

→ CHINA IN THE 21<sup>ST</sup> CENTURY: ECONOMIC GROWTH AND THIRST FOR ENERGY.

## Meeting China's energy needs in the 21<sup>st</sup> century Changing the Rules?

Consider the impact of gunpowder, the magnetic compass and the printing press. Three inventions that have left dramatic marks on human history. All were invented in China, and made their way along the Silk Road to Europe where they changed the rules that guided human development in the last 500 years. In China, gunpowder was used only for fireworks, the compass as a toy, and printing plates as a means of reproducing and perpetuating ancient writings and dogma. None moved Chinese society on, in stark contrast to their impact in Europe.

A story by guest author Michael Brown from Delta Energy & Environment

**F**ast forward to the 21<sup>st</sup> century. China today, we are all aware, is a fast growing nation undergoing rapid development. One consequence of this is rapid growth in energy demand and a frightening rate of increase in the emission of greenhouse gases and other pollutants. The country faces a twin challenge: sourcing sufficient energy to meet demand, while limiting the environmental impacts through greater efficiency and the use of cleaner energy supply options. Currently, the former is concentrating Chinese government attention most strongly, but the second is gaining ground. If the policy response is decisive, we can expect in coming decades the development and implementation of clean energy technologies in China on a scale that leaves current global activity in its wake. In this scenario, the rules which guide the growth of low carbon energy solutions today would change. Not only would the international business for clean energy solutions grow exponentially. But China, with its tradition of innovation, could be one of the major new sources of energy solutions, almost all of which are currently outside of China. And history tells us that this huge country is not short of creative flair. Nonetheless, a large question mark hangs over this perfectly plausible scenario.

Where China is concerned, uncertainties are numerous. Will the country continue to grow at the same speed for years to come? Will the governmental efforts to supply cleaner energy amount to anything more than a token? And will the environmental challenge unleash a surge in China's technological innovation, or will we see foreign clean energy technology pour into China - in the opposite direction taken by those amazing inventions hundreds of years ago - along the 21<sup>st</sup> century Silk Road? How will this story unravel - and what are the implications for a business like GE's Jenbacher gas engine division? This article attempts to explore these intriguing questions.

**The country faces a twin challenge: sourcing sufficient energy to meet demand, while limiting the environmental impacts through greater efficiency and the use of cleaner energy supply options.**

Let us look at the foundation of this complex issue - China's surging economy and thirst for energy. Figure 1 (page 26) highlights how the International Energy Agency (IEA) thinks the future trend of Chinese energy demand will look, up to >

> 2030, compared to the rest of the world. And Figure 2 shows the consequence: how China's already significant share of global energy demand is projected to continue to expand for decades to come. In stark terms, therefore, we can see that if we think China is thirsty today – we haven't seen anything yet. What might all this mean in financial terms? After all, meeting demand means a need for new investment. Figure 3 shows China's likely share of investment needs in the energy sector over the next 20+ years. In short, China will soak up almost 20% of total energy sector investment worldwide – and around 27% of investment required in the electricity sector. One clear conclusion from this is that if you are in the electricity business, China is going to be a very important part of your world for the foreseeable future. The potential environmental implications of all this are, frankly, scary. Already, global scientific consensus is unambiguous: human induced carbon emissions have changed, and are changing, the world's climate. To limit the damage, emissions trajectories have to stop increasing and start decreasing within a very short timeframe. If the IEA projections for energy demand are right – what does this translate into in terms of carbon emissions? Firstly, Figure 4 shows us what will happen in China compared to the rest of the world, while Figure 5 highlights how China's share of global emissions is accelerating.

**China will soak up almost 20% of total energy sector investment worldwide – and around 27% of investment required in the electricity sector.**

The message is clear. The environmental impacts of China's economic growth and surge in energy demand are likely to be substantial (keep in mind, however, that throughout this transition, energy demand and carbon emissions per capita in China will remain well below what they are in North America and Europe). In this scenario, the bottom line is this: China needs new supplies of energy, in particular electricity, and yet it needs to deliver these in ways that are both cost competitive and carbon efficient. If policymakers in Beijing, in the other major cities and in the provinces draw up their list of feasible solutions to this challenge, then decentralized, low carbon combined heat and power (CHP), biogas and coal mine gas projects should feature strongly. If, in addition, a firm collective effort is made to ensure that home grown technology can be a part of the solution, then expect a dramatic increase in the development of Chinese technology – for implementation not only at home but also in the burgeoning international marketplace.

This scenario, however, is not a foregone conclusion. The future, even in the most stable of times, is full of surprises. But attempting to pin down how China's energy and environmental future will turn out is particularly challenging. As the experts at the IEA itself say: "China is a major source of uncertainty for our global energy projections." Several factors could change the overall prospects for the scenarios described above. Four important ones are summarized below.

- **ECONOMIC SLOWDOWN – OR ACCELERATION.** The national economy has grown at an average rate of 10% per year for the last 20 years. This is the fastest of any major country in the world. The government has been aiming to moderate this to 7.5% between 2005 and 2010 but this has already been consigned to the bin. Growth rates are as high as ever. A national or regional economic crisis, conversely, could bring everything to a grinding halt, bringing down energy demand with it.

- **THE LINK BETWEEN ENERGY DEMAND AND GDP GROWTH.** The linkage between these two indicators is complex in China. For example, while coal demand fell between 1997 and 2001, economic growth was rapid. Subsequently, coal demand surged at 20% per year in 2003–04, despite similar rates of economic growth as before. In most western countries, economic growth and energy demand have been largely decoupled for decades; if this happens also in China, the current mainstream projections for energy demand could be significantly undercut.

- **REFORM OF THE ELECTRICITY SECTOR.** China's power sector has undergone some reform in the last few years, but many old practices remain and, for now, competition is limited while the control of the main utility players over potential new entrants and small-scale power producers is largely undiminished. If this stranglehold were to change, the power sector could be infused with more efficient processes and innovative practices. The energy demand consequences of this would likely be profound.

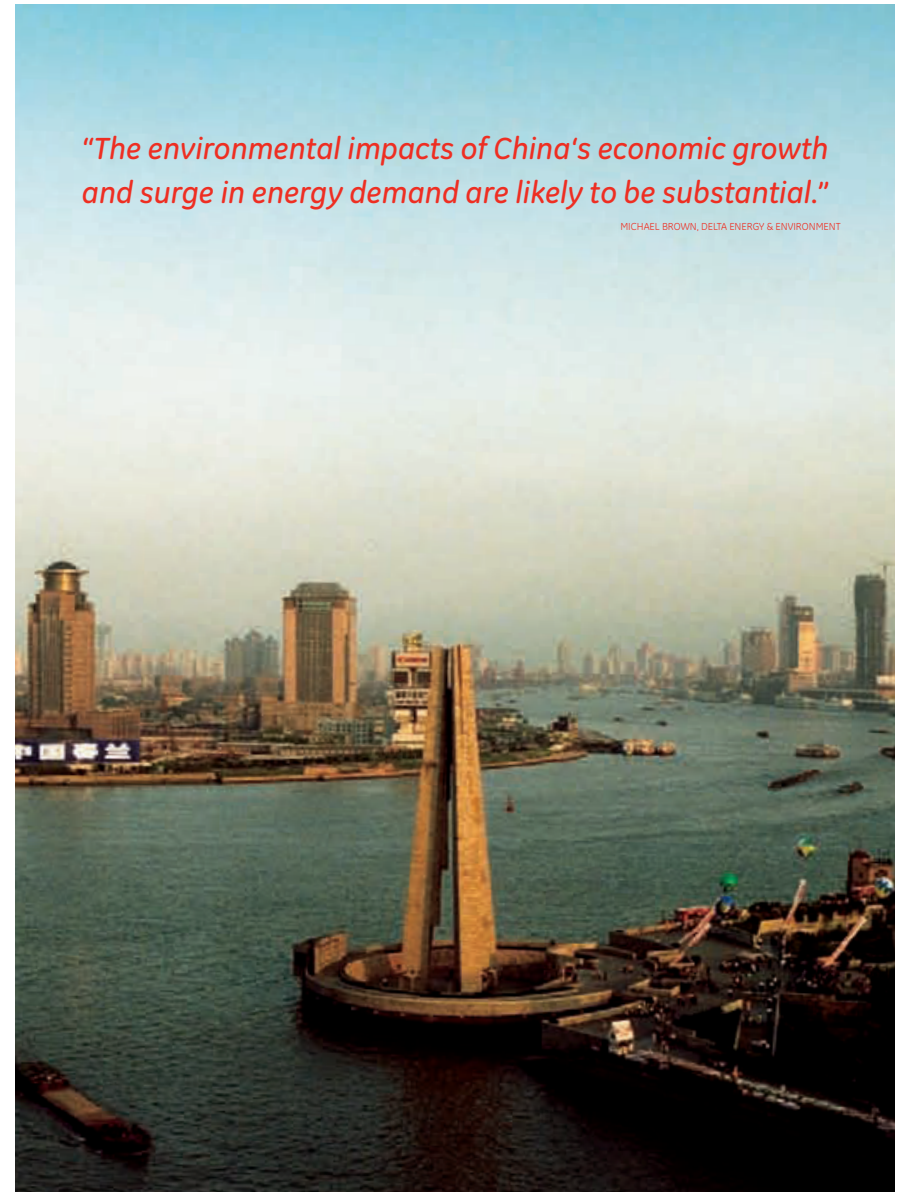
- **POLICY INTERVENTION TO FAST TRACK LOW CARBON ENERGY SOLUTIONS.** Despite the seemingly obvious need for China to adopt cost efficient and clean energy solutions as fast as possible, it is not yet clear that it will do so. Today, as several foreign companies will tell you, it remains very hard to make the economic case for highly efficient decentralized energy solutions and there is still little policy awareness of the potential and the benefits. In some respects, however, the Chinese government does have a track record of adopting solutions that put the needs of the country first without being unduly influenced by strong vested industry interests – something that cannot always be said for western governments. So the current resistance to decentralized energy that is typical in many OECD countries may be more easily overcome in China.

With such numerous and complex uncertainties, who would make a bet on the Chinese energy sector? None but the foolhardy, perhaps. But to turn the question around, who can afford to ignore it? With 25–30% of future global power sector investment projected to take place in China, companies with high quality, high efficiency and cost-competitive energy solutions must make their way to China – if they have not already done so. What would these solutions include? Here are some of the decentralized options in more detail.

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MICHAEL BROWN, DELTA ENERGY &amp; ENVIRONMENT



> **CHP.** This form of decentralized energy generation, which can include electricity, heating and cooling at efficiencies of 70-90%, is a proven, reliable and cost-effective means of providing the energy needs of industrial installations, commercial and public buildings or residential zones. CHP is already used widely around the world, accounting for around 8-10% of total electricity demand. Coal-based CHP is common in China, while CHP based on cleaner natural gas is a new opportunity – especially so as gas supply into the country increases. A typical example of an excellent opportunity for CHP is a Beijing hospital complex with high summer cooling load and an even higher winter heating load. An electrical output of 13.3 MW gas-fired, high efficiency CHP system, which will deliver very substantial carbon emission savings compared to grid-based electricity supply and on-site boilers, is under development.

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**The project payback is estimated to be around 3.2 years.**

Also under development in the Beijing area is a small (around 100 kW), low carbon CHP system in a new hotel. The hotel needs year-round hot water but its heating and peak-time electricity costs are high. The CHP system would not only cut these costs, but will also improve energy supply reliability. The project payback is estimated to be around 3.2 years.

In Guangdong province, a CHP system is under development that will meet the energy supply needs of an IT business park. The first phase will include the development of an 8 MW CHP system providing heating and cooling to the park. There is a relatively long payback of 7.4 years but there are significant benefits in terms of power supply security and energy efficiency.

**BIOGAS BASED ENERGY.** The opportunity here is less well understood, but we do know that many industrial processes in China, including waste water treatment, involve the production of large volumes of biogas, which can be used to generate either electricity and heat – or both in CHP systems. In Liaoning province, for example, a 500,000 tons/year ethanol plant produces almost 14,000 m<sup>3</sup> of biogas per day based on waste water treatment. A 1.5 MW CHP plant is

being planned to cut energy costs and provide heat for drying processes. The overall saving is likely to exceed Euro 0.5 million/year. In Hunan province, a plant producing starch, glucose and animal feeds processes around 500,000 tons of corn/year. The waste water treatment system produces around 16,000 m<sup>3</sup> of biogas per day, some of which is used to supply cooking requirements in the local community and the rest is made available, since 2006, for a high efficiency 1 MW CHP system. Savings to the plant run at almost Euro 0.5 million/year.

**COAL MINE GAS ENERGY PROJECTS.** Based on China's huge coal producing industry, there is abundant opportunity for the use of methane derived from coal mines. The carbon benefits of this approach are very significant, in part because unutilized methane is a very potent greenhouse gas and in part because the electricity generated from it is displacing conventional, high carbon, coal-based generation. For this reason, these decentralized projects are becoming an attractive potential source of carbon credits that can be traded internationally to meet emission reduction obligations (see page 15).

**If these first green shoots are encouraged to develop into an extensive national program of decentralized energy supply, the global impacts could be huge.**

**FIRST GREEN SHOOTS.** The opportunity and the need for China to bring decentralized energy into the mainstream are clear. Many of the products already exist that can ensure China can meet its energy demand growth in a significantly cleaner way than it does today. And already, there is a sprinkling of such low carbon projects appearing across the country. If these first green shoots are encouraged to develop into an extensive national program of decentralized energy supply, the global impacts could be huge. Not only will there be less carbon in the atmosphere, but the market opportunity for companies with proven, high quality products will increase dramatically – and the knock-on incentive for China's own innovators could lead to a buoyant, dynamic and competitive market-place for low emission energy solutions that will have international repercussions. And, above all, the rules of the low carbon energy market would be changed – and we'd all live in a cleaner world because of it.

**about the author**



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**International decentralized energy markets are growing rapidly. Delta Energy & Environment helps its clients understand how evolving decentralized energy technologies, markets and policy frameworks will impact on their business and financial performance. Michael Brown is a specialist in the fields of decentralized energy, cogeneration, emissions trading and carbon risk, with over 14 years of experience in the various fields.**

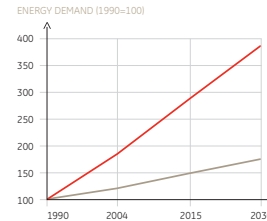


FIGURE 1: CHINA'S GROWTH IN ENERGY DEMAND

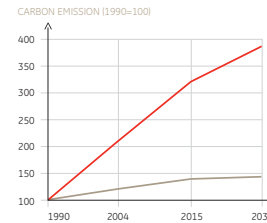


FIGURE 4: CHINA'S GROWTH IN CARBON EMISSIONS

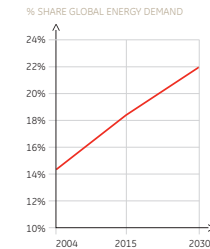


FIGURE 2: CHINA'S SHARE OF GLOBAL ENERGY DEMAND

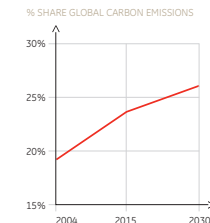


FIGURE 5: CHINA'S SHARE OF GLOBAL CARBON EMISSIONS

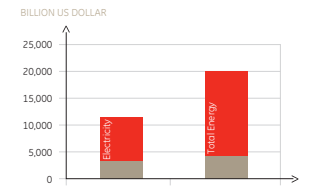


FIGURE 3: CHINA'S ENERGY SECTOR INVESTMENT REQUIREMENTS

source: international energy agency, 2006

