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## NEWS & ANALYSIS

## Helping the Dragon Leapfrog: A Survey of Chinese Energy Policy and U.S. Energy Diplomacy at the Crossroads

by Michael B. Cummings

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*Editors' Summary: As the economies of developing countries grow, so too do their energy needs. And in an increasingly interconnected world, these changes have repercussions for the rest of the world, both economically and environmentally. In this Article, Michael Cummings looks at the energy developments of China, a nation whose energy use doubled while its economic growth quadrupled between 1980 and 2000. He notes that while China's energy sector will continue to grow with its economy, what direction it will take and how big it will grow remain uncertain. He urges the world community, particularly the United States, to cooperate with and provide support to China, as a massive expansion of China's energy sector would have profound effects on the environment and climate change, the world energy and oil markets, and risks related to nuclear proliferation.*

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### I. Introduction

The trajectory of Chinese energy development over the next few decades will be critically important not only to the public health, economy, and environment of China and the East Asian region, but also to the rest of the world. China's growing contribution to soaring global energy demand<sup>1</sup> in an increasingly interconnected global energy economy, and the transboundary nature of many conventional air pollutants and greenhouse gases (GHGs) caused predominately by energy use, motivates significant attention to China's energy development by policymakers in China, the United States, and across the globe.<sup>2</sup>

In the past few years, the Chinese government has demonstrated heightened concern over its growing energy use and, accordingly, has announced some encouraging energy

policies. However, the central government's ability to implement and follow-through on these policy goals is highly uncertain. The combination of such uncertainty, the long-lived nature of the heavily polluting energy capital stock being built today, and the sheer magnitude of projected growth in China all raise doubts about China's ability to sustainably develop its energy sector over the next few decades. Further development and enforcement of a more robust energy and environmental law, policy, and regulatory regime, as well as an improved degree of cooperative federalism within China, is therefore necessary to alter the future shape of the Chinese energy development trajectory. Moreover, the slow pace that applicable laws and regulations are being developed and enforced and the continuing tension between central government goals and local-level interests may prevent energy-related law and policy from contributing to a significantly different development trajectory within the next decade or so—a critical time period in the development of the Chinese energy sector.

China's energy policy also affects the rest of the world. Steadily increasing gasoline prices in the United States, partly attributed to China's impact on the global oil market, is just one example. Thus, it is in the best interest of developed countries and regions, such as the United States, the European Union (EU), and Japan, to reduce China's long-term demand and use of conventional energy sources. The best way to do this may be by working with China on a significant technology development and deployment push. Four areas of techno-policy cooperation are particularly crucial to the interests of both China and more developed countries: oil and transportation; clean coal technology; renewable energy; and nuclear power. While helping China

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Michael Cummings is a J.D. candidate at Georgetown University Law Center where he expects to graduate in December 2006. He received his M.S. and B.S. in earth systems and his B.A. in economics at Stanford University. The author is grateful to Sophie Chou, Joanna Lewis, Jeffrey Logan, Scott Zimmerman, and especially James Feinerman, for their helpful comments on earlier drafts of this Article.

1. This is an overall growth trend recently labeled as "not sustainable" by the head of the International Energy Agency (IEA). See *Greenhouse Gas "To Rise by 52%,"* BBC NEWS, Nov. 7, 2005, <http://news.bbc.co.uk/2/hi/business/4414000.stm>.
2. Although India is also a rapidly developing country with a large population, and accordingly its energy development trajectory is also very important, China's greater focus on its manufacturing sector to fuel economic growth and its reliance on coal as a primary energy source is arguably of greater concern. See, e.g., Patrick Barta, *India Isn't Devouring Commodities—Yet: Reliance on Services Sector Means Demand Won't Hit China's Level for Many Years*, WALL ST. J., Jan. 9, 2006, at A11; Diane Farrell, *Prime Numbers: India Outsmarts China*, FOREIGN POLICY, Jan./Feb. 2006, at 30.

achieve a complete “leapfrogging” over conventional energy infrastructure and systems seems unlikely at this point, with the appropriate degree of cooperation and support from more developed countries—especially the United States—China could emerge from its current energy crossroads in a much better direction for both China and the rest of the world.<sup>3</sup>

## II. Background and Current Projections

Since 1980, China has experienced a period of rapid economic development, with gross domestic product (GDP) growth averaging 9.7% per year, contributing to an overall quadrupling of GDP between 1980 and 2000.<sup>4</sup> During that same time period, energy growth rose to just one-half the level of economic growth, keeping growth in energy use to 4.6% per year for an overall doubling of energy use between 1980 and 2000.<sup>5</sup>

This relatively impressive decoupling notwithstanding, the sheer magnitude of China’s economic and energy growth, its heavy reliance on coal as a provider of primary energy use (due to China’s vast domestic coal resource base), and its increasing use of automobiles contribute to a startling snapshot of China’s current energy sector and its projected future. The following figures give some indication of the impact of the development of China’s energy sector to date:

- The World Bank estimates that China is home to 16 out of the 20 most polluted cities in the world.<sup>6</sup>
- Approximately 70% of China’s rivers and lakes are polluted, and roughly one-third of China is exposed to acid rain<sup>7</sup> that falls on an estimated 250 cities and causes approximately \$13.3 billion dollars in annual damages (or 3.3% of its GDP).<sup>8</sup>
- Overall environmental pollution (of which energy supply and use is a major driver) inflicts

costs to the Chinese economy an estimated 8 to 12% annually.<sup>9</sup>

- In 2004, approximately 6,000 people died in China’s coal mines,<sup>10</sup> and an estimated 400,000 people die prematurely in China annually from air-pollution related diseases.<sup>11</sup>
- Chinese State Environmental Protection Administration (SEPA) officials estimate that about one-fifth of urban citizens live in seriously polluted environments.<sup>12</sup>
- The number of motor vehicles in China increased more than 10 times between the 1970s and 2003 (and by 5 times since 1986),<sup>13</sup> and as recently as 2005 annual vehicle sales grew by over 20%.<sup>14</sup>
- China is the world’s largest producer and consumer of coal and the world’s second-largest consumer of oil.<sup>15</sup>
- And in contrast to publicity surrounding Beijing’s plans for a “green Olympics”<sup>16</sup> in 2008, the city’s newest revised master plan calls for a goal for the city to be “a city suitable for living.”<sup>17</sup>

The impacts stemming from China’s current and future energy development can be felt outside of the country’s borders. The projected growth of the Chinese energy sector will continue to have consequences for the rest of the world:

- The U.S. Environmental Protection Agency (EPA) estimates that 25% of the particulate matter (PM) in the skies above Los Angeles, California, can be traced to China, and state officials estimate that China could eventually account for roughly one-third of the state’s air pollution<sup>18</sup>;
- China is expected to account for 20% of the increased global energy demand over the next 30 years<sup>19</sup>;

3. Despite common use of the term “leapfrogging” in the context of sustainable development, there is little historical empirical evidence of leapfrogging actually occurring (discussed *infra*). Nevertheless, the predicted scale and characteristics of the future Chinese energy sector, i.e., based on the current growth trajectory, has led some commentators to suggest that more radical changes to China’s growth trajectory will indeed be needed in the near future.

4. DEVELOPMENT RESEARCH CENTER OF THE STATE COUNCIL, CHINA’S NATIONAL ENERGY STRATEGY AND POLICY 2000-2020, at 3 (2003), available at [http://www.ecchina.org/documents/Draft\\_Natl\\_E\\_Plan0311.pdf](http://www.ecchina.org/documents/Draft_Natl_E_Plan0311.pdf) [hereinafter NESP REPORT].

5. *Id.*

6. *A Great Wall of Waste: China Is Slowly Starting to Tackle Its Huge Pollution Problems*, ECONOMIST, Aug. 19, 2004, [http://www.economist.com/displaystory.cfm?story\\_id=3104453](http://www.economist.com/displaystory.cfm?story_id=3104453); see also Jack J. Fritz, *Introduction, in URBANIZATION, ENERGY, AND AIR POLLUTION IN CHINA: THE CHALLENGES AHEAD—PROCEEDINGS OF A SYMPOSIUM, UNITED STATES NATIONAL ACADEMY OF ENGINEERING 1* (2004), available at <http://www.nap.edu/catalog/11192.html>; PAMELA BALDINGER & JENNIFER L. TURNER, *CROUCHING SUSPICIONS, HIDDEN POTENTIAL: UNITED STATES ENVIRONMENTAL AND ENERGY COOPERATION WITH CHINA 11* (2002), available at [http://www.wilsoncenter.org/index.cfm?topic\\_Id=1421&fuseaction=topics.publications&group\\_Id=16305](http://www.wilsoncenter.org/index.cfm?topic_Id=1421&fuseaction=topics.publications&group_Id=16305).

7. Peter Aldhous, *China’s Burning Ambition*, 435 NATURE 1152-54 (2005), available at <http://www.nature.com/nature/journal/v435/n7046/full/4351152a.html>.

8. Rujun Shen, *Booming China Awash in “Out of Control” Acid Rain*, CHINA DIGITAL TIMES, Nov. 29, 2004, [http://chinadigitaltimes.net/2004/11/booming\\_china\\_a.php](http://chinadigitaltimes.net/2004/11/booming_china_a.php).

9. ELIZABETH C. ECONOMY, *THE RIVER RUNS BLACK: THE ENVIRONMENTAL CHALLENGE TO CHINA’S FUTURE 25* (Cornell Univ. Press 2004).

10. Aldhous, *supra* note 7.

11. Jim Yardley, *China’s Next Big Boom Could Be the Foul Air*, N.Y. TIMES, Oct. 30, 2005, at D3, available at <http://www.nytimes.com/2005/10/30/weekinreview/30yardley.html>.

12. *See Residents Still Suffering in Heavily Polluted Cities*, CHINA DAILY, Oct. 25, 2005, in 2 APECC NEWS BRIEFING 32 (2005), available at [http://www.autoproject.org.cn/english/APECC\\_NEWS/APECC%20NEWS%2011-2005.pdf](http://www.autoproject.org.cn/english/APECC_NEWS/APECC%20NEWS%2011-2005.pdf).

13. Michael P. Walsh, *Motor Vehicle Pollution and Fuel Consumption in China: The Long-Term Challenges*, 7 ENERGY FOR SUSTAINABLE DEV. 28 (2003), available at <http://www.ieiglobal.org/ESDVol7No4/vehiclepollution.pdf>; Jimin Zhao, *Whither the Car? China’s Automobile Industry and Cleaner Vehicle Technology*, 37 DEV. & CHANGE 121, 122 (2006).

14. IEA, *OIL MARKET REPORT 13* (Feb. 10, 2006), available at <http://omrpublic.iea.org/omrarchive/10feb06dem.pdf>. Also, an industry trade group reports that automobile sales in China in January 2006 were up 70% over sales in January 2005. *See Gordon Fairclough, China Auto Sales Jump Over 70% as Incomes Rise*, WALL ST. J., Feb. 11-12, 2006, at A6.

15. Energy Information Administration (EIA), China (Aug. 2005), <http://www.eia.doe.gov/emeu/cabs/china.html>.

16. *See, e.g., China Aims at High-Standard 2008 Olympics*, PEOPLE’S DAILY ONLINE, Nov. 2, 2004, [http://english.people.com.cn/200411/02/eng20041102\\_162487.html](http://english.people.com.cn/200411/02/eng20041102_162487.html).

17. Jim Yardley, *Beijing’s Quest for 2008: To Become Simply Livable*, N.Y. TIMES, Aug. 28, 2005, at A4.

18. Yardley, *supra* note 11.

19. ANGIE AUSTIN, *ENERGY AND POWER IN CHINA 5* (Foreign Policy Ctr. 2005), available at <http://fpc.org.uk/publications/153> (citing the IEA).

- China's predicted oil demand growth—over 13 million barrels per day (mb/d) in 2030,<sup>20</sup> or more than 60% of current annual U.S. oil consumption—will mean that China will need to import roughly 80% of its oil needs,<sup>21</sup> adding further price pressure to international oil markets and possibly contributing to geopolitical tensions; and
- China is expected to become the world's largest emitter of GHGs in the 2020 to 2025 time frame, thereby surpassing the U.S. contribution in GHG emissions despite having a per-capita emissions level far less than that of the United States but a population roughly four times the size.<sup>22</sup>

Media coverage of the strains on China's environment caused by its voracious development to date is increasing.<sup>23</sup> Yet, the current state of the Chinese energy sector is far from providing the energy service needs of more developed countries to its citizens.<sup>24</sup> For example, in 2004, 24 out of China's 31 provinces acknowledged that they lacked sufficient power supplies (contributing to an estimated loss in economic growth of 0.5% GDP),<sup>25</sup> and access to personal automated transportation mobility is a fraction of that in coun-

tries such as the United States. In terms of carbon dioxide (CO<sub>2</sub>) emissions, which are generally proportional to fossil energy use, Chinese per capita emissions average one-sixth of emissions from countries in the Organisation for Economic Co-Operation and Development (OECD), and one-eighth those of the United States.<sup>26</sup> Accordingly, China is far from slowing its rapid economic and energy development, as demonstrated by the government's recent renewal of its goal to quadruple GDP again between 2000 and 2020 while continuing to hold energy growth to one-half that of the growth of GDP.<sup>27</sup>

### III. China's National Energy Strategy and Policy (NESP)

To meet its goal of constraining energy use while providing enough energy for economic growth, the central government announced its overarching energy policy for the next two decades in its NESP. Table 1 includes the policies and projections for controlled growth across the energy sector by 2020 as described in the NESP. To provide context to these numbers, the table also includes selected figures from EU, Japanese, and U.S. energy sectors.

20. IEA, *WORLD ENERGY OUTLOOK 2005: MIDDLE EAST AND NORTH AFRICA INSIGHTS 83* (OECD/IEA 2005) [hereinafter *WORLD ENERGY OUTLOOK 2005*].

21. The IEA also projects Chinese domestic oil production to be at 2.4 mb/d in 2030, leaving imports at 10.7 mb/d, or more than 80% of demand. *Id.* at 90.

22. EIA, *ANNUAL ENERGY OUTLOOK 99*, tbl. A10 (2005), available at <http://www.eia.doe.gov/oiaf/archive/aeo05/index.html> (depicting world carbon dioxide (CO<sub>2</sub>) emissions by region, 1990 to 2025) [hereinafter *AEO 2005*].

23. See, e.g., David Lague, *Water Crisis Shows China's Pollution Risks*, N.Y. TIMES, Nov. 24, 2005, at A6, available at <http://select.nytimes.com/mem/tnt.html?emc=tnt&tntget=2005/11/24/international/asia/24china.html&tntemail=y>; Agence France-Presse, *Polluted River Imperils Water for Large City in South China*, N.Y. TIMES, Dec. 21, 2005, <http://www.nytimes.com/2005/12/21/international/asia/21china.html?ex=1147406400&en=c9feed56cb0cc0eb&ei=5070>.

24. Although China does have an "energy-intensity" four times that of the United States, i.e., every dollar of economic output (as measured by GDP) requires four times as much energy in China as it does in the United States, such an energy-intensity is not inconsistent with China's level of economic development and its accordant heavy in-

dustrial-based economy. See *China Ponders Cost of Energy-Guzzling Industries*, PLANETARK, Sept. 28, 2005, <http://www.planetark.com/dailynewsstory.cfm/newsId/32708/story.htm>; Hu Yuanyuan, *Power Supply Likely to Remain Tight: Third Quarter Expected to See Peak Electricity Shortfall of 25m Kilowatts*, CHINA DAILY, July 30-31, 2005, at 5, available at <http://esperanto.china.org.cn/english/BAT/136767.htm>; see also *China's Winter of Discontent: Mao-Era Policy Provides Heat up North but None in South; Shivering Citizens Are Fed Up*, WALL ST. J., Mar. 14, 2006, at B1; but cf. India's economic growth pattern has followed a different energy demand pattern to date. See, e.g., Barta, *supra* note 2, at A11.

25. See *Fast Economic Growth Fuels Nation's Energy Crunch*, CHINA DAILY, June 6, 2005, [http://www.chinadaily.com.cn/english/doc/2005-06/06/content\\_448816.htm](http://www.chinadaily.com.cn/english/doc/2005-06/06/content_448816.htm); see also Peter S. Goodman, *Electrical Inefficiency a Dark Spot for China Cities: Glow for Show as Factories Black Out*, WASH. POST, Aug. 9, 2005, at D01, available at <http://www.washingtonpost.com/wp-dyn/content/article/2005/08/08/AR2005080801243.html>.

26. Mai Tian, *Energy Conservation, Efficiency Highlighted*, CHINA DAILY, Dec. 28, 2004, [http://www.chinadaily.com.cn/english/doc/2004-12/28/content\\_404062.htm](http://www.chinadaily.com.cn/english/doc/2004-12/28/content_404062.htm).

27. I.e., a doubling of energy use in comparison to a quadrupling of projected economic growth. NESP REPORT, *supra* note 4, at 12.

**Table 1: Chinese Energy Sector Growth Projections to 2020 and Current Energy Levels in the United States, Europe, and Japan**

	<b>China</b>	<b>United States</b>	<b>EU-25/Western Europe</b>	<b>Japan</b>
<b>Oil</b>	Increased oil consumption between 9 and 12 mb/d <sup>28</sup> (up from 6.6 mb/d in 2005). <sup>29</sup>	In 2005, the United States consumed 20.77 mb/d. <sup>30</sup>	In 2005, Europe consumed 16.29 mb/d. <sup>31</sup>	In 2005, Japan consumed 5.41 mb/d. <sup>32</sup>
<b>Nuclear</b>	To grow the Chinese nuclear industry by 15.9% per year, to an installed capacity of 40 gigawatts (GW), which would increase the proportion of nuclear power generation in the electricity sector from 1.2% in 2000 to 7% by 2020. <sup>33</sup> To achieve this goal China will need to more than quadruple its installed nuclear capacity of 6.6 GW (nine operational reactors) by 2020, and will require the building of six to eight new plants per year. <sup>34</sup>	The United States currently has 104 operating nuclear reactors for an installed capacity of almost 98.8 GW, <sup>35</sup> which provides roughly 20% of electrical demand. No new nuclear reactor has been ordered in the United States since 1979. <sup>36</sup>	In 2003, western Europe had an estimated installed capacity of 128.7 GW of nuclear-generating capacity, and eastern Europe and the former Soviet Union had a total of 49.4 GW. <sup>37</sup>	In 2003, Japan had an estimated installed capacity of 45.9 GW of installed nuclear capacity. <sup>38</sup>
<b>Large-Scale Hydroelectric</b>	To more than double its installed large-scale hydroelectric capacity, from roughly 100 GW today <sup>39</sup> to 200 to 240 GW. <sup>40</sup> Meeting this goal would require building the equivalent of a dam the size of the Three Gorges Dam project every two years. <sup>41</sup>	In 2003, the United States had an estimated 79.4 GW installed capacity of hydroelectricity. <sup>42</sup>	In 2003, western Europe had an estimated installed capacity of 152.9 GW of hydroelectricity. <sup>43</sup>	In 2003, Japan had an estimated 21.7 GW installed capacity of hydroelectricity. <sup>44</sup>

28. NESP REPORT, *supra* note 4, at 11, states: "Oil consumption will reach at least 450 million tons by 2020." If one barrel per day is roughly equivalent to 50 tonnes per year, this translates to 9 mb/d.

29. IEA, *supra* note 14, at 6.

30. *Id.* at 51.

31. *Id.* at 6.

32. *Id.*

33. NESP REPORT, *supra* note 4, at 19.

34. World Nuclear Association, Nuclear Power in China (May 2006), <http://www.world-nuclear.org/info/inf63.htm>; JONATHON E. SINTON ET AL., EVALUATION OF CHINA'S ENERGY STRATEGY OPTIONS I7 (Lawrence Berkeley Nat'l Lab. & China Energy Group May 2005), available at <http://china.lbl.gov/publications/nesp.pdf>.

35. See EIA, INTERNATIONAL ENERGY OUTLOOK 165, tbl. F1 (2005) (depicting world nuclear generating capacity by region and country), available at [http://www.eia.doe.gov/oiaf/ieo/pdf/0484\(2005\).pdf](http://www.eia.doe.gov/oiaf/ieo/pdf/0484(2005).pdf) [hereinafter INTERNATIONAL ENERGY OUTLOOK 2005]; see also EIA, INTERNATIONAL ENERGY ANNUAL 2003 tbl. 6.4n (2003), available at <http://www.eia.doe.gov/emeu/international/electricitycapacity.html> (depicting world nuclear electricity installed capacity from Jan. 1, 1980, to Jan. 1, 2003) [hereinafter INTERNATIONAL ENERGY ANNUAL 2003].

36. See MIT, THE FUTURE OF NUCLEAR POWER 21 (2003), available at <http://web.mit.edu/nuclearpower/>.

37. INTERNATIONAL ENERGY ANNUAL 2003, *supra* note 35, tbl. 6.4n.

38. *Id.*

39. See *China Has Huge Potential in Hydroelectric Generation*, PEOPLE'S DAILY, Oct. 24, 2005, [http://english.people.com.cn/200510/24/eng20051024\\_216366.html](http://english.people.com.cn/200510/24/eng20051024_216366.html). The EIA estimates that in 2003, China had roughly 86 GW installed hydroelectric capacity. See *id.*

40. SINTON ET AL., *supra* note 34, at 16.

41. *Id.*

42. See INTERNATIONAL ENERGY ANNUAL 2003, *supra* note 35, tbl. 6.4h (depicting world hydroelectricity installed capacity), available at <http://www.eia.doe.gov/emeu/international/electricitycapacity.html>.

43. *Id.*

44. *Id.*



**Table 1: Chinese Energy Sector Growth Projections to 2020 and Current Energy Levels in the United States, Europe, and Japan (cont.)**

	<b>China</b>	<b>United States</b>	<b>EU-25/Western Europe</b>	<b>Japan</b>
<b>Coal</b>	Reduce the percentage of coal consumption to 60% of primary energy use. Assuming China follows its plan for “least consumption,” the government projects annual coal consumption in 2020 to be 2.1 billion tons, <sup>45</sup> up from a consumption level in 2002 of 1.42 billion tons. <sup>46</sup> In contrast to China’s plans for “least consumption,” the U.S. Energy Information Administration’s (EIA’s) “reference case” scenario projects more than a doubling of coal consumption in China by 2020 and estimates annual consumption at over three billion tons coal in 2020. <sup>47</sup>	The United States consumed 1.06 billion tons of coal in 2002. <sup>48</sup>	Western Europe consumed 0.57 billion tons of coal in 2002. <sup>49</sup>	Japan consumed 0.18 billion tons of coal in 2002. <sup>50</sup>
<b>Natural Gas</b>	Increasing the annual average use of natural gas by 9% per year for a total of 160 billion cubic meters (bcm) by 2020 <sup>51</sup> (up from 39.0 bcm in 2004). <sup>52</sup>	In 2004, the United States consumed 646.7 bcm of natural gas. <sup>53</sup>	In 2003, the 25 countries of the EU consumed 233 bcm of natural gas. <sup>54</sup>	In 2004, Japan consumed 72.2 bcm of natural gas. <sup>55</sup>
<b>Renewables</b>	Doubling the use of electricity generated from renewables for an additional 100 GW of installed capacity, with 60 to 70 GW of small-scale hydroelectricity, 20 GW of wind energy, and 10 GW of biomass-fired electricity, solar, geothermal, ocean and tidal energy (with the majority of this last 10 GW focusing on biomass). <sup>56</sup> The wind target was later increased to 30 GW by 2020. <sup>57</sup> The EIA currently estimates that China had less than 1 GW of non-hydroelectric renewables as of 2003. <sup>58</sup>	In 2003, the United had an estimated 17.9 GW installed capacity of non-hydroelectric renewables. <sup>59</sup>	In 2003, western Europe had an estimated installed capacity of 29.2 GW of non-hydroelectric renewables. <sup>60</sup>	In 2003, Japan had an estimated .08 GW of non-hydroelectric renewables. <sup>61</sup>

45. NESP REPORT, *supra* note 4, at 16.46. See INTERNATIONAL ENERGY OUTLOOK 2005, *supra* note 35, at 95, tbl. A6 (depicting world coal consumption by region).47. *Id.*48. *Id.*49. *Id.*50. *Id.*51. NESP REPORT, *supra* note 4, at 16.52. BP, STATISTICAL REVIEW OF WORLD ENERGY 2005, at 25 (2005), available at <http://www.bp.com/genericsection.do?categoryId=92&contentId=7005893>.53. *Id.*

54. IEA, WORLD ENERGY OUTLOOK 2004 156 (OECD/IEA 2004).

55. BP, *supra* note 52, at 25.56. NESP REPORT, *supra* note 4, at 19; SINTON ET AL., *supra* note 34, at 17.57. See, e.g., Alexander’s Gas & Oil Connections, China to Complete Giant Windmill Projects in Four Provinces, <http://www.gasandoil.com/goc/news/nts54707.htm> (last visited Apr. 26, 2006).58. INTERNATIONAL ENERGY ANNUAL 2003, *supra* note 35, tbl. 6.4g (depicting wind, wood, and waste electricity installed capacity from Jan. 1, 1980, to Jan. 1, 2003).59. *Id.*60. *Id.*61. *Id.*

Even if China is successful in further decoupling energy use from economic growth, i.e., if the energy sector grows at a level less than one-half that of economic growth, any further expansion of the Chinese energy sector is certain to have profound effects on the local and global health and environment, geopolitical relations, and on the Chinese and global economy. If, on the other hand, energy growth continues at a rate more than one-half that of economic growth, the impacts of this expansion could obviously be much worse.

China's plan for continued energy development may not be out of line with the historical development trajectories of developed economies on a per-capita, or GDP energy-intensity basis. However, the scale of the growth involved in China's continued development (in terms of the absolute growth in the energy sector during the projected time frame); current knowledge of anthropogenic global climate change at a level that did not exist during the rise of most developed economies; and the projected peaking of conventional global oil production occurring sometime between 2010 and 2030<sup>62</sup> call into question the ability of China and the rest of the world to sustain such an expansion should China's future energy sector resemble the energy sectors of most developed countries today.

Accordingly, the spectrum of possible development trajectories for the Chinese energy sector over the next two decades presents a range of challenges and opportunities for China and the world alike. Continued development of Chinese energy law and policy can play a significant role in determining future health, environmental, and economic impacts. Perhaps as equally important will be the policies of other countries—especially the EU, Japan, and the United States as they relate to cleaner energy technologies—in helping to shape this trajectory. The next section examines sector-, technology-, and fuel-specific energy policy developments in China and looks at possible options for improving domestic and international policies in these areas.

#### IV. Recent Developments in Chinese Energy Sub-Sectors, Law, and Policy

For purposes of this Article, Chinese energy “law and policy” consists of officially announced policies (e.g., the NESP), laws passed by the central government (e.g., the Renewable Energy Law of 2005<sup>63</sup>), high-level policy pronouncements/regulations (e.g., the central government's 2006 announcement that local governments should get rid of restrictions on small cars), as well as governmental and quasi-governmental diplomatic and international business transactions motivated by energy concerns (e.g., the China National Offshore Oil Company's (CNOOC's) failed attempt to buy the Union Oil Company of California

(UNOCAL), a U.S. oil and gas company). In addition, a growing, albeit still infant, administrative/regulatory state exists in China. To date, the National Development and Reform Commission (NDRC)<sup>64</sup> has had overarching authority to make most energy-related policy decisions. The NDRC has an Energy Bureau, but it has a staff of only 20 to 30 people.<sup>65</sup> In March 2006, the Minister of Water Resources, Wang Shucheng, announced that the central government would establish a “national leading group” to oversee the energy sector, but there “is no timetable on forming an energy ministry”—a ministry that has been called for by experts both inside and outside of China.<sup>66</sup>

Continuing through the 1990s, industrial energy use accounted for roughly 70% of total energy use in China.<sup>67</sup> Although the industrial sector will likely remain a large consumer of energy in China, as China continues to experience rapid growth in its industrial and manufacturing sectors (particularly as its economy undergoes structural changes toward a more commercial and service-based economy), and as personal automobile use continues to grow rapidly, the way in which the electricity and transportation energy sub-sectors develop will be increasingly important. Accordingly, this Article focuses on policies broadly related to the electricity and oil/transportation sub-sectors, and some key fuels and technologies within those sub-sectors.

#### A. Oil and Transportation

China became a net importer of oil in 1993 and its oil imports have since grown to over 40% of total demand.<sup>68</sup> China consumed 6.6 mb/d in 2005,<sup>69</sup> and the EIA projects demand will grow to 14.2 mb/d by 2025, with net imports accounting for over 75% of oil demand (or 10.9 mb/d).<sup>70</sup> By comparison, the United States consumed 20.77 mb/d in 2005<sup>71</sup> and is projected to consume 26.05 mb/d in 2025, with imports accounting for roughly two-thirds of oil consumption.<sup>72</sup> The economy's use of oil is having a growing

64. Visit the NDRC's website at <http://en.ndrc.gov.cn/> (in Chinese). For a description in English of the NDRC, see [http://www.chinacp.com/eng/cporg/cporg\\_ndrc.html#description](http://www.chinacp.com/eng/cporg/cporg_ndrc.html#description).

65. Gong Li & Mark Spelman, *Foreword*, in AUSTIN, *supra* note 19, at ix; AUSTIN, *supra* note 19, at 18; Joanna I. Lewis, *From Technology Transfer to Local Manufacturing: China's Emergence in the Global Wind Power Industry*, at 33 (2005) (Ph.D. Thesis, Energy and Resources Group, University of California, Berkeley) (available through the author via e-mail at: [joanna@berkeley.edu](mailto:joanna@berkeley.edu)).

66. See Fu Jing, *Leading Group to Oversee Energy Sector*, CHINA DAILY, Mar. 7, 2006, [http://www.chinadaily.com.cn/english/doc/2005-03/07/content\\_422392.htm](http://www.chinadaily.com.cn/english/doc/2005-03/07/content_422392.htm); SINTON ET AL., *supra* note 34, at 2.

67. See JOANNA LEWIS ET AL., *SECTORAL AND GEOGRAPHIC ANALYSIS OF THE DECLINE IN CHINA'S NATIONAL ENERGY CONSUMPTION IN THE LATE 1990s*, at 3-4 (Proceedings of the American Council for an Energy Efficient Economy Summer Study on Energy Efficiency in Industry 2003), available at [http://china.ibl.gov/china\\_pubs-ind.html](http://china.ibl.gov/china_pubs-ind.html).

68. NESP REPORT, *supra* note 4, at 11; INTERNATIONAL ENERGY AGENCY, *supra* note 14, at 6 and 13. The IEA reports that total demand for oil in China in 2005 was 6.60 mb/d, and that total imports of crude and product into China in 2005 was 2,872 thousand b/d.

69. IEA, *supra* note 14, at 6.

70. INTERNATIONAL ENERGY OUTLOOK 2005, *supra* note 35, at 93, tbl. A4 (depicting world oil consumption by region, 1990 to 2025); EIA, *supra* note 15.

71. IEA, *supra* note 14, at 51.

72. The EIA's Annual Energy Outlook 2006 calls for net imports of petroleum to equal 60% of demand (down from the 68% in Annual En-

62. See, e.g., DAVID L. GREENE ET AL., *RUNNING OUT OF AND INTO OIL: ANALYZING GLOBAL OIL DEPLETION AND TRANSITION THROUGH 2050* xi (ORNL/TM-2003/259) (Oak Ridge Nat'l Lab. 2003), available at [http://www.cta.ornl.gov/cta/Publications/pdf/ORNL\\_TM\\_2003\\_259.pdf](http://www.cta.ornl.gov/cta/Publications/pdf/ORNL_TM_2003_259.pdf). After peak oil production is reached (a point often referred to as Hubbert's Peak), many experts believe that oil prices will rise substantially following the hypothesis put forth by geophysicist Dr. Marion King Hubbert. See, e.g., KENNETH S. DEFFEYES, *HUBBERT'S PEAK: THE IMPENDING WORLD OIL SHORTAGE* (Princeton Univ. Press 2001).

63. Hu Cong, *Legislature Passes Renewable Energy Bill*, CHINA DAILY, Mar. 1, 2005, [http://www.chinadaily.com.cn/english/doc/2005-03/01/content\\_420450.htm](http://www.chinadaily.com.cn/english/doc/2005-03/01/content_420450.htm).

impact within China, as demonstrated in part by the health and environmental statistics listed earlier in the Article. In addition, accounting for roughly 40% of growth in world demand for oil in the last four years<sup>73</sup> (and 30% of increased demand in 2004 alone<sup>74</sup>), China's impact on the world oil market became readily apparent in the last few years by contributing to a significant rise in global oil prices.

Transportation, and automobile use in particular, is expected to dominate most of China's future demand for petroleum. Vehicle sales in 2005 grew over 20% in 2005,<sup>75</sup> for a total of over 3 million vehicles sold.<sup>76</sup> And the number of automobiles in China is expected to grow from over 26 million motor vehicles in 2004<sup>77</sup> to between 54.5 and 110.2 million,<sup>78</sup> and possibly as high as 140 million, by 2020.<sup>79</sup> In comparison, as of 2004 there were over 230 million private, commercial, and publicly owned vehicles in the United States.<sup>80</sup> If China had the same level of per-capita vehicle and oil consumption as the United States, the country would have over 900 million cars (or 40% more than today's total world vehicle population) and an oil demand 18% greater than total world oil production.<sup>81</sup> Clearly, with a landmass roughly the same size of the United States, it is hard to imagine China sustaining a vehicle population of almost 1 billion automobiles. Yet, even falling far short of the per-capita vehicle and oil-use levels of the United States, China stands to experience a dramatic ramp-up of its on-road transportation sector, which will have a significant impact on conventional air pollution, congestion, and GHG emissions.

Chinese energy policy related to transportation and oil use is dominated mostly by financial incentives and regulations related to vehicle and fuel purchase price such as subsidies, taxes, and size restrictions; automobile fuel econ-

omy/tailpipe-GHG standards; and vehicle size regulations.<sup>82</sup> Policies related to the use of mass transit, efficient design of urban and suburban growth, and promotion of alternative fuel vehicles<sup>83</sup> can reduce conventional vehicle ownership and oil consumption and, therefore, should be promoted vigorously. However, assuming that the effectiveness of these methods in curbing growth in vehicle/oil demand reflects the limited success of similar efforts in other countries,<sup>84</sup> especially in the short term, and/or is overcome by continuing robust growth in Chinese car and suburban cultures,<sup>85</sup> the main near-term policy levers left for affecting the growth in car ownership and oil consumption will likely remain fuel economy or tailpipe-GHG standards/car-size regulations and incentives and regulations related to the price of fuel and automobiles.<sup>86</sup> To date, these policy tools have not been fully utilized in China.

A recent survey of vehicle buyers in three major cities of China found that most buyers list vehicle price and fuel economy as the two primary factors they consider when buying a car.<sup>87</sup> In the first two-thirds of 2005, sales of "micro" cars rose 66% over those in 2004, while sales of full-sized sedans rose 10% and sales of minivans rose 21% in the same time period.<sup>88</sup> Yet this consumer preference has

ergy Outlook 2005 due to a higher degree of projected domestic production following higher oil prices). The 2006 report calls for "gross petroleum imports" of 64% in 2030, with "net petroleum imports" of 62% in 2030. See EIA, ANNUAL ENERGY OUTLOOK 2006, at 8, 9, 64 (2006), available at [http://www.eia.doe.gov/oiaf/aeo/pdf/0383\(2006\).pdf](http://www.eia.doe.gov/oiaf/aeo/pdf/0383(2006).pdf) [hereinafter AEO 2006]; *id.* at 163, tbl. A20 (depicting international petroleum supply and disposition). The EIA projects U.S. petroleum consumption to be 27.57 mb/d in 2030.

73. EIA, *supra* note 15.

74. WORLD ENERGY OUTLOOK 2005, *supra* note 20, at 82.

75. IEA, *supra* note 14.

76. See Keith Bradsher, *China Raises Taxes to Curb Use of Energy and Timber*, N.Y. TIMES, Mar. 23, 2006, at C6, available at <http://select.nytimes.com/mem/tnt.html?emc=tnt&tntget=2006/03/23/business/worldbusiness/23yuan.html&tntemail=y>.

77. Zhao, *supra* note 13, at 122 (citing CHINA AUTOMOTIVE TECHNOLOGY AND RESEARCH CENTER & CHINA ASSOCIATION OF AUTOMOBILE MANUFACTURERS, CHINA AUTOMOTIVE INDUSTRY YEARBOOK (2005)).

78. The 54.5 million assumes 6% annualized GDP growth between 2000 and 2020, and the 110 million figure assumes a 10% GDP growth rate (following a historic worldwide relationship between income and vehicle ownership). See Walsh, *supra* note 13, at 29 (citing U.S. NATIONAL ACADEMY OF SCIENCES & CHINA ACADEMY OF SCIENCES, PERSONAL CARS AND CHINA (2003)).

79. See *China to Have 140 Million Cars by 2020*, CHINA DAILY, Sept. 4, 2004, [http://www.chinadaily.com.cn/english/doc/2004-09/04/content\\_371641.htm](http://www.chinadaily.com.cn/english/doc/2004-09/04/content_371641.htm).

80. Federal Highway Administration, Highway Statistics 2003—State Motor Vehicle Registrations, <http://www.fhwa.dot.gov/policy/ohim/hs03/hm/mv1.htm> (last visited Apr. 26, 2006).

81. Zhao, *supra* note 13, at 124 (citing D. He & M. Wang, China Vehicle Growth in the Next 35 Years: Consequences on Motor Fuel Demand and CO<sub>2</sub> Emissions, Presentation to Annual Meeting of Transportation Research Board, Washington, D.C. (2001)).

82. This assumes that the Chinese government does not intend to pursue more widespread "limiting" measures such as regulating personal (private) vehicle ownership, a version of which is pursued in Shanghai, China, where a limited number of license plates are auctioned off, although plans to loosen such restrictions have been announced. See Zhao, *supra* note 13, at 137. Improving fuel quality may also reduce conventional (and GHG) emissions from the transportation sector without reducing demand for primary energy. For more on options for improving fuel quality, see *id.* at 129-40 (citing in part Michael Walsh, *Clean Fuels in China*, 7 SINO-SPHERE J. 17 (2003); Kevin He, Policy Recommendations for Enhancing China's Fuel Quality, China Development Forum, Beijing, China (2003)).

83. Alternative fuel vehicles include, for example, ethanol, methanol, liquid propane, compressed natural gas, and hydrogen vehicles. For more on the development of these vehicles in China, see Jimin Zhao & Marc Melaina, *Transition to Hydrogen-Based Transportation in China: Lessons Learned From Alternative Fuel Vehicle Programs in the United States and China*, 34 ENERGY POL'Y 1299 (2006) (special issue on hydrogen).

84. See, e.g., Barry McNutt & David Rogers, *Lessons Learned From 15 Years of Alternative Fuels Experience—1988-2003*, in THE HYDROGEN ENERGY TRANSITION: MOVING TOWARD THE POST-PETROLEUM AGE IN TRANSPORTATION 165-81 (Daniel Sperling & James S. Cannon eds., Elsevier Academic Press 2004); Paul Leiby & Jonathan Rubin, *Understanding the Transition to New Fuels and Vehicles*, in *id.*, at 191-213; Ann Hulbert, *The Way We Live Now: Speed Bump*, N.Y. TIMES MAG., Jan. 8, 2005, at 19, available at [http://www.nytimes.com/2006/01/08/magazine/08wwln\\_lead.html](http://www.nytimes.com/2006/01/08/magazine/08wwln_lead.html).

85. See, e.g., Robert Collier, *The Good Life Means More Greenhouse Gases*, S.F. CHRON., July 6, 2005, at A1, available at <http://www.sfgate.com/cgi-bin/article.cgi?file=/c/a/2005/07/06/MNG6UDJL01.DTL>.

86. However, China is engaged in a "massive" program to relocate people to newly built cities. See ECONOMY, *supra* note 9, at 82. Such centralized planning offers the potential to significantly impact long-term transportation demand and oil consumption if such opportunities are pursued. Chinese oil and transportation policy is also broadly affected by Chinese business, government, and quasi-government energy diplomacy worldwide (discussed *infra* in Section VI).

87. Zhao, *supra* note 13, at 142 & n.36 (quoting a September 2003 Qingxue Institute survey available at <http://www.sina.com.cn>).

88. See Keith Bradsher, *Green Wheels: The Fuel-Sipping Sedan That's the Hot Seller in China*, N.Y. TIMES, Oct. 26, 2005, at G24, available at <http://select.nytimes.com/mem/tnt.html?emc=tnt&tntget=2005/10/26/automobiles/autospecial/26bradsher.html&tntemail=y> (citing the *China Automotive Report*); see also Keith Bradsher, *G.M. Thrives in China With Small, Thrifty Vans*, N.Y. TIMES, Aug. 9, 2005, at A1. Although micro cars are smaller and, thus, have higher



not yet been fully exploited to create more sustainable growth in transportation, and in fact many local government regulations have prohibited the use of some small cars based on a variety of rationales, including that they contributed to “bad image.”<sup>89</sup>

However, in a move that should reinforce Chinese consumers’ apparent and growing preference for smaller cars, in December 2005, the central government issued a notice that all local restrictions on small cars had to be lifted by the end of March 2006.<sup>90</sup> The government also encouraged manufacturers to invest in the development of more efficient vehicles and advocated lower parking charges for smaller cars.<sup>91</sup> Regulators are also reportedly considering alterations to the consumption tax scheme that would further reduce taxes on smaller cars and raise it on larger automobiles.<sup>92</sup> The government is apparently working on plans to apply significant taxes on heavier “gas guzzler” vehicles by as much as 27% and possibly reduce the current tax on smaller cars to about 3 to 8%.<sup>93</sup> In addition, the government’s supposed plans for new regulations for conventional air pollutants from automobiles during the 11th Five-Year Plan<sup>94</sup> time frame (2006 to 2011) should also promote smaller and more fuel-efficient cars and significantly reduce local air pollution.<sup>95</sup> China’s recent refocus on oil conservation and efficiency may have had a positive effect, with the government announcing that oil demand fell 0.3% to 0.5% in 2005, after a significant increase in demand in 2004.<sup>96</sup> However, some have expressed doubts as to the accuracy of this data released by the Chinese government, with the International Energy Agency (IEA) estimating that demand actually grew 2.5% in 2005.<sup>97</sup> In any event, any recent absolute reduction in oil demand is surely to be short-lived given current trends.

fuel economy and lower GHG emissions than larger cars, in China, they emit higher levels of conventional air pollutants than similar-sized cars in the EU, Japan, and the United States.

89. See Gong Zhengzheng, *Green Light Given to Eco-Friendly Vehicles*, CHINA DAILY, Jan. 5, 2006, [http://www.chinadaily.com.cn/english/doc/2006-01/05/content\\_509339.htm](http://www.chinadaily.com.cn/english/doc/2006-01/05/content_509339.htm).

90. *Limits on Small-Engine Cars to Lift*, CHINA DAILY, Mar. 11, 2006, <http://esperanto.china.org.cn/english/BAT/161128.htm>.

91. See Zhengzheng, *supra* note 89.

92. *Id.*

93. Keith Bradsher, *China Preparing to Tax Vehicles With Large Engines*, N.Y. TIMES, Aug. 26, 2005, at C5, available at [http://www.autoproject.org.cn/english/new\\_advance\\_en/China%20Preparing%20to%20Tax%20Vehicles%20With%20Large%20Engines.doc](http://www.autoproject.org.cn/english/new_advance_en/China%20Preparing%20to%20Tax%20Vehicles%20With%20Large%20Engines.doc); see also *Energy Plan Aims at Houses, Small Cars*, CHINA DAILY, Dec. 6, 2005, [http://www.chinadaily.com.cn/english/doc/2004-12/06/content\\_397568.htm](http://www.chinadaily.com.cn/english/doc/2004-12/06/content_397568.htm) (discussing the “guiding document for energy-saving work in the coming 15 years”).

94. See APECC NEWS BRIEFING, *supra* note 12, at 19-22 (including *Automobile Makers’ Profit Down 52.9%*, SHENZHEN DAILY, Oct. 28, 2005; *New Rules to Deal With Auto-Related Pollution*, XINHUANET, Oct. 24, 2005; *Small Car Production Promoted to Save Fuel*, SHENZHEN DAILY, Nov. 9, 2005; *Nation to Encourage Economy Model Cars*, Associated Press, Nov. 8, 2005).

95. See APECC NEWS BRIEFING, *supra* note 12, at 20 (*New Rules to Deal With Auto-Related Pollution*, XINHUANET, Oct. 24, 2005). For more discussion on China’s 11th Five-Year Plan, see Willy Lam, Association for Asian Research, *China’s 11th Five-Year Plan: A Roadmap for China’s “Harmonious Society?”* (Nov. 23, 2005), <http://www.asianresearch.org/articles/2756.html>.

96. See Shai Oster & Kate Linebaugh, *CNOOC Weighs \$2 Billion Bid for Owner of Kazakh Oil Field*, WALL ST. J., Jan. 14, 2006, at A2; IEA, *supra* note 14.

97. See, e.g., Shai Oster, *China’s Flat Oil Demand Sparks Market Doubts*, WALL ST. J., Jan. 17, 2006, at A2.

Another important price-related factor in transportation energy use is the price of fuel. Like most other developing countries, China subsidizes the price that consumers pay for oil-based fuels.<sup>98</sup> Yet there appears to be a growing recognition within the Chinese government regarding the need for price reform. This sentiment was recently demonstrated by NDRC Minister Ma Kai, who stated, “conserving energy and resources by raising their prices is vital to sustain China’s growing economy.”<sup>99</sup> And in March 2005, the government allowed end-use gasoline prices to rise 8% to over \$0.40/liter in Beijing.<sup>100</sup> In comparison, the IEA reports that average end-use prices for gasoline in the United States in March 2005 was \$0.58/liter, including taxes.<sup>101</sup> Furthermore, the Chinese government is supposedly investigating pricing measures in the transportation industry, including a windfall profit tax for oil.<sup>102</sup>

Reducing and/or eliminating subsidies could go a long way in influencing consumer vehicle preferences and, thus, the demand for oil. Removal of fuel subsidies could be especially powerful in China since Chinese consumers appear to factor fuel economy heavily into their purchasing decisions and may choose even more fuel efficient vehicles if fuel prices were unsubsidized. As most Chinese vehicle consumers are first-time buyers, China faces a critical opportunity to influence consumer buying preferences through education, removal of distortionary subsidies, and so on, before hardened (and sometimes economically inefficient) consumer preferences take hold, such as certain buying patterns that have developed in the U.S. vehicle market.<sup>103</sup>

Potentially more so than the removal of fuel subsidies, fuel taxes can be very effective at reducing fuel consumption. A fuel tax was passed into law by the Chinese National People’s Congress (NPC) in 1999, but it was strongly opposed by local governments and no date has yet been announced for this tax to go into effect.<sup>104</sup> The Vice Minister of Finance recently announced that the issue will be reconsidered when oil prices drop to a “rational level.”<sup>105</sup> An apprehension toward implementing a fuel tax is understandable as high fuel taxes do not seem to enjoy much political support in countries outside of Japan and western Europe, and in any country it is understandably difficult to switch from

98. *The Oiloholics*, ECONOMIST, Aug. 27, 2005, at 11. Many contend that the United States also subsidizes the end-price of gasoline that consumers face using both direct and indirect means.

99. See *China Mulls Deregulating Energy Prices*, PEOPLE’S DAILY ONLINE, Nov. 8, 2005, [http://english.people.com.cn/200511/14/eng20051114\\_221051.html](http://english.people.com.cn/200511/14/eng20051114_221051.html).

100. Wang Ying, *Retail Gasoline Prices Rise 8% in China*, CHINA DAILY, Mar. 24, 2005, [http://www.chinadaily.com.cn/english/doc/2005-03/24/content\\_427865.htm](http://www.chinadaily.com.cn/english/doc/2005-03/24/content_427865.htm).

101. IEA, *END-USER PETROLEUM PRODUCT PRICES AND AVERAGE CRUDE OIL IMPORT COSTS 4 (2006)*, available at <http://www.iea.org/Textbase/stats/surveys/mps.pdf>.

102. *Id.*

103. See Zhao, *supra* note 13, at 142. For a discussion of evidence of a market failure in consumer preferences for fuel economy in the U.S. transportation market, see DAVID L. GREENE & ANDREAS SCHAFFER, *REDUCING GREENHOUSE GASES FROM U.S. TRANSPORTATION 15* (Pew Ctr. on Global Climate Change 2003), available at [http://www.pewclimate.org/global-warming-in-depth/all\\_reports/reduce\\_ghg\\_from\\_transportation/index.cfm](http://www.pewclimate.org/global-warming-in-depth/all_reports/reduce_ghg_from_transportation/index.cfm).

104. Zhao, *supra* note 13, at 140 (citing *China Will Not Start Fuel Tax in Near Future*, PEOPLE’S DAILY (May 3, 2002)).

105. See *Gov’t Not Ready to Levy Fuel Tax*, XINHUANET, Nov. 14, 2005, in APECC NEWS BRIEFING, *supra* note 12, at 29.



subsidizing the use of a resource to taxing it. Furthermore, China has invested substantial amounts of capital into developing its automobile infrastructure and industry, and the automobile industry is starting to represent a significant contribution to GDP (possibly as high as 20%).<sup>106</sup> Accordingly, the government is likely to be hesitant to restrain this burgeoning industry.<sup>107</sup>

A policy tool less controversial than vehicle and fuel taxes, i.e., at least outside of the United States, and one that is used by almost every country with a significant vehicle fleet, is fuel economy or tailpipe-GHG emissions standards.<sup>108</sup> China recently enacted new fuel economy standards that will be phased in between 2005 and 2008.<sup>109</sup> Although tailpipe-GHG and fuel economy standards around the world differ in form, when compared using a methodology that enables a direct comparison, the Chinese fuel economy standards are more stringent than those in Australia, Canada, and the United States (including the proposed tailpipe-GHG standards in California) but less stringent than those in Japan and the EU.<sup>110</sup> Chinese fleet fuel economy could also be affected by the degree to which Chinese automobile manufacturers grow their export business.<sup>111</sup> If manufacturers concentrate on exports to markets in Japan and the EU (and choose not to manufacture different cars for different markets), then the foreign market-driven fleet fuel economy in China could effectively rise.<sup>112</sup> If, on the other hand, manufacturers concentrate on markets such as the United States, where fuel economy standards are lower than in China, and U.S. standards remain as they are now, effective fleet fuel economy may not differ much in China from those required by law.

If China can dramatically change conventional transportation growth patterns through improved urban and rural development planning and by altering consumer preferences,

the short- and long-term impacts on growth in energy use could be substantial. However, the enormous opportunity available for China to “leapfrog” over traditional automobile and highway development patterns notwithstanding, the myriad of actors involved in coordinating such changes in development patterns, the rapidly burgeoning Chinese car culture,<sup>113</sup> and current government support for growing this industry indicate that such a change is not likely in the near future.<sup>114</sup> While this predicted growth pattern in the transportation sector may indeed cause serious problems related to air pollution, congestion, climate change, and oil dependency in the future, it can be partially mitigated by promoting vigorous fuel economy or tailpipe-GHG standards with combined development of longer-term solutions such as electric or hydrogen cars and continued parallel development of mass-transit systems. Arguably more problematic for China, the region, and the world is the rapid near-term development of the Chinese electricity sector.<sup>115</sup>

### B. Electricity

At the end of 2005, the Chinese electricity sector reached an installed capacity of just over 500 GW, and is expected to double over the next 15 years.<sup>116</sup> Unlike the transportation sector, the energy-consuming parts of the electricity sector, e.g., power plants, have extremely long economic lifetimes.<sup>117</sup> Accordingly, due to the “path-dependent” nature of the electricity sub-sector, decisions made in the near-term can have dramatic long-term effects. Thus, attention to the development of the Chinese electricity sector from both the Chinese government and international community is urgently needed, especially its utilization of conventional coal technologies.

The electricity sub-sector in China has experienced some limited regulatory and price reforms in the last decade.<sup>118</sup> The Electricity Law, passed in 1995, established legislative control of the industry, and in 2002 the State Electricity Reg-

106. Zhao, *supra* note 13, at 136-37 (citing, in part, DEUTSCHE BANK, ASIA: ECONOMIC ANALYSIS, EMERGING MARKETS MONTHLY (2003)).

107. *Id.*

108. While addressing different issues, tailpipe GHG emission standards and fuel economy standards can achieve similar ends. “Automobile GHG emission standards . . . even though they are not designed to directly control oil consumption, also affect vehicle fuel consumption.” FENG AN & AMANDA SAUER, COMPARISON OF PASSENGER VEHICLE FUEL ECONOMY AND GHG EMISSION STANDARDS AROUND THE WORLD 2 (Pew Ctr. on Global Climate Change 2004), available at [http://www.pewclimate.org/global-warming-in-depth/all\\_reports/fuel\\_economy/index.cfm](http://www.pewclimate.org/global-warming-in-depth/all_reports/fuel_economy/index.cfm). The U.S. federal fuel economy standards are often referred to as Corporate Average Fuel Economy (CAFE) standards. For a discussion of the history and controversial life of the CAFE program, see ROBERT BAMBERGER, AUTOMOBILE AND LIGHT TRUCK FUEL ECONOMY: THE CAFE STANDARDS (Congressional Research Service (CRS) Issue Brief for Congress Oct. 31, 2005), available at <http://www.ncseonline.org/NLE/CRSreports/05oct/IB90122.pdf>.

109. See AN & SAUER, *supra* note 108; AMANDA SAUER & FRED WELLINGTON, DISCUSSION PAPER: TAKING THE HIGH (FUEL ECONOMY) ROAD: WHAT DO THE NEW CHINESE FUEL ECONOMY STANDARDS MEAN FOR FOREIGN AUTOMAKERS? (World Resources Inst. 2004), available at <http://population.wri.org/highfuelconomy/roadchina-pub-4003.html>.

110. *Id.*

111. See *Chinese Auto Maker to Export Cars to the United States*, PEOPLE DAILY ONLINE, Feb. 1, 2005, [http://english.people.com.cn/200502/01/eng20050201\\_172521.html](http://english.people.com.cn/200502/01/eng20050201_172521.html); *Chinese Auto Exports to Challenge World's Big Car Makers*, THE DAILY STAR, Dec. 12, 2005, <http://www.thedailystar.net/2005/12/12/d51212050551.htm>.

112. Pressure from export markets could likewise drive reductions in emissions of conventional air pollutants for both markets.

113. See, e.g., Howard W. French, *Shanghai Journal: A City's Traffic Plans Are Snarled by China's Car Culture*, N.Y. TIMES, July 12, 2005, at A4, available at <http://www.nytimes.com/2005/07/12/international/asia/12china.html>; see also Keith Naughton, *China Hits The Road*, NEWSWEEK, June 28, 2005, <http://www.msnbc.msn.com/Id/5239399/site/newsweek/>; *China May Become No. 3 Car-maker*, SHENZHEN DAILY, Nov. 14, 2005, in APECC NEWS BRIEFING, *supra* note 12, at 12 (citing research that shows that the national daily average of commuters has risen to 23.3% in 2004 from 6% in 1984, and that the percentage of daily commuters using public transport dropped to 26.5% from 35% over the same time period); see also Lin Qi, *Survey Reveals Just How Mobile Chinese Are*, CHINA DAILY, July 29, 2005, [http://english.people.com.cn/200507/29/print20050729\\_199060.html](http://english.people.com.cn/200507/29/print20050729_199060.html).

114. Furthermore, indicators of “business as usual” transportation growth patterns such as vehicle size and vehicle miles traveled continue to grow in Europe and the United States and, thus, do not provide a clear example of the level to which China should leapfrog.

115. See AUSTIN, *supra* note 19.

116. Wang Ying, *Gov't Demands More Focus on Green Energy*, CHINA DAILY, Jan. 13, 2006, [http://www.chinadaily.com.cn/english/doc/2006-01/13/content\\_511935.htm](http://www.chinadaily.com.cn/english/doc/2006-01/13/content_511935.htm).

117. Parts of the transportation infrastructure do have long physical and economic lifetimes, e.g., roads and pipelines, and can contribute to path-dependent development patterns. However, the main energy consumers (vehicles) have much shorter lifetimes, and, thus, change can be facilitated much easier.

118. For a more detailed discussion of recent events in the Chinese electricity sector, see generally Emily T. Yeh & Joanna I. Lewis, *State Power and the Logic of Reform in China's Electricity Sector*, 77 PACIFIC AFFAIRS 437 (2004).

ulatory Commission (SERC) was established by the central government. In 2004, in an effort to curb demand, the price of electricity was increased, and this was followed by the creation of the “Regulations on Electricity Supervision and Control” in February 2005.<sup>119</sup> In spite of the creation of SERC, its authority (at least as of early 2005) appears to be overshadowed by that of the NDRC,<sup>120</sup> therefore delaying the benefits of developing an independent regulatory agency for this sector.<sup>121</sup>

## 1. Efficiency

Often, the cheapest way to provide for growing energy needs is to reduce demand for more energy through efficiency or conservation measures. Efficiency can help ameliorate short-term energy shortages, and the cumulative effects of incremental efficiency improvements can have significant impacts on the long-term need for additional energy capacity.<sup>122</sup>

Energy-efficiency played a pivotal role in China’s significant decoupling of energy use and economic growth since 1980,<sup>123</sup> and China recently announced the establishment of fairly ambitious fuel economy standards, at least in comparison to Australian, Canadian, and U.S. standards. However, China’s relative investment in efficiency in the electric sector has diminished over the last 20 years. Throughout the 1980s, investment in conservation and efficiency equaled 10 to 13% of that of supply. During the 1990s, however, this figure dropped to 7%. And, in 2003, dollars invested in efficiency and conservation measures equaled 5% that invested in supply.<sup>124</sup> Recently, there appears to be heightened attention to the need for greater investments in efficiency. In 2004, the government declared efficiency and conservation

a national priority, and in early 2005 the NDRC released a conservation and efficiency plan.<sup>125</sup> This focus on efficiency was recently re-affirmed by Premier Wen Jiabao in his 2005 “Work of the Government” report to the National People’s Conference, stating that “we will resolutely adhere to the policy of simultaneously developing and conserving energy and resources, giving priority to conservation.”<sup>126</sup>

Efficiency efforts could also be aided by price reform, or at a minimum, increased price-setting transparency, and there is some belief in the Chinese power industry that the central government may be intending to pursue a fully transparent price-setting mechanism.<sup>127</sup> The NDRC and the Ministry of Finance are also considering deregulating electricity prices, and Vice-Premier Zeng Peiyan (whose authority includes overseeing the setting of prices of certain important goods and services) “is reported to have agreed on the reform strategy.”<sup>128</sup>

Despite these recent announcements, the current lack of investment in energy efficiency could have significant long-term consequences.<sup>129</sup> Accordingly, in addition to doubling investment in efficiency and conservation to roughly 10% of what is invested in new supply, analysts of the Lawrence Berkeley Laboratory (LBL) China Energy Group who recently examined China’s energy strategy recommended that China’s Energy Conservation Law be strengthened by including greater incentives for efficiency investments and by stricter enforcement of existing laws.<sup>130</sup>

## 2. Coal Use and Clean-Coal Technology

Coal is an abundant domestic resource in China, which enables cheaper electricity generation than most forms of electricity (including nuclear power, natural gas, and renewables). Coal has been a crucial part of China’s economic development to date, and all indications are that it will continue to dominate China’s energy picture for the foreseeable future. China is projected to roughly double its installed capacity of coal plants in the next 25 years—adding somewhere on the order of 400 GW of coal-burning plants.<sup>131</sup>

This amount alone could provide for the residential electricity needs for roughly 400 million U.S. citizens (more than the current U.S. population).<sup>132</sup>

119. The central government created the SERC in 2002, as well as announced the creation of the new regulations for the electricity sector in 2005. See AUSTIN, *supra* note 19, at 13; *China Issues Regulations on Electricity Control*, PEOPLE’S DAILY ONLINE, Feb. 25, 2005, [http://english.people.com.cn/200502/25/eng20050225\\_174686.html](http://english.people.com.cn/200502/25/eng20050225_174686.html).

120. Li Shi, *Comment: Electricity Agency Lacks Power*, CHINA DAILY, Mar. 6, 2005, [http://www.chinadaily.com.cn/english/doc/2005-03/06/content\\_422124.htm](http://www.chinadaily.com.cn/english/doc/2005-03/06/content_422124.htm); AUSTIN, *supra* note 19, at 17. For example, in publicizing the government’s announcement of the new “Regulations on Electricity Supervision and Control” in February 2005, the *People’s Daily* reported the following concerning central government control over the sector: “Along with [t]he State Electricity Regulatory Commission (SERC), the relevant departments of the State Council, or the central government, will also supervise and regulate electricity price.” *China Issues Regulations on Electricity Control*, *supra* note 119.

121. Yeh & Lewis, *supra* note 118, at 460.

122. For instance, in the context of determining the amount of “carbon-free” energy needed by 2050 to avoid a doubling of atmospheric CO<sub>2</sub> levels (often referred to as the level necessary “to avoid dangerous climatic interference”), in 1997, a subcommittee of the U.S. President’s Council of Advisors on Science and Technology found that yearly 1.5% reductions in energy use/GDP could reduce the amount of carbon-free energy needed by almost 40%. And, if energy use/GDP was reduced by 2% per year, it would reduce the amount of carbon-free energy needed by over two-thirds in 2050. See John P. Holdren, *Integrating Common Themes: Some Observations for the Workshop on Technologies and Policies for a Low-Carbon Future*, Presentation to the Pew Center on Global Climate Change/National Commission on Energy Policy 10-50 Workshop, Mar. 24-26, 2004, Washington, D.C., at slide 7, *available at* <http://www.pewclimate.org/docUploads/Holdren%5F10%2D50%20Workshop%5F061804%5F125409%2Epdf>.

123. SINTON ET AL., *supra* note 34, at 10.

124. *Id.*

125. Tian, *supra* note 26; *Power-Starved China Inks Energy Conservation Plan*, PLANETARK, Dec. 7, 2004, <http://www.planetark.com/dailynewsstory.cfm/newsId/28464/story.htm>; NATURAL RESOURCES DEFENSE COUNCIL, *A RESPONSIBLE ENERGY PLAN FOR AMERICA* 14 (2005), *available at* <http://www.nrdc.org/air/energy/rep/rep.pdf>.

126. *Report on the Work of the Government*, CHINA DAILY, Mar. 5, 2005, [http://www.chinadaily.com.cn/english/doc/2005-03/15/content\\_425079.htm](http://www.chinadaily.com.cn/english/doc/2005-03/15/content_425079.htm).

127. AUSTIN, *supra* note 19, at 1, 5, 7, 8; *see also* Yeh & Lewis, *supra* note 118, at 458.

128. *See China Mulls Deregulating Energy Prices*, *supra* note 99.

129. *See* JIANG LIN, *TRENDS IN ENERGY EFFICIENCY INVESTMENTS IN CHINA AND THE U.S.* (LBNL-57691) (Lawrence Berkeley Nat’l Lab. & China Energy Group June 2005), *available at* [http://china.lbl.gov/china\\_pubs-policy.html](http://china.lbl.gov/china_pubs-policy.html); SINTON ET AL., *supra* note 34.

130. *See* SINTON ET AL., *supra* note 34, at 10-12.

131. The IEA projects Chinese coal capacity to increase to 776 GW by 2030. *See* IEA, *supra* note 54, at 268.

132. A 1,000-megawatt (MW) plant can roughly provide the residential electricity needs of a city of 1 million U.S. citizens. One GW is equal to 1,000 MW.

Despite its attractiveness with regard to cost and domestic availability, coal use contributes to the discharge of a significant amount of conventional air pollutants such as sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), PM, and mercury.<sup>133</sup> In addition, coal-generated electricity produces the most GHGs per unit of power of any form of conventional electricity production. The NESP contemplates a smaller role for coal as a percentage of the overall Chinese energy economy, yet its projected growth in absolute terms is significant. Furthermore, coal use may grow more than current projections due to continued problems with large-scale hydroelectric development (discussed below),<sup>134</sup> as well as growing global apprehension regarding the expanded reliance on natural gas.<sup>135</sup> Even at current projections, China's coal use over the next few decades could be staggering. Considering the long-lived nature of the capital stock in the electricity sub-sector,<sup>136</sup> this projected development trend of China's coal industry has profound implications for the global climate system, as well as for the environment and public health of China, the region, and the world.

Using coal for electricity production with dramatically reduced emission levels of conventional pollutants has become increasingly realistic over the last two decades. Of the various "clean coal" technologies,<sup>137</sup> integrated gasification and combined cycle (IGCC) is thought to offer the most promise. Most conventional coal plants are pulverized coal (PC) plants. IGCC plants enable coal to be utilized in a way that substantially reduces the emissions of conventional air pollutants, including SO<sub>2</sub>, NO<sub>x</sub>, PM, and mercury; as well as reducing GHG emissions per unit of energy produced due to their efficiency advantages over PC.<sup>138</sup> In addition, many experts believe that it is possible to capture the CO<sub>2</sub> (the predominant GHG emitted from coal-burning plants) from IGCC plants and sequester it in a permanent/semi-permanent location—such as underground geological repository

ries—and to do so in a cost-effective manner.<sup>139</sup> Carbon capture and sequestration (CCS) is considered to be more cost-effective with an IGCC plant than with a PC plant because the emissions waste stream from an IGCC plant enables easier and cheaper capture than that from a PC plant.<sup>140</sup> IGCC may also significantly reduce the water requirements as compared to a PC plant by as much as 60%.<sup>141</sup> Such water efficiency gains could help to reduce another significant strain on China's resources—an estimated 360 million Chinese residents (mostly rural) are without access to safe drinking water.<sup>142</sup>

In addition to reducing the adverse public health and environmental impacts of the continued and expanded use of conventional coal, ancillary development benefits related to mitigating the impacts of climate change should accompany the deployment of cleaner and more efficient IGCC technology—which may be much closer to being "carbon capture ready" than conventional PC coal generation. The predicted adverse impacts of climate change, including coastal flooding, reduced freshwater supplies, and reduced food security, are projected to impact developing countries disproportionately,<sup>143</sup> partly due to reduced capacity to mitigate these adverse impacts.<sup>144</sup> Although China is rapidly becoming a more "developed" country, its geographical characteristics still leave it vulnerable to many of the predicted effects of climate change. Finally, China might engage in efforts to combat climate change in response to regional or global pressure, as well as pressure from downwind neighbors such as Japan and Korea.

133. Among other things, SO<sub>2</sub> emissions can lead to acid rain formation, NO<sub>x</sub> contributes to smog formation, PM is linked to many respiratory problems, and mercury can cause birth defects, brain damage, and weakening of immune systems. China also has a lot of "soft" or bituminous coal, which is generally more polluting than other types of coal.

134. See, e.g., Jim Yardley, *China Proposes Fewer Dams in Power Project to Aid Environment*, N.Y. TIMES, Jan. 12, 2006, at A16, available at <http://select.nytimes.com/mem/tnt.html?emc=tnt&tntget=2006/01/12/international/asia/12river.html&tntemail=y>; Peter Marsh, *Power Companies Predict Return of Coal*, FIN. TIMES, Jan. 16, 2006, at A1.

135. See, e.g., Mark Landler, *Europe Comes to Terms With Need for Russian Gas*, N.Y. TIMES, Jan. 8, 2006, at A6.

136. For example, with regard to coal plants, the IEA reports that "units exceeding 25 years operational service today account for more than 45% of coal-fired power generating capacity. It is standard procedure to extend the life of a power plant to 40 years, and some units have operated for more than 50 years." IEA CLEAN COAL CENTRE, PROFILES: LIFE EXTENSION OF COAL-FIRED POWER PLANTS (PF 05-13) (Dec. 2005), available at [http://www.iea-coal.org.uk/publisher/system/component\\_view.asp?LogDocId=81405](http://www.iea-coal.org.uk/publisher/system/component_view.asp?LogDocId=81405).

137. For more information on various "clean coal" technologies and programs, see National Energy Technology Laboratory, U.S. Department of Energy (DOE), Coal and Power Systems: CCPI/Clean Coal Demonstrations, <http://www.netl.doe.gov/technologies/coalpower/cctc/index.html> (last visited May 11, 2006).

138. William G. Rosenberg et al., *Deploying IGCC Technology in This Decade With 3 Party Covenant Financing: Volume I*, at 33 (Environment and Natural Resources Program Discussion Paper, No. 2004-07, 2004), available at [http://bcsia.ksg.harvard.edu/research.cfm?program=ENRP&pb\\_Id=413&gma=11&gmi=110](http://bcsia.ksg.harvard.edu/research.cfm?program=ENRP&pb_Id=413&gma=11&gmi=110).

139. Geological carbon sequestration still requires additional study and validation from test sites for some time, on the order of 10 to 20 years. See Sally M. Benson, Carbon Dioxide Capture and Storage in Underground Geologic Formations, Workshop Proceedings on the 10-50 Solution: Technologies and Policies for a Low-Carbon Future, The Pew Center on Global Climate Change and the National Commission on Energy Policy, Mar. 25-26, 2004, Washington, D.C., available at <http://www.pewclimate.org/docUploads/10%2D50%5FBenson%2Epdf>. However, even if IGCC plants are not used in combination with CCS in the future, the reduction in conventional air pollutants through the use of IGCC technology could result in significant health benefits for countries such as China.

140. Robert Williams states: "The cost of reducing CO<sub>2</sub> emissions for plants burning bituminous coal with CO<sub>2</sub> capture and storage (CCS) is only about half as much for IGCC as for coal steam-electric plants." Robert H. Williams, IGCC: Next Step on the Path to Gasification-Based Energy From Coal, Supporting paper for the final report of the National Commission on Energy Policy, at 7 (Nov. 2004), available at <http://www.energycommission.org/site/page.php?node=46>, and <http://www.energycommission.org/files/finalReport/IV.2.a%20-%20IGCC%20Next%20Step.pdf>.

141. Rosenberg et al., *supra* note 138, at 35.

142. See Liang Chao & Qin Chuan, *Thirsty Countryside Demands Safe Water*, CHINA DAILY, Mar. 23, 2005, [http://www.chinadaily.com.cn/english/doc/2005-03/23/content\\_427334.htm](http://www.chinadaily.com.cn/english/doc/2005-03/23/content_427334.htm).

143. See *Summary for Policymakers*, in INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2001: WORKING GROUP II: IMPACTS, ADAPTATION, AND VULNERABILITY §2.8 (2001), available at [http://www.grida.no/climate/ipcc\\_tar/wg2/010.htm#28](http://www.grida.no/climate/ipcc_tar/wg2/010.htm#28) [hereinafter IPCC, *Summary for Policymakers*].

144. *Id.* The *Summary for Policymakers* states:

The projected distribution of economic impacts is such that it would increase the disparity in well-being between developed countries and developing countries, with disparity growing for higher projected temperature increases (medium confidence). The more damaging impacts estimated for developing countries reflects, in part, their lesser adaptive capacity relative to developed countries.



In June 2005, the Chinese Environment Minister, Xie Zhenhua, essentially announced China's plans to take a "wait and see" approach on climate change, stating that he hoped "that some countries would, according to the obligations which are provided for in the Kyoto Protocol, implement in a substantive way their obligations and take up their commitments," and that "[o]n the Chinese side, the Chinese government would make its own decision after making some assessments of the implementation by other countries."<sup>145</sup> Despite these statements and recent actions in international climate change fora,<sup>146</sup> considering the adverse impacts of climate change for China itself, it is at least conceivable that China (and other countries around the world) may choose to agree to "binding" GHG emissions reductions within the next few decades,<sup>147</sup> either as part of a regional or global agreement or through unilateral domestic action.

Carbon sequestration from fossil-fuel-burning plants may be one of the cheapest ways to reduce GHG emissions under any such future emissions reduction regime. While China is unlikely to invest in CCS systems for coal plants in the next decade or two, due to the cost difference for carbon capture and sequestration from IGCC plants and PC plants, building plants that are closer to being "carbon capture ready," e.g., IGCC, today would greatly improve the cost-effectiveness of future emissions reductions. In short, considering the typical operating lifetime of a coal plant, building IGCC plants today may significantly increase the likelihood that GHG reductions from coal plants installed in the near term will happen at all over the long term.

However, IGCC plants are more expensive to build than PC plants and face additional "institutional" barriers to deployment due to the global electric power industry's relatively limited experience with such plants.<sup>148</sup> For the most

part, the technological components that make up an IGCC power plant are currently in use in other commercially related applications but are not integrated into many operating IGCC electric power plants. But with further investments in technology, experts expect a reduction in the current cost premium between IGCC and PC plants from economies of scale gained in the large-scale purchasing of the technologies. Further cost reductions will also likely come from continued "learning by doing" gained through integrating the technological components of an IGCC plant, as well as reduced risk premiums in the market from operating these types of plants.

Considering the current and projected future benefits of IGCC and the private sector's hesitance to invest in these plants, facilitating investment in IGCC technology should be a high priority for both the Chinese government and the international community. Looking at the U.S. market, in 2004, the National Commission on Energy Policy (NCEP) recommended \$4 billion in public support to cover the current cost premium between IGCC and PC for the deployment of 10 GW of IGCC power plants. The NCEP thought that this level of support would eliminate the current cost differential.<sup>149</sup>

In February 2005, President George W. Bush signed a pact with German Chancellor Gerhard Schroeder with the aim to help China and India reduce emissions from coal. However, the agreement lacked any specific commitments for new initiatives or spending,<sup>150</sup> and nothing yet has seemingly come of this agreement.

In September 2005, the EU announced a pact with China to investigate the development of a coal plant in China utilizing carbon capture technology.<sup>151</sup> If this agreement does

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dropped to the point where the technology has nearly reached breakeven with both supercritical and ultracritical steam (SCS and UCS)-electric plants in terms of lifecycle costs [cents per kilowatt-hour] for plants using bituminous coals.

145. See Jeff Mason, *China to Watch Others on Climate Change Action*, ENVTL. NEWS NETWORK, June 15, 2005, <http://www.enn.com/today.html?Id=7959>.

146. At the most recent Conference of Parties of the United Nations Framework Convention on Climate Change, China, along with the United States, refused to discuss future mandatory reductions in GHGs. See Andrew C. Revkin, *U.S., Under Fire, Eases Its Stance in Climate Talks*, N.Y. TIMES, Dec. 10, 2005, at A1, available at <http://select.nytimes.com/mem/tnt.html?emc=tnt&tntget=2005/12/10/international/americas/10climate.html&tntemail=y>; Andrew C. Revkin, *U.S. Delegation Walks Out of Climate Talks*, N.Y. TIMES, Dec. 9, 2005, <http://select.nytimes.com/mem/tnt.html?emc=tnt&tntget=2005/12/09/international/americas/09cnd-climate.html&tntemail=y>.

147. See Scott A. Zimmermann, *Climate Change Policy for China: A Key Step in Building International Support for China's Zero-Emission Coal Power*, OIL, GAS & ENERGY L. INTELLIGENCE Oct. 2005, at 4 (citing Guodong Sun et al., Joint Workshop on the Cooperation in Clean-Coal Technologies Between the United States and China, 3-4, summarizing an event on May 14-15, 2004, in Hangzhou, China, available at [http://bscia.ksg.harvard.edu/BCSIA\\_content/documents/Hangzhou2004workshopreport.pdf](http://bscia.ksg.harvard.edu/BCSIA_content/documents/Hangzhou2004workshopreport.pdf), and Guodong Sun, The Roles of Government in the Innovation and Use of Clean-Coal Technologies in the United States and China, at 3 (summarizing comments from a Harvard University event held on Sept. 4-5, 2003), available at [http://bscia.ksg.harvard.edu/BCSIA\\_content/documents/CCT\\_workshop\\_summary.pdf](http://bscia.ksg.harvard.edu/BCSIA_content/documents/CCT_workshop_summary.pdf)).

148. Rosenberg et al., *supra* note 138, at 67, state: "The capital investment required to build the next generation of IGCC plants is generally estimated to be approximately 20 percent higher than investment required to build the next generation of PC plants, which translates into 10-15 percent higher energy cost." Whereas Robert Williams states:

Many detailed reports have been carried out in recent years showing that IGCC technology has evolved and costs have

See *supra* note 140, at 6. Despite this cost convergence, Williams identifies many institutional barriers to investing in IGCC plants. These "institutional" barriers have also retarded investment in IGCC plants in the private sector and in developed countries. However, American Electric Power recently announced its intention to build a 1,200 MW IGCC plant in the United States. See General Electric, *Cleaner Coal*, [http://www.ge.com/stories/en/20343.html?category=Product\\_Business](http://www.ge.com/stories/en/20343.html?category=Product_Business) (last visited Apr. 26, 2006) (describing a letter of intent signed by GE Energy, Bechtel Power Corporation, and American Electric Power to perform a scoping study for an IGCC power plant of up to 1,200 MW). In December of 2005, DOE announced the signing of an agreement with the "FutureGen Industrial Alliance" to build an IGCC plant with CCS technology named "FutureGen." See U.S. DOE, *FutureGen Project Launched: Government, Industry Agree to Build Zero-Emissions Power Plant of the Future*, [http://www.netl.doe.gov/publications/press/2005/tl\\_futuregen\\_signing.html](http://www.netl.doe.gov/publications/press/2005/tl_futuregen_signing.html).

149. See NCEP, ENDING THE ENERGY STALEMATE: A BIPARTISAN STRATEGY TO MEET AMERICA'S ENERGY CHALLENGES 56 (2004), available at <http://www.energycommission.org/>.

150. See Robert Collier, *Bush Signs on to Help Clean Air in China, India, U.S.-Germany Pact to Cut Coal Emissions*, S.F. CHRON., Feb. 26, 2005, at A1, available at <http://www.sfgate.com/cgi-bin/article.cgi?file=/c/a/2005/02/26/MNGKVBHHQ51.DTL>. DOE's "FutureGen" program apparently invites international cooperation through its International Participation Program, but in its current form, the program entails self-funding by participating governments. See Zimmermann, *supra* note 147, at 21.

151. See *EU to Help China Tackle Greenhouse Gas Emissions*, PLANETARK, Sept. 5, 2005, <http://www.planetark.com/dailynewsstory.cfm/newsId/32362/story.htm>.

indeed result in the deployment of an IGCC coal plant with CCS capability in China, it will be a critical step in the right direction. However, the impact of one such demonstration project is likely to be completely dwarfed by the scale of the projected near-term ramp up in conventional coal plants in China.<sup>152</sup> Experts estimate that as many as 100 “first-mover” IGCC plants may need some form of financial assistance to be able to compete with conventional coal plants in China.<sup>153</sup> While some level of financial assistance for up to 100 IGCC plants could amount to a significant expense, it could easily outweigh the long-term costs. In addition to possibly reducing the cost of future CCS, it will likely substantially reduce the health and environmental impacts of air pollution. For instance, the World Bank has estimated that in the absence of action, exposure to PM alone (conventional coal is a major emitter of PM) will cost China \$98 billion by 2020.<sup>154</sup> At least one commentator contends that it is rigid Chinese policies (including shielding the electricity sector from competition) rather than the cost premium of IGCC plants that is most seriously preventing the utilization of IGCC.<sup>155</sup> However, financial assistance as well as significant demonstration of the technology in other markets, such as the United States, would likely reduce Chinese resistance to deploying IGCC technology.

In the past, China has demonstrated its willingness to work with more-developed countries on international environmental problems when financial assistance is available. For instance, as part of its participation in the Vienna Convention for the Protection of the Ozone Layer in 1989 and the subsequent Montreal Protocol on Substances that Deplete the Ozone Layer, China was eligible for financial assistance from Montreal Ozone Projects Multilateral Trust Funds, which were established to assist developing countries phase out ozone-depleting substances covered under the Protocol. As of 2002, China had received approximately \$200 million dollars in grants from the fund.<sup>156</sup> Addressing climate change has more fundamental implications for economic growth than addressing ozone depletion. Accordingly, securing China’s engagement in a future agreement on climate change that includes financial incentives would likely cost more than \$200 million and be much more difficult than addressing ozone depletion, partly due to insufficient attention to the seriousness of the challenge of addressing climate change by the Chinese and U.S. governments.<sup>157</sup>

152. If this demonstration plant is a large coal plant, it will probably be on the order of 1,000 MW, while China is projected to add over 400 GW (400,000 MW) of coal capacity in the next 25 years. *See supra* note 131.

153. *See* Guodong Sun, *The Roles of Government in the Innovation and Use of Clean-Coal Technologies in the United States and China*, at 4 (summarizing comments from Harvard University event on Sept. 4-5, 2003), available at [http://bcsia.ksg.harvard.edu/BCSIA\\_content/documents/CCT\\_workshop\\_summary.pdf](http://bcsia.ksg.harvard.edu/BCSIA_content/documents/CCT_workshop_summary.pdf); Zimmermann, *supra* note 147, at 9. For comparison purposes, the NCEP recommended that \$4 billion be spent to deploy roughly 10 GW worth of IGCC technology in the United States to strengthen market confidence. NCEP, *supra* note 149.

154. ECONOMY, *supra* note 9, at 89-90.

155. *See* Dale Simbeck’s comments in Collier, *supra* note 150.

156. *See, e.g.,* Liu Shihua, *Rewarding Experiment in China: Performance Audit of Environmental Protection Projects in Conformity to International Conventions*, ASIAN J. GOV’T (2004), available at [http://www.asosai.org/journal2004\\_April/articles\\_3.htm](http://www.asosai.org/journal2004_April/articles_3.htm).

157. China is not required to reduce emissions under the terms of the Kyoto Protocol. Kyoto Protocol to the United Nations Framework

As Michael Oksenberg and Elizabeth Economy observe, past experience shows that China and the global community may not be ready to “grapple” with the financial commitment likely needed to address the relationship of China’s development and climate change.<sup>158</sup> Nonetheless, China does not seem intent on commercializing IGCC technology on its own. Therefore, leadership by the international community—especially the United States (which has substantially more coal reserves than the EU)—in rapidly commercializing the widespread use of IGCC technology is likely necessary for the deployment of this technology in the Chinese electricity sub-sector during this critical time of rapid expansion.

### 3. Nuclear Power

China’s civilian nuclear electric power program began in 1992. The NESP calls for a quadrupling of capacity (up to 40 GW) by 2020,<sup>159</sup> and there is talk of attempting to triple installed generating capacity to 60 GW, which would increase the percentage of nuclear generating capacity to 6% by 2020.<sup>160</sup> An expansion to just 40 GW over the next 15 years alone is expected to cost almost \$50 billion and would likely require the construction of an additional 30 nuclear power plants.<sup>161</sup> Considering the relative difficulty of building a nuclear power plant, including lengthy construction times, this is no small undertaking. Yet, a scale-up of this magnitude is not unprecedented. For example, almost the entire U.S. civilian nuclear fleet (over twice China’s capacity goal for 2020) was constructed in about 30 years. Nevertheless, some doubt China’s ability to accomplish its goal, and the EIA projects an installed capacity of just over 21 GW in China in 2020 in its “reference case” scenario, and over 23 GW in 2020 in its “strong nuclear power revival” scenario.<sup>162</sup>

Nuclear power has insignificant associated GHG emissions. This fact alone has caused governments, electricity industry officials, and environmentalists worldwide to reconsider its use after a global slowdown in the industry during the last few decades. However, continued and expanded use of nuclear power still faces many challenges and risks including cost, safety, long-term waste monitoring and/or disposal, and proliferation risk.

Motivated by a concern for the need for a significant increase in GHG-free electricity in the next few decades, a group of MIT and Harvard professors conducted an in-depth

Convention on Climate Change, Dec. 10, 1997, U.N. Doc. FCCC/CP/197/L.7/Add. 1, reprinted in 37 I.L.M. 22 (1998).

158. Michael Oksenberg & Elizabeth Economy, *China: Implementation Under Economic Growth and Market Reform*, in ENGAGING COUNTRIES: STRENGTHENING COMPLIANCE WITH INTERNATIONAL ENVIRONMENTAL ACCORDS 353-94 (Edith Brown Weiss & Harold K. Jacobsen eds., MIT Press 1998).

159. SINTON ET AL., *supra* note 34, at 17.

160. *See China Pledges Billions for Nuclear Power*, CHINA DAILY, June 7, 2005, [http://www2.chinadaily.com.cn/english/doc/2005-06/07/content\\_449265.htm](http://www2.chinadaily.com.cn/english/doc/2005-06/07/content_449265.htm).

161. *Id.*; *see also* FACTBOX—Countries’ Nuclear Power Strategies, PLANETARK, Nov. 30, 2005, <http://www.planetark.org/dailynewsstory.cfm?newsId=33740>.

162. *See* INTERNATIONAL ENERGY OUTLOOK 2005, *supra* note 35, at 165-66, tbls. FA & F2 (depicting world nuclear generating capacity by region and country, 2002 to 2025, and world nuclear generating capacity by region and country having strong nuclear power revival, 2002 to 2025).



study of the nuclear industry and its future.<sup>163</sup> Although offering a frank assessment of the past and potential future problems within the industry, the group recommended a set of policies to encourage a “global growth scenario” of nuclear power—subject to the industry first demonstrating that it could meet certain cost and performance standards in newly built plants.

Whether or not the commercial nuclear industry indeed demonstrates it has overcome its past problems, nuclear power is likely to remain popular with governments around the world, especially those where there is little or no competition within the electricity industry.<sup>164</sup> Yet the degree to which the industry actually experiences its recently predicted “revival”<sup>165</sup> in countries with more competitive electricity markets such as the United Kingdom and the United States has yet to be seen.<sup>166</sup> Nevertheless, increased production of nuclear waste and its associated proliferation risks from countries such as China will be a continuing concern for the global community.

The likely significant increase in nuclear waste being generated in China over the next few decades; current tensions surrounding the operation and effectiveness of the current structure of the Nuclear Non-Proliferation Treaty (NPT), including those countries that China is rapidly increasing trade with, e.g., Iran<sup>167</sup>; the George W. Bush Administration’s (Bush II Administration’s) announced intentions to sell nuclear technology to India without requiring India to become a signatory to the NPT<sup>168</sup>; and possible ex-

pansion of the domestic nuclear power industry in the United States are all factors that should spur interest in China and the United States to strengthen or alter the structure of the NPT safeguards regime.<sup>169</sup> Such an effort would certainly further the stated interests of both countries of expanding the use of nuclear power, and there is apparent interest on the part of the Bush II Administration in revising the NPT.<sup>170</sup> Such efforts, and/or efforts to develop regimes in parallel with the NPT to increase nuclear security,<sup>171</sup> should be pursued vigorously.

Thomas L. Friedman, *Letting India Into the Club?*, N.Y. TIMES, Mar. 8, 2006, at A27; *Joining the Nuclear Family: A Strategic Partnership Built on Shaky and Controversial Foundations*, ECONOMIST, Mar. 4, 2006, at 37; *Dr. Strangedeal: Congress Should Veto George Bush’s Nuclear Agreement With India*, ECONOMIST, Mar. 11, 2006, at 9; see also David E. Sanger, *We Are (Aren’t) Safer With India in the Nuclear Club*, N.Y. TIMES, Mar. 5, 2006, at D1; Glenn Kessler, *Nunn Urges Congress to Set Conditions on U.S.-India Nuclear Pact*, WASH. POST., Mar. 21, 2006, at A9.

163. See MIT, *supra* note 36.

164. For example, despite nuclear power’s arguable failure in the U.S. market over the last 25 years, the George W. Bush Administration (Bush II Administration) is apparently planning a significant funding push to expand its use in the United States and throughout the world. See Peter Baker & Dafna Linzer, *Nuclear Energy Plan Would Use Spent Fuel*, WASH. POST, Jan. 26, 2006, at A1, available at <http://www.washingtonpost.com/wp-dyn/content/article/2006/01/25/AR2006012502229.html>.

165. See, e.g., Philip J. Deutch, *Think Again: Energy Independence*, FOREIGN POL’Y, Nov./Dec. 2005, at 20, available at [http://www.foreignpolicy.com/story/cms.php?story\\_id=3262](http://www.foreignpolicy.com/story/cms.php?story_id=3262).

166. See, e.g., Shankar Vendantam, *Uncertainties Slow Push for Nuclear Plants: Cost of Building New Facilities, Concerns About Waste Disposal Are Cited*, WASH. POST, July 24, 2005, at A6, available at <http://www.washingtonpost.com/wp-dyn/content/article/2005/07/23/AR2005072300752.html>; John J. Fialka, *Nuclear Industry Plans Ad Push for New Plants*, WALL ST. J., Feb. 6, 2006, at A9; Matthew L. Wald & Heather Timmons, *Much Talk of a Nuclear Renaissance, But So Far Little Action*, N.Y. TIMES, Mar. 3, 2006, at C3; Matthew L. Wald, *Nuclear Reactors Found to Be Leaking Radioactive Water*, N.Y. TIMES, Mar. 17, 2006, at A21, available at <http://select.nytimes.com/mem/tnt.html?emc=tnt&tntget=2006/03/17/national/17nuke.html&tntemail0=y>.

167. The NPT is a treaty signed by more than 180 countries (including most of the countries that have nuclear weapons), and is designed to prevent the spread of nuclear material for non-civilian uses to countries that previously did not have nuclear weapons at the time of treaty drafting and/or signing. Treaty on the Non-Proliferation of Nuclear Weapons, July 1, 1968, 729 U.N.T.S. 169. The text of the treaty and a list of signatory countries can be seen at <http://un.org/Depts/dda/WMD/treaty/>. In 2003, North Korea (a previous signatory to the NPT) announced its withdrawal from the treaty. See Center for Non-Proliferation Studies *Text of North Korea’s Statement on NPT Withdrawal* (Jan. 10, 2003), <http://cns.miis.edu/research/korea/nptstate.htm>.

168. See, e.g., Glenn Kessler, *India Nuclear Deal May Face Hard Sell: Rice Set to Defend Landmark Accord She Orchestrated Without Congress*, WASH. POST, Apr. 3 2006, at A11, available at <http://www.washingtonpost.com/wp-dyn/content/article/2006/04/02/AR2006040201315.html>. For views on this proposal, see Henry A. Kissinger, *Working With India: America and Asia Stand to Gain From This New Partnership*, WASH. POST., Mar. 20, 2006, at A15;

169. See, e.g., John Deutch & Ernest J. Moniz, *A Plan for Nuclear Waste* (op-ed), WASH. POST, <http://www.washingtonpost.com/wp-dyn/content/article/2006/01/29/AR2006012900719.html> (last visited Apr. 26, 2006). For a discussion of options for strengthening the International Atomic Energy Agency and the NPT, see MIT, *supra* note 36, at 87-90; REPORT OF THE TASK FORCE ON THE UNITED NATIONS: AMERICAN INTERESTS AND U.N. REFORM, ch. 4 (U.S. Inst. for Peace 2005), available at <http://www.usip.org/un/report/>. For additional discussion on options for new international waste storage options, see International Atomic Energy Agency, Expert Group Report submitted to the Director General of the International Atomic Energy Agency: Multilateral Approaches to the Nuclear Fuel Cycle (Feb. 22, 2005), <http://www.iaea.org/NewsCenter/News/2005/fuelcycle.html>; see also Luther J. Carter & Thomas H. Pigford, *Confronting the Paradox in Plutonium Policies*, ISSUES IN SCI. & TECH., Winter 1999, at 29-36, available at [http://www.issues.org/issues/16.2/p\\_carter.htm](http://www.issues.org/issues/16.2/p_carter.htm); Chauncey Starr & Wolf Hafele, *Internationally Monitored Retrievable Storage Systems: A Step Toward World Peace in the Nuclear Age*, Paper presented at the meeting on Nuclear Cooperation on Spent Nuclear Fuel and High-Level Waste Storage and Disposal, Las Vegas, Nevada, March 7-9, 2000, available at <http://eed.llnl.gov/nclm/>; see also *Special Report—Proliferation: A World Wide Web of Nuclear Danger*, ECONOMIST, Feb. 28, 2004, at 25. The Bush II Administration has proposed the Global Nuclear Energy Partnership, which includes a proposal for establishing a system of “reactor” and (reprocessing) “fuel” states. See Matthew L. Wald, *A Shift Based on Science and Politics: Bush Policy on Spent Nuclear Fuel Takes Change Into Account*, N.Y. TIMES, Feb. 18, 2006, at A11; Guy Gugliotta, *Nuclear Energy Initiative Holds Uncertainties: Bush Plan Could Cut Dependence on Oil but Relies on Unproven Technologies*, WASH. POST., Feb. 19, 2006, at A9; see also *Reactor Dreams: Not Yet Off the Drawing Board*, ECONOMIST, Feb. 25, 2006, at 38. China seems amenable to the concept of a system that distinguishes between “fuel” and “reactor” states. Under such a system, certain states, e.g., Russia, would handle more proliferation-risky activities of the nuclear fuel cycle such as uranium reprocessing, and other countries, e.g., Iran, would only operate nuclear reactors for civilian power and not partake in fuel reprocessing or spent waste storage. See Edward Cody, *China Endorses Russian Proposal on Iranian Nuclear Program*, WASH. POST, Jan. 26, 2006, at A14, available at <http://www.washingtonpost.com/wp-dyn/content/article/2006/01/26/AR2006012600884.html>; Neil King Jr., *U.S. Firms See Nuclear Pact as Door to India*, WALL ST. J., Feb. 7, 2006, at A4; John J. Fialka, *U.S. Will Seek Global Partners for Nuclear-Fuel Recycling Initiative*, WALL ST. J., Feb. 7, 2006, at A16.

170. See Steven G. Weisman, *U.S. to Broaden India’s Access to Nuclear-Power Technology*, N.Y. TIMES, July 19, 2005, at A1 available at <http://select.nytimes.com/gst/abstract.html?res=F3061EFD3C580C7A8DDDAE0894DD404482;cf=James+Traub,+Why+Not+Build+a+Bomb?>, N.Y. TIMES, Jan. 29, 2006 (Magazine), at 15; see also Somini Sengupta, *Nuclear Deal and Iran Complicate Efforts by U.S. and India to Improve Ties*, N.Y. TIMES, Jan. 23, 2006, at A5, available at <http://www.nytimes.com/2006/01/23/international/asia/23delhi.html>.

171. For a discussion on a possible Gulf Security Council to help address nuclear issues, see Flynt Leverett, Op. Ed., *The Gulf Between Us*, N.Y. TIMES, Jan. 24, 2006, at A21, available at [http://www.nytimes.com/2006/01/24/opinion/24leverett.html?\\_r=1&th&emc=th](http://www.nytimes.com/2006/01/24/opinion/24leverett.html?_r=1&th&emc=th).



## 4. Renewables

Law and policy aimed at deploying more renewables in China has been under rapid development in the last two

years and is currently far from clear. Table 2 lists selected recent developments in this sub-sector.

**Table 2: Chinese Renewables-Related Energy Policy Developments and Pronouncements**

NESP	Official Pronouncements	2005 Renewable Energy Law and Subsequent Regulations	Other
<ul style="list-style-type: none"> <li>The NESP calls for an additional 90 to 100 GW of renewables by 2020, not including large-scale hydroelectric power.<sup>172</sup></li> </ul>	<ul style="list-style-type: none"> <li>In 2004, China announced a pledge to speed up the development of its renewable resources at the International Conference for Renewable Energies in Bonn, Germany (the Bonn Conference),<sup>173</sup> pledging to increase its renewables capacity to 60 GW, or enough to provide roughly 10% of its electrical generating capacity by 2010.<sup>174</sup></li> <li>In November 2005, Zhang Guobao, Vice Minister of the NDRC, introduced a plan for China to spend approximately \$180 billion on renewables development over the next 15 years, so that renewables make up an estimated 15% of electricity production by 2020.<sup>175</sup></li> <li>This goal was reiterated by Vice Premier Zeng Peiyan, who recently stated that renewables should account for 15% of national consumption by 2020.<sup>176</sup></li> <li>However, legislation and regulations must be implemented to realize this figure, and such a percentage of renewables would likely include large-scale hydropower projects, which, as demonstrated by the Nu River Dam project (discussed below), may be the source of significant public opposition in the future.<sup>177</sup></li> </ul>	<ul style="list-style-type: none"> <li>In 2005, the Standing Committee of the NPC passed a renewable energy law<sup>178</sup> to help achieve the target set at the Bonn Conference.</li> <li>The law is to take effect in 2006 and will consist of a mix of requirements for renewable electricity purchases by utilities combined with competitive bidding, e.g. for wind,<sup>179</sup> financial incentives for renewables development, encouraging the sale of biofuels by oil distributors, and money for research and development.<sup>180</sup> This law also includes penalties for non-compliance with this form of renewable portfolio standard.<sup>181</sup></li> <li>In January 2006, the NDRC issued regulations requiring that large electricity producers ensure that 5% of their generated electricity comes from renewables by 2010, and 10% by 2020.<sup>182</sup></li> </ul>	<ul style="list-style-type: none"> <li>The Chinese government is reportedly working on drafting mid- and long-term action plans for utilization of renewables.<sup>183</sup></li> </ul>

172. SINTON ET AL., *supra* note 34, at 17. For more on the Chinese renewables policy prior to 2004, see NATIONAL RENEWABLE ENERGY LABORATORY, RENEWABLE ENERGY POLICY IN CHINA: OVERVIEW (2004), available at <http://www.nrel.gov/docs/fy04osti/35786.pdf>.

173. Visit the conference website at <http://www.renewables2004.de/> (last visited Apr. 26, 2006).

174. See Worldwatch Institute, Worldwatch in Action: Special Report on the International Conference for Renewable Energies (Renewables 2004), <http://www.worldwatch.org/features/renewables/bonn/part2/> (last visited Apr. 26, 2006).

175. See *China to Spend US\$180b to Boost Renewable Energy Use*, AFP, Nov. 8, 2005, in APECC NEWS BRIEFING, *supra* note 12, at 6.

176. See *China Lifts Target for Renewable Energy Use*, PLANETARK, Nov. 8, 2005, <http://www.planetark.com/dailynewsstory.cfm/newsId/33369/story.htm>.

177. In September 2005, Shi Lishan, Director of Renewable Energy of the National Development and Reform Commission, told an energy conference in Beijing, China, that by "2020 renewable energy (could) account for 15 percent of energy production in China, including large-scale hydropower projects." *China Mulls Raising Renewable Energy Commitment*, PLANETARK, Sept. 6, 2005, <http://www.planetark.com/dailynewsstory.cfm/newsId/32360/newsDate/6-Sep-2005/story.htm>.

178. See *supra* note 63.

179. See, e.g., Worldwatch Institute, Yingling Liu, Behind the Chilly Air: Impacts of China's New Wind Pricing Regulation (Mar. 30, 2006), <http://www.worldwatch.org/features/chinawatch/stories/20060330-1>.

180. See Hu Cong, *Legislature Passes Renewable Energy Bill*, CHINA DAILY, Mar. 1, 2005, [http://www.chinadaily.com.cn/english/doc/2005-03/01/content\\_420450.htm](http://www.chinadaily.com.cn/english/doc/2005-03/01/content_420450.htm); see also *Greenpeace Hails China's First Renewable Energy Law*, TERRADAILY, Mar. 1, 2005, <http://www.terradaily.com/2005/050301023815.ovoszih4.html>.

181. See NATURAL RESOURCES DEFENSE COUNCIL, *supra* note 125, at 14.

182. *Renewable Energy Quota Set For Power Companies*, CHINA VIEW, Jan. 17, 2006, [http://news.xinhuanet.com/english/2006-01/17/content\\_4060646.htm](http://news.xinhuanet.com/english/2006-01/17/content_4060646.htm); see also Ying, *supra* note 116; Renewable Energy Access, *China's Renewable Energy Law Takes Effect*, <http://www.renewableenergyaccess.com/rea/news/story?sessionId=aMyoudtRJH09?Id=41932>; Centre for Energy, *China Sets Pricing for Power Generated From Renewable Energy*, <http://www.centreforenergy.com/displayNewsArticle.asp?From=Sector&template=2,2&NewsID=8047227&ResultCategoryType=2,7&NewsPageID=3>.

183. See *First World Told to Guide Global Resources Saving*, CHINA DAILY, Nov. 10, 2005, in APECC NEWS BRIEFING, *supra* note 12, at 12.

In recent years, the most effective policy driving growth in non-hydroelectric renewables has likely been the wind concession program. The program includes a competitive bidding process whereby developers bid for concessions issued by the NDRC. If granted a concession, the developer is guaranteed interconnection rights and financial assistance to enable grid interconnection, as well as a power purchase agreement for a fixed amount of power produced by the project.<sup>184</sup> To date, five concessions have been awarded, and there may be up to 20 more in the pipeline.<sup>185</sup> The main benefit of the wind concession program is certainty, i.e., related to grid interconnection, a guaranteed buyer, etc., which should encourage more entrants into the bidding market and presumably lower the price of wind-generated power through competition. However, some argue that the first concessions granted under China's program were artificially low,<sup>186</sup> which may threaten the likelihood of the wind projects actually reaching completion.<sup>187</sup>

If it achieves its stated goals and commitments, China will contribute to a remarkable deployment of (especially non-hydroelectric) renewable electricity generation capacity in the next 10 to 15 years. However, these targets might be a telling example of the "aspirational" nature<sup>188</sup> and "campaign mentality"<sup>189</sup> of many Chinese environmental laws, since the prospects of the central government's ability to be able to add 60 GW of non-hydroelectric renewables by 2010<sup>190</sup> from an installed capacity of less than 1 GW today seem unlikely.

Considering the price premium of most renewables and the relatively small-scale and distributed nature of their development,<sup>191</sup> a potentially more realistic target is China's newly revised goal of spending \$180 billion to enable renewables to generate approximately 15% of electricity by 2020.<sup>192</sup> Yet the difficulty that the United Kingdom is experiencing in meeting its relatively ambitious renewables targets<sup>193</sup> highlights the difficulty of deploying relatively mod-

est percentages of renewables absent significant cost decreases or extremely stringent regulations—even for wealthy countries. In China, the high cost of renewables is likely to be a particularly strong deterrent toward renewables development, with continued decisionmaking in the energy sector occurring at the local level (discussed below in Section V). The effectiveness of the newly passed Renewable Energy Law by the central government has yet to be determined, and its effect on industrial subsectors within the renewables field such as the wind industry will likely be determined by its ability to contribute to policy/market stability and the efficacy of its implementing regulations.<sup>194</sup> However, the ability of China's Renewable Energy Law alone to significantly decrease the cost (and thus increase deployment) of more expensive renewables such as solar photovoltaics (PV) is even more uncertain.

### C. Large-Scale Hydroelectric Power

In announcing its recently revised ambitious plans for renewables development—15% of electricity by 2020—the Chinese government implied that hydroelectric plants would make up the bulk of proposed renewable energy generation in 2020 (although it was unclear how much of this is supposed to be "large-scale").<sup>195</sup> At a minimum, the NESP calls for more than doubling currently installed large-scale hydroelectric capacity by 2020.<sup>196</sup> But as analysts at the LBL China Energy Group point out, such an expansion would require building the equivalent of a dam the size of the Three Gorges Dam project every two years.<sup>197</sup>

In theory, large-scale hydroelectricity can significantly reduce the level of conventional pollution and GHG emissions<sup>198</sup> as compared to conventional fossil generation. In addition, hydroelectricity does not have the safety and proliferation concerns that accompany nuclear power. However, as demonstrated by the construction of the Three Gorges Dam (and the Nu River Dam, discussed below in Section V), large-scale hydroelectric development is not without its own set of social and environmental issues and costs.

To date, most public participation and international "involvement" in China has dealt with large hydroelectricity

184. Lewis, *supra* note 65, at 150-55.

185. *Id.* at 32.

186. *Id.* at 54, 57.

187. In addition, the NDRC issued a regulation in January 2006 apparently reversing its earlier intention to use "feed-in" tariffs in determining the price of wind power, causing concern among some as to the effects of this on the young wind industry. See Worldwatch Institute, *supra* note 179.

188. See Adam Briggs, *China's Pollution Victims: Still Seeking a Dependable Remedy?*, 18 GEO. INT'L ENVTL. L. REV. 305, 312-13 (2006) (citing in part Richard Ferris & Hongjun Zhang, *Reaching Out to the Rule of Law: China's Continuing Efforts to Develop an Effective Environmental Law Regime*, 11 WM. & MARY BILL OF RTS. J. 569, 600 (2003)).

189. ECONOMY, *supra* note 9, at 23, 121-27.

190. As pledged at the renewables conference in Bonn, Germany. See *supra* note 173.

191. Most renewables development projects are on the scale of kilowatts, e.g., a rooftop PV system, or megawatts, e.g., a 100 MW wind farm, whereas large-scale coal, nuclear, or hydroelectric plants are in the 500 MW or 1 GW scale. This difference in project scale can, under some circumstances, make it easier and quicker to develop the same amount of installed electricity-generating capacity with large-scale plants than with smaller-scale projects.

192. "Realistic" in terms of the time needed to develop such a program, which would obviously still require a significant amount of money.

193. See ENVIRONMENT, FOOD, AND RURAL AFFAIRS COMMITTEE, U.K. HOUSE OF COMMONS, CLIMATE CHANGE: LOOKING FORWARD, NINTH REPORT OF SESSION 2004-2005, VOLUME I, at 26-29 (2005), available at <http://www.publications.parliament.uk/pa/cm200405/cmselect/cmenvfru/130/130i.pdf>; see also, e.g., *EU Says Won't*

*Meet 2 Percent Biofuel Target This Year*, PLANETARK, Mar. 3, 2005, <http://www.planetark.com/dailynewsstory.cfm/newsId/29810/newsDate/3-Mar-2005/story.htm>; Marc Jacoby, *A Danish Island Touts Clean Energy, But Reality Sets In: Europe Has Ambitious Plans, Yet Samsoe's Residents Find It Tough to Convert*, WALL ST. J., Feb. 9, 2006, at A1. On the difficulty of meeting GHG reduction targets in wealthy countries, see *Britain Set to Miss Its Own Greenhouse Gas Target*, PLANETARK, Mar. 29, 2006, <http://www.planetark.com/dailynewsstory.cfm/newsId/35820/story.htm>.

194. Lewis, *supra* note 65, at 308.

195. *China Lifts Target for Renewable Energy Use*, *supra* note 176.

196. *China Has Huge Potential in Hydroelectric Generation*, *supra* note 39. The EIA estimates that in 2003, China had roughly 86 GW installed hydroelectric capacity. See INTERNATIONAL ENERGY ANNUAL 2003, *supra* note 35, tbl. 6.4; SINTON ET AL., *supra* note 34, at 16.

197. SINTON ET AL., *supra* note 34, at 16.

198. However, there is some concern that dams in certain climatic locations can contribute to significant GHG emissions, mostly due to anaerobic releases of methane (a potent GHG) from dam reservoirs. See WORLD COMMISSION ON DAMS, DAMS AND DEVELOPMENT: A NEW FRAMEWORK FOR DECISION-MAKING ch. 3 (2000), available at <http://www.dams.org/report/contents.htm>.

projects.<sup>199</sup> This is understandable, as such projects tend to affect the most people in a direct and substantial way through relocation and potential loss of livelihood, and there is continued debate over the ability of large dams to meet economic and resource expectations as well as their net long-term contribution to development.<sup>200</sup> Thus, in spite of the potential social cost and disruption of such an increase, and in the face of possibly increasing international pressure, whether or not China will indeed meet its goals for large-scale hydroelectricity is yet to be determined. However, without offsetting deployment of large-scale hydroelectricity plants with efficiency measures and/or other forms of renewable energy, any reduction in planned hydroelectric capacity will likely increase the development of less-than-ideal energy sources, with more direct effects on the international community (through emissions from fossil resources, and safety and proliferation concerns related to nuclear power).<sup>201</sup> In contrast to international concerns over China's present and planned development of its hydroelectric resources, international concern and engagement with respect to these other sources appears lacking in comparison.

### V. Current and Future Drivers of Chinese Energy Policy

At the heart of current Chinese energy policy is a drive to rapidly increase supply. Evidence of this can be seen in the government's plans for a massive ramp-up in coal, nuclear, large-scale hydroelectricity, and (to a lesser extent) non-large-scale renewables capacity; commercial and government engagements with international oil producing companies and countries<sup>202</sup>; and the government's apprehension toward a global agreement to reduce GHG emissions (i.e., one that would entail emissions reductions by China), which was most recently demonstrated at the Conference of the Parties meeting of the United Nations Framework Conven-

tion on Climate Change (UNFCCC) in Montreal, Canada, in December 2005 by its aligning with the United States against mandatory emissions reductions.<sup>203</sup> Whether or not this current drive to massively increase the supply of energy will be tempered by increased civic awareness and "grass-roots" pressures (e.g., pollution victims lawsuits; protest movements related to pollution, wealth inequality,<sup>204</sup> and land rights; or perhaps public unease with the loss of life from coal mining, etc.) is yet unknown. For the time being, it is clear that China is pursuing a strong policy of growing its supply of energy—both domestically and abroad.

As discussed above, investments in energy efficiency in the electricity and industrial sectors in China results in reductions in aggregate energy demand. The same is true with respect to transportation and oil use. Yet, similar to the United States, China seems to be putting more emphasis on the historically flawed strategy of "securing" oil supplies abroad, as well as a less than ideal hedge toward price fluctuations through the establishment of a strategic petroleum reserve.<sup>205</sup> China also has a fairly robust program to convert coal to liquid fuels, which arguably has much greater potential to contribute to real "energy security" than its other two supply-side oil security strategies.<sup>206</sup>

Despite the inclination of governments worldwide to act otherwise, attempts to achieve energy security through securing supplies abroad<sup>207</sup> is a fairly ineffective way to secure energy needs in a global oil economy. Reducing energy (oil) use is the best way to reduce the vulnerability of an economy

203. See *supra* note 146.

204. See, e.g., Joseph Kahn, *Pace and Scope of Protest in China Accelerated in '05*, N.Y. TIMES, Jan. 20, 2006, at A10, available at <http://www.nytimes.com/2006/01/20/international/asia/20china.html>; Edward Cody, *A Chinese City's Rage at the Rich and Powerful*, WASH. POST, Aug. 1, 2005, at A1, available at <http://www.washingtonpost.com/wp-dyn/content/article/2005/07/31/AR2005073101163.html>; Edward Cody, *China Promises Equitable Growth*, WASH. POST, Oct. 1, 2005, at A12, available at [http://www.washingtonpost.com/wp-dyn/content/article/2005/09/30/AR2005093001545.html?nav=rss\\_world](http://www.washingtonpost.com/wp-dyn/content/article/2005/09/30/AR2005093001545.html?nav=rss_world); Edward Cody, *China Warns Gap Between Rich, Poor Is Feeding Unrest*, WASH. POST, Sept. 22, 2005, at A16, available at <http://www.washingtonpost.com/wp-dyn/content/article/2005/09/21/AR2005092100727.html>; Edward Cody, *China's Party Leaders Draw Bead on Inequity*, WASH. POST, Oct. 9, 2005, at A24, available at <http://www.washingtonpost.com/wp-dyn/content/article/2005/10/08/AR2005100801214.html>.

205. See, e.g., *China Orders Oil Companies to Build Reserves*, AFP, Nov. 14, 2005, in APECC NEWS BRIEFING, *supra* note 12, at 26; Jason Dean, *China's Planners Slow Timetable for Oil Reserves*, WALL ST. J., Mar. 7, 2006, at A6.

206. In February 2006, China announced \$15 billion in investment in coal liquefaction plants over the next 5 to 10 years. See, e.g., OilNews.com.cn, *Coal Liquefaction to Get Major Investment* (Feb. 10, 2006), <http://english.oilnews.com.cn/Info.asp?id=99321>; see also Robert H. Williams & Eric D. Larson, *A Comparison of Direct and Indirect Liquefaction Technologies for Making Fluid Fuels From Coal*, 7 ENERGY FOR SUSTAINABLE DEV. 103 (2003), available at <http://www.ieglobal.org/ESDV07No4/dclversussicl.pdf>.

207. Shai Oster, *China Will Strike an Energy Deal With the Saudis*, WALL ST. J., Jan. 23, 2006, at A3; Joseph Kahn, *Behind China's Bid for Unocal: A Costly Quest for Energy Control*, N.Y. TIMES, June 27, 2005, at A1; see also *Sino-Russian Energy Links to Expand*, CHINA DAILY, Nov. 4, 2005, in APECC NEWS BRIEFING, *supra* note 12, at 24; *China, Viet Nam to Jointly Explore Oil, Gas*, CHINA DAILY, Nov. 2, 2005, in APECC NEWS BRIEFING, *supra* note 12, at 24; *Oil Pipeline Linking China, Kazakhstan Joins Together*, XINHUANET, Nov. 15, 2005, in APECC NEWS BRIEFING, *supra* note 12, at 24; Christopher Pala, *China Pays Dearly for Kazakhstan Oil*, N.Y. TIMES, Mar. 17, 2006, at C5; Gregory L. White & Shai Oster, *Beijing and Moscow Agree to Widen Energy Ties: Pacts May Bring Big Supply Of Russian Oil and Gas to China for the First Time*, WALL ST. J., Mar. 22, 2006, at A4.

199. For example, international protests and the controversy surrounding the World Bank's possible involvement in the Three Gorges Dam (which the World Bank eventually decided not to help fund).

200. See, e.g., WORLD COMMISSION ON DAMS, *supra* note 198; see also *China's 3 Gorges Raises Questions for Future Dams*, PLANET-ARK, May 15, 2006, <http://www.planetark.com/dailynewsstory.cfm/newsid/36356/story.htm>.

201. See, e.g., Shai Oster & Patrick Barta, *China Stumbles in Attempt to Cut Use of Coal and Oil*, WALL ST. J., Mar. 3, 2006, at A1.

202. Labeled "China's Go-Out Strategy" in Kenneth Lieberthal & Mikal Herberg, *China's Search for Energy Security and Implications for U.S. Policy*, 17 NAT'L BUREAU OF ASIA RES. 11 (2006), available at <http://www.nbr.org/publications/analysis/pdf/vol17no1.pdf>. For more on China's energy diplomacy activities throughout the world, see David Zweig & Bi Jianhai, *China's Global Hunt for Energy*, FOREIGN AFFAIRS, Sept./Oct. 2005, at 25-38; see also James F. Feinerman, *Seven Questions: China and Unocal*, FOREIGN POLICY, July 1, 2005, [http://www.foreignpolicy.com/story/cms.php?story\\_id=3121](http://www.foreignpolicy.com/story/cms.php?story_id=3121); Zhang Jianxin, *Oil Security Reshapes China's Foreign Policy* (Hong Kong Univ. of Science and Tech., Working Paper No. 9, 2005), available at <http://www.cctr.ust.hk/articles/pdf/WorkingPaper9.pdf>; see also David Barboza, *Chinese Energy Giant to Buy Stake in Nigerian Oil Field*, N.Y. TIMES, Jan. 10, 2005, at C5; Oster & Linebaugh, *supra* note 96; Jim Yardley, *China's Leader Signs Oil Deals With Africans*, N.Y. TIMES, May 1, 2006, at A4, available at <http://select.nytimes.com/search/restricted/article?res=F30D15FF3A5B0C728CDDAC0894DE404482>; Steven Mufson, *As China, U.S. Vie for More Oil, Diplomatic Friction May Follow*, WASH. POST., Apr. 15, 2006, at D1, available at <http://www.washingtonpost.com/wp-dyn/content/article/2006/04/14/AR2006041401682.html>; Shai Oster, *China Downplays Growing Quest for Oil Supplies*, WALL ST. J., Apr. 25, 2006, at A8.



to price shocks (the major source of oil insecurity) in the global oil market.<sup>208</sup> In fact, increasing efficiency and/or fuel switching is the only way to increase real “energy security” in a free-market economy, absent a wartime situation where international energy trading is limited or ceases.<sup>209</sup> Furthermore, an oil-importing country that pursues a supply-focused strategy instead of a demand-focused strategy will continue to increase worldwide demand for oil, which will add additional price pressure to global oil prices, further reducing the country’s energy (price) security. Although it is impossible to know what the current oil market would look like without U.S. military presence in the Persian Gulf in the latter half of the 20th century, it would be hard to classify the United States as “secure” with respect to its oil supplies. And despite Chinese and U.S. efforts to secure reliable supplies of oil, the world will nevertheless become increasingly dependent on oil from the Persian Gulf region.<sup>210</sup> Geologic and market realities of the global oil market should motivate the two largest oil consumers and importers, China and the United States, to work together to meaningfully increase energy security through reduced demand for oil.

Pursuing energy security via strategic petroleum reserves has in the past suffered from less than ideal management,<sup>211</sup> and is by nature a short-term approach toward ensuring oil availability and price security. As demonstrated by a recent simulation exercise of the affect on the U.S. economy in response to a relatively small disruption (4%<sup>212</sup>) in global oil supply,<sup>213</sup> a major disruption in the global oil market is not

required to inflict serious economic pain on the United States despite the existence of a strategic oil reserve. The mitigating effects of a strategic petroleum reserve on China’s economy are likely to be similarly short-lived and limited. Nevertheless, China’s entry into the IEA, or at a minimum some sort of cooperative arrangement between China and IEA countries (and thus cooperation in pooling strategic petroleum reserves), has been suggested as one way to significantly engage China on energy issues in a way that would benefit all major oil consuming countries.<sup>214</sup>

A continued focus on developing domestic supplies of energy, as well as increasing access to foreign supplies of energy, will likely continue to heavily influence Chinese energy policy and diplomacy over the next few decades. On the demand side, the (potential) rise of Chinese regulatory mechanisms, the inclusion of public participation in legal and regulatory processes, China’s evolving legal system, and the evolving level of “cooperative federalism” inside China could all influence the trajectory of energy development within the Chinese sector over the next few decades. A brief discussion on each of these drivers is included below.

### A. Regulatory Mechanisms

China’s impressive decoupling of growth in energy use from economic growth between 1980 and 2000 was in part due to regulatory mechanisms such as energy quotas, as well as to policies such as low-interest loans and tax-credits for efficiency investments.<sup>215</sup> However, the regulatory bodies and mechanisms currently operating in the energy sector have not kept up with the dramatic growth in the sector.

As mentioned above, an Energy Bureau exists within the NDRC, but it has a staff of 20 to 30 people.<sup>216</sup> Therefore, its effectiveness in managing a sector that is attempting to provide the energy needs of 1.3 billion people is likely to be

208. See, e.g., MARC LABONTE & GAIL MAKINEN, ENERGY INDEPENDENCE: WOULD IT FREE THE UNITED STATES FROM OIL PRICE SHOCKS? (CRS Report for Congress Nov. 17, 2000), available at <http://www.ncseonline.org/nle/crsreports/energy/eng-74.pdf>.

209. For an interesting discussion on oil markets and supply disruptions within the Chinese/U.S. context, see Lieberthal & Herberg, *supra* note 202, at 19-22.

210. Interestingly, the 2006 National Security Strategy of the United States asserts:

China’s leaders must realize, however, that they cannot stay on this peaceful path while holding on to old ways of thinking and acting that exacerbate concerns throughout the region and the world. These old ways include: . . . Expanding trade, but acting as if they can somehow “lock up” energy supplies around the world or seek to direct markets rather than opening them up—as if they can follow a mercantilism borrowed from a discredited era; and Supporting resource-rich countries without regard to the misrule at home or misbehavior abroad of those regimes.

WHITE HOUSE, NATIONAL SECURITY STRATEGY OF THE UNITED STATES 41, 42 (2006), available at <http://www.whitehouse.gov/nsc/nss/2006/>; see also Carla Anne Robbins & Neil King Jr., *White House Puts Iran at Top of List of Threats to the U.S.*, WALL ST. J., Mar. 16, 2006, at A1. Yet, as Lieberthal and Herberg point out:

The United States . . . has a stated policy of relying largely on global markets to deliver energy supply security. [FN: 4 Though in reality, this policy has been augmented over the past 50 years by major interventions of U.S. power, influence, and diplomacy designed to keep oil flowing to world markets.] The United States does not always fully appreciate how its colossal weight in global energy and geopolitics affects China’s concerns regarding U.S. ability to threaten China’s energy interests.

Lieberthal & Herberg, *supra* note 202, at 9 & n.4.

211. See, e.g., David W. Keith & Alexander E. Farrell, *Rethinking Hydrogen Cars*, 301 SCIENCE 315 (2003).

212. That is, small in relative terms. Four percent of global oil supply is significant in absolute terms.

213. NCEP & SECURING AMERICA’S FUTURE ENERGY, SIMULATION REPORT AND SUMMARY OF FINDINGS—OIL SHOCKWAVE: OIL CRI-

SIS EXECUTIVE SIMULATION (2005), available at [http://www.energycommission.org/files/contentFiles/oil\\_shockwave\\_report\\_440cc39a643cd.pdf](http://www.energycommission.org/files/contentFiles/oil_shockwave_report_440cc39a643cd.pdf). For more on the growing level of “energy insecurity” in the global energy market, see, e.g., *Nervous Energy: Consumers Are Highly Vulnerable to a Sudden Break in Energy Supplies*, ECONOMIST, Jan. 7, 2006, at 61.

214. China is not a member of the IEA. Membership in the IEA first requires membership in the OECD, which requires a country to meet minimum economic and human rights standards. For more on this subject, see Lieberthal & Herberg, *supra* note 202, at 32. For discussion on options for IEA/China cooperation outside of formal IEA membership for China, see, e.g., Council on Foreign Relations, Transcript: Remarks by Senator Joseph I. Lieberman and William F. Martin, China-U.S. Energy Policies: A Choice of Cooperation or Collision (Nov. 30, 2005), [http://www.cfr.org/publication/9335/chinaus\\_energy\\_policies.html](http://www.cfr.org/publication/9335/chinaus_energy_policies.html); Jeffrey Logan, The Changing Context of Sino-U.S. Energy Relations, Presentation at Competition or Cooperation for Energy: China and the North American Response, Woodrow Wilson International Center for Scholars (Mar. 29, 2006), available at <http://www.wilsoncenter.org/events/docs/logan.pdf>; Lieberthal & Herberg, *supra* note 202, at 30-35; Amy Myers Jaffe & Kenneth B. Medlock III, *China and Northeast Asia*, in ENERGY AND SECURITY: TOWARD A NEW FOREIGN POLICY STRATEGY 286 (Jan H. Kalicki & David L. Goldwyn eds., Woodrow Wilson Center Press 2005). For additional views on the need for cooperation on oil issues between China and major oil consumers of the world, see BP, *China’s Peaceful Rise—An Energy Perspective From BP* (Apr. 24, 2005), <http://www.bp.com/genericarticle.do?categoryId=98&contentId=7005892>; Wenran Jiang, *Is Beijing Greedy for Oil?*, BUS. WK., Feb. 27, 2006, [http://www.businessweek.com/globalbiz/content/feb2006/gb20060227\\_364974.htm](http://www.businessweek.com/globalbiz/content/feb2006/gb20060227_364974.htm).

215. See LIN, *supra* note 129.

216. Gong Li & Mark Spelman, *Foreword*, in AUSTIN, *supra* note 19, at ix; Lewis, *supra* note 65, at 33.

minimal. The role of the “leading group” on energy has yet to be defined publicly,<sup>217</sup> but it does not appear to be the type of administrative or regulatory agency that many experts think is necessary for the Chinese energy sector. Some commentators have called for the establishment of a Ministry of Energy, with clear and established powers to manage the expanding and diverse energy sector.<sup>218</sup> At a minimum, the World Bank and the Asian Development Bank have called for the creation of a truly “independent” regulatory body for the electricity sector alone—a role that has yet to be filled by the newly created SERC.<sup>219</sup>

### B. Public Protests/Public Participation

Generally speaking, “public participation” is on the rise in China in the form of citizen protests, lawsuits, and public engagement in regulatory processes. The short- and long-term effect of a recent increase in public protests related to pollution and environmental issues to land rights is yet to be determined<sup>220</sup> and may depend in part on how long such protests are “tolerated.” But, if these protests are effective in raising attention and awareness to pollution concerns (and they continue without repercussions for the protesters<sup>221</sup>), they may lead to cleaner development of the Chinese energy sector.

Over the past 25 years, the number of lawsuits brought by pollution victims against polluters<sup>222</sup> has increased substantially, and such suits even appear to be encouraged by the government.<sup>223</sup> Judging by western standards, however, the Chinese judiciary is far from being independent, and judges are often influenced by local business and economic concerns.<sup>224</sup> By adding to a legal culture that disincentives pol-

lution, these lawsuits could affect the development of the energy sector. Yet most of these (successful) suits seem to be in response to egregious pollution events<sup>225</sup> or practices that are usually isolated in nature and not relevant to the chronic lower-level daily pollution caused by the energy sector. Furthermore, absent the development of energy projects that do not meet standards set by the government, it is hard to imagine much successful litigation related to conventional air pollution or GHG emissions from the energy sector.

Public participation in energy-related matters is also on the rise through public disclosure of environmental data and citizen input into regulatory decisions. Public disclosure or “sunshine”<sup>226</sup> policies can be a powerful tool for citizens, both domestically and internationally, to become better informed about their surrounding environment and their government’s efforts to address environmental issues, and can influence industrial development patterns over time. Accordingly, the announcement from the governor of China’s Guangdong province, Huang Huahua, of an agreement with Hong Kong<sup>227</sup> to disclose daily air quality data is a positive indication of increasing public disclosure of energy-related pollution.<sup>228</sup> The government was also reportedly pursuing pilot “green GDP” programs in 10 provinces whereby bureaucrats were to receive statistics on their efficacy (including the total costs and benefits of environmental degradation of their policies). SEPA officials had planned to have a “framework” for a green GDP accounting system in three to five years.<sup>229</sup> However, in May 2006, the government announced its intentions to instead pursue a “green accounting” system endorsed by the United Nations due to difficulties encountered in trying to calculate green GDP.<sup>230</sup>

In October 2005, SEPA officials announced their intention to start “blacklisting” cities that are out of compliance with national air quality standards, with the intended effect of deterring investment in those locales.<sup>231</sup> And in the first half of 2006, the government announced that SEPA would be establishing a public disclosure system for major environmental disasters including “regular reporting procedures,” and Premier Wen Jiabao “asked local governments to release information on energy consumption and pollutant emissions every six months.”<sup>232</sup> All of these examples

217. See *supra* note 66.

218. See, e.g., SINTON ET AL., *supra* note 34. There is some indication that a cabinet-level energy department is in the works. See, e.g., *Energy Law Aims at Power Conservation*, CHINA DAILY, Feb. 7, 2006, in APECC NEWS BRIEFING, Feb. 2006, at 10.

219. Yeh & Lewis, *supra* note 118, at 449, 460; Shi, *supra* note 120; AUSTIN, *supra* note 19, at 17.

220. See, e.g., ECONOMY, *supra* note 9, at 85-88; *China’s Land Disputes: Turning Ploughshares Into Staves*, ECONOMIST, June 23, 2005, available at [http://www.economist.com/printedition/displayStory.cfm?Story\\_ID=4109014](http://www.economist.com/printedition/displayStory.cfm?Story_ID=4109014); Howard W. French, *Riots in a Village in China as Pollution Protest Heats Up*, N.Y. TIMES, July 19, 2005, at A3; Edward Cody, *China Grows More Wary Over Rash of Protests: Cell Phones, Internet Spread the Word, Magnify Fallout*, WASH. POST, Aug. 10, 2005, at A11, available at <http://www.washingtonpost.com/wp-dyn/content/article/2005/08/09/AR2005080901323.html>; Edward Cody, *China’s Rising Tide of Protest Sweeping Up Party Officials: Village Chiefs Share Anger Over Pollution*, WASH. POST, Sept. 12, 2005, at A1, available at <http://www.washingtonpost.com/wp-dyn/content/article/2005/09/11/AR2005091101681.html>; Edward Cody, *For Chinese, Peasant Revolt Is Rare Victory: Farmers Beat Back Police in Battle Over Pollution*, WASH. POST, July 13, 2005, at A1, available at [http://www.washingtonpost.com/wp-dyn/content/article/2005/06/12/AR2005061201531\\_pf.html](http://www.washingtonpost.com/wp-dyn/content/article/2005/06/12/AR2005061201531_pf.html); *China’s Pollution Galvanizes Peasants to Action*, PLANETARK, Feb. 3, 2006, <http://www.planetark.com/dailynewsstory.cfm/newsid/34850/story.htm>; *Pollution Test for China, Democracy Needed—Official*, PLANETARK, Feb. 10, 2006, <http://www.planetark.com/dailynewsstory.cfm/newsid/35023/story.htm>; see also *supra* note 204.

221. See, e.g., *Prison for Anti-Pollution Protesters: They Create Social “Disorder,”* ASIANEWS, Jan. 10, 2006, <http://www.asianews.it/view.php?l=en&art=5080>.

222. Successful verdicts have also increased, although these verdicts are not always successfully executed. See Briggs, *supra* note 188.

223. *Id.*

224. ECONOMY, *supra* note 9, at 112-17.

225. For a description of one such event, and a settlement described as “landmark,” see *Chinese Firms Pay in Pollution Deal*, WASH. POST, Jan. 5, 2006, at D6.

226. See generally Edith Brown Weiss, *Strengthening National Compliance With International Environmental Agreements*, 27 ENVTL. POL’Y & L. 297 (1997), available in EDITH BROWN WEISS ET AL., *INTERNATIONAL LAW AND POLICY* 534 (Aspen Law & Bus. 1998).

227. Hong Kong neighbors the Guangdong province off the southern mainland.

228. See *Hong Kong Leader: Southern China Aims to Announce Air Quality Data Daily*, ENVTL. NEWS NETWORK, Sept. 30, 2005, <http://www.enn.com/today.html?id=8924September%2030,%202005%20%E2%80%94%20By%20Associated%20Press>.

229. *Controlling Pollution: The Greening of China*, ECONOMIST, Oct. 22, 2005, at 43.

230. Richard McGregor, *China Abandons Plan for Green GDP Index*, FIN. TIMES, May 9, 2006, <http://news.ft.com/cms/s/9c7ac7ba-df8c-11da-afe4-0000779e2340.html>; see also Martin Regg Cohn, *Conservation Still Hard Sell in China: Booming Economy Taking a Toll*, TORONTO STAR, June 30, 2005, <http://www.indianjungles.com/190705k.htm>.

231. See *China to Blacklist Worst-Polluting Cities*, REUTERS, Oct. 24, 2005, in APECC NEWS BRIEFING, *supra* note 12, at 12.

232. *SEPA Calls for Quick Reporting of Pollution*, XINHUANET, Feb. 7, 2006, <http://in.china-embassy.org/eng/zgbd/t234071.htm>; *Wen Sets*

signify increased public disclosure and will likely have some effect on the development of the energy sector over the long term.

Finally, China seems to be moving toward a system of public participation in environmental impact assessments. In February 2006, SEPA announced a tentative regulation that outlines procedures for increasing public participation and disclosure in the environmental impact assessment process in China, and these regulations themselves were issued after a process of public comment and consultation.<sup>233</sup>

### C. "Rule of Law"

China's adoption of the "rule of law" principle has arguably been slow, at least in the eyes of many Western observers.<sup>234</sup> The country's continued push to develop energy resources provides opportunities to test the strength of its evolving commitment to its own laws. Such an example is the current controversy surrounding the Nu River Dam, which is planned to be even bigger than the Three Gorges project.<sup>235</sup> The Nu River project is already underway, but it was approved without the completion of an environmental impact assessment—a requirement under recently enacted environmental laws.<sup>236</sup> Partly as a result of this new law, construction is currently halted, but how the government eventually decides on the fate of the dam will be an important sign of how the central government balances its desire to promote a "rule of law" image and its continued need to develop energy resources.

Also relevant is the degree to which local officials actually enforce national laws or policy initiatives. The Nu River is an example of a high-profile project that garnered provincial, central, and international attention and has caused the government to focus on whether or not the project is being built in violation of a national law. However, most energy projects are much smaller in scale and, thus,

local officials will often be the only "regulatory body" overseeing projects.

### D. Cooperative Federalism

Like most countries, the effectiveness of China's national energy policies will largely depend on the balance struck in achieving some form of cooperative federalism and/or the central government's ability to enable somewhat uniform enforcement of national policies and laws. Significant decentralization has historically compromised Chinese efforts to implement and enforce international environmental agreements,<sup>237</sup> and now such decentralization also threatens compliance with current national energy goals.

Increasingly, development of the Chinese energy sub-sectors is being carried out at the local and regional level, making it hard to have a national energy policy.<sup>238</sup> As Elizabeth Economy notes, devolution of control to local and provincial governments has been a main contributor to economic growth, but at the same time it has weakened environmental enforcement.<sup>239</sup> Historically, such lax enforcement was partly due to the fact that local officials knew that environmental protection was not a high priority of the central government and partly due to the fact that they have had little guidance from the central government as to what is actually covered under environmental laws and how they should be implemented.<sup>240</sup> In some instances local authorities have apparently been successful in influencing, and even delaying, implementation of national laws, such as the gas tax increase/subsidies reduction passed by the NPC. In other instances where national laws are implemented, commentators have observed that some laws supposedly "in effect" are not enforced by local officials due to pressure from the industries from which they collect local taxes.<sup>241</sup> According to one commentator: "Specialists say China has some of the best environmental laws in the world, but the sheer scale of development, inadequate planning, corruption and poor enforcement often result in uncontrolled pollution."<sup>242</sup> Even when national laws are seemingly enforced, the results may not be effective for a long period of time. In December 2004, SEPA shut down 32 new coal plants that were built by local governments but were not in compliance with national emission standards for hazardous air pollutants. However, all the plants paid a relatively minor fine (\$24,000) and were back in operation within months, and most plants did not attempt to become compliant with the national standards.<sup>243</sup>

While local control can lead to positive outcomes in wealthier areas, such as Shanghai, China, where there is talk

*Environment Protection Goals*, CHINA DAILY, Apr. 19, 2006, [http://www.chinadaily.com.cn/china/2006-04/19/content\\_570941.htm](http://www.chinadaily.com.cn/china/2006-04/19/content_570941.htm).

233. See Worldwatch Institute, Yingling Liu, SEPA Releases New Measure on Public Participation in Environmental Impact Assessment Process (Feb. 24, 2006), <http://www.worldwatch.org/features/chinawatch/stories/20060224-2>.
234. See generally RANDALL PEERENBOOM, CHINA'S LONG MARCH TOWARD RULE OF LAW (Cambridge Univ. Press 2002). For recent discussions of China's struggle to promote the rule of law and an independent judiciary accessible to most all citizens, see, e.g., Jim Yardley, *A Judge Tests China's Courts, Making History: Unintentionally Opens Debate on Autonomy*, N.Y. TIMES, Nov. 28, 2005, at A1; Joseph Kahn, *When Chinese Sue the State, Cases Are Often Smothered*, N.Y. TIMES, Dec. 28, 2005, at A1.
235. The Nu River Dam project will be bigger if completed as originally contemplated. Purportedly, the Three Gorges project was built not just for electricity generation, as the Chinese government lists flood control as a major, if not the primary, benefit of the Three Gorges project. See China Development Gateway, *The Three Gorges Water Control Project*, <http://www.chinagate.com.cn/english/1634.htm> (last visited May 1, 2006).
236. See, e.g., Jim Yardley, *Rule by Law: Seeking a Public Voice on China's "Angry River"*, N.Y. TIMES, Dec. 26, 2005, at A1, available at <http://www.nytimes.com/2005/12/26/international/asia/26china.html?ex=1293253200&en=2593623612c175a0&ei=5088&partner=rssnyt&emc=rss>; see also Yardley, *supra* note 134. The effectiveness of conducting an environmental impact assessment and/or changing projects based on the results of the assessment process often depends on its scope. For example, changing one part of the project can often cause another aspect of the project to be environmentally detrimental in a different way.

237. See generally Oksenberg & Economy, *supra* note 158.

238. See STEVEN LEWIS, THE NORTHEAST ASIA ENERGY COOPERATION WORKSHOP PROGRAM CONFERENCE REPORT: THE FUTURE OF ENERGY SECURITY AND ENERGY POLICY IN NORTHEAST ASIA: COOPERATION AMONG CHINA, JAPAN, AND THE UNITED STATES 16-18, 25 (The James A. Baker III Inst. for Pub. Policy, Rice Univ., 2004), available at [http://www.rice.edu/energy/research/asiaenergy/docs/UFJ\\_conferencereport\\_web.pdf](http://www.rice.edu/energy/research/asiaenergy/docs/UFJ_conferencereport_web.pdf); LEWIS, *supra* note 67, at 32.

239. ECONOMY, *supra* note 9, at 91-92, 97-98, 101-02.

240. *Id.*

241. See, e.g., Yardley, *supra* note 11; see also Rebecca Blumenstein, *Chinese Regulator Lacks Enforcement Power to Close Polluters*, WALL ST. J., Mar. 17, 2006, at A6.

242. See Lague, *supra* note 23.

243. Collier, *supra* note 85; see also Cohn, *supra* note 230.



of equipping 100,000 rooftops with solar PVs by 2015 and Guangzhou province's announced plans to boost wind development,<sup>244</sup> more often than not it is likely to lead to energy development that prioritizes local energy and economic development over national/regional/international energy development objectives—especially when newer and cleaner technologies are more expensive and/or appear risky due to local officials' unfamiliarity with them.<sup>245</sup> China is not alone in facing difficulties in developing and/or implementing a comprehensive national energy policy,<sup>246</sup> but the intense pressures to foster economic (and thus energy) development at the local level contributes to the larger "tragedy of the commons"-type development in the Chinese energy sector.

Improving the public health and environment of China over the long term requires strengthening the national-level energy and environmental regulatory infrastructure and bureaucracy, as well as the enforcement powers of provincial and local actors<sup>247</sup>; finding a more effective model for cooperative federalism as it relates to the energy sector; and improving the overall legal system and "rule of law" culture in China. Early 2006 witnessed the release of the 11th Five-Year Plan, with a supposed focus on environmental protection, including tougher enforcement of environmental regulations and the establishment of regional SEPA divisions to improve coordination and enforcement across provinces, and a national target to reduce oil and coal use and energy intensity per dollar of GDP produced.<sup>248</sup> However, even if the central government is successful in some of its newly announced efforts (which some doubt it will be<sup>249</sup>), it is unclear that China, the region, or the rest of the world can wait for China to continue to slowly evolve toward a better legal and regulatory framework for developing its energy sector without significant impacts on the environment and energy economy.<sup>250</sup> The EU, Japan, and especially the United

States thus face a critical chance to meaningfully engage China on energy issues.

## VI. Prospects for Chinese-U.S. Cooperation

Concerns about "China" and "energy" moved from the background to the foreground in the United States in 2005. A variation of the combination of these two topics—Chinese energy development and policy—is also of critical importance to the U.S. economy, environment, and international relations, and awareness of this issue is slowly rising. Even five years ago, a report by the National Academy of Sciences (NAS), National Research Council (NRC), Chinese Academy of Sciences (CAS), and Chinese Academy of Engineering (NAS/NRC Report) appropriately noted that the energy futures of China and the United States are "intimately linked."<sup>251</sup> This fact was most recently reflected in the latest EIA *Annual Energy Outlook*, in which the EIA increased its projected price of oil by \$21/barrel (or almost 40%) for 2025, reflecting "a shift in EIA's thinking about long-term trends in oil markets," largely due to increased demand for oil from China and the United States.<sup>252</sup> Oil is just one example of a larger increase in the globalization and interconnectedness of the energy sector—from oil and natural gas<sup>253</sup> to transboundary air pollution and the effects of climate change.

More than just being "linked," the energy economies of China and the United States, as well as of Europe and Japan, can influence one another and benefit from further cooperation. The NRC/CAS Report identifies many areas for, and policy options related to, cooperation on energy issues between China and the United States. Two other recent reports address Chinese-U.S. energy relations as well: a Woodrow Wilson Center report identifies options for Chinese-U.S. cooperation on environmental and energy issues<sup>254</sup>; and a National Bureau of Asian Research report discusses the need for Chinese-U.S. energy cooperation and makes recommendations for how the United States can engage China on energy issues.<sup>255</sup>

The discussion below highlights some opportunities for cooperation that are of great importance to addressing climate change, increasing security of energy supply throughout the world, and reducing the overall impact of continued growth in the Chinese and U.S. energy sectors on local and global environments and on each others' respective economies. Some of these have been identified previously in the reports mentioned above; some have become more relevant and/or urgent in light of changed circumstances, and others

244. *Rooftop Plan for Solar Power Production*, CHINA VIEW, Aug. 25, 2005, [http://news.xinhuanet.com/english/2005-08/25/content\\_3400402.htm](http://news.xinhuanet.com/english/2005-08/25/content_3400402.htm); *S. China Province to Boost Wind Power Development*, CHINA VIEW, Jan. 16, 2006, [http://news.xinhuanet.com/english/2006-01/16/content\\_4060128.htm](http://news.xinhuanet.com/english/2006-01/16/content_4060128.htm).

245. Zimmermann, *supra* note 147, at 14. For more on the general trend of devolution contributing toward low-prioritization of environmental protection, see ECONOMY, *supra* note 9, at 116-21.

246. See LEWIS, *supra* note 238, at 25.

247. Oksenberg & Economy, *supra* note 158, at 392.

248. The 11th five-year plan includes a target of cutting energy intensity (consumption per unit of GDP) by 20% over that of the end of the 10th five-year plan period (2001 to 2005). See *Premier Wen Sets Out Strategy to Tackle Environmental Pollution*, CHINA VIEW, Apr. 23, 2006, [http://news.xinhuanet.com/english/2006-04/23/content\\_4464603.htm](http://news.xinhuanet.com/english/2006-04/23/content_4464603.htm); see also Shai Oster, *China Plans to Curb Oil, Coal Use Despite Expected Demand Growth*, WALL ST. J., Feb. 14, 2006, at A17; Kathy Chen, *China Unveils Plans to Improve Its Environment*, WALL ST. J., Feb. 16, 2006, at A6; Shai Oster, *China's Environmental Watchdog Vows Tougher Enforcement of Rules*, WALL ST. J., Mar. 13, 2006, at A6; Jason Dean, *China Tackles Growth Pitfalls: Leadership Meeting Will Address Ills Wrought by Economic Boom*, WALL ST. J., Mar. 1, 2006, at A6; *China Issues Guidelines to Tackle Pollution*, PLANETARK, Feb. 16, 2006, <http://www.planetark.com/dailynewsstory.cfm/newsid/35136/story.htm>.

249. Oster, *China Plans to Curb Oil, Coal Use Despite Expected Demand Growth*, *supra* note 248, at A17; Chen, *supra* note 248, at A6.

250. For example, in the late 1990s, Chris Nielson and Michael B. McElroy suggested that "structural barriers" will prevent national emissions policies from being effective in the next 10 to 20 years. Chris Nielson & Michael B. McElroy, *Introduction and Overview*, in *ENERGIZING CHINA: RECONCILING ENVIRONMENTAL PROTECTION AND ECONOMIC GROWTH* 20, 36 (Harvard Univ. Press 1998)

(as reported in BARBARA A. FINAMORE, *TAMING THE DRAGON-HEADS: CONTROLLING AIR EMISSIONS FROM POWER PLANTS IN CHINA* 27 (Natural Resources Defense Council/Energy Found. 2000) available at [http://www.efchina.org/documents/Taming\\_theDragonHeads.pdf](http://www.efchina.org/documents/Taming_theDragonHeads.pdf)).

251. NRC ET AL., *COOPERATION IN THE ENERGY FUTURES OF CHINA AND THE UNITED STATES IX* (2000), available at <http://www.nap.edu/catalog/9736.html>. Leiberthal and Herberg also note that "[i]n some regards both China and the United States, despite their very different political and economic systems, have similar types of dysfunctions in energy policy decisionmaking and implementation." Leiberthal & Herberg, *supra* note 202, at 23.

252. AEO 2006, *supra* note 72.

253. See, e.g., Landler, *supra* note 135.

254. BALDINGER & TURNER, *supra* note 6, at 11.

255. Lieberthal & Herberg, *supra* note 202.

were not mentioned in these reports. All are in the interests of both China and other large economies in the world, particularly the United States. Although studies have shown that traditional notions of “leapfrogging” are in fact very difficult and rarely backed up empirically,<sup>256</sup> the EU, Japan, and the United States (and even Korea and Taiwan) still have the opportunity to help the Chinese energy sector develop in a significantly different manner.

### A. Strengthening Civil Institutions

In general, U.S. support for strengthening civic institutions, public participation, the role of regulatory agencies, and the “rule of law” would likely encourage a more sustainable and equitable growth in the energy sector. To the extent that the United States can contribute to such improvements through sponsoring and/or collaborating on trainings and informational exchanges with judges, regulators, and policymakers would likely benefit the short- and long-term development of the Chinese energy sector. The Chinese government appears willing to learn from other countries in the energy regulatory arena, particularly with respect to electricity regulation.<sup>257</sup>

Although important, the U.S. role will probably be limited in speeding up the likely continued slow development of such civic and governmental institutions in China. This continued slow development, and the “tragedy of commons” nature of trying to achieve national- and international-level energy policy goals through the multitude of actors in the Chinese energy sector and economy, suggests that incremental improvements in the legal and regulatory environment in China over the next two decades will probably be insufficient to address the problems posed by continued “business-as-usual” development of the Chinese energy sector during this critical time period. It also suggests that the United States and other developed countries need to dramatically ramp up their energy diplomacy efforts with respect to China, including a focus on efforts to develop and deploy radically different energy technologies and energy sector development practices in China and throughout the world.

Fundamentally, the United States needs to meaningfully engage China on energy issues. The Bush II Administration’s Secretary of Energy and Deputy Secretary of State have reportedly initiated some dialogue on energy issues with China, but these need to be strengthened, broadened, and take place at a higher level.<sup>258</sup> Passage of the Energy Diplomacy and Security Act of 2006, introduced by Sen. Richard G. Lugar (R-Ind.) in March 2006,<sup>259</sup> might enhance dialogue on the issue, but recent history may not bode well for formal engagement with China on energy issues as contem-

plated in the bill. With a few exceptions,<sup>260</sup> most public discourse in the United States related to China and energy has been dominated by serious concerns at CNOOC’s recent attempt to buy UNOCAL.<sup>261</sup> While such concern may seem logical, it does not accurately reflect the realities of the global energy economy. Similar to the growing realization that the United States might not be able to “contain” China’s military growth,<sup>262</sup> it is hard to imagine a future where the United States can “contain” China’s demand for energy without significant impacts on the U.S. and global environment and economy. A vigorous engagement policy, therefore, should be pursued. This sentiment was reflected in the *2005 Annual Report to Congress* by the U.S.-China Economic and Security Review Commission (the Commission), recommending that the U.S. Congress mandate the creation of a “U.S.-China Energy Working Group” tasked to, among other things, work together to develop technologies to reduce both countries’ dependence on oil, cooperate on clean coal technologies, and investigate options for renewable energy.<sup>263</sup> Although China and the United States recently established the “U.S.-China Energy Policy Dialogue,” and the U.S. Department of Energy (DOE) opened an office in Beijing, China,<sup>264</sup> to date, the level of engagement does not seem to be to the level envisioned by the Commission, nor is it commensurate with the scale of the energy-related problems faced by both countries.

Other recent developments in Chinese-U.S. energy engagement also seem to fall short of what the Commission recommended. In April 2005, the “Fossil Energy Protocol” between China and the United States was extended until 2010, yet most of the activities under this protocol still ap-

256. For a discussion on this, see Lewis, *supra* note 65, at 294-96.

257. AUSTIN, *supra* note 19, at 24. For more on the need for the United States to engage China more in developing its environmental legal and regulatory framework, see Economy, *supra* note 9, at 273.

258. See Lieberthal & Herberg, *supra* note 202, at 5, 38.

259. S.B. 2435, 109th Cong. (2006), available at [http://lugar.senate.gov/energy/pdf/EDSA\\_S2435.pdf](http://lugar.senate.gov/energy/pdf/EDSA_S2435.pdf); Office of Senator Richard G. Lugar, Lugar Introduces Energy Security Act (Mar. 17, 2006), <http://lugar.senate.gov/pressapp/record.cfm?id=252838>; see also The Brookings Institution, Erika S. Downs, National Energy Security Depends on International Energy Security (Mar. 17, 2006), <http://www.brookings.edu/views/op-ed/fellows/downs20060317.htm>.

260. Amy Meyers Jaffe, Op. Ed., *Wasted Energy*, N.Y. TIMES, July 27, 2005, at A23, available at <http://www.nytimes.com/2005/07/27/opinion/27jaffe.html>; Thomas L. Friedman, *Living Hand to Mouth*, N.Y. TIMES, Oct. 6, 2005, at A27, available at <http://select.nytimes.com/2005/10/26/opinion/26friedman.html>; Feinerman, *supra* note 202; *Giving China a Bloody Nose: By Sabotaging a Chinese Bid, America Has Damaged Its Own Interests*, ECONOMIST, Aug. 6, 2005, at 49.

261. See, e.g., Edmund L. Andrews, *China’s Oil Setback: The Politics*, N.Y. TIMES, Aug. 2, 2005, at C2, available at <http://www.nytimes.com/2005/08/03/business/03react.html?th&emc=th>.

262. See, e.g., Edward Cody, *Shifts in Pacific Force U.S. Military to Adapt Thinking: New Plans Reflect Reaction to China’s Growing Power*, WASH. POST, Sept. 17, 2005, at A1, available at <http://www.washingtonpost.com/wp-dyn/content/article/2005/09/16/AR2005091601983.html>; Keith Bradsher, *U.S. Seeks Cooperation With China*, N.Y. TIMES, Sept. 12, 2005, at A9; Ann Scott Tyson, *Chinese Buildup Seen as Threat to Region*, WASH. POST, July 20, 2005, at A16, available at <http://www.washingtonpost.com/wp-dyn/content/article/2005/07/19/AR2005071900946.html>; Henry A. Kissinger, *China: Containment Won’t Work*, WASH. POST, June 13, 2005, at A19, available at <http://www.washingtonpost.com/wp-dyn/content/article/2005/06/12/AR2005061201533.html>. For a different view on “containment” and China, see Robert Kagan, *The Illusion of “Managing” China*, WASH. POST, May 15, 2005, B7, available at <http://www.washingtonpost.com/wp-dyn/content/article/2005/05/13/AR2005051301405.html>.

263. See U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION, 2005 ANNUAL REPORT TO CONGRESS 17-18 (2005), available at [http://www.uscc.gov/researchpapers/annual\\_reports.htm](http://www.uscc.gov/researchpapers/annual_reports.htm).

264. See U.S. Department of State, Andrzej Zwaniacki, U.S.-China Cooperation Could Advance Mutual, Global Energy Goals Have More to Gain as Collaborators Than Rivals, U.S. Officials Say (Apr. 4, 2005), <http://usinfo.state.gov/eap/Archive/2005/Apr/04-622583.html>; U.S. Department of State, Energy Department Opens Office in Beijing Office; Energy Policy Dialogue to Advance Bilateral Issues (June 30, 2005), <http://usinfo.state.gov/eap/Archive/2005/Jul/01-4937.html>.



pear to remain “proposed.”<sup>265</sup> And in July 2005, the United States announced the formation of the Asia-Pacific Partnership on Clean Development, a group with Australia, China, India, Japan, and South Korea that will “focus on voluntary practical measures taken by these six countries in the Asia-Pacific region to create new investment opportunities, build local capacity, and remove barriers to the introduction of clean, more efficient technologies” and “help each country meet nationally designed strategies for improving energy security, reducing pollution, and addressing the long-term challenge of climate change.”<sup>266</sup> Shortly after this announcement, Sen. John McCain (R-Ariz.) described the pact in an interview as “The [Asia-Pacific] pact amounts to nothing more than a nice little public-relations ploy. . . . It has almost no meaning. They aren’t even committing money to the effort, much less enacting rules to reduce greenhouse-gas emissions.”<sup>267</sup> To date, his characterization seems pretty accurate. At the conclusion of the first two meetings, it remained uncertain as to how much public or private money (if any) would actually be spent by the countries involved on the eight areas of cooperation identified by the forum.<sup>268</sup>

Some have commented that Chinese-U.S. communication and cooperation on clean coal technologies remains more extensive than most people think.<sup>269</sup> Despite the U.S. “first-mover” status on energy engagement with China dating back more than a decade,<sup>270</sup> the EU appears to be more committed to producing tangible results with China on energy and climate issues.<sup>271</sup> In September 2005, the EU and

China issued a “Joint Declaration on Climate Change,” which “confirmed the establishment of a China-EU partnership on climate change,”<sup>272</sup> and includes the “China-EU Action Plan on Clean Coal” and the “China-EU Action Plan on Energy Efficiency and Renewable Energies,” both of which were signed earlier in 2005.<sup>273</sup> The two goals of the partnership, described as “concrete cooperation goals” by the European Commission, include:

- to develop and demonstrate, in China and the EU, advanced “zero-emissions” coal technology; and
- to significantly reduce the cost of key energy technologies and promote their deployment and dissemination.<sup>274</sup>

Both of these goals are to be achieved by 2020.<sup>275</sup> This agreement between China and the EU includes a plan to investigate the feasibility of building an IGCC with CCS demonstration project between 2010 and 2014,<sup>276</sup> although there are no formal funding commitments from either China or the EU for such a plant. This agreement was reinforced with the signing of a memorandum of understanding on clean-coal cooperation at the Sixth Bi-Annual EU-China Energy Conference in February 2006 (the United States has no such conferences with China).<sup>277</sup> The United States has pledged to work with China on clean coal,<sup>278</sup> but nothing has yet come of it. Thus, to date, the EU (and its member countries), with its long-running dialogue, its agreement to possibly help China build an IGCC plant, and by specifically engaging China on the issue of climate change by asking them to “take a lead among developing nations” on climate change,<sup>279</sup> is arguably ahead of the United States in this critical area of the Chinese energy sector.

### B. Energy Technology-Specific Initiatives

Any efforts by the EU, Japan, and the United States to engage China on energy policy should include an explicit effort to develop and deploy cleaner energy technologies. The United States is particularly well-suited for engaging China

265. See U.S. DOE, *Bilateral Agreements: Fossil Energy Protocol Between the United States and China*, [http://fossil.energy.gov/international/International\\_Partners/China.html](http://fossil.energy.gov/international/International_Partners/China.html) (last visited May 17, 2006).

266. See OFFICE OF THE PRESS SECRETARY, THE WHITE HOUSE, *FACT SHEET: PRESIDENT BUSH AND THE ASIA-PACIFIC PARTNERSHIP ON CLEAN DEVELOPMENT (2005)*, <http://www.state.gov/g/oes/rfs/fs/50314.htm>.

267. Amanda Griscom Little, *Pact or Fiction?: New Asia-Pacific Climate Pact Is Long on PR, Short on Substance*, GRIST MAG. (2005), <http://www.grist.org/news/muck/2005/08/04/little-pact/index.html?source=daily>.

268. See Wendy Frew et al., *Trust Firms on Climate, Say Leaders*, SYDNEY MORNING HERALD, Jan. 12, 2006, at 2, available at <http://smh.com.au/news/national/trust-firms-on-climate-say-leaders/2006/01/11/1136956242983.html>; Australian Department of Foreign Affairs and Trade, *Asia-Pacific Partnership on Clean Development and Climate Inaugural Ministerial Meeting—Sydney, January 2006, Work Plan*, [http://www.dfat.gov.au/environment/climate/ap6/work\\_plan.html](http://www.dfat.gov.au/environment/climate/ap6/work_plan.html) (last visited May 1, 2006); see also *More Hot Air: Asia’s Latest Contribution to Global Warming*, ECONOMIST, Jan. 14, 2006, at 46. As of February 2006, the Bush II Administration had proposed a U.S. contribution of \$52 million as part of the president’s 2007 proposed budget. U.S. DEPARTMENT OF STATE, *FACT SHEET: ASIA-PACIFIC PARTNERSHIP ON CLEAN DEVELOPMENT AND CLIMATE (2006)*, <http://www.state.gov/r/pa/scp/2006/60852.htm>; see also Office of the Spokesman, U.S. Department of State, *Asia-Pacific Partnership on Clean Development and Climate (May 1, 2006)*, <http://www.state.gov/r/pa/prs/ps/2006/65549.htm>. More on the Asia-Pacific Partnership can be found at Asia-Pacific Partnership on Clean Development and Climate, <http://www.asiapacificpartnership.org/>.

269. See Sun, *supra* note 153, at 2; Zimmermann, *supra* note 147, at 20.

270. For more information on cooperative activities over the past decade, see AUSTIN, *supra* note 19, at 28. And as early as 1995, China and the United States were working toward an effort to cooperate on an IGCC demonstration plant in Yantai, China, but funding was held up by both the Chinese and U.S. governments. For a discussion about this project, see Zimmermann, *supra* note 147, at 20.

271. Cf. AUSTIN, *supra* note 19, at 18, which states: “In contrast with the EU and Britain, the U.S. began its cooperation with China almost a decade ago.”

272. See Europa, *EU-China Summit: Joint Statement (Sept. 5, 2005)*, [http://ec.europa.eu/comm/external\\_relations/china/summit\\_0905/index.htm](http://ec.europa.eu/comm/external_relations/china/summit_0905/index.htm).

273. See Europa, *EU and China Partnership on Climate Change (Sept. 2, 2005)*, <http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/05/298&format=HTML&aged=0&language=EN&guiLanguage=en>.

274. *Id.*

275. *Id.*

276. See Jürgen Lefevere, European Commission, *EU Technology Cooperation With India and China, Presentation to Sixth Dialogue on Future Actions to Address Climate Change in Lima, Peru, Center for Clean Air Policy (Oct. 12, 2005)*, available at <http://www.ccap.org/Presentations/Lefevere-China%20and%20India%20Technology%20Cooperation%20-%20Oct%202005-FINAL.pdf>.

277. Press Release, European Commission, *European Commission and China Step Up Co-Operation on Clean Coal Technologies and Other Energy Issues (Feb. 20, 2006)*, available at <http://europa.eu.int/rapid/pressReleasesAction.do?reference=IP/06/190&format=HTML&aged=0&language=EN&guiLanguage=en>. As part of the “Fossil Energy Protocol,” a “U.S.-China Oil and Gas Industry Forum” does take place. See *supra* note 267.

278. See Collier, *supra* note 150; see also *supra* note 267.

279. See *U.K. Seeks Chinese Lead on Climate Change*, PLANETARK, Nov. 8, 2005, <http://www.planetark.com/dailynewsstory.cfm/newsId/33371/story.htm>.



on this issue due to its level of overall energy consumption and similar fuel-consumption and importing characteristics. There are several technology- and sector-specific areas where Chinese-U.S. cooperation in the energy sector would be especially beneficial to both countries.

### 1. Oil and Transportation

As the two largest oil consumers and importers in the world, China and the United States have great potential to reduce global demand for oil. Although the countries should continue to work together on potential long-term solutions to the use of oil in transportation such as hydrogen fuel cell or electric cars, the prospects for hydrogen vehicles being commercialized before 2020 are not high.<sup>280</sup> The easiest and cheapest (and more politically viable<sup>281</sup>) way to reduce demand in the near term is through enhanced fuel economy or tailpipe-GHG standards. By working together to develop common fuel economy or tailpipe-GHG standards, the Chinese and U.S. governments can facilitate greater harmonization between the two respective, and increasingly integrated, automobile markets.

In part due to the Iraq war, China has intensified its global search for energy, investigating and signing deals with companies and governments from Canada, Iran, Latin America, Nigeria, Russia, and Sudan.<sup>282</sup> As a result of this increasing global competition for energy resources from countries such as China and India, traditional and recent (i.e., post-Cold War) strategic alliances may be increasingly hard for the United States to hold together in the future.<sup>283</sup> China's quest for energy may also inflame old tensions in the East Asian region.<sup>284</sup> Although the Bush II Administration has shown

no believable concern about global climate change, it is presumably concerned about China's dealings with oil-exporting states such as Iran and Sudan<sup>285</sup> as part of its heightened and increasingly aggressive energy diplomacy.<sup>286</sup>

In 2005, the U.S. Central Intelligence Agency submitted a report to Congress stating that "Chinese companies have 'helped Iran move toward its goal of becoming self-sufficient in the production of ballistic missiles.'"<sup>287</sup> If the United States remains interested in isolating unsavory regimes, it needs to work aggressively to reduce global demand for oil. Aggregate reduction in oil demand starts at the vehicle level. Increased and standardized fuel economy or tailpipe-GHG standards between China and the United States could significantly reduce global demand for oil, including, but not limited to, incentivizing widespread deployment of hybrids and advanced diesels and/or the development of commercial plug-in hybrids.<sup>288</sup> Volkswagen's announcement in 2005 that it would start to manufacture its first hybrid automobile through a partnership with the Shanghai Automotive Industry Corporation signals both the ever-increasing globalization of the automobile industry as well as China's advancement and potential interest in competing in the global automobile market, including the high-technology segment.<sup>289</sup> In addition to helping U.S. manufacturers compete in the Chinese market (and vice versa), such initiatives that enable policy-induced technological change could help U.S. manufacturers regain technological competitiveness with Japanese automobile companies, and in so doing might help domestic manufacturers regain some of their substantial loss of market share in the United States.

280. See Joan Ogden, *Hydrogen as an Energy Carrier: Outlook for 2010, 2030, and 2050*, Workshop Proceedings on the 10-50 Solution: Technologies and Policies for a Low-Carbon Future, The Pew Center on Global Climate Change and the National Commission on Energy Policy, Mar. 25-26, 2004, Washington, D.C., available at <http://www.pewclimate.org/docUploads/10%2D50%5FOgden%2Epdf>.
281. As compared to fuel taxes, that is. Cf. Thomas L. Friedman, *Who's Afraid of a Gas Tax*, N.Y. TIMES, Mar. 1, 2006, <http://select.nytimes.com/search/restricted/article?res=FB0E1FF73D550C728CDDAA0894DE404482>.
282. See Peter S. Goodman, *Big Shift in China's Oil Policy: With Iraq Deal Dissolved by War, Beijing Looks Elsewhere*, WASH. POST, July 13, 2005, at D1, available at <http://www.washingtonpost.com/wp-dyn/content/article/2005/07/12/AR2005071201546.html>; see also Joel Brinkley, *Canada's Smiles for Camera Mask Chill in Ties With U.S.*, N.Y. TIMES, Oct. 25, 2005, at A8, available at <http://www.nytimes.com/2005/10/25/international/americas/25diplo.html>; Chietigi Bajpae, *China Fuels Energy Cold War*, ASIA TIMES, Mar. 2, 2005, <http://www.atimes.com/atimes/China/GC02Ad07.html>; Kahn, *supra* note 204; Yardley, *supra* note 202.
283. See, e.g., David E. Sanger, *The New Global Dance Card*, N.Y. TIMES, Sept. 18, 2005, at D3, available at <http://www.mezomor.com/week/news-3044.html>; Peter S. Goodman, *China Rushes Toward Oil Pact With Iran*, WASH. POST., Feb. 18, 2006, at D1; Shai Oster & Sally Jones, *China-Iran Energy Talks Complicate Nuclear Standoff*, WALL ST. J., Feb. 17, 2006, at A6; see also John Reed, *China on Track to Win Friends in Oil-Rich Angola: Beijing Is a More Supportive and Less Critical Partner Than the West*, FIN. TIMES, March 4/5, 2006, at 7.
284. Bajpae, *supra* note 282; Howard W. French, *Japan's Rivalry With China Is Stirring a Crowded Sea*, N.Y. TIMES, Sept. 11, 2005, at 4, available at <http://select.nytimes.com/gst/abstract.html?res=F40817FC3B550C728DDDA00894DD404482>; Steven R. Weisman, *Wider U.S. Net Seeks Allies Against Iran's Nuclear Plan*, N.Y. TIMES, Sept. 10, 2005, at A3, available at <http://www.nytimes.com/2005/09/10/politics/10iran.html?th&emc=th>; Kahn, *supra* note 204; see also Somini Sengupta, *Hunger for Energy Transforms*

*How India Operates*, N.Y. TIMES, June 5, 2005, at A3, available at <http://www.nytimes.com/2005/06/05/international/asia/05india.html>; Yardley, *supra* note 202.

285. The Bush II Administration is also presumably concerned about China's push to secure energy assets in certain central asian countries and its push into Western Hemisphere energy resources—traditionally considered America's "backyard."
286. Zweig & Jianhai, *supra* note 202, at 32; see also Feinerman, *supra* note 202.
287. Bajpae, *supra* note 282.
288. For a brief discussion of plug-in hybrids and policy recommendations to foster commercialization of such vehicles, see SET AMERICA FREE COALITION, SET AMERICA FREE: A BLUEPRINT FOR U.S. ENERGY SECURITY, available at <http://www.setamericafree.org/blueprint.pdf> (last visited May 1, 2006); E2I/EPRI, THE PLUG-IN HYBRID ELECTRIC VEHICLE: TODAY'S CAR FOR TOMORROW'S TECHNOLOGY—AN E2I INITIATIVE (2002), available at [http://www.epri.com/attachments/285860\\_1007115Print\\_081902.pdf](http://www.epri.com/attachments/285860_1007115Print_081902.pdf); Wired.com, *Support Grows for Plug-In Hybrids* (Aug. 17, 2005), <http://www.wired.com/news/technology/0,1282,68535,00.html>; John J. Fialka, *Coalition Turns On to "Plug-In Hybrids": Utilities, Localities, DaimlerChrysler Give Traction to Professor's Drive for High Mileage*, WALL ST. J., Jan. 25, 2006, at A4.
289. Mark Landler & Keith Bradsher, *VW to Build Hybrid Minivan With Chinese*, N.Y. TIMES, Sept. 9, 2005, at C3; see also *China May Become No. 3 Carmaker*, *supra* note 113; *Car Exports Up 174% in First Three Quarters*, XINHUANET, in APECC NEWS BRIEFING, *supra* note 12, at 12, 16; James Mackintosh, *GM Eyes China as Base for Exports to Developing World*, FIN. TIMES, Jan. 12, 2006, at A30; Jeremy W. Peters, *See the U.S.A. in Your New Car From China, Starting in 2007*, N.Y. TIMES, Jan. 10, 2006, at C10; Gordon Fairthclough, *China Auto Exports May Roil Rivals: Competition Could Intensify for Ailing U.S. Car Makers; Selling \$7,000 Compact QQ*, WALL ST. J., Feb. 16, 2006, at A2; Gordon Fairthclough, *Chinese Autos Aimed at Mainstream Market: Entrepreneur Sees Camry as Good Target*, WASH. POST., Mar. 1, 2006, at D1; Keith Bradsher, *Thanks to Detroit, China Is Poised to Lead*, N.Y. TIMES, Mar. 12, 2006, at C1.

## 2. Clean-Coal Technology

Demonstrating the commercial viability of IGCC and CCS technology is urgently needed.<sup>290</sup> The long-term integrity of geologic carbon storage still needs to be validated via tests over the next 10 to 20 years,<sup>291</sup> but even if CCS does not end up working, the benefits to China, to the East Asian region, and to the whole world from a reduction in conventional air pollutants through the use of IGCC technology would be significant. Whether or not the loan guarantees for IGCC included in the U.S. Energy Policy Act of 2005 are successful in jump-starting significant IGCC deployment in the United States is uncertain.<sup>292</sup> However, the scale of current coal development in China cannot wait for commercial validation in the U.S. market over the next one to two decades. Therefore, a program to invest in IGCC technology in China (or a joint effort in both countries) is urgently needed. Even though possibly located in China, such a program would also benefit the U.S. coal industry, which is arguably at a standstill due to uncertainty over future carbon policy. Such a program could be funded through a cost-share program between China and the United States (or through institutions heavily influenced by the United States such as the World Bank or G-8), as well as with China's wealthiest downwind neighbor, Japan, which has a significant interest in the continued development of Chinese coal resources and their associated conventional air pollutant emissions. Some estimates for covering the cost premium between regular coal and IGCC plants for China are as low as \$10 billion per year—relatively small compared to official international development assistance every year, especially considering the stakes at hand and the development benefits that could result from such a program.<sup>293</sup> One way that China might speed up commitments for joint investment by other countries into IGCC development, demonstration, and deployment activities could be through demonstrating to the world community that it seriously intends to reduce its own GHG emissions<sup>294</sup> by playing a more constructive role in international climate change talks and negotiations.

## 3. Renewables

If China is able to meet its stated goals for renewables development in the near term, it will certainly be an impressive feat. Current plans call for most of this renewables ramp-up

to be with small-scale hydroelectricity or wind energy, although, as mentioned above, the degree to which large-scale hydroelectricity will contribute to these targets is unclear. In the United States, there is no equivalent national policy to promote deployment of renewables, although many states have renewable portfolio standards,<sup>295</sup> and most renewables growth consists of increased wind deployment encouraged by the wind production tax credit. In contrast to energy-efficiency developments in the transportation (hybrids) and coal (IGCC) sub-sectors, where joint efforts could promote widespread deployment of known and/or near-market-competitive technologies, perhaps the greatest opportunity for Chinese-U.S. cooperation in the field of renewables is for a cooperative effort to make solar PV<sup>296</sup> energy cost competitive.

As of 2004, the installed solar PV capacity in China was estimated at 12 megawatts (MWs), and it is projected to grow to 450 MWs under the government's plan to increase all renewables to 10% of electricity production.<sup>297</sup> This relatively small projected share for solar electric power in the Chinese electricity sector highlights the fact that except for niche applications, solar energy is currently cost uncompetitive with both conventional energy sources and with other renewable energy resources such as wind. Yet making solar energy cost competitive is almost certainly vital to any energy future that addresses the world's climate and energy challenges. The urgency of the challenge of making solar technologies work in the marketplace was recently summed up by physics Nobel Laureate Steven Chu as "the single most important problem that science and technology must solve in the coming decades."<sup>298</sup> While some contend that the solar PV industry requires a fundamental technological breakthrough to ever become cost competitive,<sup>299</sup> others see the potential for major cost reductions from improvements in manufacturing and business models in the PV industry and are more optimistic about its potential in the near future.<sup>300</sup> One of the rea-

290. While many commentators agree that IGCC combined with CCS will be a critical part of addressing global GHG emissions from coal, scientists are pursuing other options for dealing with GHG emissions from coal. See, e.g., Mark Clayton, *Algae—Like a Breath Mint for Smokestacks*, CHRISTIAN SCI. MONITOR, Jan. 11, 2006, at 1, available at <http://www.christiansciencemonitor.com/2006/01/11/p01s03-sten.html>.

291. See Benson, *supra* note 139.

292. Energy Policy Act of 2005, Pub. L. No. 109-58, 2005 H.R. 6, 42 U.S.C.A. §15801 (2005).

293. Collier, *supra* note 150. In 2005, official development assistance from OECD countries was estimated at \$106 billion, with \$27.5 billion of that coming from the United States. See OECD, *Aid Flows Top USD 100 Billion in 2005*, [http://www.oecd.org/document/40/0,2340,en\\_2649\\_33721\\_36418344\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/document/40/0,2340,en_2649_33721_36418344_1_1_1_1,00.html); U.S. DEPARTMENT OF STATE, FACT SHEET: THE UNITED STATES AND INTERNATIONAL DEVELOPMENT: PARTNERING FOR GROWTH (2006), <http://www.state.gov/r/pa/prs/ps/2006/66060.htm>.

294. See Zimmermann, *supra* note 147, at 13.

295. See BARRY G. RABE, RACE TO THE TOP: THE EXPANDING ROLE OF U.S. STATE RENEWABLE PORTFOLIO STANDARDS (Pew Ctr. on Global Climate Change, June 2006), available at [http://www.pewclimate.org/global-warming-in-depth/all\\_reports/](http://www.pewclimate.org/global-warming-in-depth/all_reports/).

296. Solar PV is the most common technology for generating electricity with solar energy.

297. No new targets for solar PV have yet been announced as part of the new renewables target of 15% by 2020. See CRIEnglish.com, Solar Energy Industry to Have Broad Prospects in China (Oct. 10, 2005), <http://en.chinabroadcast.cn/2238/2005-10-11/64@276074.htm> (citing AsiaPulse). Although this article said that 2004 installed capacity was 12 GW, a typographical error is assumed, as that would be much larger than the stated goal for 2020 of 450 MW; see also Earthtoys, Edwin Koot, Enormous Growth of Chinese PV Industry, [http://www.earthtoys.com/emagazine.php?issue\\_number=06.02.01&article=solarplaza](http://www.earthtoys.com/emagazine.php?issue_number=06.02.01&article=solarplaza) (last visited May 1, 2006).

298. Ian Hoffman, *Nanoscientists and Biologists Copying, Co-Opting Nature for Solar Fuel: The New Disciples of the Sun*, SAN MATEO TIMES, Nov. 27, 2005, [http://www.rtt.edu/~930www/News/inthenews/2005-11/2005-11-27\\_bayArea\\_sun.pdf](http://www.rtt.edu/~930www/News/inthenews/2005-11/2005-11-27_bayArea_sun.pdf); see also Amy Meyers Jaffe, *Seven Ways to Fix the Oil Crisis*, ESQUIRE, Dec. 2005, at 217.

299. See, e.g., GRANGER MORGAN ET AL., THE U.S. ELECTRIC POWER SECTOR AND CLIMATE CHANGE MITIGATION 33 (Pew Ctr. on Global Climate Change 2005), available at [http://www.pewclimate.org/global-warming-in-depth/all\\_reports/electricity/index.cfm](http://www.pewclimate.org/global-warming-in-depth/all_reports/electricity/index.cfm).

300. See, e.g., MICHAEL ROGOL ET AL., SOLAR POWER: SECTOR OUTLOOK (CLSA Asia-Pacific Markets 2004), available at <http://www.photon-magazine.com/news/ww%20ms%20Sun%20Screen%20Studie.pdf>; Electronic Engineering Times—Asia, Solar Vendors Move Towards Moore's Law (Jan. 13, 2006), <http://www.eetasia.com>.

sons that more aggressive deployment policies may spur further cost reductions is that the “installed” cost of PV comes from a variety of factors and is not just linked to silicon cost/performance issues.<sup>301</sup> Thus, it is not unforeseeable that its market will grow substantially with decreased manufacturing costs and installation costs. For instance, in the relatively infant Chinese wind-turbine manufacturing industry, current estimates for turbines are 30% cheaper than foreign-manufactured turbines.<sup>302</sup> Cooperatively harnessing China’s growing manufacturing prowess with U.S. research and development superiority to further this critical energy resource should be a high priority of both countries.<sup>303</sup>

#### 4. Nuclear Power, Waste Disposal, and Proliferation

President Bush and some members of Congress have expressed their desire to expand the use of nuclear power.<sup>304</sup> There is no larger constraint on the future use of nuclear power than dealing with waste storage domestically in the United States, and with waste and proliferation issues internationally. Whether or not the United States is successful in solving the techno-political problems surrounding domestic waste disposal issues in the near term, China nevertheless seems intent on rapidly moving forward with its nuclear program—and in a significant way. Accordingly, the international community, with U.S. leadership, should engage China and other nuclear countries in developing and enforcing an enhanced international waste and proliferation safeguards regime. The fact that China is growing increasingly dependent on uranium imports to supply its nuclear industry might suggest that it would be willing to work with the United States to improve the safety and security of the global nuclear fuel cycle.<sup>305</sup> In addition, China’s increasing

energy trade with Iran positions it especially well to help tackle the complex and challenging issues surrounding the NPT and the nuclear fuel cycle. It has been suggested that the United States should replace its efforts to form a new strategic relationship with Russia based on oil in favor of one based on safeguarding nuclear power,<sup>306</sup> but increasingly it appears that any effort aimed at ensuring the safety of nuclear power, and thus its future, needs to include China as long as it continues its path toward a dramatic expansion of nuclear power.

#### VII. Conclusion

The global economy, energy system, and environment are rapidly increasing in terms of integration and interdependence. Just as China’s economic growth will continue to have global repercussions,<sup>307</sup> so too will the continued development of its energy sector. China’s energy sector will continue to grow with its economy, yet what direction it will take and how big it will grow in the next two to three decades is uncertain. The United States and the world community should be concerned with the way in which China continues the massive expansion of its energy sector, as it stands to have profound effects on the global environment and climate system, world energy and oil markets, and risks related to nuclear proliferation.

Of course, China bears significant responsibility for developing its enormous energy sector in as responsible a way as possible, as both the Chinese population and the world are unlikely to be able to sustain development of this sector in the same manner that other economies have developed. Increasing and strengthening the energy sector regulatory regime, including local enforcement of national laws and policies; increasing respect for the “rule of law”; and strengthening civic institutions and society are all obvious areas for improvement. However, considering the urgency of the situation and the significant development pressures felt by China, dramatic change within the Chinese energy sector is unlikely to occur without help—most likely including financial assistance related to energy technology development and deployment—from more developed countries. While the EU and the United States have engaged China on some energy issues, the level of engagement is arguably far less than proportional to the challenge at hand. As Michael Oksenberg and Elizabeth Economy have noted: “engaging China in environmental protection entails a protracted, serious commitment by the international community that cannot be lightly abandoned.”<sup>308</sup>

Perhaps more than any two other countries, China and the United States are poised to affect the future of the world’s energy system—be it a positive or continued unsustainable way. And, as the current world leader in energy consumption, the United States has an enormous opportunity to engage China in cooperative efforts to further both countries’

[com/ART\\_8800403542\\_765245\\_43dfc7d5\\_no.HTM](http://www.eli.org/ART_8800403542_765245_43dfc7d5_no.HTM); see also *Sunrise for Renewable Energy?* ECONOMIST, Dec. 10, 2005, at 18.

301. See, e.g., Robert M. Margolis, Photovoltaic Technology Experience Curves and Markets, Presentation at the National Center on Photovoltaics and the Solar Review Meeting, Denver, Colo., Mar. 24, 2003, available at [http://www.nrel.gov/ncpv\\_prm/pdfs/33586008.pdf](http://www.nrel.gov/ncpv_prm/pdfs/33586008.pdf).
302. Lewis, *supra* note 65, at 258.
303. China’s PV manufacturing industry is currently experiencing significant growth and is projected to reach over 16% of the global share of PV production in 2007. See *China to Surpass Taiwan in Solar Cell Production Capacity at End of 2007*, SAYS AGENCY, DIGITIMES, Mar. 28, 2007, [http://www.digitimes.com/bits\\_chips/a20060328A1002.html](http://www.digitimes.com/bits_chips/a20060328A1002.html). China is also a growing research and development center, and China’s government has announced policies to encourage greater research and development growth. See, e.g., Edward Cody, *Chinese to Develop Sciences, Technology*, WASH. POST, Feb. 10, 2006, at A16, available at <http://www.washingtonpost.com/wp-dyn/content/article/2006/02/09/AR2006020901006.html>; Kathy Chen & Jason Dean, *Low Costs, Plentiful Talent Make China a Global Magnet for R&D*, WALL ST. J., Mar. 13, 2006, at A1; Jason Dean, *China Tackles Growth Pitfalls: Leadership Meeting Will Address Ills Wrought by Economic Boom*, WALL ST. J., Mar. 1, 2006, at A6; Renewable Energy Access, Jesse W. Pichel, *China’s Solar Push More Than Just Low-Cost?* (Mar. 27, 2006), <http://www.re-access.com/real/news/story?id=44457>.
304. See, e.g., George W. Bush, State of the Union Address (Jan. 31, 2006), available at <http://www.whitehouse.gov/stateoftheunion/2006/index.html>; U.S. to Push Nuke, Hydrogen Power at Climate Confab, PLANETARK, Jan. 9, 2006, <http://www.planetark.com/dailynewsstory.cfm/newsId/34375/story.htm>.
305. See World Nuclear Association, Nuclear Power in China, <http://www.world-nuclear.org/info/inf63.htm> (last visited May 1, 2006). For example, China recently signed an agreement with

Australia for the import of uranium. Jane Perlez, *Australia to Sell Uranium to China for Energy*, N.Y. TIMES, Apr. 3, 2006, at A6, available at <http://select.nytimes.com/search/restricted/article?res=F00E11FA38540C708CDDAD0894DE404482>.

306. See, e.g., David G. Victor & Nadejda M. Victor, *Axis of Oil?*, FOREIGN AFF., Mar./Apr. 2003, at 47.

307. Zweig & Jianhai, *supra* note 202, at 26.

308. Oksenberg & Economy, *supra* note 158, at 391.



interests, specifically on issues related to oil and transportation, nuclear waste and proliferation, development and deployment of cost-competitive and commercial IGCC technology, and technological and cost breakthroughs in

renewables—especially solar PVs. Failure to capitalize on this opportunity increases the risk that both countries will leave this critical energy crossroads continuing in the wrong direction.