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I. Introduction

Surging world energy prices, the breakneck pace of China's economic development, and a high-profile bid by the state-owned China National Offshore Oil Corporation (CNOOC) to acquire Union Oil of California (Unocal), have all underscored what many Americans believe to be a new reality: China is now engaged in a purposeful, systematic, and centralized global quest for energy, with disturbing, even frightening ramifications for the adequacy of world energy resources and for the global environment.

Many Americans are only vaguely aware of our own, massive presence in the world oil market, and if anything are even less aware of how domestic U.S. energy consumption may be affecting the global climate. But when it comes to China the focus is much clearer. In the American understanding, China's accelerating consumption of hydrocarbon fuels, its recent emergence as a major oil importer, its status as the world's second largest emitter of greenhouse gases (after the United States), and the aggressive efforts of its national energy companies to buy assets overseas add up to a straightforward story: China, led by its rigidly authoritarian government and indifferent to the impact of

its actions on other nations or the global environment, is on a relentless mission to secure scarce energy resources to fuel its economic growth.

We argue in this essay that the real picture is very different -- in some ways worse, in some ways better, but in almost all ways at odds with the prevailing wisdom. On the one hand, U.S. opinion leaders across the spectrum, from environmentalists to energy security hawks, have consistently underestimated the scale of China's energy demand growth. On the other hand, the attribution of strategic purpose and coherence to China's current energy posture is mostly mistaken, and causes Americans to misconstrue the real drivers of China's growing presence on the energy scene.

Any real understanding of China's current energy footprint – the types of fuels being consumed, the kinds of technologies employed, the effectiveness of environmental regulation, and the international reach of its enterprises, including the sorts of overseas asset purchases attempted – must start with three key characteristics of the Chinese system. First, especially at the national level, China's energy-related governmental bureaucracy is highly fragmented and poorly coordinated. Responsibility for energy pricing, for the approval of infrastructure projects, for the oversight of state energy companies, and for long-term energy policy is spread across many agencies, most of them seriously understaffed, and some of which – given their very recent emergence on the scene – are notably weak in relation both to other agencies and to the players they are supposed to be regulating.

Second, under these conditions it is the state energy companies – the national oil corporations and the national power generating groups – that are among the most coherent entities. These are the organizations that are most capable of defining their own

interests and that are most likely to act, making decisions that their ostensible state regulators and overseers can barely keep up with and sometimes do not even monitor. At the same time, and reflecting China's increasingly deep integration with the global economy, these corporate entities are hardly simple organizations themselves. Listed on both domestic and foreign stock exchanges, the state energy corporations encompass complicated groupings of stakeholders, including state-appointed senior executives, domestic and foreign corporate board members, major financiers from the global investment banking community, and international institutional investors. Textbook examples of shareholder-driven corporate governance they are not, but neither are they simple puppets of the state – in no small part because the state itself is so fragmented and lacks a clear voice on energy policy. In essence, the central government in Beijing today has neither a coherent national energy strategy nor much capacity to monitor, support, or impede the actions of state-owned energy companies – actions that are often misunderstood by outsiders as merely echoing government policy.

Third, and most important, the remarkably rapid growth of energy consumption in China has been possible because a host of infrastructural issues are being resolved very quickly by individuals and organizations operating well below the level of national energy corporations. Key decisions about China's physical and technological infrastructure – decisions with profound consequences for its long-term energy development – are being made almost daily by actors at the grass roots level.

To attribute China's aggregate energy demand growth – or even the actions of the state-owned energy companies – to central government agendas or geopolitical strategy is thus mistaken. What many outsiders take to be the deliberate result of Chinese national

‘energy strategy’ is in fact better understood as an agglomeration of ad hoc decisions by local governments, local power producers, and local industrial concerns, few if any of whom have the national interest in mind, and most of whom are rushing to fill a void left by the absence of national-level energy strategy. Amidst surging energy demand and frenetic local decision-making, agencies and individuals in the central government are scrambling simply to keep abreast of developments on the ground. China’s astonishingly rapid energy development may well be spinning the heads of outsiders, but it is vexing, perplexing, and even overwhelming Chinese governmental insiders too.

II. The Big Picture

Of the many contributors to China’s recent energy demand growth, two stand out for their long-term implications. The rapid expansion of the transportation sector has been an important driver of China’s surging demand for oil, which alone accounted for 40% of the increase in world oil demand over the past four years. China is now the world’s second largest consumer of petroleum products after the United States. Domestic oil production has not kept pace with demand, and China now imports almost half of its consumption of about 6.7 million barrels per day.

The growth of the power sector has been even more dramatic. Total generating capacity grew by nearly a third in just the last three years. This year alone, and for each of the next two years, about 70 gigawatts of new generating capacity will be brought into service. In effect, the Chinese are adding the equivalent of nearly the entire UK power grid each year. Most of this generating capacity, both new and existing, is fueled with

coal, and China's coal-fired power plants are the main cause of the rapid increase in its greenhouse gas emissions, now the world's second largest after the United States.

These supercharged growth rates may not last much longer. The rate of growth of China's motor vehicle fleet has already eased a little, after increasing by more than 50% per year earlier in the decade. And it would be surprising if the massive program of power plant construction did not result in overcapacity problems in some regions before long.

But whatever happens over the next few years, the key point is that future growth in China's energy demand will undoubtedly far exceed the growth that has already taken place. Private car ownership today stands at 10 million, or a little over 7 cars per 1000 people, far below the global average of 120 per thousand. (As the *Economist* recently noted, as long ago as the beginning of the Great Depression there were already twice as many cars on U.S. roads. as there are in China today.) Similarly, electricity consumption per capita in China, at about 1700 kilowatt hours per year, is only about 20% of the average per capita consumption in the advanced economies. In short, China's energy demand is certain to grow very significantly over the next few decades. Its consumption and imports of hydrocarbons will continue to increase, with major implications for the world market for oil and gas, and its carbon dioxide emissions are fast approaching a level that, unless something is done to reduce them, will make it increasingly difficult for other countries to justify the effort to reduce theirs.

III. The situation on the ground

Capacity Expansion in the Electric Power Sector. Capacity expansion in China's electric power sector provides us with some of the clearest evidence of how energy-related decisions are actually being made on the ground. On paper, the story seems straightforward. Most power plants belong officially to one of five major state-owned national energy corporations, enterprise groups that in theory answer upward to the central government while issuing orders downward to exert direct financial and operational control over their subsidiary plants. This chain of command should mean that for a new power plant to be built, the state-owned parent must secure the necessary central government approvals and demonstrate that the new project meets relevant national technical standards, stipulations about what fuels to utilize, and, once the plant is up and running, national operational requirements, including environmental regulations.

The reality, however, is far more complex. For example, as central government officials themselves acknowledge, of the 440 gigawatts of generating capacity in place at the beginning of 2005, there were about 110 gigawatts of 'illegal' power plants, which never received construction approval by the responsible central government agency (the Energy Bureau of the National Development and Reform Commission, the former State Planning Commission.) These plants were obviously all financed, built, and put into service, but nobody at the center can be sure under what terms or according to what standards.

The key to understanding how this could happen lies in the local government role. In China today, localities in high growth industrialized regions like the coastal provinces Zhejiang and Guangdong desperately need electricity. Local officials, long accustomed to operating in a bureaucratic system that for all its confusion has consistently

emphasized the maximization of economic growth and consistently tolerated ‘entrepreneurial’ ways of achieving that goal, have stepped in to play key roles in power plant construction and operation. For example, only about 25% of the capital required for new power plant investment is provided by the parent national energy corporations. Much of the remainder comes in the form of loans from the municipal branches of state-owned banks. These banks in theory answer to a headquarters in Beijing, but in practice are likely to respond to the wishes of local governmental officials, partly because local officialdom exerts substantial control over personnel appointments within local bank branches. Another important source of capital is even more directly controlled by the locality. These are municipally-owned energy development corporations -- quasi-commercial investment agencies capitalized through various fees and informal taxes levied by local government.

Thus, regardless of formal ownership ties running up to the center, power plants built for the urgent purpose of meeting local demand are often built with locally-controlled financing. It should not be surprising, then, to find municipal governments providing construction approval to get the plants online as quickly as possible, while simultaneously shielding them from the need for further approvals from the center that might well require stricter technical, environmental, or fuel standards. The fact that 110 gigawatts of installed capacity is ‘illegal’ means neither that the plants are hidden in a closet nor that they lack any governmental oversight. What it does mean is that they are not part of a coherent national policy, that they frequently operate outside national standards, and that they often evade control even by their ostensible owner at the national corporate level.

In this system, the lines of operational accountability and responsibility are often blurred. On the one hand, power plants that are supposed to be controlled by a parent national firm end up dealing with the parent at arms length. Some investment and working capital funds are provided by the parent to the plant, and some profits are returned upward. In accounting terms, the financial performance of the plant is subsumed within the integrated financial statement of the parent corporation. On the other hand, financing and project approval come primarily through local agencies that are intent on ensuring power delivery regardless of the commercial ramifications for the plant or the parent group. Thus, power plants can and do operate at a loss for years on end, further complicating incentives for plant managers. Indeed, because of the lack of clarity in the governance structure these operators sometimes themselves engage in creative financial and investment strategies. Central officials acknowledge that it is not unusual for power plants to operate sideline, off-the-books generating facilities, the profits from which can be hidden from the parent energy group and thus shielded from upward submission. As one Chinese government researcher recently observed, the electric power sector may be a big loss maker on the books, but people in the sector always seem to have a great deal of cash. Of course, none of this could happen without local government compliance, if not outright encouragement. China's fastest growing cities are effectively pursuing a self-help approach to meeting their power needs, and they are abetted in this by blurred lines of governance and accountability.

Environmental Regulation. This pattern of de facto local governance also characterizes the administration of environmental regulation. For example, the central government has

established extensive legal restrictions on emissions of sulfur dioxide, the acid rain precursor produced as a by-product of coal combustion. The 1998 and 2000 amendments to China's Law on the Prevention and Control of Atmospheric Pollution set stringent national caps on total sulfur emissions and required coal-fired power plants to install pollution-reducing flue gas desulfurization systems, commonly known as "scrubbers." To promote the utilization of these technologies, which add significantly to plant capital and operating costs, the central government imposed mandatory pollution emission fees on power plants. Yet today, central government researchers estimate that only about 10 gigawatts of coal-fired plants have purchased such equipment, a small fraction of the total capacity subject to the anti-pollution laws, and they could only guess at how often the equipment is actually turned on.

Once again, the fragmented, ad hoc system of energy-related governance in large part explains how this could happen. Environmental policy at the national level is primarily, though by no means exclusively, the responsibility of the State Environmental Protection Agency (SEPA), a relatively weak organization, though one that has been gaining authority recently. But implementation and enforcement come under the authority of provincial and municipal-level arms of SEPA. As with the local bank branches, personnel appointments in these local environmental bureaus are for the most part controlled by local governmental officials rather than by the parent central agencies. If the locality's main goal is to achieve economic growth, and cheap electric power is needed to fuel that growth, then environmental enforcement will play a secondary role. Local environmental officials who take a different view are likely to run into career difficulties. Moreover, budget allocations for local environmental bureaus are very tight,

so bureau officials are often forced to resort to self-help mechanisms of financing just to survive. To keep up staffing levels and ensure that their employees are paid, they must rely either on the collection of local pollution emission fees or on handouts from the local government. In practice, this translates into incentives for local environmental regulators either to allow emitters to pollute (as long as they compensate the local SEPA office with the payment of emission fees) or to accept payment from the local government in return for ignoring emissions entirely.

Within-the-fence generation. In the fastest-growing and most power-hungry areas of China the self-help approach goes right down to the level of the industrial enterprises that account for so much of the growth in electricity demand. In provinces like Guangdong and Zhejiang, major industrial cities have grown up out of what only recently were still small towns or villages. In the absence of adequate municipal or regional power infrastructure, large numbers of manufacturers in these areas have been installing their own diesel-fired generators. The diesel fuel is expensive, and the electricity is more costly than from a large coal-fired power plant. But the factories have little choice. Many of them are tightly integrated into global production networks and are scrambling to meet overseas demand for their products. They cannot afford to shut down for lack of power. Some of them operate sensitive production processes with no tolerance at all for power interruptions. China is now the world's largest market for industrial diesel generators, and the country's consumption of diesel fuel, much of it produced from imported crude, has climbed substantially. Generator manufacturers estimate that ten percent of China's total electric power consumption is supplied by these 'within-the-

fence' units. Local officials have generally tolerated and in some cases actively supported such solutions, and environmental regulation of these diesel generators has lagged behind that of central station power plants.

IV. The Path Forward: Coal versus Oil and Gas.

The complicated, fragmented governance of China's energy sector will also have a major bearing on one of the most important aspects of its future development: the relative roles of coal, on the one hand, and oil and natural gas, on the other. The vast scale of China's demand ensures that all energy sources, including nuclear power and renewables, will be used heavily. But in China, as in the world as a whole, fossil fuels will dominate the supply side for the foreseeable future. (China's ambitious plans for nuclear power underscore this point. If these plans come to fruition, more nuclear plants will be built in China over the next two decades than in all other countries combined. But even then, nuclear energy will still only provide about 4% of China's electricity; fossil-fired plants will account for much of the rest.)

The inevitable dominance of fossil fuels in China is not good news for the global climate. But the severity of the problem will depend on the proportions of oil, gas, and coal in China's future energy mix, and that is much less certain. In one scenario, China, like almost every country that has preceded it up the economic development ladder, will rapidly shift from reliance on solid fuels towards oil and gas, with gas playing an increasingly important role in electric power generation, in industrial and residential heating, and potentially also in transportation. In an alternative scenario, China will remain heavily dependent on coal for electric power, for industrial heat, as a chemical

feedstock, and increasingly, for transportation fuels, even as demand continues to grow rapidly in each of these sectors. The prospect of continued high oil and gas prices make the coal-intensive scenario more plausible today than it was during the era of cheap oil.

These two scenarios pose very different risks and benefits for China and for the rest of the world. For the Chinese, the heavy coal use scenario would have the merit of greater energy autonomy, given China's very extensive coal resources. It would also mean less Chinese pressure on world oil and gas markets. But the impact on the environment would be substantially greater, both locally and internationally. In the worst case, the heavy environmental toll inflicted by today's vast coal mining, shipping, and burning operations, already by far the world's largest, would grow much worse as China's use of coal doubled or even tripled over the next 25 years. More optimistically, China would become the world's largest market for advanced 'clean coal' technologies, including gasification and liquefaction, and eventually also including carbon dioxide capture and storage. But these technologies will add considerably to the cost of coal use, and, in the case of carbon capture and sequestration, are unlikely to be deployable on a large scale for decades. By then China will likely have used up much of the world's remaining carbon 'budget' – the largest tonnage of carbon dioxide emissions for which there is still a chance of avoiding severe global climate change.

The high oil and gas scenario would not prevent these problems, but it would make them more manageable. A modern gas-fired electric power plant is not only cleaner than its coal-fired counterpart, but also emits 70% less carbon dioxide per unit of electrical output. A petroleum-based transportation system emits only about half as much carbon dioxide per barrel as it would if the liquid fuels were produced from coal. But

the high oil and gas scenario would also force China, with few resources of its own, to compete ever more aggressively for access to them around the world. In that case, the recent tensions with Japan over drilling in the East China Sea and the flurry of dealmaking in Iran, Africa, Central Asia and elsewhere may in retrospect come to seem like a period of calm before the storm.

Much is riding, therefore, on which of these scenarios China will follow more closely. There are already some indications of which way the wind is blowing. China's coal is for the most part located inland, far from the major energy consuming regions along the coast. So a clean-coal-based development strategy would require a national-scale energy infrastructure, with large-scale, technologically-advanced, highly efficient power plants and 'polygeneration' facilities (producing a mix of chemical products, liquid transportation fuels, hydrogen, and industrial heat as well as power) located in the coal-rich areas of the north and west, and linked to the coastal regions via long-distance, high-voltage transmission networks. But although a few demonstration projects have been started, these advanced coal technology solutions have been slow to take hold. Despite years of deliberation, most are still held up in the planning or early construction phases.

A major obstacle is that these solutions require a strong central government role, centralized funding, and substantial cross-regional coordination, all of which are lacking in China's energy sector today. Instead, China's most-developed coastal regions, rather than waiting for a national strategy to emerge, are moving forward with their own solutions. Many municipalities are simply building conventional coal-fired power plants as fast as they can, often with subpar environmental controls. While they are willing to

import coal from the poorer inland provinces, they are not willing to invest in the large-scale infrastructure that would make them dependent on electricity generated in those interior regions. It is commonly observed that in China everybody wants to generate power, and nobody wants to rely on others for it.

More developed provinces like Zhejiang and Guangdong, or provincial-level municipalities like Shanghai, struggling to provide adequate power supplies but also facing growing demands by an increasingly sophisticated public for a better environment, recognize the need for more sustainable approaches. However, these wealthier regions are investing not in clean coal, but rather in a burgeoning natural gas infrastructure, based mainly on liquefied natural gas (LNG) imports. In this, their interests coincide with those of the state petroleum companies, which have become significant investors in – and builders of – the infrastructure of port facilities, terminals, LNG regasification plants, pipelines and power plants, frequently partnering in these projects with the energy development arms of the municipalities and provinces. Since the viability of these investments depends on the availability of natural gas, the state petroleum companies have recently been focusing their overseas acquisition activities at least as much on gas as on oil. CNOOC's recent bid for Unocal, for example, was motivated as much or more by Unocal's natural gas reserves than by anything having to do with oil.

In effect, commercial and quasi-commercial interests at the local and national levels – almost always in cooperation with international investors – are moving China's coastal regions, if not China as a whole, down a natural gas-intensive path. More than any other players in the Chinese system, these are the organizations with cash, commercial sophistication, links to global partners, access to global fuel supplies, and

ready entrée to downstream infrastructure and major energy consumers. It is they who are making national energy policy. And none of them – not the national fuel and power firms nor the decision-makers in the leading coastal provinces – has much incentive to advocate advanced coal-based solutions or technologies. For the state petroleum firms, which increasingly see themselves as gas companies and hold substantial cash reserves, coal is a substitute for their products and the coal industry a competitor. Large-scale clean coal solutions are scarcely more appealing to the national power companies, the nominal parents of most of China’s coal-burning plants. Large-scale clean coal is associated with power generation at the mine mouth, which in turn is associated with control by the mining industry, and the power companies have little interest in yielding control of their industry to mining concerns.

Finally, powerful provincial and municipal governments along the industrialized coast, facing rapidly growing local power demand and able to draw on substantial investment resources to meet it, seem to be opting for dependence on foreigners for gas over dependence on interior provinces for coal. The Shanghai government last year banned the construction of new coal-fired plants, while at the same time working to build an LNG infrastructure. Some coastal municipalities have little choice but to rely on coal from the interior in the near term, though even here they maintain control over power generation through the exercise of financial and regulatory power, and by building new coal plants scaled to serve only local or intra-provincial needs. However, the real trend-setters over the long term, the richer and more advanced municipalities like Shanghai, are pursuing self-help on a grand scale, by investing in natural gas infrastructure. In effect, they are tying themselves to overseas natural gas supplies while maintaining a regulatory

and financial stake in the downstream gas infrastructure. As they partner in these projects with national energy companies, they become at once investors, producers, consumers, and regulators of the natural gas business. This is all done in lieu of national-scale advanced coal solutions which would remove from their control not only the fuel but the power generation business as well.

V. Conclusions

In light of this fragmented system of governance, what can the West expect of China in those aspects of its energy development that matter most to us? And what, if anything, might be done to influence China's energy development in a favorable direction?

First, we should recognize that the Chinese government's capacity to achieve targets for reducing hydrocarbon consumption or pollutant releases, or Kyoto-like limits on greenhouse gas emissions, is in practice quite limited. Neither louder demands for compliance by outsiders nor escalating penalties for non-compliance are likely to yield the desired results. China's national leadership may eventually be prepared to enter into such agreements, but if so those undertakings should be understood primarily as aspirational. China's system of energy-related governance makes the fulfillment of international commitments problematic. Nevertheless, those commitments can be an important source of domestic leverage for leaders seeking to strengthen internal governance in the long run.

Second, the unquestionably authoritarian nature of the Chinese state does not mean that the state itself is internally coherent or effectively coordinated. One result of

China's particular path of reform is that the boundaries between state and non-state, public and private, commercial and non-commercial, and central and local have all become extraordinarily blurred. China's increasingly deep integration into the global economy is even blurring the distinction between foreign and domestic. The Chinese energy companies are majority-owned by the state (though who actually represents the state is open to debate), but they also list on overseas stock exchanges, have foreigners among their corporate directors, and receive financing and guidance from international investment banks. As a practical matter, the number of actors exercising de facto decision-making power over energy outcomes in China is large, and they are not exclusively confined within China's borders. We should not reflexively invest the actions even of the ostensibly state-owned Chinese energy entities with geostrategic intent.

Third, we should recognize that the fragmented structure of governance may ironically have created a 'golden moment' in the development of China's energy system. Actors at many different levels of this system are reaching out for support and advice as they struggle to meet their nation's rising energy needs. Many are seeking to move their nation, province, city, or company toward a 'world class' or 'global' standard, and are looking particularly to the advanced industrial economies for models of energy sustainability. We should engage with them in that search. This means promoting information exchange at every level, exposing Chinese officialdom as much as possible to our own market and regulatory models as well as our own uncertainties about what constitutes effective regulation and deregulation. We should make every effort to include them in these conversations, because they will follow us with their own attempts at

system design. More specifically, we should engage the most developed, forward-thinking municipalities and companies in experimental projects. The Chinese system is inherently experimental in nature and has high tolerance for ‘systems within systems’. The experiments most likely to succeed will not be national in scale, but localized, replicable, and able to propagate on a similarly small scale to other localities. These experiments should also be consistent with trends in advanced economies. China’s economic and commercial development is now so dependent on global integration that it will not be an outlier in terms of its energy system.

Finally, Americans know that the direction of China’s energy development will have profound implications for energy security and environmental sustainability in the West. In this sense, China’s struggle for sustainable energy solutions is also our struggle. But we must also recognize that China’s energy system is in its own way as politically complex, fractured and unwieldy as our own. In this respect, too, China’s struggle over energy policy is also our struggle. And we would be unwise to expect from the Chinese what we do not expect of ourselves.