Energy+Environmental Economics

Electricity with Chinese Characteristics

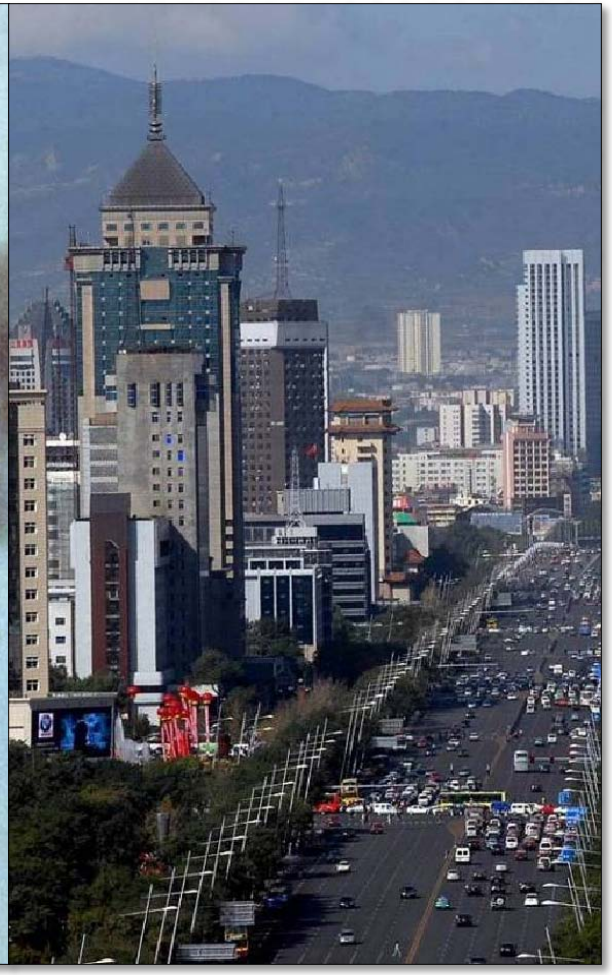
The Complexities of Decarbonizing China's Electric Power Sector

Jim Williams, Fritz Kahrl, Ding Jianhua, Snuller Price

Outline

- Importance of China's power sector
- E3 in China
- An evolutionary moment
- Lessons from the field
- U.S. role
- Concluding thoughts

Electricity, Economy and Environment

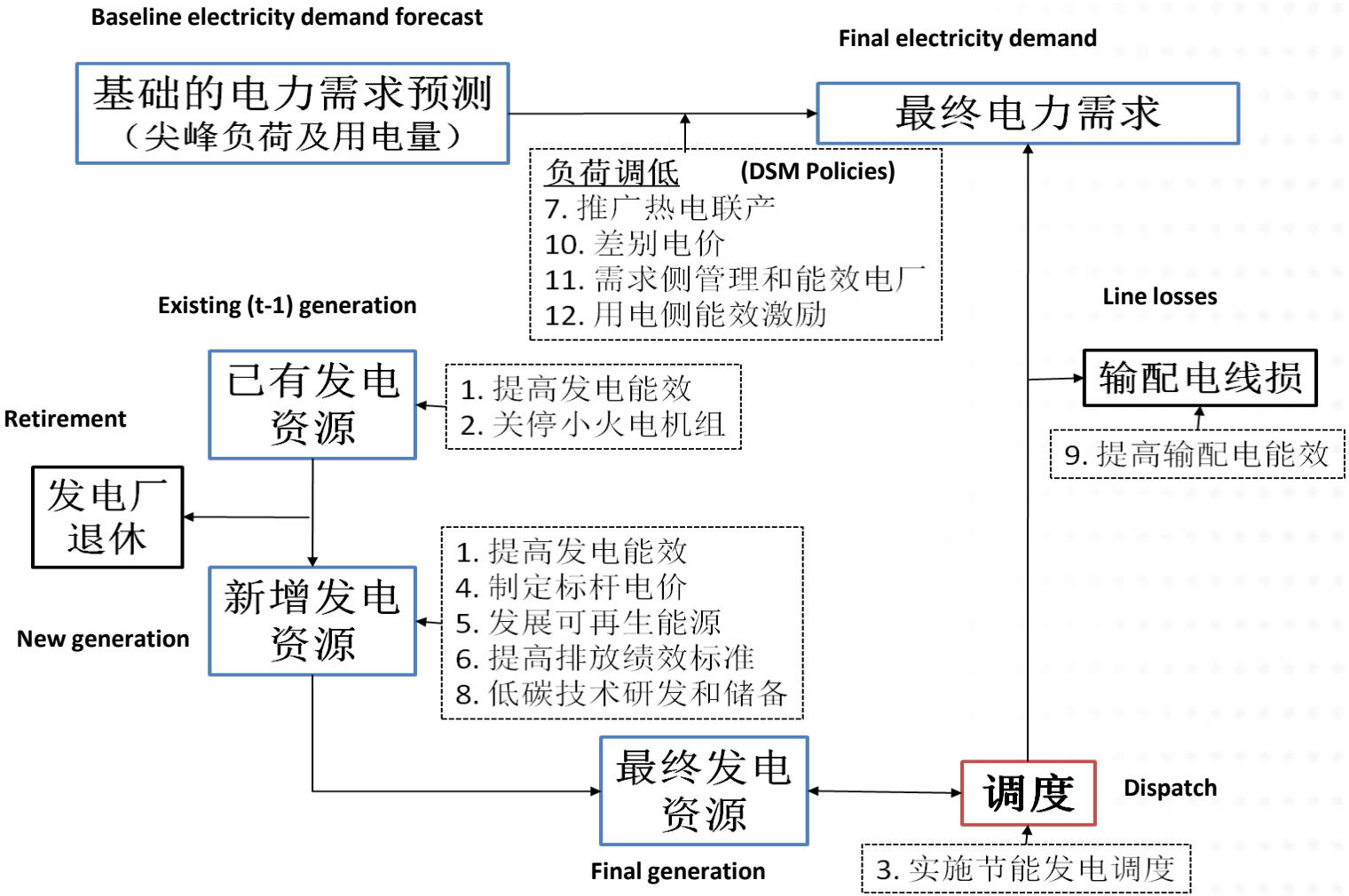


Energy and Environmental Economics, Inc.

- San Francisco-based consulting firm
- Deep expertise in electricity sector
- Policy analysis a specialty
- AB32 implementation analysis
- National Action Plan on energy efficiency (SEENet)
- 33% renewable energy standard
- 2050 low-carbon technology path model


能效电厂规划和建设
Planning and Constructing an Efficiency Power Plant
2010.06.01– 03 中国·北京
NRDC
NRDC(美国自然资源保护委员会）中国项目
Natural Resource Defense Council China P
美国能源基金会
Energy Foundation
RAP中国项目

Working with SERC Team on GHG Modeling




Energy · Environmental Economics
Getting to 2050
Technology Pathways
to a Low Carbon Future
June 7, 2010
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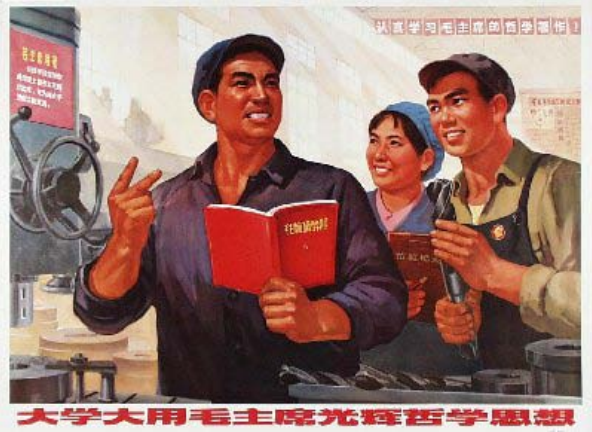
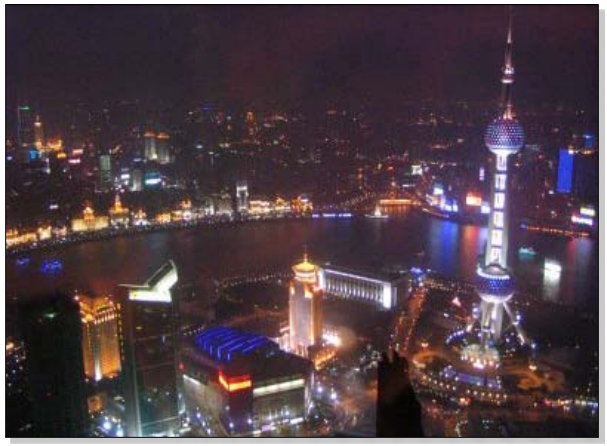
The Punchline

Sector Transition

Policy Analysis → **Decision-Making**

An Evolutionary Moment





Relatively Simple → **More Complicated**

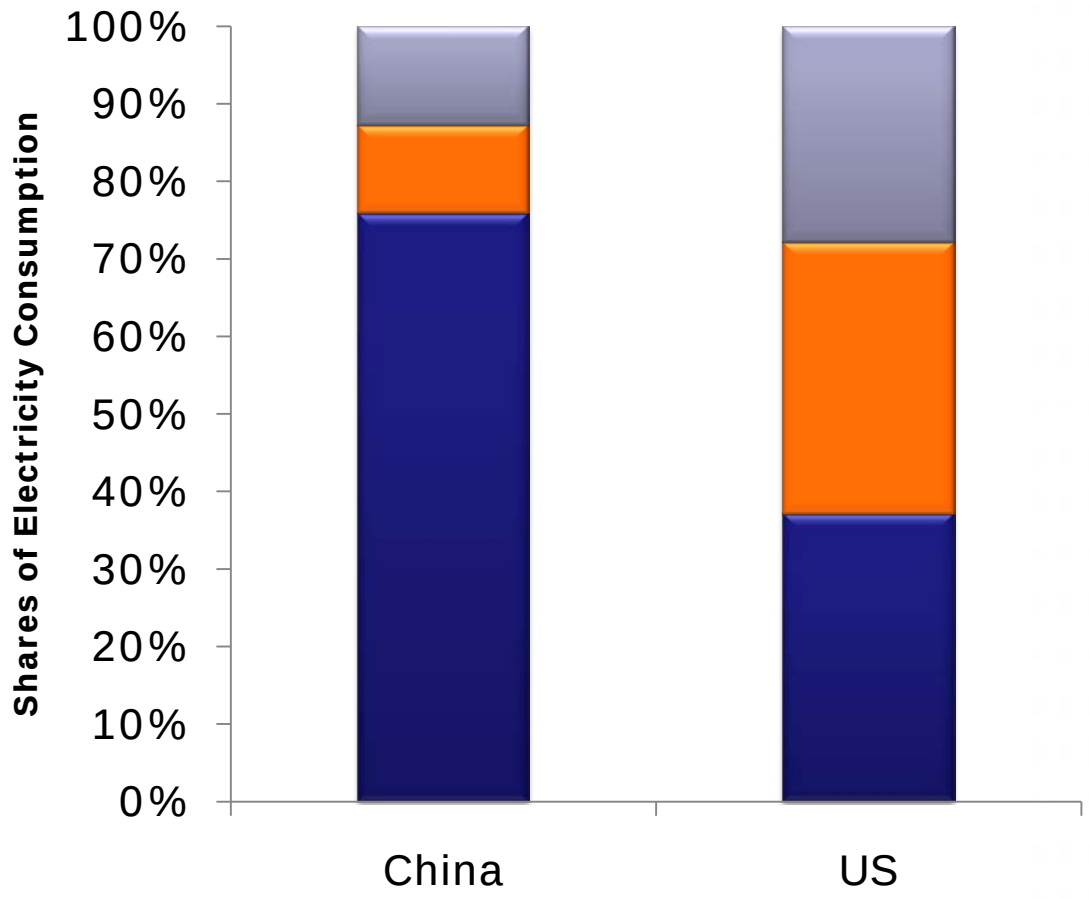
Generation Mix
Dispatch
Pricing
Planning and Investment
Regulatory Institutions

Drivers of Change

1. Changing patterns of demand forcing changes in the way the system is run
2. Concern about environment, both local air pollutants and CO_2
3. Rising electricity prices – already expensive system is about to get more expensive
4. Institutional pressures are reigniting reform efforts

Driver 1: Patterns of Demand

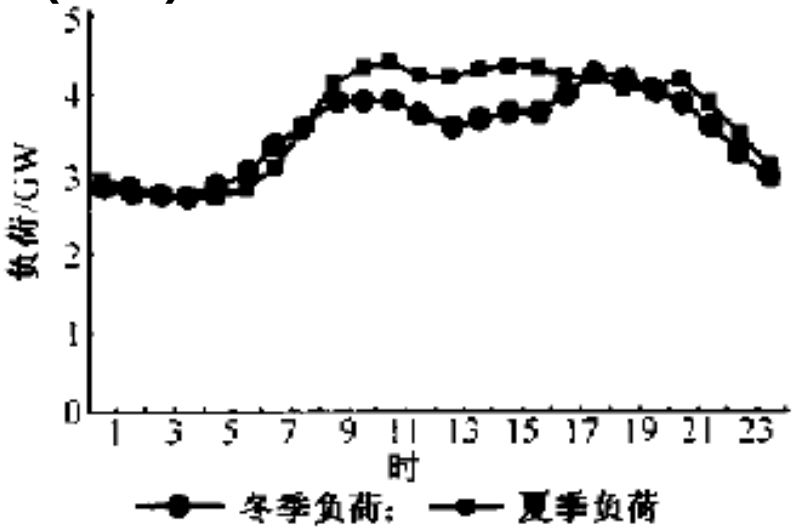
Figure 1: Electricity Consumption in China and the U.S. by Sector, 2005



Source: China data are from the National Bureau of Statistics, *China Statistical Yearbook*, various years; U.S. data are from the EIA website. For both countries, transportation is bundled in the Commercial sector. Industry includes agriculture in both countries.

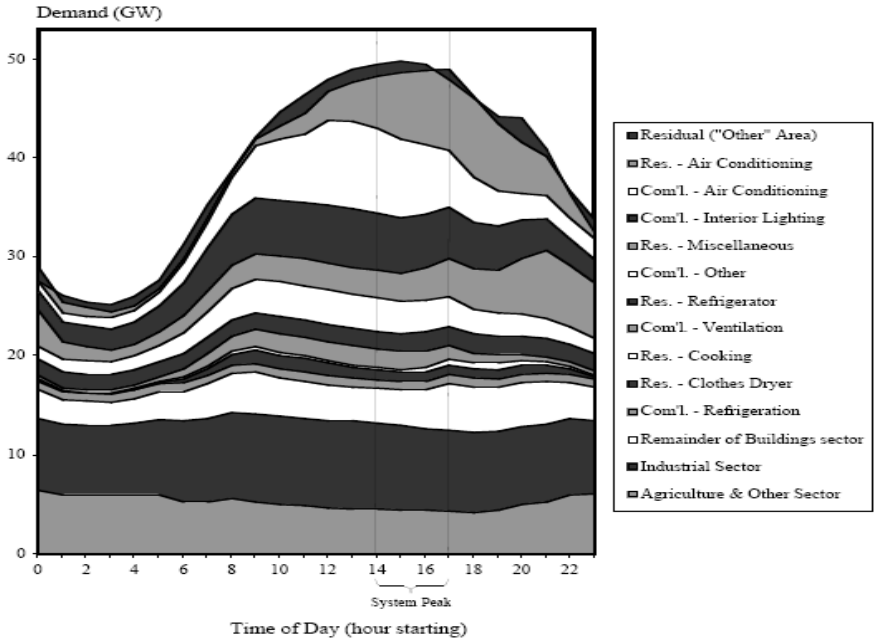
Changing Patterns of Demand

Summer Load Profile, Beijing (1997)



Source：胡兆光，2001，“需求侧管理在中国的应用与实施,”电力系统自动化,第25卷第1期。

California Load Profile, 2003



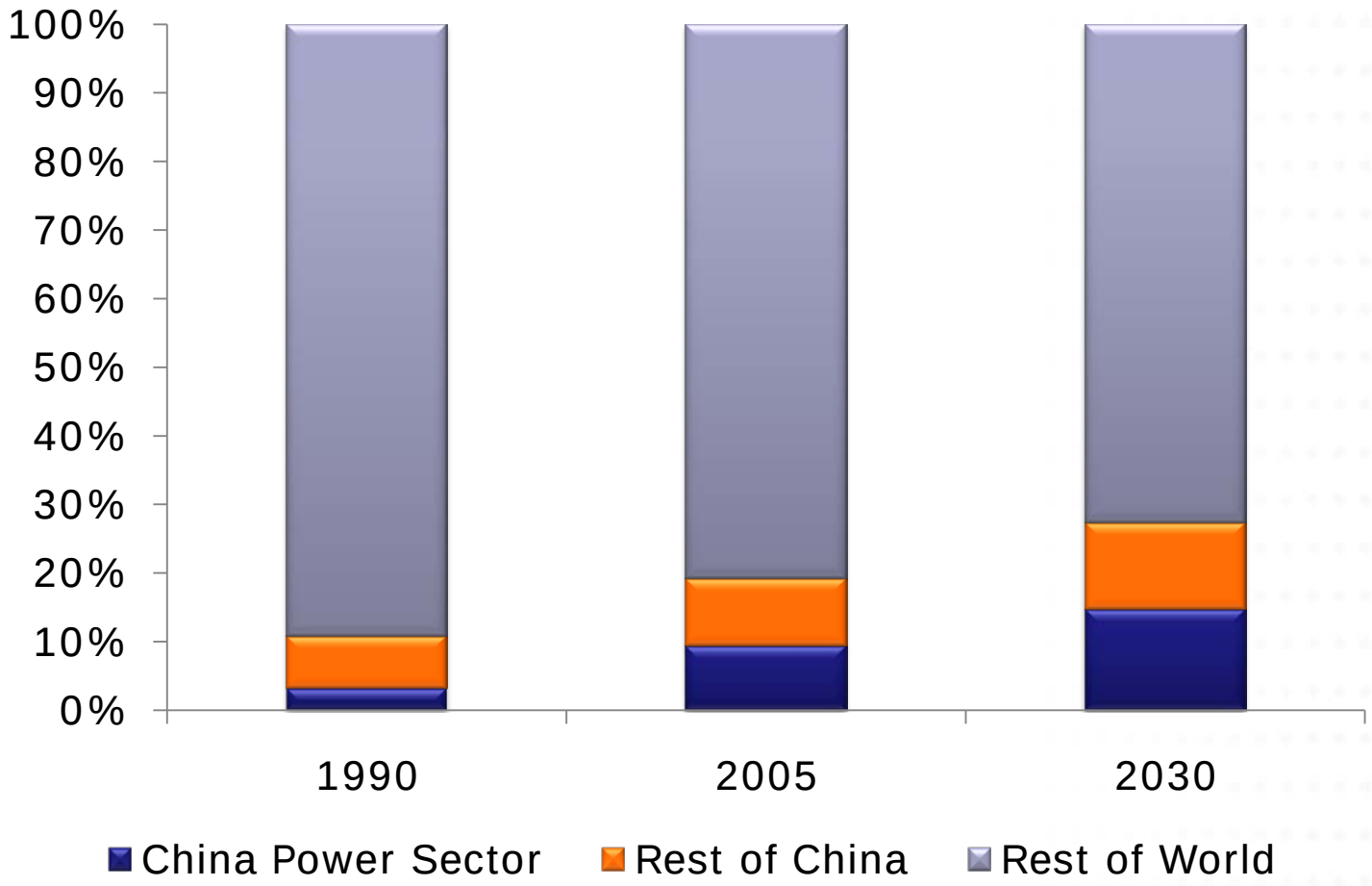
Source: Brown and Koomey, 2004

Demand Patterns Have Shaped Electricity Sector Evolution

- **High industrial demand and flat load shape has allowed:**
  - A system run on a baseload resource (coal ~80% of generation, does baseload, load following, peaking)
  - Equal shares dispatch
  - No direct relationship between production costs and retail prices
  - Strong residual roots in planned economy institutions – regulator does not have pricing authority and state-owned companies and NDRC still have predominant influence over sector investment / operational decisions

Driver 2: Electricity and GHG Emissions

Figure 2: China's Power Sector as a Share of Global Energy-related CO_2 Emissions



Source: IEA, *World Energy Outlook 2007*; 2030 projections are based on the IEA's Reference Scenario for China.

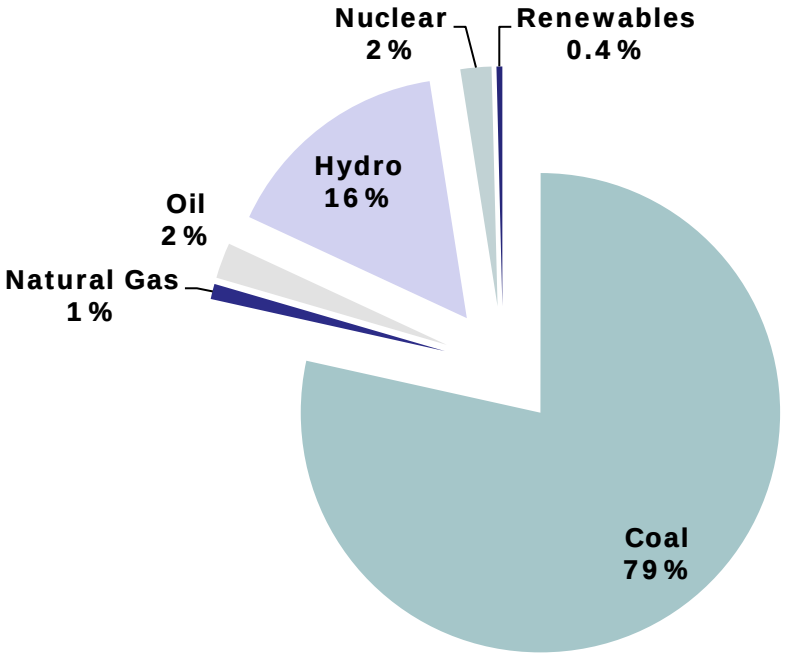
Growth and the Challenge of Reducing the Share of Coal

Electricity Demand

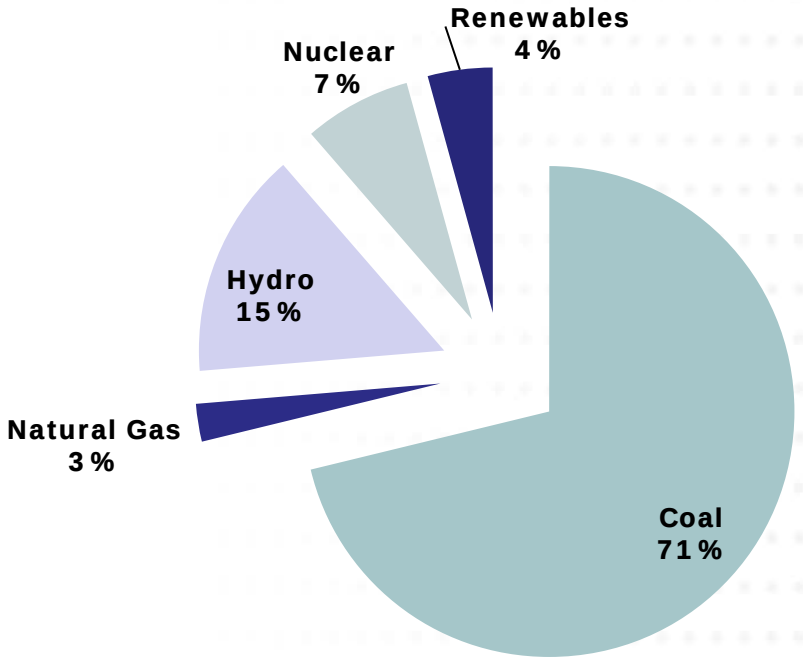
2005	2020
2,543 TWh	7,496 TWh

	2005	2020
Nuclear	53 TWh	530 TWh
Renewables	10 TWh	321 TWh
Hydro	397 TWh	1,122 TWh

Generation Mix, 2005

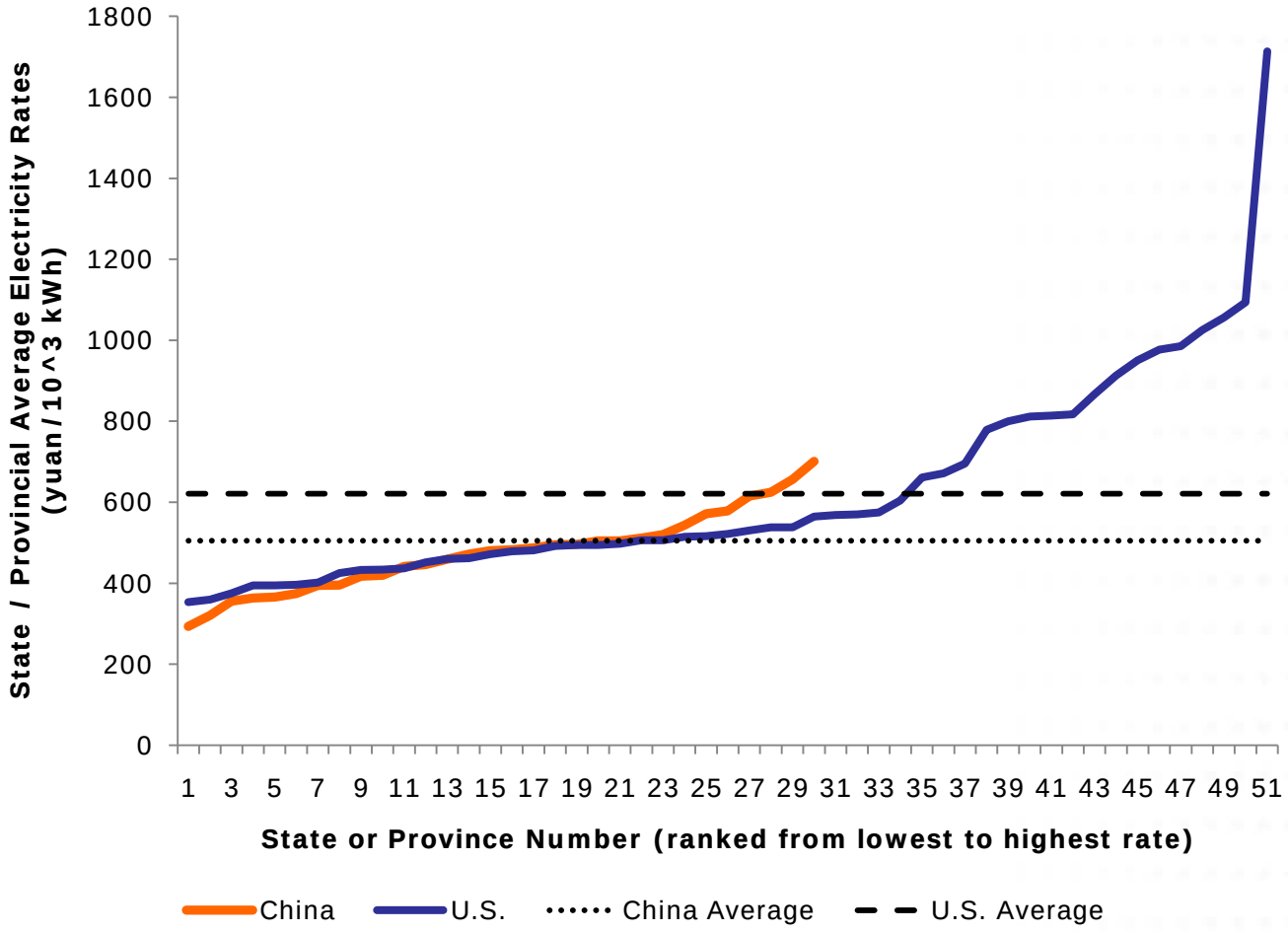


Generation Mix, 2020



Driver 3: Prices
Electricity in China is not Cheap

Figure 3: Average Retail Electricity Rates in China and the U.S. by Province/State (ranked lowest to highest), 2005



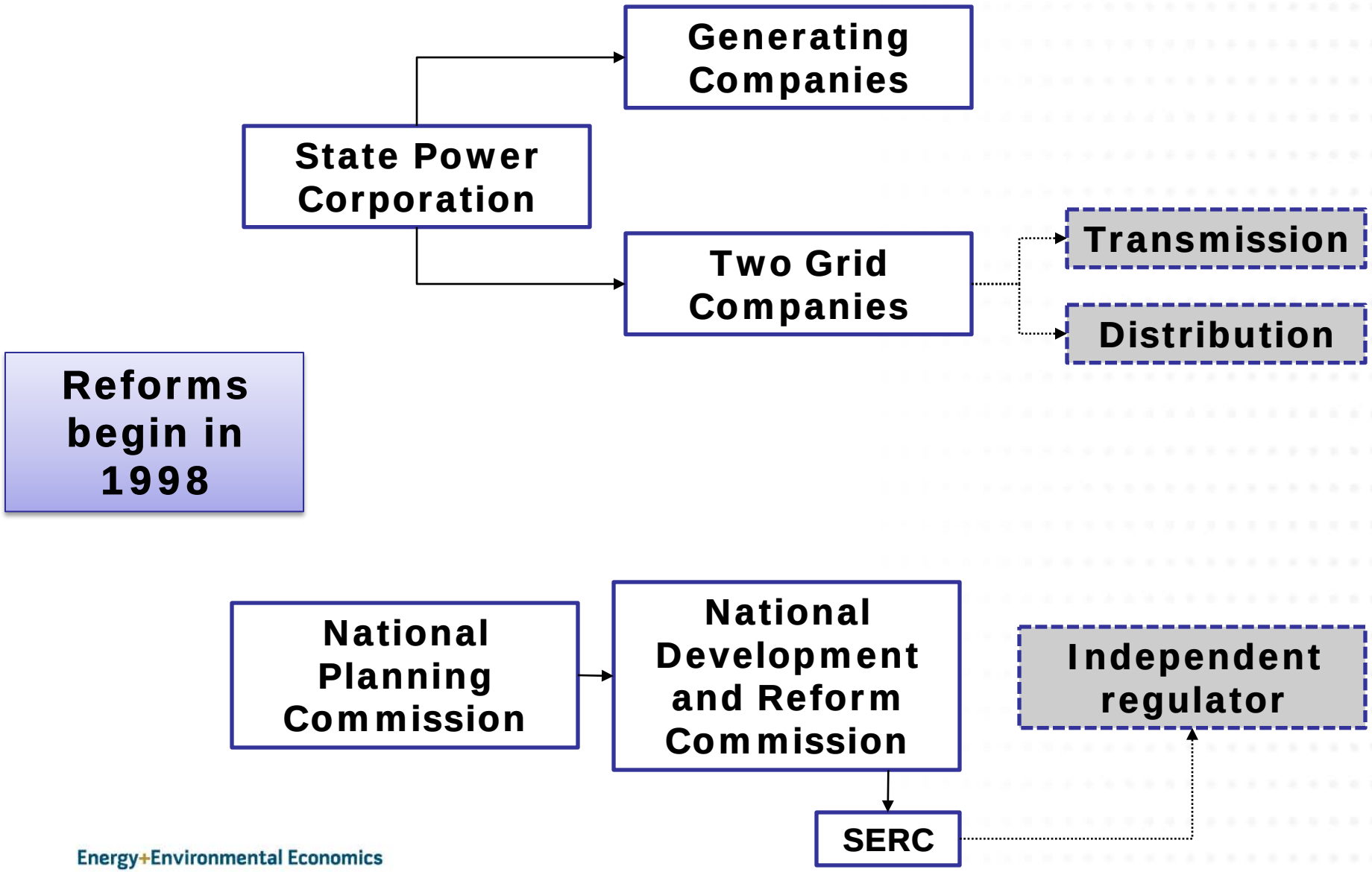
Sources: U.S. data are from the EIA website. China data are from State Electricity Regulatory Commission, *Annual Report 2008.*

Rising Costs are Putting Upward Pressure on Prices

“Price is the main issue in China’s electricity system”

- Professor Zhou Yuhui, Beijing Jiaotong University

Driver 4
Pressures for Institutional Reform



Wind is an Example of Part of Power Sector Shaped by Transition

- Environmental: Demand for wind power, possibly more than 150 GW by 2020
- Demand: Changes in the way system is being run change the reliability and economic considerations of bringing more wind online
- Prices: How to limit the impact of large amounts of wind on cost and rates?
- Institutional: Who should pay for the additional cost of wind, and how?

These are kinds of questions that policy analysis can address

Lessons from the Field

+ E3 Work in China:

- Introduce analysis tools from the U.S.
- Explore appropriate analysis tools for China
- Provide feedback

+ Insights:

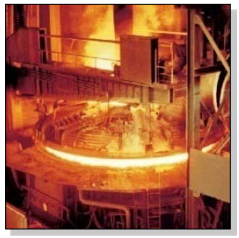
- Models need to be localized
- Data can be an issue, but…
- Digging into the details often reveals surprises
- Value of exchange

Two Framing Questions

- What is the cost of reducing GHG emissions?

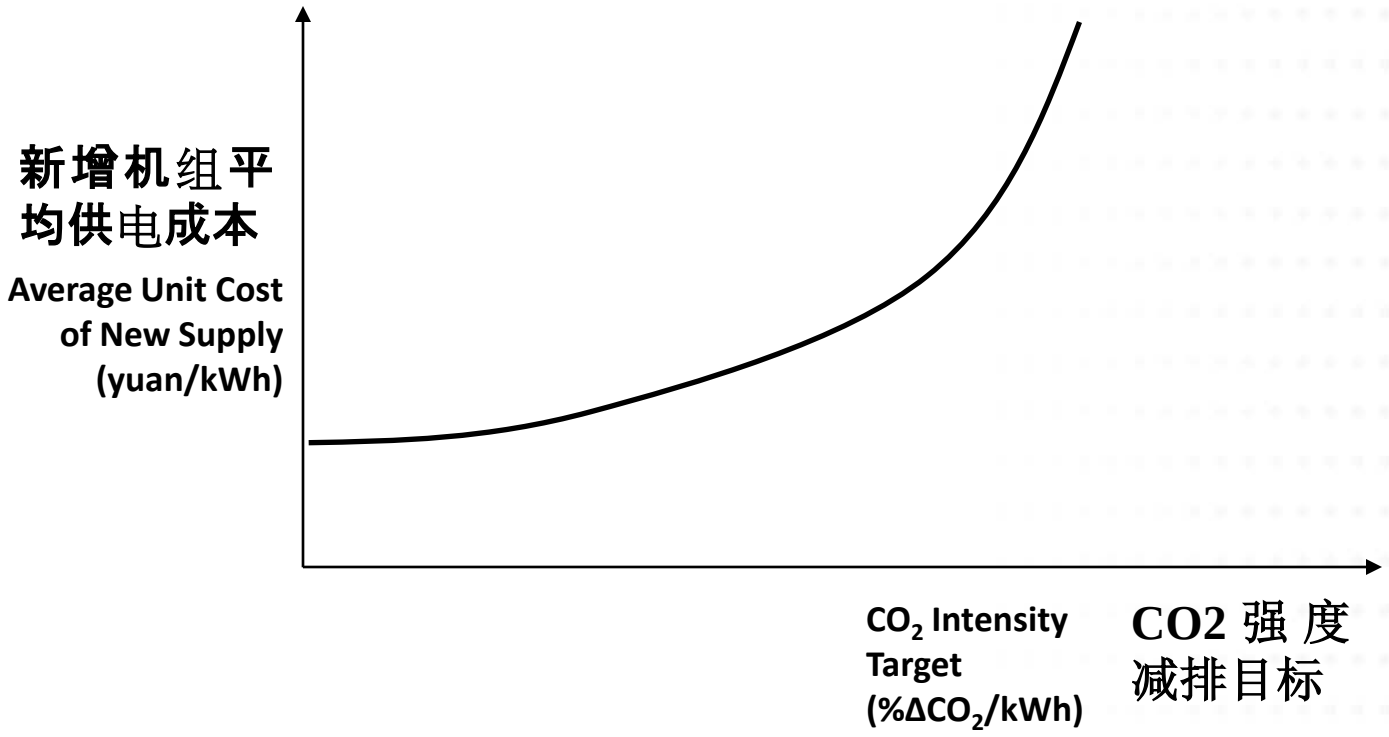


- How much to invest in energy efficiency?




SERC's Question: What is the Cost of Reducing GHG Emissions?

Figure 4: Cost of Reducing CO_2 Intensity of Electricity Generation



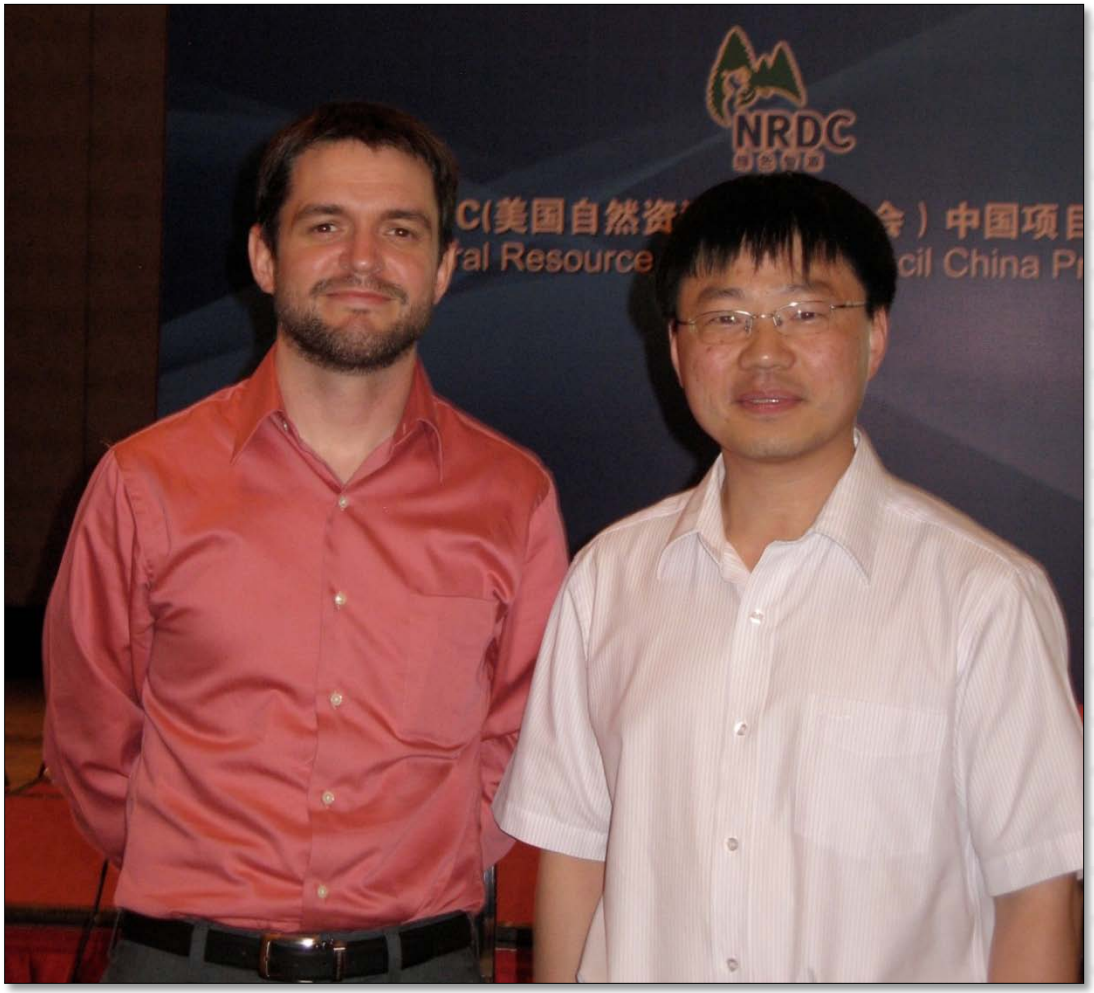
GHG Reduction Policies: Questions are Similar to U.S.

Many of the questions for GHG reduction policies in China are the same as those in the U.S.

- What level of reductions is feasible for given cost?
- What's the right mix of supply and demand side policies?
- How will new generation technologies change the way operations work?
- How much new transmission required and how to pay for it?
- How can increases in cost be fairly allocated?

Shared Learning and the Value of Process

- U.S.-China: bridging between space, time, language, terms, rules of thumb, modeling preferences
- Researcher-policymaker: collaboration between SERC and its modeling team



How Much to Invest in Energy Efficiency?

"EE/DSM funds are often inefficiently spent"
Dr. Chen Jianghua, Vice Director, State Grid DSM Center

- **Lack of coordination among actors**
  - Central and local governments main investors in energy efficiency
  - Gridcos main actor in demand-side management
  - Emergence of ESCOs, though still small
  - No explicit ratepayer advocate
- **Institutional framework still incomplete**
  - No standard methods for rationalizing EE/DSM
  - No clear rules on allocating EE/DSM costs and benefits
  - Lack of transparency and little accountability
- **Inefficient use of funds, investments not cost-effective from a societal perspective**

Energy Efficiency: Similar Questions as U.S.

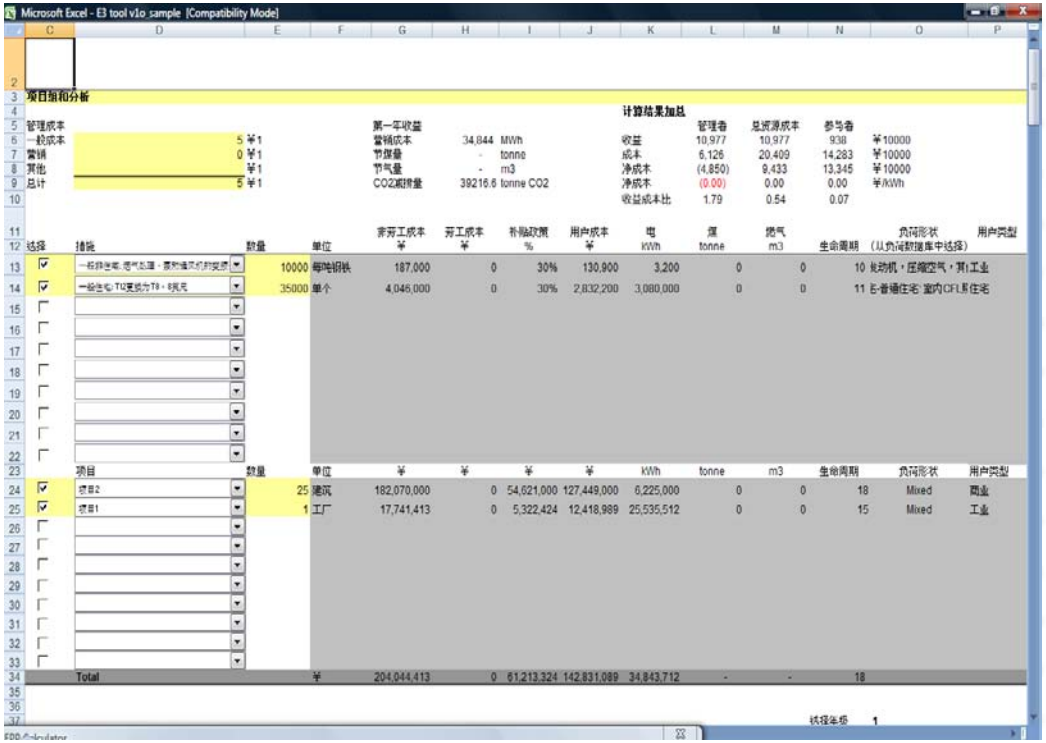
Many of the questions for energy efficiency in China are the same as those in the U.S.

- How much does energy efficiency cost?
- What are the demand-side and supply-side benefits?
- Who pays for the costs and who receives the benefits
- How can costs and benefits be fairly allocated?

Using Analysis to Overcome Institutional Obstacles

- 750 billion RMB in supply-side investment in 2009
- Scaling up energy efficiency will require more coordination and accountability
- Need for analytical tools that can bring more transparency to investment decisions

E3 EPP Calculator



What's Next for China's Power Sector? What's the U.S. Role?

Changes are Inevitable

Government Work Report 2010
- Tiered electricity pricing
- Resource pricing & pollution tax
- Renewables pricing & cost sharing

Renewable Energy Law 2010
- Provincial strategy development
- Grid interconnection

Electricity Reform Guidance 2010
- T&D separation
- Electricity price reforms

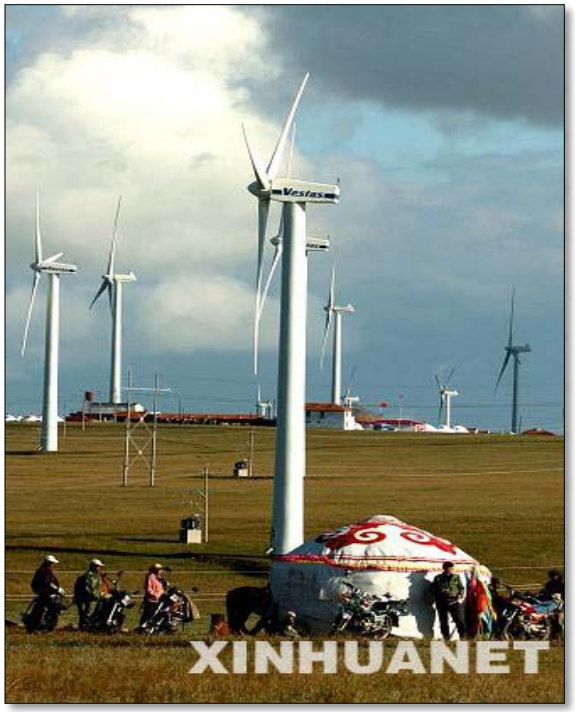
Intriguing Possibilities

Potential game-changers in 12th FYP:

+ Ministry of Energy
+ Diminished NDRC Role
+ Expanded SERC Role
+ Grid Companies EE/DSM

Two Sides to the Story: Industrial vs. Electricity Policy

- Wind and PV industries in China booming
- Wind capacity surging in China
- RE very popular in stock market



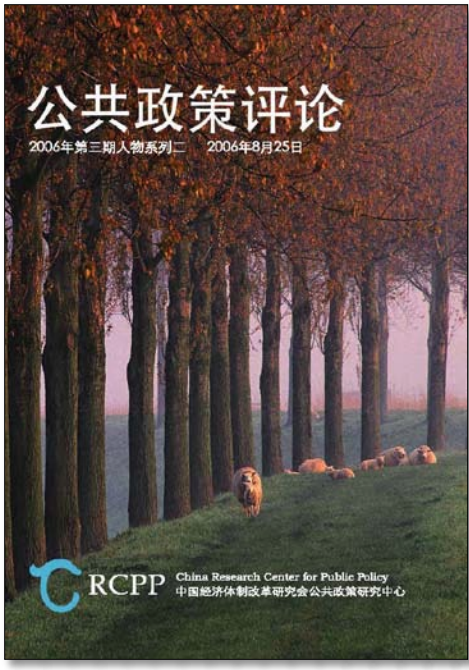
- Grid connection very difficult
- Hard to get permits for generation
- "Garbage electricity"

U.S.-China Energy Relations

- U.S. government role increasingly active: DOE hiring, Economic and Strategic Dialogue, 10-year plan, technology cooperation agreements & centers
- NGOs, universities, national labs working with Chinese agencies and experts have played a valuable role energy policy formation
- LBNL China Energy Group has been a leader in creation of public data, capacity building, demand side policy
- Still gaps related to electricity sector analysis and research

Many in China are aware that change is coming and are thinking proactively

People in government, universities, industries, private sector are thinking about the same issues as in the U.S.



"We need to change core values to make the electricity sector more sustainable."

- Xiao Peng, Vice President, Southern Grid of China

Building Capacity

Research

U.S. Choices

- US cooperation with China entails choices of what, who, how
- What: hardware not enough - need to invest in institutional change and soft technology
- Who: need to empower people and organizations with high potential for making positive change
- How: whispering in leaders' ears not enough - need to invest in process

How Can the U.S. Help?

“Methodology is what is most needed.“

- Hu Junfeng, Lecturer, North China Electric Power University

“Analysis tools for China eventually need to be generated in China.“

- Dr. Chen Jianghua, Vice Director, State Grid DSM Center

Soft Technology Approach

+ Analytical capacity building

- Tools for making cost effective decisions, identifying key institutional and policy problems to be addressed

+ Cooperative modeling

- Shared models of clean energy pathways required in both countries can inform cooperation agreements and benefit climate negotiations

+ Knowledge creation and sharing

- Mutual understanding of each others' power sectors is important for trust building and effective cooperation
- Provide stimulus for developing publicly available data

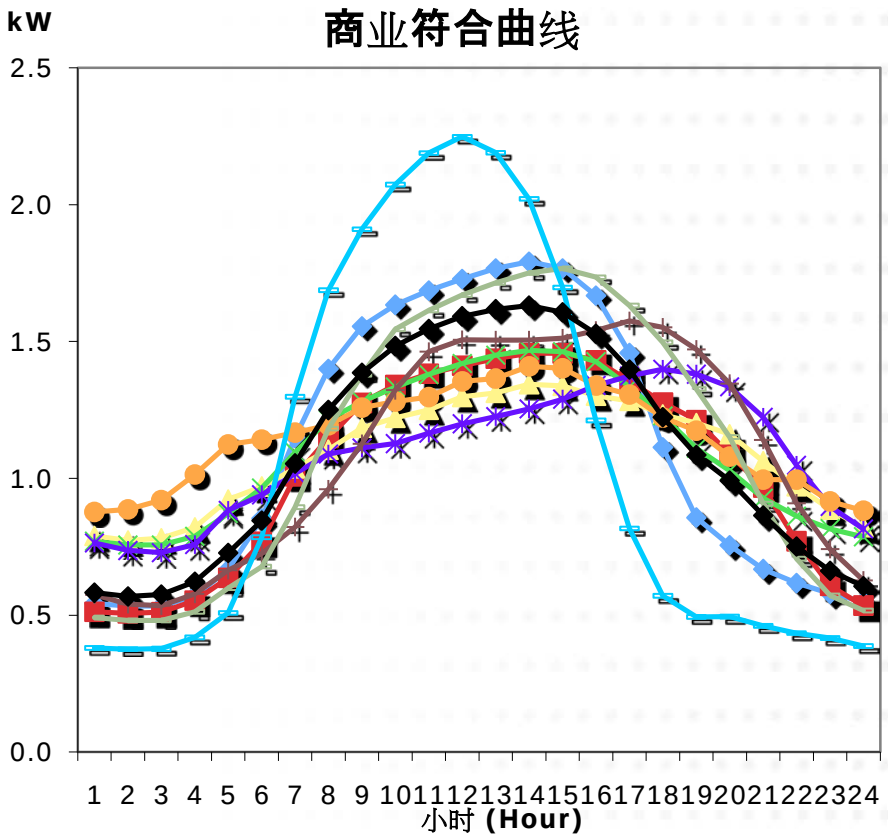
"China needs to do quantitative analysis if it wants to get the policies right and not waste money"
– Professor Wang Yanjia, Qinghua University

+ Importance of quantitative analysis:

- China has broadly accepted the need for higher efficiency in electricity use and cleaner forms of generation
- The key questions are now "how much," "when," and "who pays", all of which require quantitative analysis
- Quantitative research facilitates more rational policy decisions and a more transparent process

Addressing Information Gaps

- Sometimes information exists, but is not made publicly available because of incentive conflicts
- Sometimes information does not appear to exist because no one has an incentive to collect or analyze it
- Information useful for policy analysis often has to be created



Sharing Experience

- In the past China hasn't had the regulatory and planning drivers that make analytical tools and information creation necessary
- Rising prices, changes in operations, and environmental concerns are changing that
- US power sector went through a comparable transition starting in the 1970s

Importance of Process

- Strategy of trying to directly influence Chinese leaders will be increasingly limited by power sector realities, like cost
- Promoting policies and technologies without process will be less likely to succeed
- Support processes that promote capacity building, scientific rigor, policymaker understanding, transparency, accountability
- Investing in process is cheap compared to the cost of technologies and the results of poorly considered policies

Summary

- Transitional moment in China's power sector
- Opportunity for U.S. to help address analysis gap and encourage institutional processes
- Providing decision-makers better information could lead to more ambitious goal-setting and higher likelihood of success

谢谢！Thank you!

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