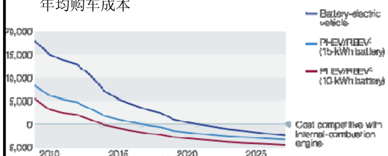


政策建议:
优先鼓励电动汽车在商业运营部门的使用




政策建议:
营造有利于电动汽车使用的外部环境

年均购车成本



政策建议:
发展能够实现自我维系的商业模式


替代能源与碳捕集技术的进展

范英，朱磊

能源与环境政策研究中心
中国科学院科技政策与管理科学研究所

内容

一、可再生能源发展规律研究

背景

- 化石能源的日益耗竭和各国面临的前所未有的温室气体减排压力，寻求低碳能源是共同的目标
  - 以清洁高效著称的核电曾一度被认为是替代化石能源最有效的选择，但日本福岛核电站泄漏事故使得各国开始重新审视核电发展规划
  - 在化石能源供给有限和应对气候变化的双重压力下，长期世界能源需求缺口在很大程度上需要通过可再生能源来弥补
- 在所有可再生能源品种中，当前发展最充分且技术最完善的是风能和太阳能，这两种能源在全球的总装机已十分可观
  - 大规模、集中式的开发方式使得过去10年间，全球风电装机以年均26.9%的速度增长，其装机规模已由2000年的17.4 GW增加至2011年的238.4 GW
  - 2000年时，全球累计太阳能装机仅为678 MW，2011年这一数值已跃至42.6 GW，年均增长率达46.4%

问题提出

- 世界各主要可再生能源大国的风能和太阳能市场呈现出什么样的特点，这些特点又将如何影响各自的发展？
- 各国风能和太阳能技术间存在着怎样的相互关系，共生促进，彼此阻滞抑或是捕食依存？
- 从全球范围来看，太阳能和风能技术的扩散有着怎样的规律，规律背后隐含着哪些政策共性与差异？

研究方法

基于产品和技术扩散理论，我们采用Lotka-Volterra模型，利用跨国分析的方法来研究世界主要国家风能和太阳能技术的发展规律，彼此间的扩散关系，以及未来各自的发展趋势

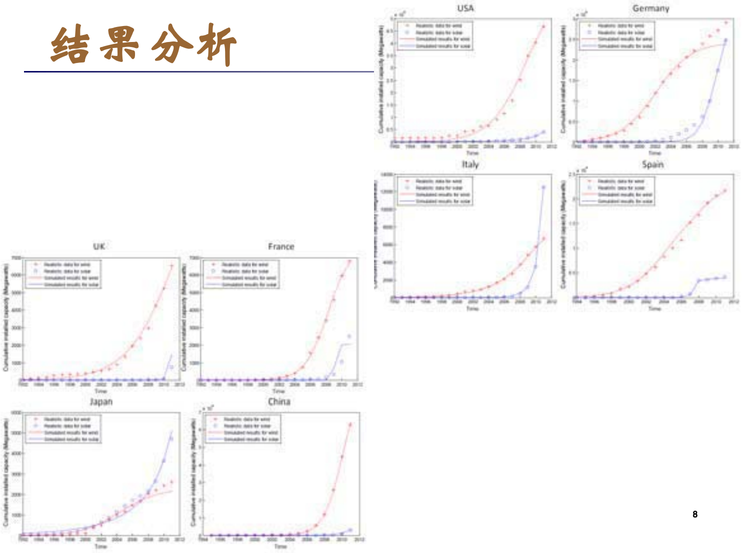
$$\begin{cases} \dfrac{dx_1}{dt} = x_1(a_1 + b_1x_1 + c_1x_2) \\ \dfrac{dx_2}{dt} = x_2(a_2 + b_2x_2 + c_2x_1) \end{cases}$$

结果分析

Table The parameter estimation for selected leading countries

Parameter	Coef	Sta error	Adjusted-R^2	Parameter	Coef	Sta error	Adjusted-R^2
Estimation results for wind power				Estimation results for PV solar			
USA				USA			
a_1	0.5109	0.0794	0.9902	a_2	0.1958	0.0271	0.9995
b_1	-1.04e-5	6.16e-6		b_2	8.42e-5	2.91e-5	
c_1	2.88e-5	8.75e-5		c_2	6.17e-6	2.12e-6	
Germany				Germany			
a_1	0.4501	0.0373	0.9985	a_2	-1.4159	0.5103	0.9970
b_1	-1.86e-5	2.14e-6		b_2	-5.26e-5	8.59e-6	
c_1	7.81e-6	1.88e-6		c_2	1.01e-4	2.35e-5	
Italy				Italy			
a_1	0.3699	0.0477	0.9976	a_2	1.0076	0.4075	0.9997
b_1	-2.58e-5	1.51e-5		b_2	2.00e-4	5.00e-5	
c_1	-1.740e-5	1.51e-5		c_2	1.49e-4	9.83e-5	
Spain				Spain			
a_1	0.4617	0.0637	0.9967	a_2	2.0657	0.3821	0.9835
b_1	-2.33e-5	5.81e-6		b_2	-0.00138	1.12e-4	
c_1	1.83e-5	1.58e-5		c_2	1.61e-4	2.64e-5	
UK				UK			
a_1	0.3799	0.0631	0.9943	a_2	-1.8640	0.4815	0.9978
b_1	-3.32e-5	2.62e-5		b_2	0.2058	0.0115	
c_1	6.340e-4	0.0015		c_2	-5.27e-4	2.17e-4	
France				France			
a_1	0.6810	0.0734	0.9973	a_2	-0.9114	0.4481	0.9971
b_1	-8.78e-5	2.4e-5		b_2	-2.501e-3	3.4e-4	
c_1	-1.40e-5	7.88e-5		c_2	8.24e-4	1.29e-4	
Japan				Japan			
a_1	0.4326	0.0594	0.9950	a_2	0.1597	0.0862	0.9921
b_1	-2.02e-4	7.23e-5		b_2	3.54e-5	6.15e-5	
c_1	3.62e-5	4.32e-5		c_2	8.19e-6	1.06e-4	
China				China			
a_1	1.3283	0.0706	0.9991	a_2	0.3699	0.1618	0.9982
b_1	-2.72e-5	7.02e-6		b_2	-1.44e-4	7.53e-4	
c_1	3.24e-4	2.84e-4		c_2	4.48e-5	1.75e-5	

结果分析



结果分析

Table Summary on internal competition of wind market and PV solar market and the relationship between them across countries

Country	Wind market scale dependence*	PV market scale dependence	Relationship between wind and PV solar technology	
	Yes or No?	Yes or No?	Mutualism	Predator-prey
U.S.A	Yes	No	√	×
Germany	Yes	Yes	√	×
Italy	Yes	No	×	√
Spain	Yes	Yes	√	×
U.K	Yes	No	×	√
France	Yes	Yes	×	√
Japan	Yes	No	√	×
China	Yes	Yes	√	×

* Scale-dependence originates in the phrase 'density-dependence' in Population Ecology, and density dependence processes may occur when population growth rates are regulated by the density of a population.

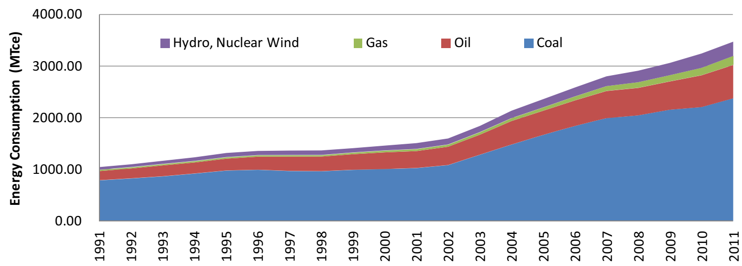
结论

- 从全球范围来看，风能技术仍处于快速发展和扩张阶段，各国风电市场均存在着规模制约现象
- 分散式发展模式下的光伏太阳能市场发展可实现规模促进效应
- 不同国家可再生能源政策差异性使得风能和太阳能技术之间关系不同
- 缺乏长远的可再生能源发展规划和稳定的能源政策使得当前多数国家风能和太阳能技术市场无法达到稳定状态

二、不同情景下国内替代能源技术未来发展趋势分析

背景

- 国内经济的持续快速增长也带来了能源消费的快速增长，作为一个能源消费以煤为主的国家，国内煤炭消费在能源消费中所占比例接近70%，这导致了大量的温室气体排放



问题提出

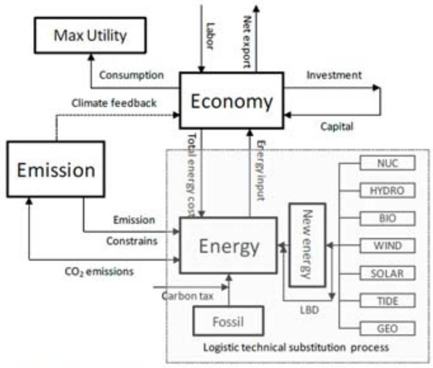
Center for Energy and Environmental Policy research

- 在不同的排放空间约束下，如何对国内未来的替代能源发展进行综合评价分析？
- 国内未来的替代能源发展趋势如何？

研究方法

Center for Energy and Environmental Policy research

模型框架

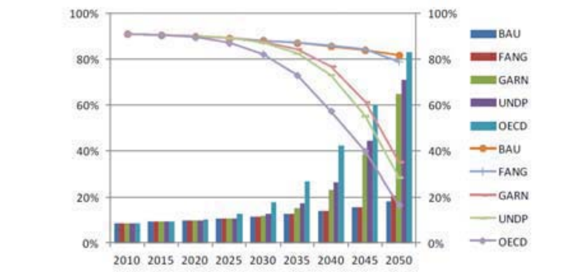


(NUC, HYDRO, BIO, WIND, SOLAR, TIDE and GEO in figure 1 means nuclear, hydropower, biomass, wind, PV solar, tide and geothermal energy technologies, respectively. Potential climate feedback damage that is depicted by dotted line in figure 1 is not considered in this model)

图. CE3METL 模型框架图

结果分析

Center for Energy and Environmental Policy research



(Bars and lines in this figure show the shares of new energy technologies and those of fossil fuels in the primary energy demand, respectively)

图. 排放约束对中国新能源技术发展的影响

结果分析

Center for Energy and Environmental Policy research

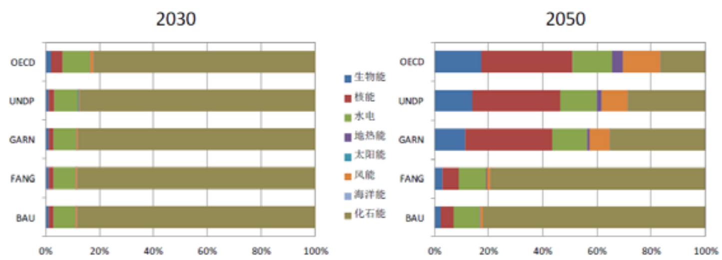


图. 各情景下 2030 年与 2050 年各种新能源技术的消费比重

结论

Center for Energy and Environmental Policy research

- 受技术发展水平的限制、化石能源资源禀赋的优势以及经济对化石能源的依赖惯性，能源结构大规模调整需要比较长的时间。这意味着即使在最严格的OECD情景下未来20-30年内的能源市场仍将由化石能源主导
- 在没有碳减排政策的激励下，国家提出的“十二五”非化石能源发展目标至少要在2030年左右才能实现
- 新能源技术的发展及其市场竞争力的培养不是通过短期的政策行动就能完成的，niche市场的快速成长以及无碳新能源对传统化石能源替代能力的最终形成需要相关部门尽早行动

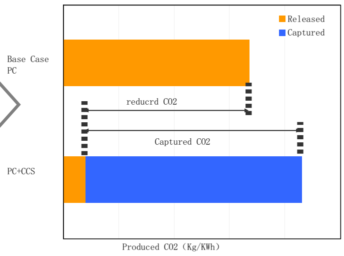
Center for Energy and Environmental Policy research

三、碳捕集技术进展与投资评价

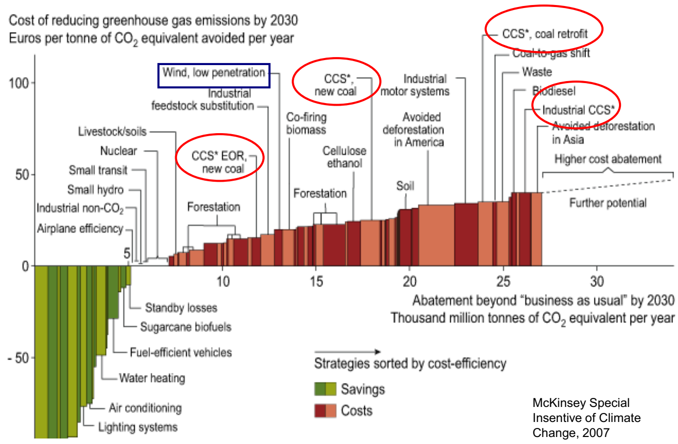
背 景

- 影响CCS发展的两个主要因素
  - 气候政策

  - 成本



背 景

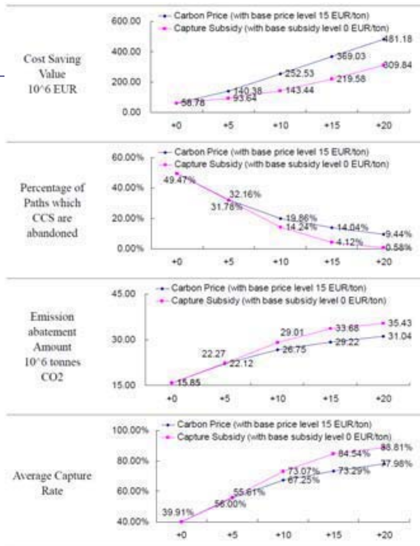


案例研究

- 欧盟认为EU-ETS将会是一个主要的促进CCS发展的政策工具
  - 促进CCS发展的合理碳价格水平？
  - 特殊的CCS激励措施？-碳捕获补贴？
  - 设置碳价格底价（e.g. UK）是否可以促进CCS投资？
- 案例研究

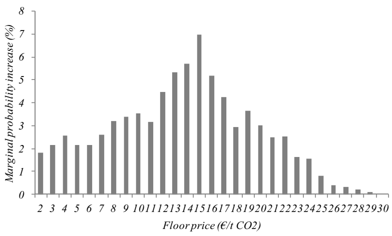
改变碳价格水平和捕获补贴水平：

- 碳价格水平与补贴水平的提高都有助于促进对现有电厂进行CCS的改造投资，但是边际效用递减
- 增加捕获补贴的效果要好于碳价格水平的提高
- 如果要将CCS改造投资风险控制在5%以内（此时投资决策将较为可行），捕获补贴水平(15 EUR/ton)和碳价格水平(35 EUR/ton) 都需要达到十分高的水平



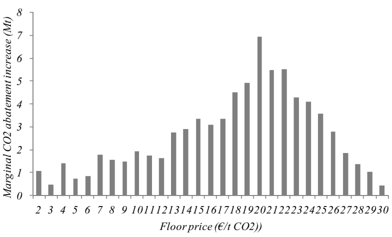
合理的碳价格底价设置

The marginal effect of the floor price increase on the investment probability



合理的碳价格底价需要达到25-30 EUR/ton

The marginal effect of the floor price increase on the CO2 abatement



结论

- 因为技术发展的不成熟和气候政策的不确定性，现有发展水平下的CCS改造风险十分高
- 当改造投资达到可行状态（投资风险控制在5%以内）时，对应的碳价格需要超过35 EUR/ton。但是因为目前较低的碳价格水平和相对较短的投资回收期，决策者很难推动电厂进行CCS改造投资
- 未来随着气候政策的更加严格以及电力部门排放配额分配的进一步缩减（或减排目标的进一步提高），电厂或将拥有更多的意愿去进行CCS改造投资

谢谢大家！

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