

CHINA

38TH OVERSEAS EXCURSION OF LÄMPÖVOIMAKERHO 2019



BEIJING | JINAN | QINGDAO | SHANGHAI



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OVERSEAS EXCURSION

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20.8. - 4.9.2019

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Beijing

Jinan

Qingdao

Shanghai

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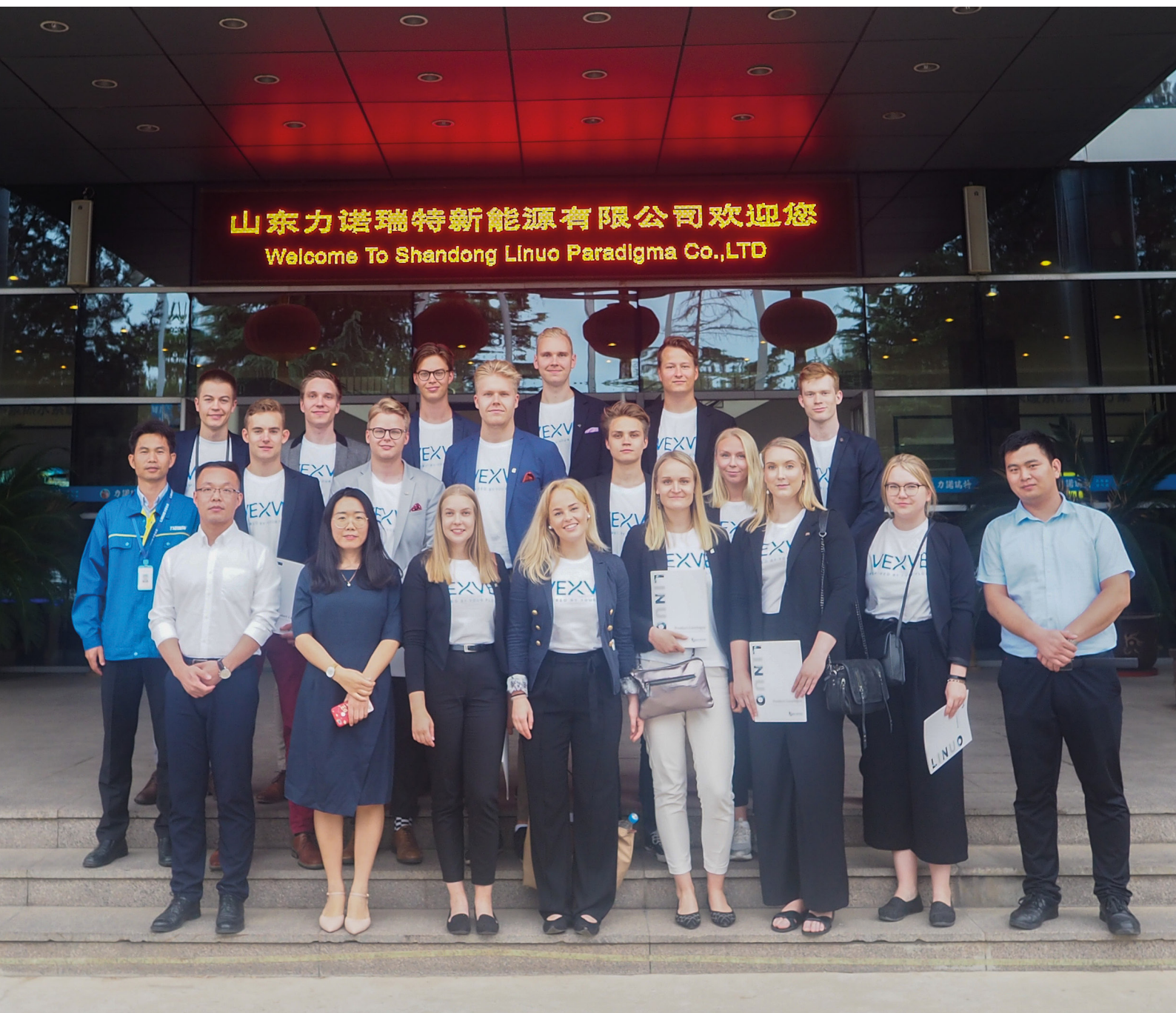
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CONTENTS

| | |
|---|-----------|
| China Energy Outlook | 06 |
| The Link between Finnish and Chinese Cultures | 13 |
| Excursion to Embassy of Finland in Beijing | |
| Air Quality - A Metropolitan Issue | 14 |
| Excursion to Vaisala | |
| A Glance into the Student Life of China's Top University | 18 |
| Excursion to Tsinghua University | |
| The Future of Wind Power | 23 |
| Excursion to Vestas | |
| The Great Wall of China | 26 |
| Fast Changes and Cultural Differences in Business | 30 |
| Excursion to AFRY | |
| Different Working Cultures | 34 |
| Excursion to Linuo Group | |
| The Solver and the Cause | 36 |
| Engineering with a Difference | 44 |
| Excursion to Etteplan | |
| Cleaner Future with Waste Refining | 46 |
| Excursion to BMH Technology | |
| Nuclear Power - a CO2-free Choice | 49 |
| Thank you! | 54 |



38

Qingdao

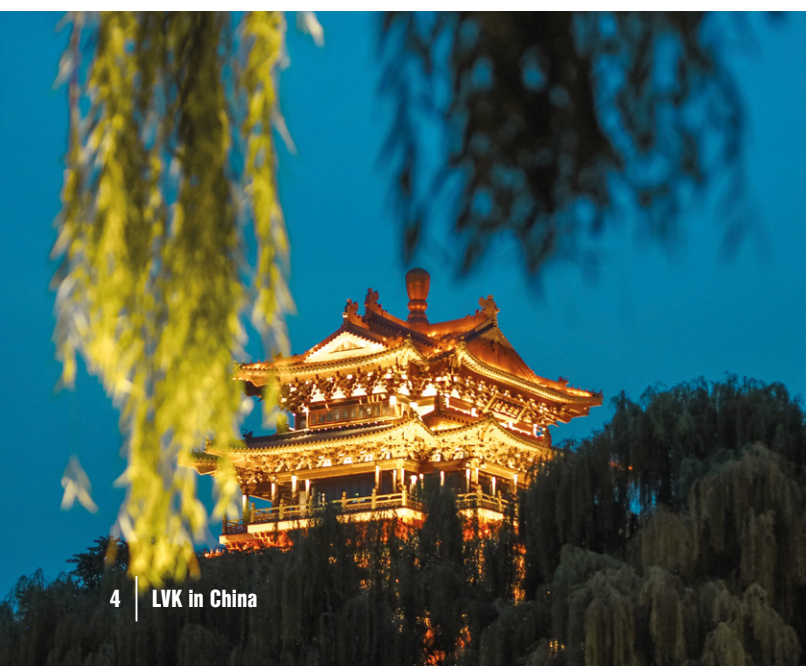
Beer, Beaches and
Mountain Views



29

Jinan

The City of Springs



42

Shanghai

The Lights of Shanghai



10

Beijing

Peking Duck and Other Must
Do's in Beijing



EXCURSION LEADER'S PREFACE



Organizing a two-week overseas excursion is a lengthy but rewarding endeavor. The project began back in the fall of 2018 when I and four other organizers gathered to select the destination of the excursion. After some deliberation, we settled on China, the country that the media has described as the world's renewable energy superpower.

As energy engineering students, we were eager to see and learn how China will transform their energy production from fossil fuels towards sustainable energy sources and how these carbon-neutrality goals influence the company strategies and research done in universities. We were also interested in learning how Western companies are entering the Chinese markets and how they are adapting to the Chinese working culture.

After arriving back from the trip, I felt that we had experienced everything that we wanted to and were more than satisfied with the outcomes of the excursion. It is very valuable for students to experience trips like this during their studies and to broaden their views of different cultures and business environments. We are so grateful to have been part of this adventure.

We had a variety of company visits which focused, for example, on air pollution, renewables, waste-handling solutions, consulting services and Chinese manufacturing industry.

As most of the companies had their origin in Europe, we had many interesting discussions about the working cultures and challenges they face in the Chinese markets. Also, by visiting Tsinghua University we got a chance to meet local students and to familiarize ourselves with the Chinese student life.

Of course, we scheduled time to do some fun activities as well. During those 14 days we visited four totally different cities. I enjoyed the most hiking up to the Laoshan Mountain or seeing an amazing Chinese acrobatic show, not to mention the river cruise along the Huangpu River in Shanghai. Shopping in Chinese markets and ordering food in restaurants were also quite experiences.

Definitely, one of the best things in our trip was the great team spirit, partly thanks to the karaoke nights in local KTV bars. We had so much fun exploring Beijing, Jinan, Qingdao and Shanghai, and as a result, now we have many unforgettable moments to be shared together later on.

We want to thank all the companies and organizations for supporting the 38th overseas excursion of Lämpövoimakeryho. Without you, our trip would not have succeeded.

Finally, I wish you all enjoyable moments while reading our stories!

Katri Suistio

CHINA ENERGY OUTLOOK



“

When the field of energy comes into question, China can not be left without a mention, as it is the largest player in many terms

It's been almost a decade since LVK visited China. The last time was during *the Asia excursion* in 2010 when China had just become the world's largest energy consumer [1]. Since then, the economic growth rate has slowed down a little but it still has been enormous in absolute terms. China is now a truly dominant player in the energy markets as well. Let's take a quick look at the interesting field of energy in China from the student and statistics perspective.

ENERGY CONSUMPTION AND EMISSIONS

China is currently consuming significantly more energy than any other country. Figure 1 shows the comparison of energy demand in seven areas. China is also the world's most polluting country, producing now over a quarter of all greenhouse gas emissions in the world [2]. And yet the energy consumption growth rate was 3.7% from the year 2017 to 2018 [1]. Emissions are also growing rapidly, at a rate of 2.3% during 2018 [3]. The addition of carbon dioxide emissions during one month can be larger than all of Finland's one-year CO₂ emissions [2]. For these reasons, China is an important player in energy politics.

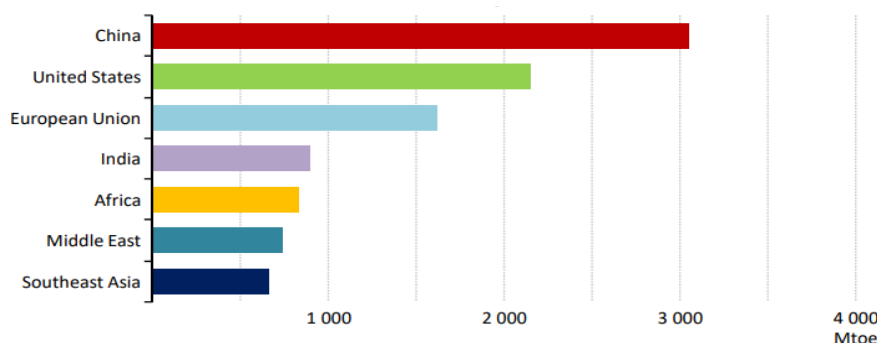


Figure 1. Energy demand comparison of different areas in 2017 [4]

THE RELIANCE ON COAL IN ENERGY PRODUCTION

The share of coal in the total energy consumption in China is declining; it was a little under 60% in 2018, which is smaller than 64% in 2015. However, the use of coal in China is still increasing. This increase is due to the fast-growing electricity consumption and coal usage in the chemical

industry. [5] To point out, half of the coal consumption is used to produce electricity [3].

Electricity generation is highly dependent on coal, as it can be seen from Figure 2. Coal is currently the most significant energy source in China, but natural gas is growing faster, at the rate of 17.7% in 2018. [3] Natural gas is helping to replace coal in the energy mix and that will make it the world's largest gas importer. Most growth of gas usage by 2040 is expected to come from LNG [4].

In Finland, coal is nowadays used only in combined heat and power production (CHP), but in China, that is not the case. Coal is used 4.6 times more to electricity production than to heat production in primary energy terms [6]. Figure 3 shows the dominance of coal in the heating markets, and natural gas comes in as second with a small portion as 11%. Even though China is relying on coal, the average carbon footprint of a Finnish person is double the size of a Chinese person. But the trend is worrying, China might add 290 GW of coal production until 2030. That is the size of the USA's current coal fleet. [7]

RENEWABLE ENERGY

Despite this rapid fossil-based energy production growth, China is still the largest consumer of renewable primary energy [6]. They have been increasing the amount of renewable energy at an unbelievable pace. For instance, wind power generation grew by 29% in 2018 [8]. China is believed to remain the largest investor in

clean energy as nearly 30% of global investment in wind and solar is made there [9].

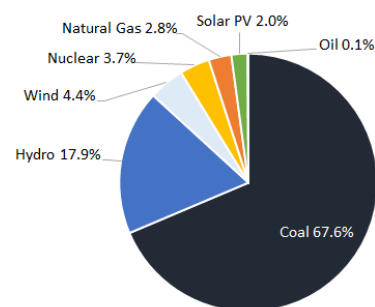


Figure 2. The distribution of electricity generation by source in China in 2017 [6]

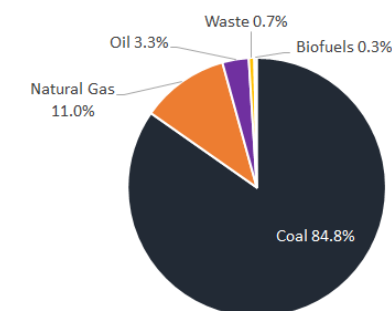


Figure 3. The distribution of heat generation by source in China in 2017 [6]

While we were planning and organizing this excursion, China added 11.4 GW of new solar photovoltaics (PV) capacity to their grid in the first half of 2019. The total solar PV capacity is currently 186 GW. [10] On the contrary, China increased its GHG emissions by 4% during the same time period [2]. China is adding a lot of low-carbon production but it can't keep up with the speed of increasing demand. Clean energy growth covered only 30% of the incremental power demand in 2018 [8]. The constantly decreasing prices of renewables could bring a change to this.

China tries to combat climate change in other ways too, not only by increasing the share of renewables. They plant trees to expand forests and take good care of the older forests. Increase in the forest areas during recent years accounts for roughly the same area as the total area of Finland. [11] A quarter of the global net increase in leaf area through 2000-2017 came from China [12].

THE FUTURE SCENARIOS FOR ENERGY SYSTEMS

Overall, China is still ahead of Paris climate agreement goals in terms of investments in renewable energy, CO₂ intensity, and CO₂ emissions growth declination [2]. They have promised to cap emissions by 2030, and some studies suggest that it might happen even earlier [13]. It is a different debate whether the targets are sufficient to maintain the global warming under 1.5 C. An independent scientist group called CAT has stated that it might not be enough to stop the global warming

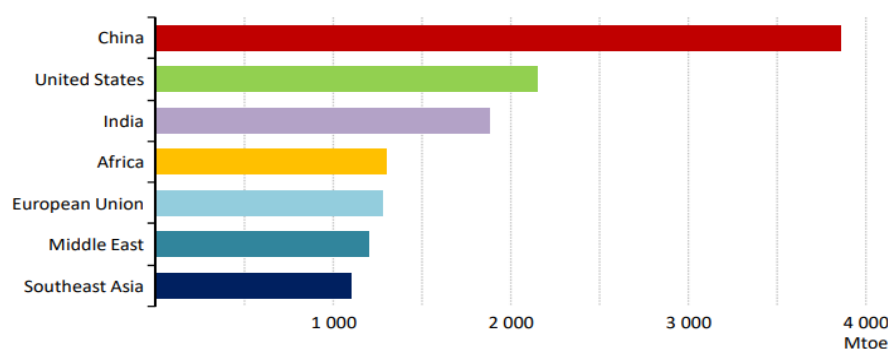


Figure 4. Energy demand estimate of different areas in 2040 [4]

even at 2.0 C unless other countries do significantly more than their fair share of reductions [14].

Energy demand growth is expected to continue and China will remain the largest consumer globally, as is shown in Figure 4. Of all countries, China has the most expected growth in nuclear because it can build it with the lowest cost [15]. In 2040 it could have up to 150 GW of installed nuclear capacity [4].

China has started to be active also outside its borders by starting to export knowledge in coal and investing capital in its Belt and Road Initiative. The belt and road initiative is a global development strategy adopted by the Chinese government and it involves infrastructure development and investments to other countries and international organizations. This means for example that a quarter of all foreign coal investments were backed by Chinese institutions and corporations. We have to wait and see what happens as the cost of solar is

ever decreasing and thus approaching the cost of coal production. If China is moving towards renewables and is decreasing the use of coal more and more, are they going to sell their huge coal reserves abroad? [16]

China believes that electric vehicles (EV) are great means to diminish the pollution levels. They are subsidizing the production of EVs to increase their share on the roads. To illustrate, 1.2 million EVs were bought in China last year and by 2040 one of four cars will be electric. [9]

When the field of energy comes into question, China can not be left without a mention, as it is the largest player in many terms. To conclude, China has a billion interesting opportunities in the working life to offer when we graduate.

Atte Hinkka

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PEKING DUCK AND OTHER MUST DO'S IN BEIJING



With its enormous size and long history, Beijing has plenty of activities, attractions and experiences to offer.

Whether you like historical, cultural or culinary treats, Beijing has it all. Moving around to visit different places in Beijing is easy. The taxis are quite cheap, but often the metro can be a more convenient option. But where should you go and what should you do? Here is our humble take on our experiences and recommendations.

The Forbidden City is one of the most important historical sites in all China. It was built between 1406 - 1420 by the Yongle emperor of the Ming dynasty as an imperial palace for the emperor. The Forbidden City served as a home for the emperors from 1420 in the Ming dynasty until the end of Qing dynasty in 1912. South from the Forbidden City is the Tiananmen square. It is the place where Mao Zedong announced the foundation of the People's Republic

of China. Every morning at sunrise, there is a flag raising ceremony at the square. A squad of troops marches to the flagpole and raises the Chinese national flag. Some of us went to see it at five o'clock in the morning, and the rest of us waited until the next day to see the square in all sunlight.

During the constructions of the Forbidden City, the ground excavated from the area was carried and piled up north of the Forbidden City. This was done in order to create an artificial hill called Jingshan Hill, that hosted an imperial garden now known as Jingshan Park. We climbed to the top of the hill, where we got a great view of the Forbidden City and the Beijing skyline. The Jingshan Park has gardens, some old pavilions and good views from the top, but one of its biggest tourist attractions is the spot where the Chongzhen Emperor, last emperor of the Ming dynasty, hang himself when the rebels reached the Forbidden City at the end of the Ming dynasty.

When planning a visit to the Forbidden City, one should prepare and buy the tickets ahead of time. Unfortunately, we were not aware of that and the tickets to the City had been sold out a week in advance. Still, we got to see the Forbidden City from the Jingshan Hill above. Also, we visited the Yonghe Temple, also known as the Lama Temple, a Tibetan Buddhist temple and monastery. Beijing has countless temples to see, and this beautiful and peaceful temple was our choice to visit with our limited time in the city.

In addition to its history, Beijing has a lot of cultural experiences to offer. To absorb some of that culture, we went to see the traditional Chinese opera and the Beijing acrobatic show. The Chinese opera is a very old tradition with roots going back to the early periods of China. The opera is a combination of traditional music and storytelling, and the stories typically tell tales about the events during the past dynasties. We also went to see the

famous Beijing acrobatic show and we were impressed! It is hard to describe the magnificence of the show - you must experience it yourself. Almost every performance exceeded our expectations by at least two orders of magnitude. We saw ten women riding one bike in one performance, and eight motorcycles simultaneously driving loops in a ball-shaped cage in another, just to name a few.

You cannot have just history and culture without a bit of food. The Chinese food itself is an experience, and there are a lot of local dishes in Beijing that people will tell you are a “must eat”. And to be fair, at least the hot pot probably is. However, the most iconic must eat in Beijing is the Peking duck. The dish has earned its place among the world-famous regional culinary treats, and rightfully so. Peking duck is enjoyed by rolling very thin pancakes around the roasted duck and other fillings, including a dark soy-based sauce and some thin cut vegetables such as cucumber. Like



many other things in China, Peking duck has long historical roots. The dish has been mentioned in a cooking manual as early as in 1330. So, even if everyone might not find it their favorite dish, trying it is also a cultural and historical journey.

As with any big city, there are also a lot of less popular attractions in Beijing. These are not the ones for which most people go to Beijing. Nevertheless, these fun attractions can be a nice alternative to the historical sites. A good example of this is the “Friends café”. The main part of the café is decorated to look like Central Perk, the café in the TV show Friends. In addition to that, there is an extra room made to represent the living room of Chandler and Joey’s apartment. You can play table football or try their famous super comfortable armchair. There was even supposed to be a “smelly cat” living in the café, but we didn’t see her.

Beijing has a lot to see. There are countless temples, museums and parks to visit. It’s impossible to experience it all in just a few days, but that’s not the point! The point is to feel the city and focus on the things you find the most interesting (or fun).

Markus Laitinen

“

We saw ten women riding one bike in one performance, and eight motorcycles simultaneously driving loops in a ball-shaped cage in another



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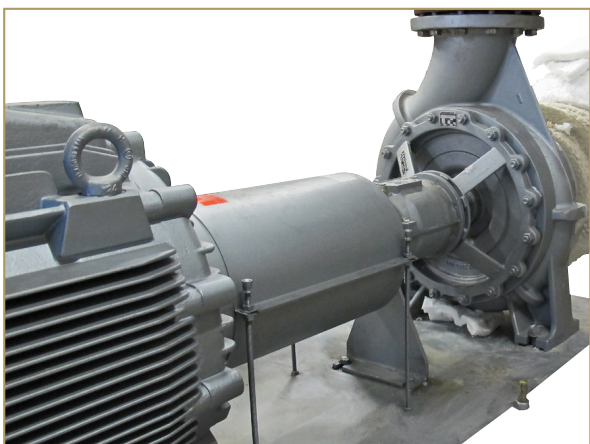
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THE LINK BETWEEN FINNISH AND CHINESE CULTURES



The best place to get a nice overview of China is definitely the Embassy of Finland in Beijing. Therefore, we wanted to begin the overseas excursion by heading to the business district of Beijing to introduce ourselves with the Chinese culture. We were hosted by a multidisciplinary group of hosts with a wide variety of experiences from China as a business platform and as a working place for Finns. Jaakko Koivusaari from the Embassy of Finland in Beijing gave us an informative general presentation on China as a country, as well as its energy production and politics. China is currently changing its energy sector rapidly and it has evolved to a pioneer in developing new technologies within the field. It quickly became clear to us that the Chinese market is strongly driven by government decisions - a factor that needs to be taken well into account in international political discussions and decision making, but also among Finnish companies that are entering the Chinese business market with their products and services.

We heard some insights on business co-operation between Finland and China from Juha Tuominen, Chairman of the board of the Finnish Business Council Beijing. He presented a few example companies that operate in China. We were told that the number of Finnish companies in China has increased quite a lot during the last

decade, and that currently there are approximately 400 Finnish companies in China. However, it might be easier for Finnish companies to co-operate with a local company to avoid difficulties, for example with permitting, and consequently, Finnish companies often form joint ventures when entering the Chinese market.

One of our hosts was a Finnish hockey coach who lives in China and teaches ice hockey to local children. At first glance, this might sound confusing - we are engineers after all, why would we be hearing a presentation about hockey in China. We heard interesting stories regarding working life and business practices in China. Working hours, requirements and contracts are dealt with a different way compared to Finland. Also, an important focal point of Finnish trades, winter sports, was highlighted multiple times in the discussions and it was an interesting common factor for engineering and sports as fields.

We were able to learn about the Chinese culture from a Finnish point of view, but also share our views about the current trends in Finland,



Currently there are approximately 400 Finnish companies in China

focusing on the energy sector. This led to an interesting discussion on the differences between the trends in Finland and in China. In Western countries, it is a shared common goal to overcome the global threat of climate change, whereas in China, the driving force in the energy sector is reducing air pollution. Government's interest is to keep the people satisfied and air pollution is one of the things that bothers the most, affecting health and living. Again, something to keep in mind when developing Finnish exports.

Ida Tasa



AIR QUALITY - A METROPOLITAN ISSUE



Air pollution is probably one of the first things that comes to mind when you think about China. Everybody knows that the air quality in big cities can be so bad that it might even reduce visibility. Nevertheless, concerning our trip to China, it was fake news. However, that was only because we did not experience “a bad day” regarding air pollution. For us, the air quality was more or less ok, almost as good as in Helsinki, but it also could have been ten times worse. We were lucky.

In some countries, such as USA, there are so called snow days when children can skip school. In China, these days are known as pollution days. Not everyone can avoid these bad days, and that is why the locals have started to demand actions to improve air quality. Due to the political pressure, the government takes air quality problems seriously, which has led to a huge demand for cleantech in China. A Finnish company called Vaisala is one of the firms that are helping to solve these issues related to air quality.

Vaisala was established in 1936 to manufacture radiosondes for weather measurement purposes. Since then, Vaisala has developed numerous devices and applications for measuring air temperature, pressure and humidity. The company even had an important role in the early development of weather forecasting. In addition to weather observation and measurement products, they also deliver applications for industrial purposes.

“ Locals have started to demand actions to improve air quality

Vaisala has long history in China. Finland was the first capitalist country to start commercial trade between the countries in 1953, by signing the bilateral trade agreement with the People's Republic of China. However,

Vaisala had started doing business with the Chinese even before that, and in the 1950's China had already become a significant market for Vaisala. Currently, they have two offices and around 70 employees in China.

It is not easy for a Western company to compete in the Chinese markets. The Chinese tend to favor products made by domestic companies, and foreign operators are also under the microscope of the authorities. Vaisala's key to success is the quality of their products. Having the best quality is the only reason why a Chinese company would choose Vaisala - or any other Western company - over its Chinese competitors.

Vaisala's business in China started with selling radiosondes for weather measurement, but nowadays they work a lot with air pollution too. At the moment, there are only scattered networks of accurate measuring stations for air pollution in China, and Vaisala would like to make them denser. Current networks can provide good statistics, but they cannot be



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used to form accurate models of the local pollution levels. A precise model would help in identifying dangerous pollution concentrations and in informing the locals of the pollution rates. Monitoring the air quality can

warned and informed about pollution levels that are harmful for their health.

Regulation regarding polluting is strict in China, and the supervising authority has a lot of power.

“

Having the best quality is the only reason why a Chinese company would choose Vaisala – or any other Western company – over its Chinese competitors

also help in controlling the pollution rates since the city's performance could be adjusted accordingly. If the amount of emissions in the air increases to an alarming level, the emissions could be reduced by regulating traffic or closing factories, for example.

The air quality in Beijing is very liable to changes and it varies drastically on a daily basis. The most important factors are the wind and the location of the power plants. Mountain winds bring fresh air from the northwest and clear the sky from pollution, whereas wind from the south pushes the particles emitted from factories towards the capital. Rapid changes in wind are one of the reasons why it is important to make reliable forecasts on pollution rates. People should be

Sometimes the pollution rates are controlled by shutting down factories for a couple of days. This can be done, for instance, before an important event, such as an international sports event or a major political visit. However, there is a really simple loophole in the monitoring of the polluting. The inspectors only work during the weekdays, which means that during the weekends no one is keeping an eye on the polluters. This also reflects to the pollution rates which start to increase on Fridays, reach the maximum on Saturdays and start declining again on Sundays. Sounds like the pollution could be reduced quite easily by expanding a couple of work schedules...

Although there is still a lot of work to do, efforts have also been made to

reduce the pollution. For example, China has invested more in wind and solar energy than any other country in the world. Their motivation, however, is not climate change like in many European countries, but local pollution issues. Nevertheless, the capacity of wind electricity is growing exponentially in China. Locating wind farms is heavily weather dependent. Modelling “the wind rose” is vital before making further investment decisions. Therefore, Vaisala is also involved in the wind energy sector by making weather forecasts. So, they help in predicting the availability of wind power. With good forecasts, it is possible to make preparations for the windless time.

Investing in clean energy is a very common way to reduce emissions and pollution. China, however, has also had its own methods. One child policy, for instance, prevented significant amounts of emissions and pollution - less people, less pollution. Another measure that, at least I think, is somehow typical to China, is moving the problem elsewhere. A lot of factories and power plants have been moved away from the capital to improve the air quality locally. This can work on a city scale, but at least they can't move the air pollution to other countries. Luckily for us, air pollution is usually a local problem. Indeed, it is enough that we need to deal with China's emissions.

Eetu Laitila



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A GLANCE INTO THE STUDENT LIFE OF CHINA'S TOP UNIVERSITY

When visiting China, we as university students were of course interested to see the life of a student in a Chinese university. We were eager to experience what it is like to study in one of the most respected universities in China - Tsinghua University.

The university located in the northwest Beijing providing teaching in all fields you could imagine, from humanities to medicine and from aerospace engineering to arts. The university graduates are known to end up in top positions for example in politics, business and science. Having around 36 000 students, over double the amount of Aalto University, the scale of the campus quickly surprised us when we first arrived at the wrong

entrance. No wonder, since the total area of the campus is around 400 hectares. Luckily, our kind hosts picked us up and we walked to the department of Energy and Power Engineering. In this very moment some of us realized a blazer was maybe a bit too much for walking long distances on this baking hot day.

In the department, our host Jingyu Chen walked us through China's energy situation and policy. Here are some key takeaways: As a still developing country, China's demand of energy is continuously growing. While big investments in renewables have been made, still around 59% of the primary energy consumption comes from coal. When it comes to the politics, the government of China has made a goal for the carbon emissions

to peak in 2030 and for the primary energy consumption portfolio to be as follows:

| | 2008 | 2018 | 2020 | 2030 | 2050 |
|-------------|------|-------|------|------|------|
| Coal | 72% | 59% | <58% | | |
| Oil | 17% | 19% | | | |
| Natural Gas | 3.4% | 7.5% | >10% | >15% | |
| Non-Fossil | 6.8% | 14.5% | >15% | >20% | >50% |

Without a doubt, China has a huge impact on the reduction of CO₂ emissions. Surprisingly, the goals of the government were presented to us as "guaranteed". In reality, this means that the goals either have to be met, or the original goals will be changed. Let's hope that the Chinese government will announce even more ambitious goals in the near future, since China is known to be efficient when needed.

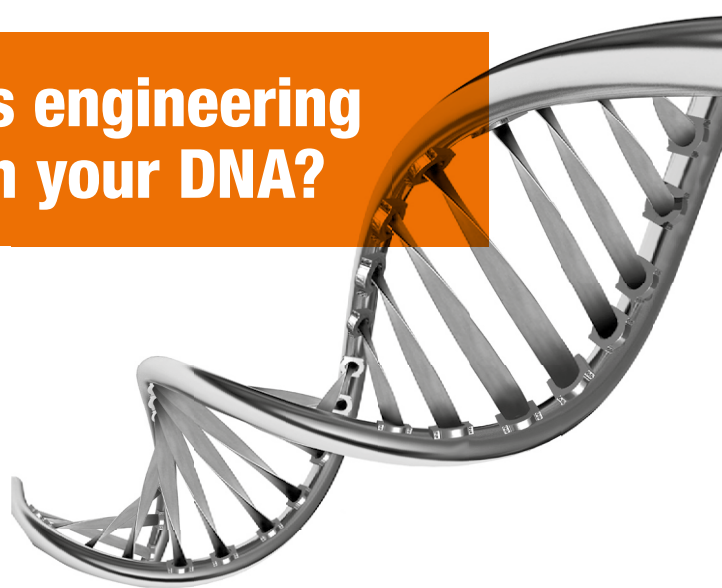


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We also got to hear about the department of Energy and Power Engineering and their research from associate professor Yuxin Wu. According to him, an early form of the department was first established in 1932 as Power Engineering Group, department of Mechanical Engineering. Under current name, the department has operated since 2017. There's quite a long history behind it. The department itself has around 360 undergraduate students majoring in Energy and Power Engineering and around 450 postgraduate students majoring in Power Engineering and Thermophysics, Power Engineering and Engineering Management. Furthermore, around 40 post-doctoral students major in Power Engineering and Thermal Physics.

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The university graduates are known to end up in top positions

The department of Energy and Power Engineering consists of six research institutes with following research subjects:

INSTITUTE OF THERMAL ENGINEERING

- Pulverized coal and circulating fluidized-bed combustion
- Coal gasification
- Pollutant emission control
- Solid waste incineration
- Renewable energy utilization (Biomass, solar etc.)
- Fuel cell

INSTITUTE OF ENGINEERING THERMOPHYSICS

- Flow and heat transfer in micro/nano scale



- Heat control in power engineering and high-tech area
- Refrigeration and heat pump system
- Fluid thermophysics and energy system optimization
- Thermal parameter measurement and diagnostics
- CO₂ resource utilization and storage

INSTITUTE OF GAS TURBINE

- Energy and power system
- Aerothermodynamics of turbomachinery
- Combustion science and technology
- Heat and mass transfer of internal flow
- Device and technology of gas turbine
- Control and engineering of turbomachinery
- Theory and technology of renewable energy

INSTITUTE OF FLUID MECHANICS AND ENGINEERING

- Fluid mechanical theory and flow control
- Dynamic theory and optimal design for fluid mechanical system
- Advanced fluid machinery

INSTITUTE OF SIMULATION AND CONTROL OF POWER SYSTEM

- Modeling, simulation, analysis and optimization of multi-scale energy systems
- Advanced measurement and control of energy and power system
- Techno-economical research on CO₂-reduction-oriented low carbon energy system

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- Combustion chemistry
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- Combustion equipment and technology
- Fuel design
- Prevention of fire and explosion disasters
- Cross-disciplinary combustion science

Still, a major part of the research has a focus on exploiting coal and other fossil fuels. One reason for this is that the coal industry is a significant employer in China and the resources are large so the transition from fossil fuels is quite slow. We got the impression that the most popular study fields are still related to conventional technologies, such as gas turbines. We also asked if there is nuclear research in the university and learned that this field of research is located on another department. It's important to bear in mind that as a massive country China has been able to put a lot of effort into education, and thus they have the capacity to research extensively in all fields, i.e. can have one department fully focusing on a specific area.

Some major achievements of the department are for instance a 600 MW supercritical circulating fluidized-bed, coal gasification technology and LIBS (laser-induced

breakdown spectroscopy) solid fuel quality monitoring. In addition, the department is taking part in projects regarding carbon capture, utilization and storage; unconventional resource utilization and high-performance heat pumps. Later, we also had an amazing opportunity to explore the department's labs with the guidance of two post-doctoral students, Haowei Lu and Yuli Cao. In the labs we had a chance to hear about the research equipment related to the CCS and extracting of unconventional oil including a massive room-sized pump in the basement.

We were offered a local school lunch with the host students, to get the authentic experience of the everyday life of a Tsinghua university student. Both us and our hosts were interested in discussing the differences in student life between our countries. Chinese students were surprised that we

rarely have compulsory lessons at our home university. They instead have mandatory physical education, which includes jogging a 3-kilometer-run 20 times in a semester, for instance. Another interesting fact was that some military training is included at some point of the studies. Generally speaking, the local students seemed to have a lot of assignments and the schoolwork consumes a really big part of their everyday life.

Nuutti Hernesniemi



Sumitomo SHI FW

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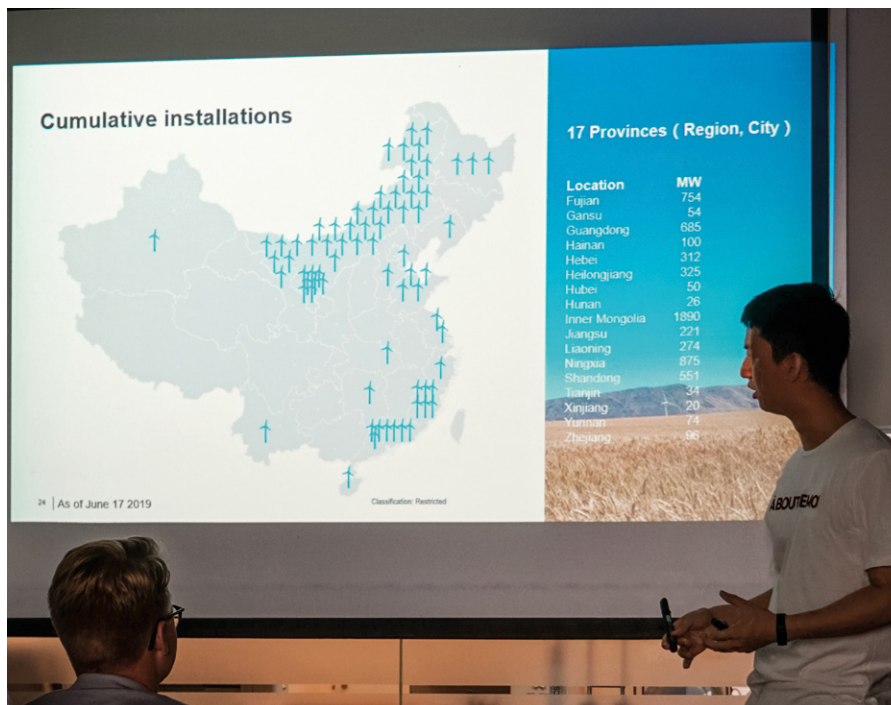
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THE FUTURE OF WIND POWER



and smart data. They have a long-term vision to be “Global Leader in Sustainable Energy Solutions”. In 2018, Vestas reached a 22% market share of wind turbines worldwide and describes itself as a global leader in wind technology.

In 1986, Vestas came to China and built the country’s first commercial wind farm – Shandong Malan Wind Farm. Shandong Malan Wind Farm has three wind turbines with a capacity of 55 kW installed. Nowadays, Vestas employs over 2 300 people in China and they have contributed to the country’s wind power capacity by 6.7 GW. In 2018, 21 GW of new capacity was installed in China (onshore 19.5 GW, offshore 1.7 GW), which was 7.5% more than in 2017. For comparison, the total installed capacity of wind power in China was 209 GW (onshore 205 GW, offshore 4.4 GW) at the end of 2018. Wind power is regionally very distributed in China and over 60% of the new wind farms are located in Central and North-Coastal areas.

Admittedly, the development of wind turbines over the last decades has been considerable. In Vestas, both size and capacity have increased significantly, and today Vestas has turbines with a diameter of 162 meters and rated power of 5.6 MW. For comparison, in 2004 Vestas launched turbines with a diameter of 90 meters and rated power of 2 MW. As we can notice, the size and power have almost doubled.

During our visit to their office in Beijing, we had a discussion of whether it is more difficult for a foreign company to enter the Chinese market, compared to a local company. However, the main challenge for

Renewable wind power plays a significant role in future energy production. Currently, wind power is the fastest growing renewable energy industry and there is still a lot of growth potential all over the world. However, China has the largest wind power capacity in the world and its capacity is still rapidly growing. As everyone knows, China has a long coastline and a large land area, so the resources for wind power production are remarkable. Therefore, the world’s largest manufacturer of wind turbines has found its market share also in China.

Vestas, a Danish company, was established in 1898. Today, they operate in over 80 countries and have more than 24 500 employees. The company designs, manufactures, installs and services wind turbines across the globe. Vestas service operates at various business areas: parts and repair, maintenance and partnering, fleet optimization

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In 2018, Vestas reached a 22% market share of wind turbines worldwide





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Vestas in the Chinese market is the price. There are other local companies offering wind turbines at a cheaper price but usually, it means a shorter lifetime for these turbines. After this, our host wanted to learn more from us about the Nordic electricity market, which led to an interesting discussion about prices and feed-in tariffs. China has planned to remove subsidies from onshore wind power (FiT) by 2021.

Vestas also sells wind turbines for the Finnish wind power company

TuuliWatti, which is the biggest wind power producer in Finland. There are already some turbines from Vestas in Finland, but in 2021 there will be a delivery of the previously mentioned, the most advanced wind turbines. The new wind farm in Lapland will consist of 27 wind turbines, with an annual production that equals 8% of all electricity produced with wind power in Finland in 2018. We even got a chance to teach our host to pronounce TuuliWatti correctly - or at least close enough.

Overall, the visit taught us a lot about Vestas as well as wind power in general. Wind power capacity in China will keep growing, and the Chinese government has announced that the capacity will be 250 GW in 2020. The need for wind power in the future will be even greater. At the end of the visit, we had a nice surprise when Vestas gave us a miniature model of one of its turbines as a gift.

Amanda Jokinen





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THE GREAT WALL OF CHINA



6 259 kilometers of rammed earth, bricks and stones. The Ming Great Wall was built by the Ming Dynasty between 1368 and 1644 and it is the wall we know from photos in history books and news, or at least the most elaborate part of it. Trenches and natural defensive barriers included, the length of the Ming Great Wall measures up to 8 850 km. However, these numbers are historical and based on archaeological surveys.

The wall has been worn by the erosion for hundreds of years and its bricks have been used as a building material for houses and roads. More than 30 per cent of the human-made wall has vanished and more is in danger to disappear, regardless of the fact that the wall has been a UNESCO World Heritage site since 1987. Luckily for the tourists however, the entire wall is not in disrepair and parts of the wall have been renovated and reconstructed.

These repaired parts form the main tourist attractions of the Great Wall and they all are located near Beijing. We visited Mutianyu which is the second most popular sight, about 73

kilometers away from the city center. The Mutianyu wall is 7 to 8.5 meters high and four to five meters wide. The restored part is 2.5 kilometers long and includes 23 watchtowers. The watchtower on the highest peak reaches an altitude of 540 meters above sea level whilst the lowest point is 54 meters below that.

Our journey to the top of the wall started from watchtower number six. We used cable cars to get up. Depending on where you enter the wall, the route and its views are different. We decided to head to watchtower number one with a steep rise. From the watchtower at the end of the tourist route, we were able to see part of the unrepaired section of the wall. It was nothing like the wall we walked on. Plants had taken over it, just a tiny part of it could be seen and the height was few meters less than with the reconstructed section.

While walking up the stairs, we started wondering what it had been like building the wall. The wall was built in the Middle Ages and it must have required an effort of millions of workers. Then again, after this visit to China, I'm not at all surprised that it's



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There were dozens of people whose job was just to tell people to slow down



China where this wall is located. After all, China is known for the biggest building projects in the world even today. And it is not just the size, but the vast amount of projects. There must have been millions of houses under construction in China at the time of our trip. We once had a 20-kilometer bus ride and throughout the drive we never stopped seeing apartment buildings under construction. Entire quarters were built everywhere – and that was just next to the road.

Wonder, how long it would take for the Chinese to build over 6 000 kilometers of wall today. At least workers would have better working conditions. Considering the location

of the wall, on the edges of the ancient empire, and the fact that some were forced to build the wall, the workers must have worked in poor conditions. Obviously, there were no means to transport massive amounts of building materials from one place to another, so the builders always tried to use the closest resources possible. That's why in the mountains the wall is made of stone and bricks, and on plain ground, mainly rammed earth was used.

Like in any proper tourist sight at high altitudes, there is a toboggan ride down – subject to a charge, of course. The ride was really cyclic; once you had accelerated to high speed on a steep slope, you had to brake to avoid hitting the person in front of you.

Luckily, there were dozens of people whose job was just to tell people to slow down. Sometimes we were surprised to find people with jobs like this since their job description was so simple. In Finland, it would be too expensive to have as many people working in similar track telling people to brake. However, in China, this must be a way to find jobs to the still-growing population.

Finally, I would like to teach you a lesson we learned in China. Every time you think you have seen it all, there's more – and the wall is no exception. You see, the Ming Great Wall forms just the most visible parts of the Great Wall, and its total length is actually even more. The oldest parts of the Wall were built around 500-800 BC, over 2 500 years ago. However, the Ming Dynasty was the first to use bricks and stones and therefore left behind the best-preserved part of the wall. Before them, rammed earth was commonly used, and the oldest walls have almost completely disappeared. Combining all the historical series of fortification systems, an archeological survey suggests that the total length is 21 196 kilometers. That's the Great Wall of China.

Eetu Laitila



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JINAN - THE CITY OF SPRINGS

Jinan is a city of 8 million people. It is located 430 kilometres south of Beijing. It takes only two hours to get there by a bullet train. The city is called the City of Springs since it has many wells that flow to Daming Lake and further to Yellow River. The watershed of the river was once the cultural centre of China.

Jinan charms with its more natural and peaceful beauty than that of the other Chinese cities we visited. A great example of the presence of nature is the huge Daming Lake Park in the center of the city. You can walk through the park and view ancient pavilions, residences and temples. We also got to experience the tastes of Shandong cuisine - especially known for its seafood dishes - which originates from Jinan.



FAST CHANGES AND CULTURAL DIFFERENCES IN BUSINESS

AFRY (former ÅF Pöyry) is an international company that operates in very different working cultures and locations. They have projects in more than 100 countries, and offices in four Chinese cities: Jinan (which we visited), Shanghai, Beijing and Chengdu. Pöyry carried out its first projects in China already in the 1970s and has had a presence in China since the early 2000s. AFRY provides engineering and consulting services in many fields such as power generation, transmission and distribution, forest industry and biorefining. We were hosted by Pertti Koivuniemi, the Vice President of Process Industries China. We heard about the projects of the company in China, along with some views about what the situation of paper and energy industries looks like now and in the future. It was interesting to learn about the trends and also about the real-life differences between China and Western countries a global design and consulting company faces. Our visit

ended seeing great illustrations of the differences in the two cultures.

The AFRY office we visited is located in Jinan, Shandong province. We heard an interesting fact that most of the cars in Jinan are gas powered and that gas production is increasing. This led to a discussion on the energy production portfolio in China. China is investing heavily in renewable energy production and the share of solar and wind power is increasing in Chinese electricity production. But it is important to mention that also the amount of coal power is increasing. However, it must be taken into account that the competitive electricity markets were introduced in China only a couple of years ago, in 2015.

One notable trend in recent years has been the pace of changes. Before, China was lagging Western countries in development and economic growth. But in recent years, a great deal of progress has happened, and China is catching up fast. For example, many factories have been automatized.

Regardless of the fast progress, China is still changing more rapidly than the developed countries. The question is when will the development reach the same level as in Western countries. So far, the increasing profitability of investments has compensated for

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The sense of community is however something to be appreciated and learned from Chinese work environments**

the increasing costs, for example increasing salaries. However, this might not be the case forever. Already by now, salaries have increased fast and the difference in the salaries of an engineer in China and one in Finland might not be that great anymore.

From a business point of view, the environment in China is quite different. For example, almost all of the clients of AFRY in China are state-owned companies. The way to make business must be adjusted to the country in question. For instance, it is easier to sell actual products rather than services in China. There are also some problems regarding data security. Every company in China has to take into account the risk of copying and stealing of the



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tasks. Another difference is how mistakes in work are considered. In Western countries, attitudes towards failing are more neutral. The Chinese avoid “losing their face”, and mistakes are more difficult to handle and talk about. The sense of community is, however, something to be appreciated and learned from Chinese work environments. Typically, new employees are welcomed warmly to the work community and they feel like a part of the team from very early on.

All in all, we were given new insights and ideas on the visit to AFRY office. A company - this global and connected as AFRY - is the one you want to hear these lessons from. To conclude, we learned that great and fast changes are still in motion in China. Even when comparing the cultural differences, it is important to remember that the young, educated Chinese in many cases think in a different manner than their parents, the more traditional ones. In addition to the great discussions and presentations, our host was so kind to provide us with some delicious pizza and beer to not be so overwhelmed by the Chinese culture. We certainly enjoyed the culture and the new experiences, but it felt refreshing to taste something familiar.

Miia Nevander

know-how or the confidential data of the company. It can be difficult to find reliable subcontractors. Also, finding employees that speak English and are competent for a job is a challenging combination to find. Many companies have to train their employees that work at the key positions. There are many differences from the perspective of the employees too. Nowadays in China, the market defines the work benefits and compensations. Typically, at many work fields, about half of the salary is relative to achievements in the job. On the positive side, it is relatively easy for an expert to get

employed, and the same applies to some occupations with lower salaries, such as cleaners.

Our host also shared some insights about the differences between the Finnish (or Western in general) and the Chinese work cultures. The differences include the social position of the manager, the dealing with mistakes and the sense of community. In China, the managers have more authority, whereas a Finnish boss would be more of a friend or almost equal to the employees and only leading the meetings or delegating



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DIFFERENT WORKING CULTURES

Linuo Group is a typical Chinese conglomerate. This means that they operate in multiple different industries. Western companies extremely rarely operate in two sectors, let alone in multiple different industries. But then we have these Chinese corporations like Linuo Group that sell products in chemicals, solar power, healthcare and ceramics just to name a few. In the era of specialization and finding a suitable niche market, this sounds pretty unbelievable, right?

Well, in China, many unbelievable things are real. When our bus arrived at Linuo Group's headquarters, we immediately understood that this is not an HQ we would find from Finland. The campus was the size of a small city and there were many different blocks that had various industry-focused factories inside them.

From the very first minutes when we met our host and entered the flawless exhibition room, we noticed probably the biggest differences between Finnish and Chinese company cultures: the cult of personality, the value of different titles/awards won and the organizational structure. This exhibition hall demonstrated all of these things. First, there were all of Linuo's products neatly put on display. The story was thought through multiple times and you could see what kind of impact each of their products had had on society. After this product display, the most important part was shown to us, the story of Linuo and its previous CEOs/leaders shaking hands with soon-to-be president Xi Jinping.

If you go to any office in China and that specific company has been lucky

enough to host the president of China, for example, you will see a picture of Xi Jinping or some other political figure meeting with the leaders of the company. These moments are extremely valuable for the companies and they really cherish them.

This thing called "title" is more powerful in China than what it is in Finland. Management styles differ a lot, Chinese leaders have much more power and they can and will decide what should be done next. In Western companies, we have gotten used to flat organizations and discussions between people in different positions. One of the pros of this Chinese model is efficiency: when something is decided, it gets done. And it gets done quickly. But then again, the pros of Western-style are that you get more point of views through engaging more people in the decision making. And with those conversations, you are more likely to avoid huge mistakes and acknowledge factors that would have gone unnoticed with only the director making the decision.

Not all Chinese companies are the same though. We ended our visit with Linuo Group in a conference room where the staff wanted to encourage our group to let them know what we would do differently or whether something caught our attention during the factory tour. It was a little unexpected, but we were glad that they brought it up. After some thinking, our crew mentioned that safety could be improved. For instance, we didn't see many safety goggles being used in the manufacturing process. I hope that giving feedback gets a better foothold in the Chinese company culture.

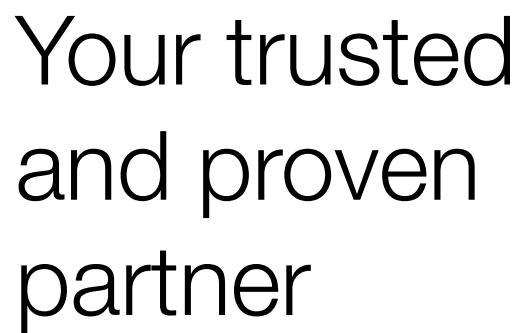
All in all, there are many differences between the companies and working cultures in Western and Chinese organizations. You should really acknowledge them before you go to China and start waving your (firm's) checkbook. Because there will be obstacles - that you did not even know could exist - in building a thriving business in China.

Be humble and ask even about the things that should be no brainers, from people who have been there and done that before you.

Sakari Huhtanen



One of the pros of this Chinese model is efficiency: when something is decided, it gets done. And it gets done quickly



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THE SOLVER AND THE CAUSE

When it comes to China and climate change, there are two sides to the discussion. China's carbon dioxide emissions are said to be almost uncontrollable, but on the other hand, it invests heavily in carbon-neutral energy. One could think that there's a conflict between these claims, but the truth lies in both. China accounts for a quarter of global emissions but is ahead of the Paris Climate Agreement targets.

So, both claims can be defended, even with good arguments.

What should we think of all this?

Because China has such a huge impact on climate change, many use it to undermine the importance of Finland's climate actions. Why should we change our habits or lower our standard of living when it has such a small global impact? So far, burning fossil fuels has worked as an energy source, why not in the future? It's also so cold in Finland.

Well, that's not how it goes.

In August, I asked some Chinese university students why China isn't doing more to reduce its emissions, even though it's the world's biggest polluter. The answer really got me thinking.

"You have to understand that a large part of the people still lives in poverty and hunger. They don't even know about climate change."

Can we blame the Chinese for their emissions, even though they haven't come close to the same standard of living as the Finns? China has 260 times more people than in Finland, so

the amount of overall emissions will inevitably be high. Naturally, emissions will increase as the standard of living of the Chinese increases. Not to mention all the goods that are made in China and shipped to Finland - their emissions are caused by our demand.

When climate emissions are calculated per capita, Finns have nothing to boast about.

LET'S TAKE CARE OF OUR OWN EMISSIONS FIRST

China has a lot to do with global emission targets.

The harsh truth is that global climate targets can't be achieved without China. The annual rate of installation of solar panels will not make China carbon neutral if, and when, new coal power plants are built at the same rate. China's first challenge is not, like Finland's, to clean its current energy production, but to produce its new energy demand without emissions.



China accounts for a quarter of global emissions but is ahead of the Paris Climate Agreement targets

Local particulate matter emissions often come up when it comes to China's climate policies. Large cities such as Beijing and Shanghai are known for their visible smog, which at worst prevents people from going out. For China, particulate matter emissions are a more tangible threat than climate change, and thus they have been in the center of climate policies.



People's dissatisfaction has forced the state to act, and the urban air quality has clearly improved over the last decade. One way has been to move factories to the countryside. In this case, the overall impact on the climate hasn't even improved.

VOLUNTARILY OR FORCIBLY

I believe that it's easier to reduce emissions in Finland than in China.

There is a huge amount of potential for emission reductions in Finland that can be done cost-effectively and without lowering the standard of living. For example, energy efficiency has a high demand as saving energy also saves money.



In China, I asked about companies' interest in reducing their energy consumption. Interest wasn't really found, and the reason was the energy prices. The Chinese state deliberately keeps the price of electricity low so it wouldn't hinder the cost-effectiveness of the industry. So why save money when it only costs so little? In Finland, the costs of electricity and especially of heating have been constantly increasing, which is why, for example, local energy production by heat pumps or solar panels is in strong growth.

The decisive difference between the countries' climate actions is how much they count on the private sector to take initiative by themselves. Finland trusts individuals and companies, while China has a central responsibility for reducing emissions. Action will be taken, but only if it is in the interest of the state. Outsourcing the responsibility reduces the actions of companies and individuals as they can rely on someone else to make the big decisions.

Discouraging the voluntary nature of energy investments will not boost emission reductions. For example, for some properties, geothermal heat can be an excellent option to reduce the carbon footprint of heating. For others, different methods work better. That's why we shouldn't favor certain means but create a space for investments that supports the implementation of the best solutions.

The emissions trading system (ETS) is a good example of a system that encourages emission reductions but does not prescribe the means. ETS has been particularly successful in 2019, as sharply rising costs of emissions are driving the energy market towards a low-carbon market. The system is well placed to reach its goals if benefits, such as lower energy bills, are achieved by reducing emissions.

Anton Närekorpi

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BEER, BEACHES AND MOUNTAIN VIEWS



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Most Western people will probably recognize the city because of the beer Tsingtao

Qingdao is a coastal city in the east of the Shandong Peninsula. It is a relatively big city with a population of about 9 million. Despite its size, most Western people will probably recognize the city because of the beer Tsingtao, which has its roots there. The famous beer was invented in 1903 during the German colonial period (1897-1914), and still, the influence of that time can be seen in the streets of Qingdao. Architecture has many Western features, and when strolling around the different districts of the city, European-style buildings stand out from the view.

Of course, we were curious to visit the Tsingtao museum and brewery. The museum was very different from any Western museums we had ever visited. The focus of the exhibition was on the people that had founded and lead the company throughout its history and not so much on the beer itself. The museum was also full of medals and prizes that the brand had won. As the most interesting fact, we learned that Tsingtao was the first Chinese company to be listed on the Hong Kong stock market. After the museum, we enjoyed the interesting beer culture of Qingdao. There was a wide range of beers from which to select. Also, it was possible to buy beer in a plastic bag and drink it with a straw - something you would not experience anywhere else.

As facing the Yellow Sea and being surrounded by Laoshan Mountain,



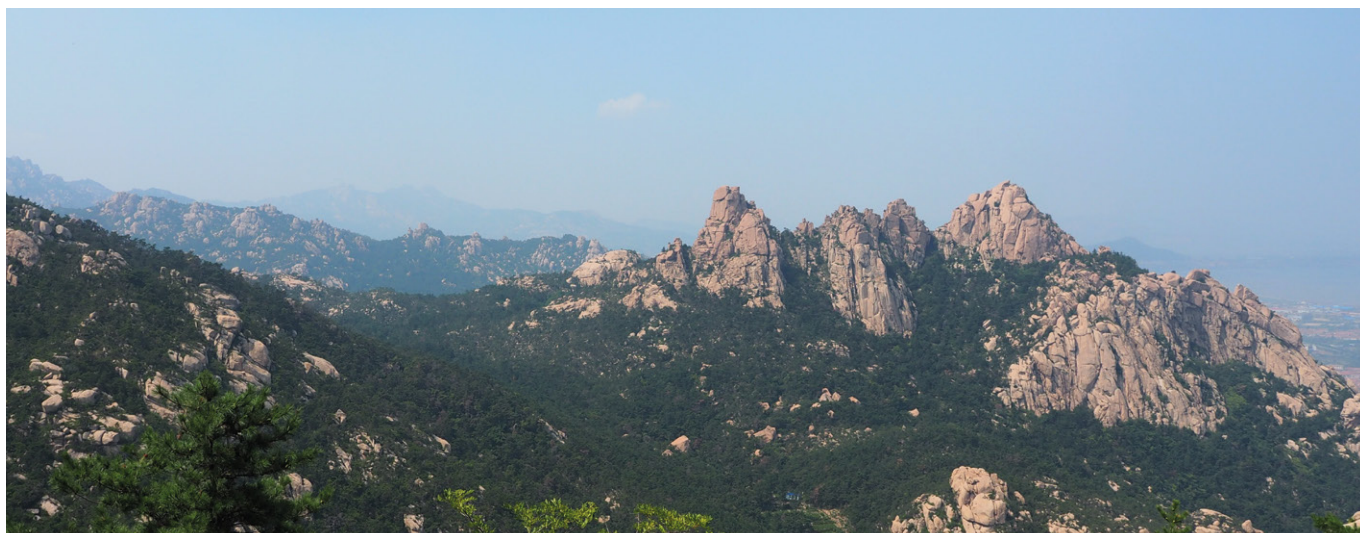
Qingdao has spectacular landscapes to admire. One of the must-do activities we wanted to include in our trip was hiking in the scenic area of Laoshan Mountain. It is rich in history since the mountain is considered to be one of the birthplaces of Taoism. Therefore, the remains of ancient temples, monasteries and nunneries are still a part of the scenery. Laoshan Mountain has several scenic spots to visit from crystal-clear springs to rocky peaks above the sea of clouds, and you could spend days exploring the area. One of the main attractions is Yangkou scenic spot, where we headed for a day.

There were two ways to get up to the top of Yangkou, either by foot or with a cable car. Because of the hot and humid weather, we decided to take the cable car and enjoy the views. Once again, we got to experience the Chinese mass of people as we queued for the cable car for about an hour. As we got up, we continued our way towards the highest point, Lion Peak, by foot. On the way to the summit,

there was a cave inside large boulders. The way through the cave was dark and we had to climb up the stairs in a narrow space. Since the route was so difficult and slow to proceed, there was a queue to get in. There was nothing special to see in the cave, and it surely wouldn't meet the Western safety regulations. It made us wonder why the route even went through the cave. This is a classic example of a cultural difference between China and Finland, which is hard to understand from a Finnish point of view.

All our queuing was rewarded when we got to the top and saw the spectacular views. The harmony between the untouched rocky nature, the beautiful beach and city of Shanjiao was magnificent.

The Qingdao International Sailing Center was built for the 2008 Summer Olympics. As a memorial, a sculpture of the Olympic rings has been placed there. The marina is a really beautiful area to walk around, especially during evenings when Qingdao's famous





The city has a lot to offer and everyone will surely find something interesting to do there. A day can easily be spent by enjoying the best beaches of China or by taking awesome pictures of the whole city from the observatory at Signal Hill Park. An educational option would be a visit to Qingdao Naval Museum, which tells the story behind the development of the Chinese Navy.

Our overall impression of Qingdao was truly positive. From our point of view, everything seemed to work quite easily. For example, getting a taxi was not a challenge. In other cities, it took so much time to stop a taxi driver, especially one that would not try to charge you extra money. People in Qingdao were very helpful and polite, even though we did not have a common language. However, luckily we shared the same passion for “pussikalja” (beer in a plastic bag).

Mikael Väisänen

skyline is lighted up. The light show is spectacular as about 50 skyscrapers are used as a giant “led-screen”. The show started with changing still pictures and then evolved to videos which displayed dragons, birds, Qingdao’s architecture and even beer. The show was astonishing, but towards the end, the show became all about Chinese power as it presented Chinese army arsenal and patriotic phrases. It was surprising that some

slogans were presented in English - “Be loyal to the party, stick to the course” was shown on the screens. While walking on the streets with numerous traffic cameras flashing above us, we discussed a lot about how the Chinese patriotic culture might change in the future, as the world becomes more and more global. Our conclusion was that we just have to wait and see.





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THE LIGHTS OF SHANGHAI

When someone mentions Shanghai, you immediately think of a megacity with a sea of skyscrapers and bright lights. We traveled from Qingdao to Shanghai via bullet train, which let us admire the view outside the cities for a while. From an energy point of view, it was nice to see numerous large wind turbines perched upon the hills along the railroad. However, many of the turbines were not rotating at all,

and we saw at least as many large condensate towers connected to coal plants.

The look and feel of Shanghai were immediately upon arrival very different from our initial destination of Beijing. While Beijing had very limited amounts of truly tall buildings, Shanghai had them as far as the eye can see. Streets in Shanghai were larger and thus less hectic, and the city felt more Western in multiple



ways. Still, it was unbelievable to notice that even in such a huge city as Shanghai, we still struggled as almost no one understood English.

Shanghai is China's largest city in terms of population, which is roughly 26 million. The city is much newer than the other big cities in China, and you can see it in the modern infrastructure of the city. Since the 1990s, the city has grown rapidly following economic reforms, and has a very modern look; serving as a shining example of China's economic growth. This is very visible on the city streets: everything is clean, the infrastructure is modern and traffic flow is much more organized than in Beijing, for example.

We got to visit the highest building in the city, the 632-meter tall Shanghai Tower. The tower has the world's highest observation deck at 562 meters and the world's second-fastest elevators, so it was quite an experience. The view from the observation deck was something to behold, indeed. For instance, the notable landmark Pearl Tower, which seems very tall from the Huangpu River, was completely dwarfed by the Shanghai tower and appeared tiny from the observation deck.

When in China, you should see a Chinese garden. We headed to Yu Garden, which is located in the





northeast of the Old City of Shanghai. The Chinese name, Yu Yuan, means the garden of happiness, and one could definitely sense the tranquil atmosphere there. Built already during the Ming dynasty 400 years ago, the garden is a model example of classical Chinese gardens. We also went to visit a market place called Yuyuan Bazaar, which is right next to Yu Garden. It was a perfect spot to buy tea and other souvenirs.

Due to some cancelled excursions, we had more free-time in Shanghai than anticipated. Much of this time was naturally used for seeing many of the numerous sights the city has to offer. One of the most memorable 'hidden' sights in Shanghai was the fake merchandise market of Xinyang. There, we got to hone our haggling

Without a question, the shining highlight of Shanghai is the Lujiazui skyline light show that takes place every evening at the bend of the Huangpu River. In every direction of the river bend, skyscrapers are lined with lights of every color. We got a good look at this on our first night in Shanghai but had to come back again

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Since the 1990s, the city has grown rapidly following economic reforms, and has a very modern look; serving as a shining example of China's economic growth

skills and bargained for souvenirs. Not all shopping involved heavy deal-making, and the rest of our shoppings were conducted in western-style shopping centers.

for a river cruise for an even better view. It was a perfect finish to our trip to have drinks at a rooftop terrace, watching the bright nightly lights of Shanghai.

Roope Rauta





ENGINEERING WITH A DIFFERENCE

Etteplan invited our excursion group to their office in Kunshan 60 kilometers outside of Shanghai and offered a tasty dinner in a fine restaurant. Our hosts were the regional director of China, Martin Zachrisson from Sweden, and Miika Jatuli, who is general manager of Etteplan Xi'an, from Finland. The program of the office visit included presentations about the operations of Etteplan China and their business as a foreign company in China. We also heard three presentations from local engineers about their own projects. These projects were about technical documentation, elevators and a design for Wärtsilä related to NOx emission reduction with SCR (Selective catalytic reduction) systems.

Etteplan Oyj is an engineering design company which has grown from a small Finnish firm into a global company that has over 3,400 professionals in seven countries. Etteplan was founded 1983 in Hollola, Finland. Nowadays, Etteplan has offices in Finland, Sweden, The

Netherlands, Germany, Poland, The United States and China. Etteplan's customers are the world's leading companies in the manufacturing industry. Their services cover solutions for industrial equipment and plant engineering, software and embedded solutions, and technical documentation. Etteplan had a turnover of approximately 236 million euros in 2018, and their revenue growth target is ca. 15% annually.

In China, Etteplan has eight offices, including offices in Kunshan, Shanghai, Beijing and Qingdao. Operations in the country began in 2004 as a first Nordic engineering design company. Nowadays, Etteplan has over 120 customers in China, the largest of which are, for example, Kone and Valmet. Etteplan has more than 400 engineers and experts who are serving international and local customers in China. The role of the local customers has shifted to more advanced and comprehensive engineering operation, which requires a good level of education in offices that work almost independently and are mainly led by locals.

China's role in the global markets and in industry has changed since the early 2000s. In the past, China used to be a place for basic engineering design production for offshore markets. However, the cost of engineering work has increased rapidly in China, and cheaper countries like Thailand have become more cost-effective when it comes to performing basic design works. Nowadays, 50% of the projects in the Chinese offices of Etteplan are for China's own markets and the rest are for offshore markets. China has lost some of the products that have been traditionally produced there to cheaper countries, but simultaneously some production that demands higher expertise is shifting to China, such as shipbuilding. One of the key factors when designing a supply chain is to know and calculate where to produce different items. Some countries may have lower salaries, but there it can be challenging to find professionals. A Western company can never compete with price in China, so they have to offer products or services that are better than competitor's or that no one else is offering.

China can be divided into four industrial mega clusters which have their own typical industries. For example, a lot of shipbuilding is moving to Beijing area. High tech companies are located in Shanghai and Guangzhou-Shenzhen areas. Wuhan area, situated inland, is much less urbanized than the coast. Therefore, there exists a more traditional manufacturing industry which is possible due to the lower rate of pay. On the other hand, finding trained professionals is challenging there.

Some global trends are shaping the engineering industry globally. Altogether, the need for engineering services is growing globally as developing countries continue to grow. Accelerated technological development leads to shortened product life-cycles and improved manufacturability through low-cost mass production. Digitalization causes renewing of business models and increased intelligence of machinery and equipment. Increased need for sustainability focuses on life cycle thinking and eco-efficiency. An example in this regard is the new standards by IMO (International Maritime Organization) for ships' NOx emissions, which have required a lot

of new designs for marine engines. Etteplan has provided solutions for these new designs for Wärtsilä also in Kunshan office. The latest global trend is structural changes in the global economy. Emerging markets are gaining more market share, urbanization continues, the population grows and is aging. These trends affect strongly also the markets in China.

Etteplan offered a delicious four-course dinner and some other Finnish professionals from Etteplan joined us. During the dinner, we discussed the energy sector and the working life in China. Especially this part of the excursion was rewarding as we got

plenty of insights about what it is like to work and live in China and how to get the most out of it. The visit was well arranged and instructive, and it was our pleasure to be hosted by such welcoming hosts.

Joni Palin



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The role of the local customers has shifted to more advanced and comprehensive engineering operation, which requires a good level of education in offices that work almost independently and are mainly led by locals



CLEANER FUTURE WITH WASTE REFINING

Finland-China Innovation Center (FinChi) is a platform for Finnish companies to get access to the Chinese markets. The innovation center was officially established in 2005 and there are more than 50 Finnish companies located in the center nowadays. Companies operating in the center vary from energy and industrial companies to Lapland marketing and children's playground manufacturing companies. There are also some well-known Finnish companies such as Nokia and Rovio which have started their business in China with FinChi. This time, however, we had an opportunity to visit a company called BMH technology located in FinChi Innovation Center. There was a friendly and homely feeling and even Fazer chocolate on a coffee table.

BMH technology is a Finnish cleantech company with 160 employees. The

company has two main business areas. The more traditional business area of the two is solid biofuel handling solutions. The other concentrates on waste refining. BMH was founded in 1929 and the original name of the company was Oy Sytytin. It manufactured contact and fuses for the artillery. Ever since, the company has changed a lot and their mission is to master cleantech solutions for sustainable fuels.

BMH established its sales office in Shanghai in 2012. The office seems pretty independent and the office's eight employees do not include any Western ones. These eight employees take care of sales, administration and projects with power plants and cement factories in China. BMH also has Chinese subcontractors for manufacturing products locally. The company is focused especially on waste refining solutions in China and

there are several projects going on at the moment.

BMH's key product in China is waste refining plant called Tyrannosaurus. The process of the waste refining plant turns MSW (Municipal Solid Waste) and ICW (Industrial and Commercial Waste) into SRF (Solid Recovered Fuel) or RDF (Refuse Derived Fuel). Tyrannosaurus waste refining plant is more suitable for bigger cities than rural areas since the plant requires large volumes and constant flow of waste. Chinese law limits waste treatment, which has to be taken into account when planning the location of a new waste refining plant. It is forbidden to transfer waste to the other provinces in China so waste treatment has to be done inside the boundaries of the province.

There are several problems with waste refining in China. One big





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It is forbidden to transfer waste to the other provinces in China so waste treatment has to be done inside the boundaries of the province

issue is wet waste which is a result of the lack of waste recycling. Some improvements have been made, such as compulsory recycling bins in Shanghai, but it will take a long time for everyone to recycle their waste properly. Wet waste leads to a lower net calorific value which causes higher operating costs compared to similar waste refining plants in Europe. There is no cost-effective drying solution available for wet waste yet, although BMH has started to have collaboration with other companies. Operation costs of drying wet waste are still too high and drying takes at

least two weeks before waste can be further processed.

Another big problem is rejects which are formed during the waste refining process. Typical rejects are magnetic and non-magnetic metals, fine fraction such as sand and heavy inert fraction. There are no companies specialized in handling rejects compared to Finland where Lassila & Tikanoja takes care of them. Some waste streams are sent to other plants for incineration and a part of them can be used in cement production. However, these processes can't use all of the rejects, so the



problem is where to transfer the rest of them.

Overall, there is a huge potential for waste refining plants in China. BMH has decided that their main targets for new waste refining plants are in Asia. The products of BMH have an important role in sustainable waste handling. There is a huge demand for these kinds of waste solutions in developing countries to minimize waste on landfills.

Elsa Heinolainen

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NUCLEAR POWER - A CO₂-FREE CHOICE

Nuclear power has become an important form of energy production in the fight against climate change. Every operator in the energy sector must take into account the zero-emission targets. We simply can no longer depend on energy sources that create carbon dioxide emissions. Wind, solar and nuclear power are the major zero-emission production methods to be taken into consideration, while hydro, biomass and waste have limited potential. Wind and solar power work well to a certain extent in existing power systems, but without a comprehensive energy storage technology, variable renewable energy (VRE) is very hard to connect in large amounts (> 50%) to the electricity grid.

Nuclear power generation profile generally follows primary production, as high capital costs and low operating

costs require high uptime in order to make the highest revenues. Nuclear power can be flexible, but it is rarely economically viable. However, when compared to VRE production, nuclear power generation is predictable and

current electricity markets. Nuclear power thus provides an excellent primary production source with zero-emissions for current and future energy systems in addition to other low carbon energy sources.



China is the third-largest producer of nuclear power in the world and is constantly building more nuclear power plants

steady, which offers great benefits for the stability of the electricity grid. In France, nuclear power covers about 75% of electricity production. Producing the same share with VRE and energy storage would almost certainly be more expensive in the

OPINIONS ON NUCLEAR POWER IN WESTERN COUNTRIES

Finland's nuclear culture is known worldwide for its excellent safety record. This gives us good competitiveness in the international



markets, says Pekka Ottavainen, CEO of STUK International Oy. "With the help of STUK International Oy, we can improve nuclear and radiation safety in countries where it is needed, but where adequate competence for operating is not found yet. Finnish competence has a very good international reputation in this field and countries are generally interested to cooperate with us" [1]. Finnish nuclear companies can use Finland's good reputation in nuclear safety when entering new international markets. Pushing Finnish nuclear power to the world may be one of Finland's most effective ways to reduce emissions globally.

Many energy technology students are interested in developing the Finnish nuclear industry further and are already working in the nuclear power field. At Aalto University, the teaching of nuclear power is very neutral, and both the good and bad aspects of it are discussed based on facts. This will allow each student to form his or her own opinion on the need for nuclear power today and in the future. I believe that most of the energy technology students are aware of the serious threat of climate change,

and thus see nuclear power playing a critical role in the future zero-emission energy system.

The popularity of nuclear power has been declining in the world after nuclear accidents, and in the Western world, nuclear power has not been built much after the 1980s. Following the Fukushima accident, many countries decided to close their nuclear power plants early. In Finland, nuclear accidents have not affected the popularity of nuclear power as much as in other Western countries, and nuclear power is currently quite popular in Finland, as the fight against climate change is finally starting to be taken seriously. In Finland, the challenges in building nuclear power have been more in the delayed projects and rising costs. This is worrying about conventional nuclear power because the construction relies heavily on the levelized cost of electricity (LCOE). A major problem with elaborate projects, such as Olkiluoto 3, has been the lack of standards and reference plants, which can make the purchase of individual parts and services very expensive. In the future, small modular reactors (SMR) could be the solution to the

problems of today's large nuclear power plants. SMR's have reduced power levels in reactors, which is naturally easier to control, so the security measures do not need to be as comprehensive. In addition, smaller reactors could be manufactured as a production chain, which will lower the cost of individual parts. Both of these characteristics reduce the capital costs of SMR plants, enabling nuclear power to remain competitive in the future.

NUCLEAR POWER IN CHINA

China is the third-largest producer of nuclear power in the world and is constantly building more nuclear power plants. In 2018, China had 48 nuclear power plants in operation and nine new ones under construction. Nevertheless, nuclear power accounted for just over 4% of China's electricity production in 2018. Thus, there would be enormous potential for China to increase the share of nuclear power to cover its growing energy demand and to replace existing coal plants. Currently, China is the world's largest builder and developer of nuclear power and is one of the first SMR plant builders. [2]





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China has been developing the new high-temperature gas-cooled reactor pebble-bed module (HTR-PM), which is expected to be commissioned within 2019 [3]. The pebble-bed reactor under construction at Shidao Bay is cooled with helium and is graphite moderated. Due to the helium coolant, a high temperature of 750 degrees celsius is obtained in the reactor, which allows the steam temperature to be at 566 degrees celsius, making a high efficiency of 40% in electricity generation. In China's HTR-PM project, two reactors will generate 210 MW of electric power for the turbine. [4]

The HTR-PM project can play a very important role in reducing China's emissions. If the reactors are completed successfully and cost-effectively, they can replace existing coal boilers, as the temperature of the generated steam is the same as in existing coal boilers. The

infrastructure of old coal power plants can be utilized, which will significantly decrease the costs of new nuclear power plants. If China really takes climate change seriously, they have a potential solution here for large and rapid emission reductions.

In China, energy policy decisions are made quickly and construction times of power plants are an order of magnitude shorter than in Western countries. Fast changes in the energy field can help nuclear power gain ground in China. As mentioned earlier, China has a huge potential to increase the share of nuclear power in energy production. The Chinese market can be difficult for Western companies, but if they manage to break through, the nuclear equipment manufacturers and operators could obtain access to a very large and growing nuclear power market in China. In Western countries, nuclear power has faced strong criticism, but in China, the potential

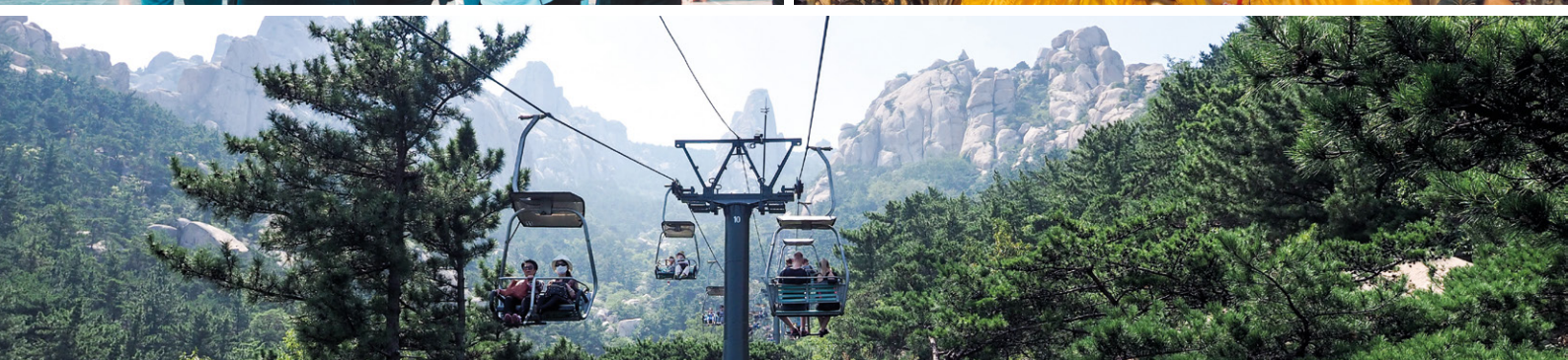
of nuclear power is just starting to be realized.

Ilpo Petäjä

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We also did volunteer work in some events to gather money for our trip. These events include Nordic Nuclear Forum 2019 and Helsinki City Run 2019.

Lämpövoimakerho thanks all our associates for the support and funding we received to make this trip possible!



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