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ParisTech
 GRANDES ECOLES D'INGENIEURS DE PARIS
 PARIS INSTITUTE OF TECHNOLOGY

Class of 2004



Field Trip : CHINA

Growth and GDP

China is experiencing growth at an unprecedented rate, approaching 10% a year. It currently ranks as the 6th economic power in the world in terms of GDP, and will probably overtake both France and Great Britain this year, to claim second place before 2020 and become the top economic world power at some time between 2040 and 2050.

Raw materials

China is the top buyer in the world for cement (55% of world output), coal (40%), steel (25%), nickel, aluminium ... Since 2003 imports have outgrown exports.

Petroleum

China is the second oil importer after the U.S., while it had been a net exporter until 1993. These oil importations have gone up 30% in 2004.

Most of the Chinese hydrocarbon oil resources lie far away from the large demand centres (Beijing and the growing metropolis in the south eastern part of the country).

The oil reserves are estimated at 23.7 billions barrels (11th place in the world behind the U.S.). Daily production is 3.3 Mbbl (6th place in world), essentially on-shore. 80% of the underwater resources have not yet been exploited.

Oil consumption has nearly doubled over the last ten years. At 5.5 Mbbl/day, it now outpaces Japan (5.3 Mbbl/day) but still lies far behind the U.S. (20Mbbl/day). Oil dependency, on the increase, is currently 40%, the Middle East supplying roughly half the needs.

The reserves/production ratio is less than twenty years. The three major State companies in the hydrocarbon field are the China National Petroleum Corp (CNPC), the China Petrochemical Corp (SINOPEC) and the China Offshore Oil Corp (CNOOC).



CHINA

Energy Sector

Natural Gas

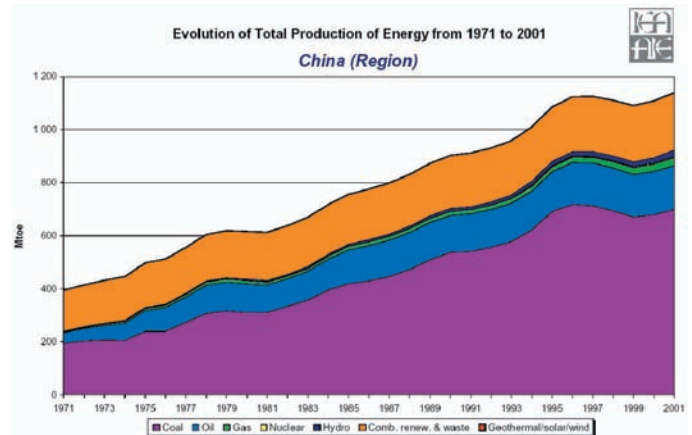
Known reserves reach 1,820 Gm³, ranking China number 23 in the world. Gas production, although on the rise for the last ten years, is still low: 34 Gm³ in 2003 (thus a reserves/production ratio of over 50 years).

Consumption, having risen for the last ten years, was 33 Gm³ in 2003. The country is therefore barely self-sufficient, whence the growth of imports, particularly as liquefied natural gas.

coal in China is 60 years.

With 97 Mt of coal exported in 2002, China is the second exporter in the world after Australia.

The reduction in its exports due to the increase in national demand has led to an increase in world prices.



Hydroelectricity

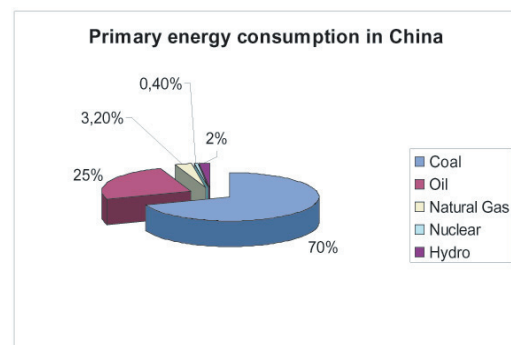
China has the largest hydroelectric potential in the world. Only 20% of this potential is as yet exploited, supplying one fourth of total electric production via 20000 dams and making China the first producer of hydroelectric power in the world, ahead of the US and Canada.

Around 2020 the installed capacity of the hydroelectric plants will reach 200 GW, representing an increase of more than 100% over the current situation.

Nuclear

The nuclear plant stock is composed of eleven reactors and accounts for 1.6 % of total electric power in the country. The electronuclear program is developing, with a goal of at least 36000 MW, or around twenty reactors, to reach by 2020 4% of electricity from nuclear origin.

In 2004 was announced the construction of eight new reactors, four of which of third generation, the most up-to-date on the world market. Competition is running high for the new reactor market between France, Russia and the U.S.



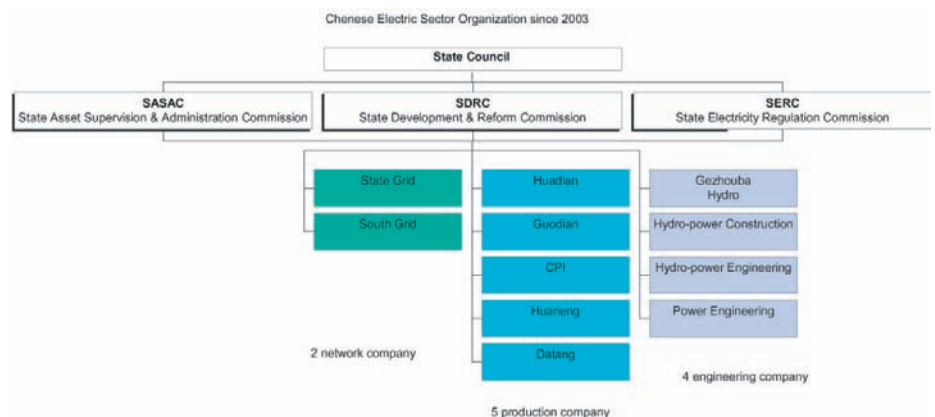
Coal

China is both the first producer (29%) and the first consumer in the world, and ranks third for reserves after the U.S. and Russia. This energy source accounts for 75% of electric power.

Over half (60%) of coal consumption is devoted to electric energy production, and this share should keep growing.

This sector calls for investments not only to increase production capacity, but also to modernize existing mines. Coal furthermore presents major challenges in terms of transport infrastructures. Two thirds of output are hauled over more than 600 km, cramping the traffic of goods and passengers. At its current production level, the reserves/production ratio for

The Three Gorges dam will supply by 2009 18,200 MW, equivalent to twice the total French hydroelectric capacity. Exploitation will be directed along the seven rivers, including the intermediate courses of the Yellow River and the Yangtse, as well as the intermediate and lower courses of the Yarlung Zangbo river.



CHINA



The electric system

The electric system is undergoing a major upheaval. Since 2003 three State state-owned bobbies have been regulating both-grid companies, the five national producers and the four engineering and construction companies.

Besides the five producers under State control (Huaneng, CPI, Guodian, Datang and Huardian), three national producers (Guohua, Huarun and SDIC) and three specialist producers (Three Gorges, China National Nuclear Corporation, China Guangdong Nuclear Power Company) are still competing with provincial producers (Shenergy, SEG, Yuedian, Luneng, BIPI).

Energy challenges

The energy supply is insufficient: 24 out of the 31 Chinese provinces have had to ration energy last summer, and even though electricity production has gone up by 15% over the last year, it will still not be enough to meet demand.

The major Chinese oil companies have also reached their refining limits. Furthermore, the strong demand for steel has diverted the better grade of coal from power to steel plants, thus contributing to lower productivity in the coal-fired installed basis which remains the main contributor (80%) to the supply of electricity. Close to 40% of the electricity production capacity comes from small thermal plants from which a large amount of pollution originates.

In 2004, electric consumption went up by 17%. Industry guzzled up 70%. Electricity produced from gas is expensive

and will be reserved for the use of megapolies such as Beijing and Shanghai. To guarantee its development China must rely on two major national resources, coal and hydroelectricity, as well as on nuclear technology.

Insufficient supply of electricity forces some companies to operate their own generators to keep production going. This results in a run on refined oil on the market. Some companies have begun to hoard oil as a measure of preparedness.

Economic growth is highly fossil energy intensive. Besides, energy efficiency still leaves to be desired: it takes 30% more energy in China than in the European Union to obtain a comparable output.

China consequently emits 50% more CO₂ than Europe per marginal unit of GDP.

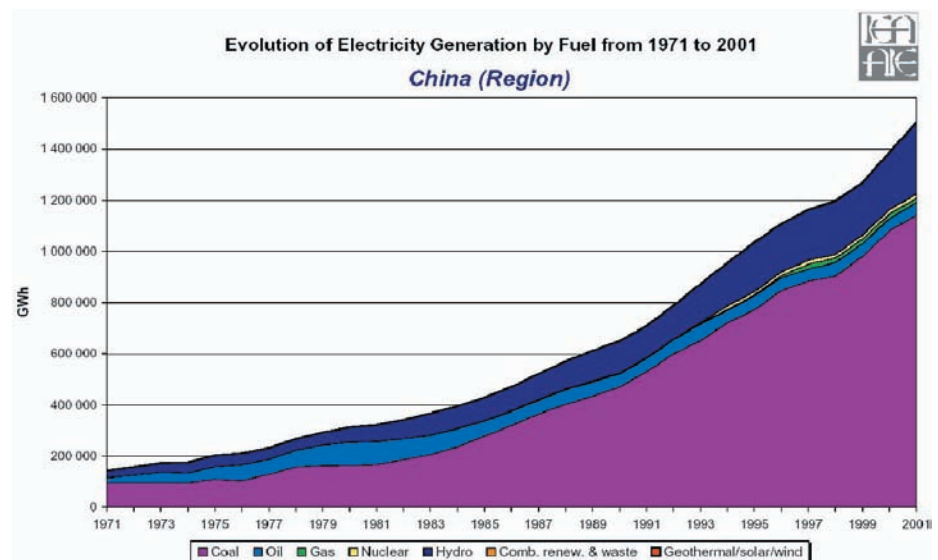
The explosion in demand does not appear ready to let down, seeing how low the current energy consumption levels are with respect to developed countries: a Chinese uses on average five times less electricity and twelve times less oil than a European.

Moreover only one Chinese out of a hundred owns a car ...

The consumption of oil per year and per inhabitant in industrialized countries is over a ton. Were China, with its 1.3 billion inhabitants, were to reach this level, it would use all of the oil resources currently commercialized in the world.

In order to face this imbalance between supply and demand China first of all implements a strategy intended to secure its supplies of hydrocarbons on the one hand, and furthermore diversify its energy supplies while progressively reducing the share of fossil fuels in its electricity production on the other.

The major energy challenges faced by China concern the whole world. Considering the specific and increasing weight of China in the world economy, the Chinese energy policy has a major impact on the security of supplies for the rest of the world as well as on the price of oil, gas and coal, not forgetting the international fight against climate changes.



TSINGHUA

Tsinghua University

Beijing, March 14th 2005

Tsinghua University is a prestigious Chinese university, that counts about 20 000 students.

Our visit was divided in two parts.

First, we visited the Energy Environment Economy (3E) Institute. Professor Su Mingshan presented us the department and its activities. Some graduate students of the institute were also present, as were Mr Alain Darthenay and Mme Florence Jiang Hui, respectively Industrial Operations and Relations Director and Business Development Manager of EDF Asia Pacific.

General activities of the Ecole des Mines and the Mastère OSE were presented to the audience, then in more detail our work that deals with Energy Synergies in Industrial Parks. The talk interested the audience and the questions session was very rich.

Professor Su Mingham asked us first questions concerning our work methodology – how had we worked all together? Then questions concerning the Ecole des Mines were asked, especially about the foreign students.

Our presentation led Professor Su Mingshan to evoke the notion of recycling economy, which consists in the use of industrial waste and by-products in order to reduce the use of raw materials. This notion is actually very close to that of industrial

ecology. He also insisted on the adverse effects of competition, which should be replaced by cooperation. This consideration joins our analysis of synergies.

Afterwards students asked us about pollution problems in industrial parks – because the implementation of synergies may move the localisation of the pollution. They asked us also about the role of the government concerning synergies – this role being only incentive in France.

Then Mr Darthenay described the activities of EDF in China. In particular he insisted on the fact that energy will become more and more scarce, thus expensive.

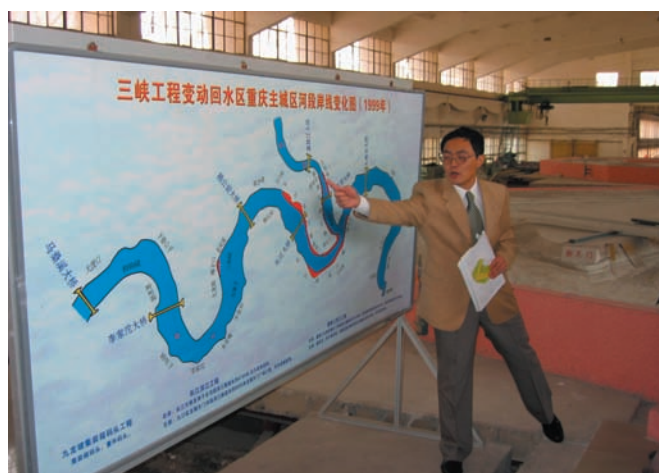
This clearly shows the interest of energy synergies. However they have to be considered as a business model: a contractual framework which would define the role of each player in an industrial park. This is one of the projects of EDF in China.

After this questions session, Mme Ye Guiqin from the international relations service of the University led us to the Department of Hydraulic Engineering where we were introduced to professor Shao Xuejun who guided us through his laboratory.

He actually works on a sediment transport hydraulic module that models the sediment deposit in the Yangzi river bed. In fact, the construction of the Three Gorges Dam modifies the flow of the river, which has an effect on the sedimentation phenomenon and raises problems for navigation on the Yangzi and for the turbines of the power plant. The question of sedimentation is a major stake for the population which depends a lot on the river.

This work is based on the approach of professor Fargue, a French hydraulic scientist, in the 1900's.

In order to determine a management plan of the dam that respects navigation constraints of the watercourse, the lab team works on an imposing model at the scale of 200:1 of the riverbed, which sedimentates



TSINGHUA



300 times faster than in reality. Therefore, sand is replaced by plastic particules. The speed of water flow is measured thanks to cameras and infrared sensors. In addition to that, a numerical model has been built but gives only rough results. The aim of this experience is to find a dam operation that optimises power production, considering the water spill necessary to wash the

sediments that accumulate due to lower river flow, the amount of sediment not allowing a remove by mechanical devices.

To conclude, professor Shao Xuejun compared the actual situation in China with the one that French rivers have known a few decades ago, with a great construction of canals and dams followed by a return to a more

natural method of watercourse management. For him, it is inevitable that China makes the same errors as France in its development before becoming aware of environmental problems due to river bed modifications.

Mastère OSE Presentation at Tsinghua University : Energy Synergies in industrial parks

Energy synergies are the subject of a four month study done by the group "Mastère OSE". Implementing energy synergies is a way of improving the energy efficiency of industrial parks.

The state of the art regarding the subject was first established, by consulting literature and researching existing cases. Then a survey was conducted in order to get the general opinion in French industries. This allowed us to identify the barriers to synergies and what trends were building up.

Worldwide, energy consumption is raising concerns. At present, the main resources used are limited. Tension in the energy markets is enticing high price volatility. Massive emissions from combustion of fossil fuels is damaging the environment. Any reduction in energy consumption, and any effort in energy management show significant benefits both in terms of financial savings and in terms of environmental protection.

Large industries have long been a target for the reduction of energy consumption. Although major efforts have been made in that sense, in some cases the energy management can be improved. When industries group themselves on a close geographical location to share the advantages of an infrastructure such as a harbour, or a particular resource of energy, they form what is called an industrial park. Because of the gathering of different and complementary industries, a particular synergism can develop. This issue is particularly important because an industrial park is a very large energy consumer.



The concept of synergy is based on a plant-to-plant relation. The output of one plant becomes the input of another plant, thus reducing losses and improving global efficiency. Energy synergies follow this principle. A typical example is the Kalundborg industrial park, in Denmark. There, industries have developed a synergy in order to reduce waste and to optimise energy consumption (trading heat, power, and by-products). Smaller firms benefit from the output of the main plants, such as low-temperature heat that would otherwise be wasted.

Kalundborg remains a model in the synergy field. The assessment of the situation in France shows that energy synergy systems are seldom implemented in industrial parks. And indeed, surveys of the different actors in French industrial parks have pointed out that there are many barriers for their development, such as technical, regulatory and business barriers.

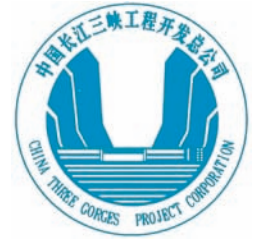
For new or developing industrial parks, another type of synergy can be implemented. It consists in taking advantage of major economies of scale by sharing common utilities and infrastructure. The Jurong Island industrial park, in Singapore, was built on this concept. It is center on a particular industry segment : refining and petrochemicals. This trend is identified as a possible rationale for new and future industrial parks worldwide.

The development of energy synergy systems in industrial parks faces many challenges, but this is part of a larger idea of industrial ecology, which aims at optimising both resources and the environment for industry. The impact of this concept on the development of the industrial sector is dawning.

TGP

The Three Gorges Project

Yichang, March 15th 2005



In the morning we visited the exhibition hall of the construction project and the afternoon was dedicated to the visit of the dam itself and one of its powerhouses.

The idea of this project goes back to the beginning of the 20th century, when Dr Sun Ya-Tsen ambioned to regulate the course of the Yangtze River. After many 'many' years of studies the construction of this biblical dam finally started in 1993 and is to be finished in 2009.

The project aims at three objectives:

- The first is to control floods. This part of the country has known lots of disasters, hundreds of thousands people being killed in decennial floods.
- Clearly the real reason today is power generation. When it will be finished, this dam will be the most powerful in the world. The total installation of generating capacity is 18 200 MW (twice the French hydro-power capacity) for an annual output of 84.7 TWh.
- Navigation will be considerably improved : thanks to the 660 km

long reservoir, 10 000-ton barges will navigate more easily.

Three reasons led this site being chosen:

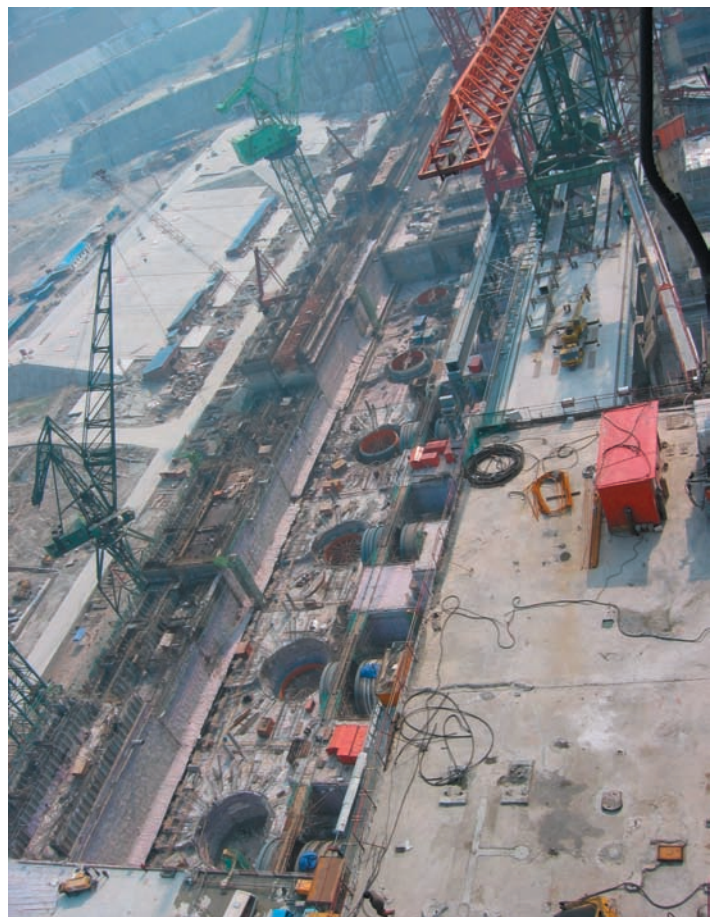
- The bedrock is made of granite;
- The presence of a natural island makes the civil engineering work easier;
- The river banks are large enough to receive the entire infrastructure needed.

The reservoir needed the relocation of 1.1 million people, mostly on higher grounds in the same region. The dam is of a concrete gravity type.

Its length is 2309 m with a height of 185 m so that 28 millions m³ of concrete were necessary. It is composed of a spillway in the middle, two power plants and navigation facilities.

One of the power-house is nearly finished and in production since 2003. At the time of the visit 11 of the 14 Francis turbines of 700 MW were installed. The production was only of 3800 MW because of the low level of the Yangtze. These turbines were made by Alstom.

There will be 12 hydro-turbines of the same capacity but made in a joint venture between Alstom and a Chinese company.



TGP



The project will be ended by the shiplift that will allow passenger boats up to 3000 tons to cross the dam in only 40 minutes. Today it takes 3 to 4 hours with the system of five ship locks for boats up to 10000 tons. This system of ship locks is the largest in the world: it is 280 m long and 34 m large, and it has been operating since June 2003.

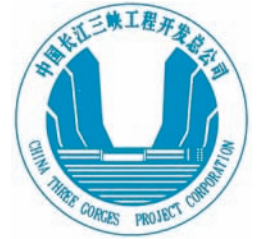
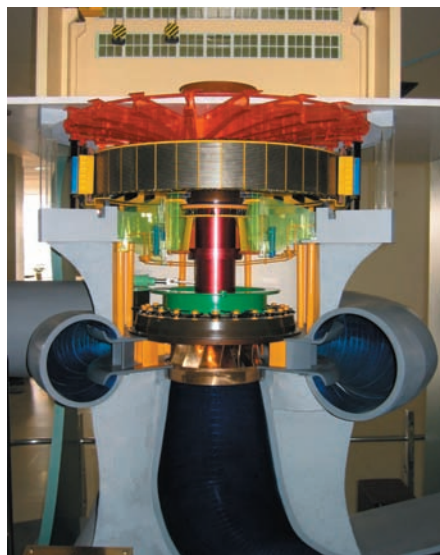
The power is transmitted by 500 kV DC lines for long distance and AC lines for shorter ones. Today the dam is delivering power as far as Shanghai and a transmission line to Beijing is in project.

At present, four other dams are in project upstream on the Yangtze River, and at completion the total installed hydropower capacity will reach 38 000 MW. The Three Gorges Project launches the large scale exploitation of the huge Chinese hydropower potential.

Dam Key Figures :

- Installed Power: 18.2 GW (26 Francis water turbines, each 700 MW, rated speed 75 r/min)
- Mean annual energy output: 84.7 TWh
- Annual coal avoided: 40 à 50 million tons.

- Dam Length: 2.3 km
- Max. Dam Height: 185 m
- Penstocks: 122.2 m long and 12.4 m diameter.
- Maximum static waterhead: 113 m
- Reservoir capacity: 39.3 billion m^3
- Maximum control flow rate: 102 500 m^3/s
- Maximum natural flow rate (except floods) : 50 000 m^3/s
- Mean natural flow rate: 35 000 m^3/s



The Route

As China is a huge country, this trip was the opportunity to use local air transport. This was organized as follows :

- Arrival at Beijing Saturday March 12th.
- Tsinghua University visit Monday morning, then departure to Yichang in the afternoon.



- On Tuesday morning in Yichang, visit of the TGP (Three Gorges Project) headquarter and show-room, then in the afternoon, visit of the dam before leaving for Shanghai

- Wednesday morning, visit of the Shanghai University of Electric Power, then in the afternoon, visit of the first Shidongkou Power Plant.

- Thursday morning visit of the Tongji University, then visit of the Jiangqiao MSW (Municipal Solid Waste) Incineration Plant.

- Friday morning visit of the Shanghai Chemical Industrial Park, then visit of the Baosteel Steel Plant.

- Finally return to Nice via Paris on Saturday.

Electric Power

Shanghai University of Electric Power

Shanghai, March 16¹⁵ 2005

We were welcomed in the Shanghai University of Electric Power by Mr. Hao Zhang, Mr. Heping Tu and a translator from the international affairs. The interpreter has given us a brief introduction concerning the University then we had a discussion with them about the electric issues in China.

The University was founded in 1951 by both the Central government and Shanghai Municipal Government. The University possesses ten Departments and three Colleges.

Devoted to electric power and focusing on the needs of the future, the guidelines and aims of the University are high quality environment and attractive features. The university insists on cultivating the engineering and technical talents to meet the requirements of the production forefront of electric power.

At present, there are about 3800 undergraduates students and 3000 correspondence students in school. 60 % of managers of present power companies in South China come from this university.

After this presentation, we have been invited to ask questions to Mr. Hao Zhang and Mr. Heiping

Tu. Our questions concerned the electric issues in China. In China there are several different power companies which produce electricity.

Production of electricity in Shanghai is provided by the East Company. The territory of China is covered by two different transmission grids, the national one and the south one. Hong Kong has its own power station.

Sale prices of electricity are set by the government for industries and for individual consumers. Prices are higher for industries than for residents. Prices are different depending on the regions. For residents, it is about 0,6 yunnan (0,06 euros) per kWh. Electricity comes from coal for 78 %, from hydro-electricity for 20 % and from nuclear plants for 2 %.

Hydroelectricity has to be highly developed as China has a great hydraulic potential. Moreover, the Chinese government wants to develop nuclear power plants and renewable energies. Electricity supply in Shanghai

is particular in China because of its high level of development compared to the remaining parts of the country. Adequacy between supply and demand is not always respected, so they have to cut power sometimes. Priority is given to citizens, and industries bear the power cut. This situation mainly occurs during the summer due to the huge use of air conditioning. People are aware of this. For example they have used low consumption lights for several years and to reduce the peak, they use "trough hours".

To avoid those problems, the government wants to encourage energy savings. For example, the reduction of industrial consumption seems to be quite easy because of the inefficiency of equipments which have to be modernized. Moreover, the government financially supports the use of new materials in new buildings.

To conclude, as China, with an insufficient electricity supply, has a high growth rate and a high level of development that leads to an energy intensity close to one, tensions in electricity field are high and it is difficult to predict how it will evolve.



Coal Power Plant

Huaneng Shanghai Shidongkou Power Plant

Shanghai, March 16th 2005



wharf at the plant by ship. Coal consumption is over 3 Mt/year. Currently, electricity generated by the Shanghai Power Plant is delivered to the China East Power Grid for sale.

In 2003, one unit has been partially renovated in order to reach 325MW. Two main parts of the unit have been modernized:

- **The control system:**

designed and supplied by ABB and installed by a Chinese company,

- **The turbine:**

after negotiations with Alstom

China produces 1200TWh a year of electricity with coal. This represents 80% of the Chinese production of electricity. With such a massive use of this technology we had to visit a coal fired power plant in China. This was the Shi-don-kou power plant. Located on the outskirts of the city of Shanghai, the Shi-dong-kou power plant began operation in 1984. Initially, it had been designed for 4 units of 300MW each. The plant has been manufactured in China



and operates continuously (base). The average operation time reached 6800 hrs/unit last year and electricity production was over 8 billion kwh. Coal comes from the Chinese province and is shipped to the

the power producer chose a domestic company. The proposal of Alstom was rejected because of an uncompetitive ratio additional power/investment. The rehabilitation of the other three units will be completed in 2007 in the same way. Thus, from 2007 on, the power plant will have a nominal power of 1300MW.

Tongji University

Tongji University

Shanghai, March 17th 2005

同濟大學
TONGJI UNIVERSITY

The University was founded in 1907 as the Tongji German Medical School. It is one of the leading Universities in China. It became national in 1927 and since then it has grown and diversified into 5 schools: sciences, engineering, medicine, liberal arts and law. The 5 schools are also divided into 18 colleges among which we can quote Traffic and Transportation Engineering, Mechanical Engineering, Environmental Science and Engineering. The University numbers 54000 students among which 1500 international students (particularly from France, Germany, Korea, USA, and Australia), and 8000 staff members among which 4000 researchers.

After a short visit of the library of the University, we were given a short presentation about the project conducted in the HVAC and Gas Institute of Shanghai.

The 4 main topics studied at the Institute were presented by the President of the Department, Pr Zhang Xu. They concern heat and mass transfer in air conditioning, indoor air quality and control of contamination, building energy reduce and renewable energy, gas transportation technologies.

Then Pr Qin gave us a global view of the energy context in China. Here are some key ideas:

- High percentage of coal utilization in primary energy
- Energy resources located far away from end users
- Environment protection more and more important
- Oil import percentage higher and higher
- Problem of dependence degree on imported oil.

The consumption of China in primary energy is mostly from coal (70 %) and oil (25 %). Nuclear power is a non significant source of energy in China (less than 1 %). In 2002, coal consumption was 1,37 Gt. Indeed, China is the biggest producer and consumer of this kind of energy. It brings China to the first rank for SO₂ emissions and second for CO₂. Consequently 8 of the 10 most polluted cities in the world are located in China. One particular use for coal is for power generation: 232 GW are produced by coal fired power plants (74 %). As a remedy, the Chinese government tried

to change the way of consuming energy and particularly to improve the use of NG and to reduce the use of coal. In 2003, NG consumption reached 3 % of the primary energy supply of China (32 Gm³), compared with 27 % worldwide. In 2020, the Chinese government expects to reach 200 Gm³/year (12 %). To reach this target, a 4000 km long pipeline from Western China (Xinjiang) to Shanghai, designed to transport 12 Gm³ per year, is under construction. Several LNG terminals are also considered for building. For the moment, NG is mostly used for industrial needs and particularly the chemical ones (38 %). The government would like to develop its use to transport and city gas. That is why Tongji University is studying the application of NG in air conditioning, even if it is currently not competitive due to its price (2.1 RMB/Nm³), compared with electricity (0.61 RMB/kWh).

Then, the Professor gave us a brief overview of his research and showed us the laboratory. Finally, Professor Lee introduced us to her work concerning energy efficiency in buildings.



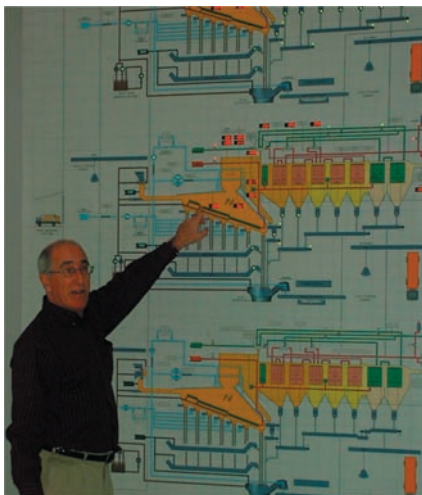
Incineration Plant

Shanghai Jiangqiao MSW Incineration Plant



Shanghai, March 17th 2005

The Jiangqiao Incineration Plant is the first plant of this kind developed by Onyx in China. It has been operational for one year and has cost roughly 80 M€ (the payback time is expected to be within 5 to 7 years). This plant is a joint venture between Onyx (51 % partner) and the Chinese government. The first role of this plant is to treat the municipal waste, and electricity is just a by product: the municipality collects waste and pays a fee to the operator for its incineration;



then the electricity generated is injected into the grid. However, there is no district heating. The incinerator is a full time working installation. It is composed of 3 lines: only 2 of them are operational so far and use technologies and key equipments imported from Europe (Spain, Germany). The third one will be built by the Chinese themselves.

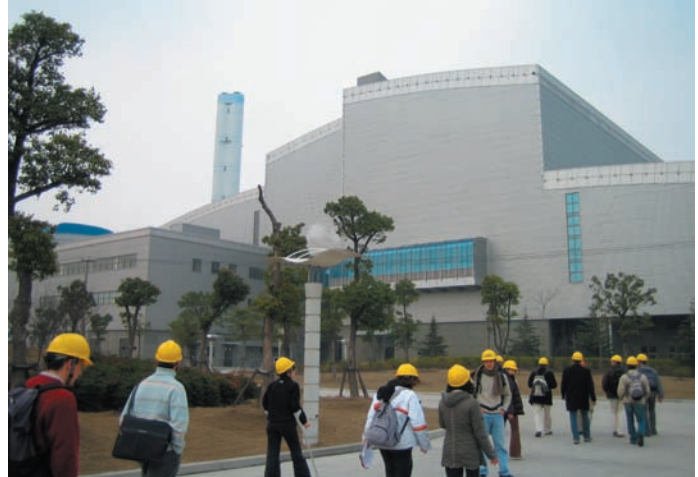
Mr Rivara permitted us to get a look around the whole installation from the waste storage to the turbine.

The daily handling capability of garbage is up to 1500 tons, which is 10 % of the total waste

of Shanghai. The incinerator is not in charge of hazardous and medical waste. It is designed for household waste and a little bit of industrial one.

First, waste is stored in order to reduce its moisture. The leachates (water in any kind of contact with waste) is collected underneath and then treated with an appropriate system on the plant. Thereafter, the waste is burned to produce 40 bars steam (44 t/h). The burners are especially designed to suit low thermal value and high water content garbage. Indeed, the collected waste is especially full of organic materials due to the non official recycling done by the population: papers, cans, cardboards are collected in the streets in order to be sold. As a matter of fact, the waste quality is lower than in Europe. As a remedy to this poor heating value and to sustain an 850 °C temperature inside the boilers, the plant can use fuel to improve the combustion. But Mr Rivara expects the waste quality (more packages) to improve during the next 20 years (the contract length) as a result of Chinese development.

This combustion leads to the production of final waste: 20 % of bottom ash, used afterwards in road construction, and 3 % of fly ash, stored in se-

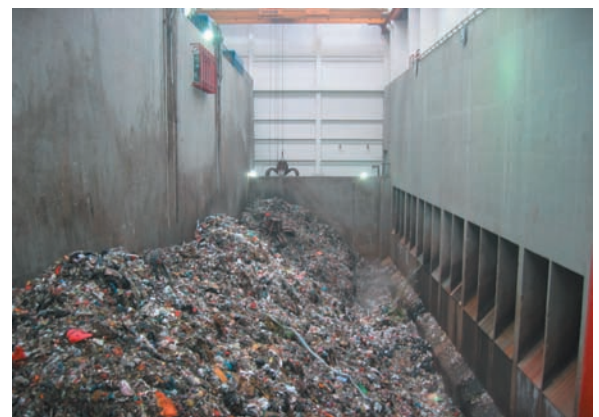


cured landfill as hazardous waste.

The flue gases are then treated according to the European standards although there is neither real reporting regulation in China nor specific guidelines. They control HCl, SO₂, CO, HF and dust but there is no NO_x control. The flue gases are continuously monitored.

Electricity is obtained by combining the resulting steam with the help of two 15 MW turbines. They are coupled with generators that should allow the production of 100 GWh per year.

The incineration of Shanghai municipal solid waste is ensured by another device located in Pudong; 4 more incinerators are currently in project.



SCIP

Shanghai Chemical Industry Park

Shanghai, March 18th 2005

A tour of SCIP took place on Friday the 18th of March. The morning started with a short introduction around the SCIP characteristics. Thereafter a more general view gave us the opportunity to learn more about the different industries present in the park and focus more on the site facilities (power, water and waste treatment plants). The day ended with a detailed presentation of the SCIP by the park technical president Mr Li Guo Hua. The main subjects raised were about both the energy and the environmental management plans.

This modern chemical park is located 50 kilometres south of Shanghai, more precisely on the north shore of the Hangzhou bay. The activities are focused on a single industry segment, the petrochemical and by-products industry. The total planning area covers

29.4 km². The park will extend to the west and merge with the former SCP providing a 60km² chemical production site. Right after Houston (USA), Antwerp (Belgium) and Jurong

the future ones) are divided onto three main integrated activities in the up and the downstream:

- Refinery and basic petrochemicals.
- Chemical by products
- Synthetic materials and fine chemistry



Today, 38 international and domestic large-scale companies are located in the Shanghai Chemical Industry Park. The global investments are reaching the amount of 8.82 billion dollars. Moreover, with a minimum of 2 billion dollars investments per year it will become one of the world biggest chemical producer and the most concentrated chemical plant worldwide.

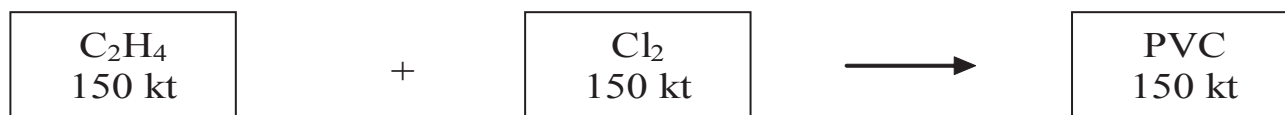
Island (Singapour), SCIP in China will become the world forth biggest industrial park.

The different companies which are already present in the SCIP (and

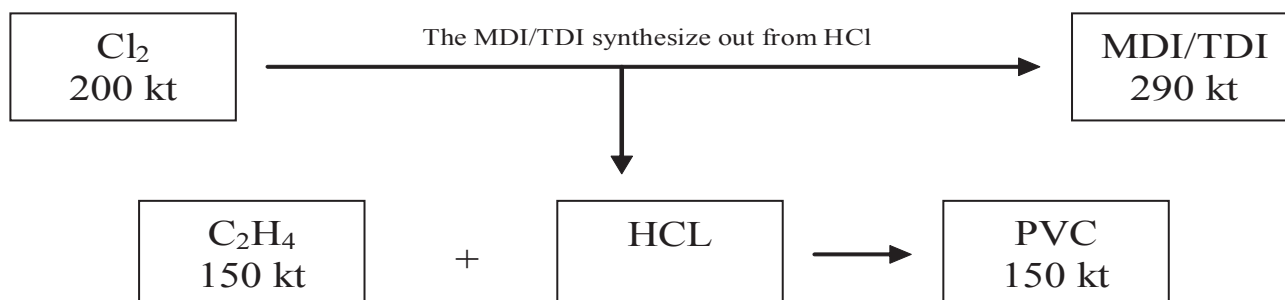
plant

Integrated services is a key to this project. The concept is to offer industries which are investing a turnkey project, share facilities and share utilities.

Usual Procedure



Procedure realised in SCIP by BASF and Lianheng Isocyanate Co



MDT/TDI are the necessary components for the polyurethane production.

SCIP



中国 · 上海化学工业区

SHANGHAI CHEMICAL INDUSTRY PARK



1994 年



2003 年 11 月

Indeed, SCIP is constructed following a very sharp conception and advanced technologies leading to an integration of production projects, public utilities, logistics, environment protection and administrative services.

For example production: on the upstream part Naphthalene is being produced along with Ethylene. Thereafter, are synthesized Polyethylene, Polycarbonate etc... Eventually, on the downstream part the following products are derived: fine chemistry and synthesized materials.

Or logistics: a pipe network, a warehouse, a jetty looking over the sea, highways together with a train network connection allow a strong industry integration and efficient production and distribution.

The companies proximity allow synergies, which considerably reduce consumption (cf. previous page figure). In this industrial park, everything has been



thought of so as to be shared in the best possible manner. A mark of this environmental integration is the choice of natural gas as energy source with the project of a LNG terminal along with gathering the different energy utilities industry and

a strong waste policy.

We can find today on site:

- A natural gas cogeneration plant (producing 600 MW electric and 660 tons per hour of steam)
- A solid and liquid waste incinerator (up to 60 000 tons per year)
- And a water treatment plant (12 500 tons per day which

eventually will treat up to 100 000 tons per year depending on the demand. Waste from this treatment plant is burned in the incinerator)

Beside economic issues, the Shanghai Chemical Industry Park motto is to

optimize all the onsite fluxes in order to avoid an environmental impact of the industry.



Steel Plant

Baosteel Steel Plant

Shanghai, March 18th 2005

After having worked on an optimization project focused on the Sollac steel company in Fos-sur-mer, it was interesting for us



to have a look at the different processes that we had studied. Also a steel production site such as the Baosteel plant shows a high level of energy synergies in its processes. Consequently, the goal of our visit to the Baosteel firm were dual.

Baosteel is the largest and most modernized integrated iron and steel company in China and one of the most competitive steel producer in the world.

The Baosteel plant presents three phases built from 1978 to 2000 and occupying an area of 19 square kilometres in the north-eastern part of Shanghai, on the Yangtze River. The whole site represents a total investment of about 8 billion euros and 15 325 people work there.

In China, as the largest steel supplier to automobiles, household appliances, oil and natural gas extraction sectors, Baosteel is the leader in the production and sales of hot and

cold rolled coils and seamless steel tubes.

A Baosteel guide led us through the plant during our visit. The first step of it was the jetties where raw materials, coal and ore, arrive by ship from the Yangtze River. The ships are unloaded through several 644 m jetties, which total capacity is 1800 tons per hour and 15 million tons per year. The coal comes from China, whereas the iron ore is sent from China, Brazil and Australia. The annual consumption of raw materials is presented as follows:

Category Annual consumption

Iron ore: 16.8 million tons
Coal: 11.7 million tons
Dolomite, limestone: 3.2 million tons
Heavy oil: 2400 tons
Fresh water: 53 million m³

The production processes follows several steps:

- Sintering
- Black Furnace
- Coke Oven
- Converter
- Electric Arc Furnace
- Refining Stand
- Continuous casting
- Rolling mill



Among these processes, we have been presented the hot rolling process. It aims to convert a 30 cm thick cast slab into a 1 to 5 mm sheet and then coil. The slab is first reheated between 800 and 1200 °C in a furnace. This makes it more malleable, facilitating the rolling and forming process. Each slab passes successively through several rollers. These rollers are key element in the process. Therefore, they are designed to allow their change in less than 2 hours in case of problem. At the end of the 2 km length rolling line, the slab is transformed into a thin steel rolled plate. It forms a 30 tons average weight coil which length varies from 1 to 3 km.

Steel production is an energy intensive industry. In 2003, energy consumed in Baosteel amounted to 5.42 Mtoe. Coal accounts for 99 % of the outsourced energy. Facing this high level of energy consumption, the iron industry has developed several means to recycle energy from their processes. For instance, the company pays attention to energy recovered from residue pressure and heat. In 2003, recovered energy reached 0.64 Mtoe, 12 % of energy purchase.



Partners

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We have been very impressed with the high level of the presentations and the speakers who have been most competent and made themselves available.



Partners



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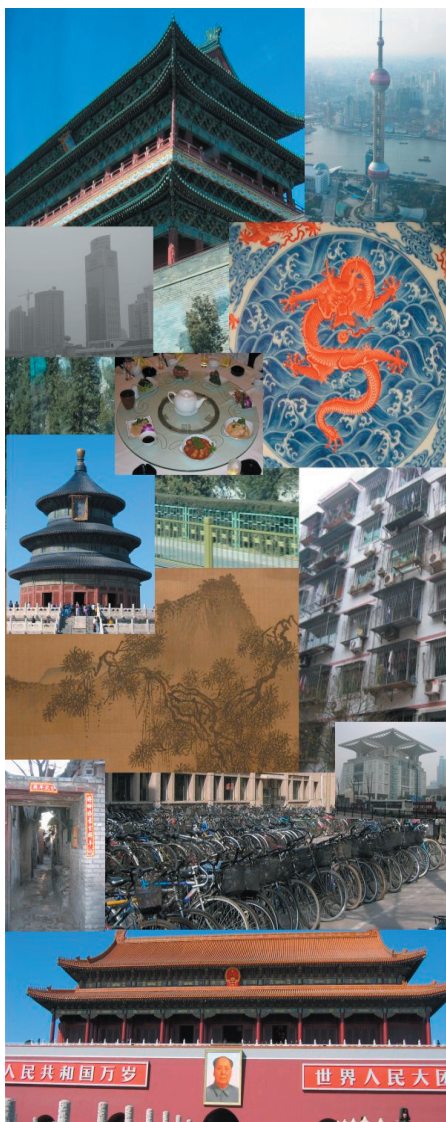
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