ASIA-CLEAN project

ANALYSIS OF CROSS-BORDER VALUE CHAINS

Energy sector examples in China and Malaysia

Project Deliverable DT 1.2.1

Date: 30.9.2021

Publisher:

ASIA-CLEAN project

Green Net Finland

Turku Science Park

Tehnopol Tallinn

Publications of Green Net Finland nr. 4/2021

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Introduction and outline

This deliverable report is made by the EU Central Baltic project ASIA-CLEAN - Access & Success In northeastern Asia Cleantech markets, which is run by Green Net Finland, Turku Science Park and Technopol Science Park (Tallinn). The ASIA-CLEAN project started on 1.4.2019 and it will finish on 31.12.2021. The project aims to boost exports in the cleantech, smart city, health tech and environmentally friendly products and services to the target markets, which are North-Eeastern China and Malaysia.

The project has worked in assisting the companies with their early stage marketing plans, where it is necessary to dig into identifying each company's potential customer segments at the target market and to plan how to start approaching the target market. In this work the project has used selected external expert companies. The operative structure and business models at the Asian target markets are mostly very different from the operation at corresponding markets in Finland or Estonia.

In the focus areas of ASIA-CLEAN, essentially cleantech, there are differences in value chains between Central Baltic / Scandinavia and **China** or **Malaysia**. For any company who operates in the Scandinavian market it is useful to understand and to take into account these differences before going across the international and cultural borders to Asia.

This deliverable describes and analyses selected value chains and focuses on their differences. It is mainly targeted to provide support information to the SMEs with limited resources to do extensive market research and who might not be able to use specialized services in the research of the markets.

This report will be free of charge to use. As this report is made by merely an Interreg-project, the authors of this report realize that there are several experienced international companies who provide extensive market information in specific areas with extensive resources and skills and we do not aim to compete with such operators. We also encourage those who have the

interest and budgets to use their services to utilize them. However, we hope that this report is useful and inspiring to our readers. Already now - Thank you for your interest!

Sincerely,

The ASIA-CLEAN project team,

Ilkka Aaltio, Evilina Lutfi, Green Net Finland

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Value Chains of CHINA Target area

Here we focus on the District Heating (DH) market value chains and particular features and differences between North and East China and Finland. The topic is selected because it fits rather well to the interest area of several participating companies of the current project. Because of the huge size of the market and the presently remarkable buying power, despite the many challenges such as fierce competition and different culture, China is potentially a promising export market to advanced Finnish and Estonian companies. The role of China as an export trade partner has become quite significant in the last couple of decades. Of course, this opportunity is not without any risks. It is clear that for successful results the entering approach in China should be carefully planned and tailored to suit the local market and culture.

It is therefore interesting on a general level to view and compare the business value chains between the two countries. This hopefully gives the reader some new information, creates inspiration and makes him/her think of new opportunities for exports.

Energy sector / District heating market: Finland vs. China

Compared to the Finnish energy sector the very obvious fact to consider first is the huge size of the district heating market in China, which is easy to understand by the hugely different sizes and population densities of the countries. There are many other remarkable differences, which will be discussed later. Let us first concentrate on the Finnish District heating value chains.

DH value chain in Finland

In Finland the total population is 5.3 million and about half of the population is concentrated at the greater Helsinki Capital area. In the largest cities and concentrated urban areas, such as Helsinki or Turku, district heating has largest market share of other heating methods, even if in the latest years there have been some examples of apartment buildings moving into geothermal heating or utilizing solar PWs as a part of their heating system (i.e., a hybrid heating system). District heating (DH) operators in these cities are mostly co-owned by the city but they are now more and more private corporations. These DH companies possess the power plants for heat production and also the areal district heating networks, which have been usually operated for many decades and in many cases have been renovated several times over. In Finland 26% of the energy used is spent on heating of houses and domestic hot water (2015-2019) and DH accounts for about 6.3 % of the total energy [2].

In major cities the DH network and large energy production facilities are operated by a company, which is traditionally often founded and co-owned by the city. However, many of these operating companies have been partially or entirely sold to the private sector, such as investment funds, e.g. [4]. Based on the background and still in many cases existing public sector ownership of many DH companies it is understandable that climate strategies of owner cities have an influence on the companies. The pressure is felt at the DH company to respond to the city's wishes for approaching the climate goals. In addition, the government uses regulation for supporting low carbon development by eg. tax and support policies.

The ownership changes of DH companies from public to private sector has led to substantial and gradual increase of the energy price in many cases. This has even led to

authority investigations. However, the competition authority of Finland reported that even if the profit margins in the energy sector in relation to risks appear to be quite high, there is not essential overpricing which is restricted by law [3].

Recently practically all DH companies in Finland have presented a strategy to strongly reduce carbon emissions, as the pressure to reduce emissions in the European Union level, National level, Districts and Municipalities is felt in the energy sector. However, DH companies are struggling to satisfy their customers (local citizens, industry) and to keep their market share (by pricing, services, etc.) at the same time when they have to make significant long term investments on the low carbon energy production. This is not an easy task to fulfill.

Figure 1 shows a typical value chain of the DH market in Finland. The DH company is delivering heat energy via its DH network (orange color, Fig. 1) to blocks-of-flats, which are typically “housing companies” (yellow, Fig. 1). The housing company in Finland is the standard legal/administrative body owning the apartment building, where all apartment owners actually own shares of the housing company, which entitle them to use and own the apartment. Their ownership share of the housing company is relative to their apartment’s area (m^2) versus the total apartment area of the company. Consequently, the housing company shareowners consist entirely of owners of the subject house apartments. The actual client of the DH company is the housing company. The housing company pays at least two separate fees to the DH company. They pay a fixed DH interface-fee when they join the network and also a fixed interface cost each month. In addition, they pay for the consumed energy. The heating equipment at the house, which in the case of DH is not very expensive, belongs to the housing company as well.

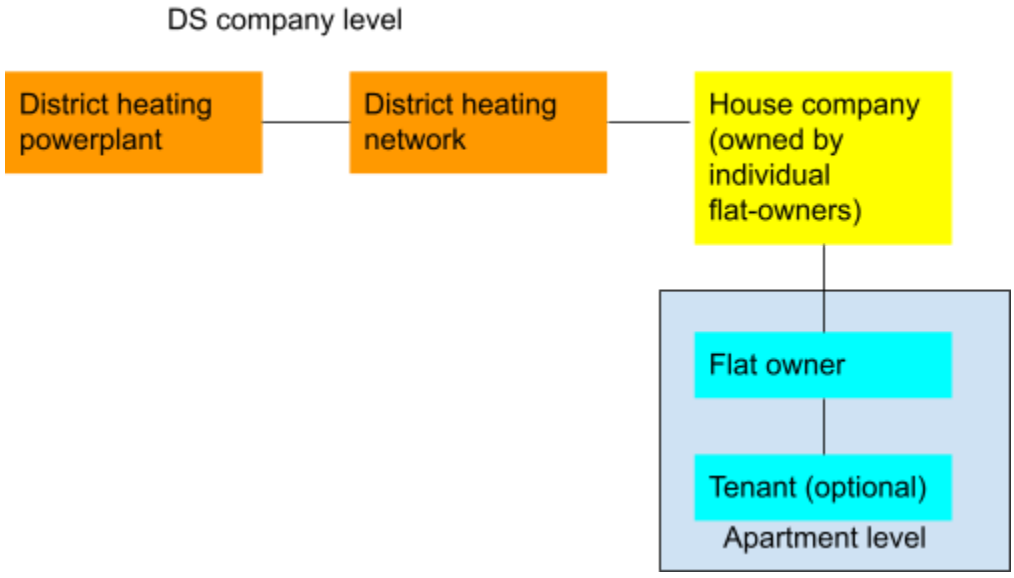

Figure 1. Value chain schematic example of DS market in Finland.

At the end user side, the end user is typically an apartment owner or a tenant. The apartment owner pays the housing company a monthly fee which includes energy for heating and for hot water (centralized heating). The fee is usually based on the area (m^2) of the apartment and it also includes shared heating costs for mutual space such as those of staircases. In addition, it includes service costs, which are not in the scope of this value chain study.

The estimated total heating costs of the house are shared to the apartment owners based on the relative area of their apartments. Thus, owners of several-room-flats pay several times more fees than a single-room apartment owner. For a tenant, the fees are usually

included in the monthly rent and the apartment owner pays the fee to the housing company. Housing company has a board of members and an annual meeting of apartment owners (i.e., share owners), which is the highest decision maker of the housing company. The fixed fee contains also the heating energy costs of mutual spaces such as staircases as well as the service fees. The heating devices at each apartment belong to the housing company. Also, the housing company owns all exterior walls, exterior windows, exterior doors and even doors between the flat and the staircase. Thus, the apartment owner does not own the radiators, thermostats, etc. He does not even have the right to install any different instruments or to install any instruments outside his apartment.

In Finland it is clear that the average consumption of District heat in summer is much smaller than that in winter. According to [1] the average consumption in July is about 15 % of that in February. However, DH is run also during the summer. In summer a significant task is to heat the domestic hot water.

Analysis - Finland

As one can realize from this scheme, there are some discrepancies in the FIN way in terms of saving energy or climate actions. The current way is that neither the heating energy nor the hot water spent is measured at individual apartment level. Instead, the fee is only based on the area of the apartment. For water usage it is customary to pay for the number of persons living in one apartment, but there is no separation between hot or cold water use. It could be considered, where is the motivation to save the room heating costs or hot water, if the apartment owner has to pay the same fee, no matter how much energy he uses each month? In an interview a chairman of a residential block-of-flats

commented that in Finland many houses are simply heated too much and significant savings could be achieved without a drop in comfort of living [5].

In this aspect, there is a recent change of legislation [6]. All new apartment buildings in Finland have to have in each apartment individual water consumption meters, while previously only the consumption at the whole building was measured. It is expected that eventually the individual pricing for the actual consumption of energy will have more influence on actual costs for the users.

The District Heating network in Finland is one of the most advanced ones in the world and new more efficient and low-carbon solutions are under constant development. As an example is the two-way District Heating. In the two-way DH, industry or even apartment buildings can charge and sell energy to the DH network, in addition to conventional use of the DH heat energy. However, in Finland there has not previously been open commercial use of the 2-way networks [1]. Instead, some DH companies have purchased excess heat to their network from large industrial suppliers. From 2018 on, the two-way DH has been experimented by a few Energy companies in Helsinki, Vantaa [2]. It can be estimated that in the future the two way DH will become more common in Finland.

Several DH companies see the two-way DH as a significant way to solve the seasonal energy storage issue. E.g. Vantaan Energia company is currently constructing the world's largest seasonal energy storage at Vantaa. It will serve as a part of the DH network of the city. The company and the city see it as a feasible way to answer the large-scale seasonal variation of DH energy in the future.

DH value chain in China

A distinctive difference in China, when compared to Finland, is that the DH market is very regulated and big. China has the word's largest and fastest-growing District energy system with 192721 km of hot water networks and 11692 km of steam networks [9]. The Provincal and State authorities have a strong control on DH companies, which are significantly larger than those in Finland, which was clearly observed in a comparison study of DH systems in Denmark (relatively similar to FIN) and China [7]. The control is implemented by strong regulation, such as pollution regulations/licenses, central planning and budgeting (for investments) or by subsidies (at consumer/user end). In practice, the authorities have a lot of power and they can influence the business decisions in the energy sector. Another distinctive difference is the large average energy consumption, which is in China even two times larger (kW/m^2) than on average in developed countries in the same latitude [7]. A third important difference is that the heating season is winter only - and the DS systems exist in the northern part of the country. Thus our focus area is not in South China.

The DH infrastructure in China was built mainly since 1953 and until 1980s it mainly relied on CHP plants. The construction of DH networks has proceeded hand in hand with the enormously fast urbanization and there has been special focus on developing the DH network in e.g. 12th five-year-plan. This has aimed to substitute numerous coal-fired small boilers (HOB) with DH.

Generally the DH networks use a high temperature of steam and they are often not very economically designed, in terms of scandinavian standards. The country has currently a heat reform in process [7]. It is well known that the air quality in cities and many industrial areas in China has been very poor due to large amounts of fine polluting particles which result from coal combustion. A major change is driven to reduce the coal use and often

substitute it by gas, however the country is still the greatest user of fossil coal in the world.

In China the energy consumed by manufacturing industries accounts for ⅔ of the total society's energy, high compared to total global average ⅓ [9]. Industry's excess heat is an important resource which is also utilized by long distance networks.

In China there is a law that apartments should have at least 18 ℃ room temperature, which has affected the way DH networks have been built [7]. Another significant difference is that each apartment owner usually owns extra radiators and heaters, which are inside the flat. The heating bill for the DH is fixed and it is counted by the apartment area m^2, however, separate devices for extra/surplus heating are used frequently [8]. Traditionally the mutual spaces such as staircases are not heated at all and thus unlike in Finland no-one has to worry who pays for that.

Current policies aim to prioritize locally based and tailored solutions. Local governments are required to carry out heat mapping and to find heat resources and map demand. DS networks could be improved through urban planning to affect energy densities. Clean energy sources need positive signals such as tax on coal heat for new districts. On the demand side new demand-based solutions are recommended. In the supply side, excess heat, geothermal and biomass shall be promoted taking into account local factors. Also it is recommended to develop progressively cleaner sources and increase the share of renewables [9].

Analysis - China

In the DH level, critical decision makers are the ones in control of the DH companies. Often the key persons for future investments are at the regional authority level. The DH company complies with the regulations and directives given by the regional authorities, who comply with the ones given by the national authorities. The DH company can only invest, if their investment is in line with the given regulation. On the other hand, there will appear an incentive for the DH company to invest, if a new regulation requires them to change their current production infrastructure.

However, large DH projects are often made, because typically construction projects in the giant Chinese cities are large and they involve realization of many buildings and structures in the same project [7].

On the consumer side, the Chinese consumers are obviously much more used to a cold apartment in winter than what has been conventional in Finland [8]. The district heating is heavily subsidised [7] but provides often just enough energy so that the flat is still not really warm. The consumers use electric heaters for improving their room comfort [8], and obviously for that purpose the energy is not subsidised. Regarding the extra heaters, in China the individual apartment owner has a direct advantage in saving a significant part of the energy that he uses. It is common that in the same house, different apartments have various heating instruments and even have installed solar PV panels at the exterior of the building for providing energy to the apartment owner.

Industrial surplus heat is an existing resource in China, which could be used at DH networks [7]. This could be a relevant market opportunity for FIN/EST companies with adequate products and services.

Value Chains of MALAYSIA Target area

We focus here on an interesting new application - consumer demand/production capacity response in using electricity. In all countries, there are time-based differences in the consumption of electric energy: e.g. in Scandinavia, the peak consumption occurs on coldest winter nights when the temperature is very low. Price of the electric energy is varied all the time, based on the Nord Pool trading market of offered energy and demand. The more energy is used the higher the price becomes.

Electrical energy Value chain in Estonia / Finland (case Fusebox)

The company through which it participates in this market is the Transmission System Operator (TSO). TSO is the backbone of the electrical system. Its aim is for the whole electricity system to work smoothly and to be an example of cooperation with neighboring countries. They need and buy rebalancing from the public market. Such TSO companies are Elering in Estonia and Fingrid in Finland.

Thus, there is a need in the global energy markets for products to balance electricity production and consumption.

The main driver is unpredictable manufacturers (sun, wind, water). An additional reason is high energy prices. This creates an opportunity to bring new products to market. The problem is easy to compare with blood pressure, it needs to be balanced. When there is overpressure or under pressure, the body begins to function irregularly. In the energy market, this is reflected in a power outage, in other words, a blackout.

The Transmission System Operator (TSO) pays to solve this problem. This will be solved with high-speed power plants, which are gas, petrol or diesel stations. If high-speed power plants are widely paid for today, a new way is to switch the equipment off or on (for example, to pre-cool the cold store). This significantly reduces CO2 emissions.

Consumption management companies (including Fusebox) bring together consumers who use a lot of electricity and want to earn extra income. Additional revenue is generated if they allow devices to be turned on or off. Honestly, this switching is done in a way that the company doesn't even notice.

An important intermediate layer is smart infrastructure companies. Those who automate large industries. The equipment of a consumption management company can be connected to such smart systems. Consumption management companies do not make industry smart, but they do use smart industry to solve the problems of an energy company. Making more money with it for themselves and industrialists. At the same time reducing CO2 emissions. Figure 2 shows the concept of Fusebox platform.

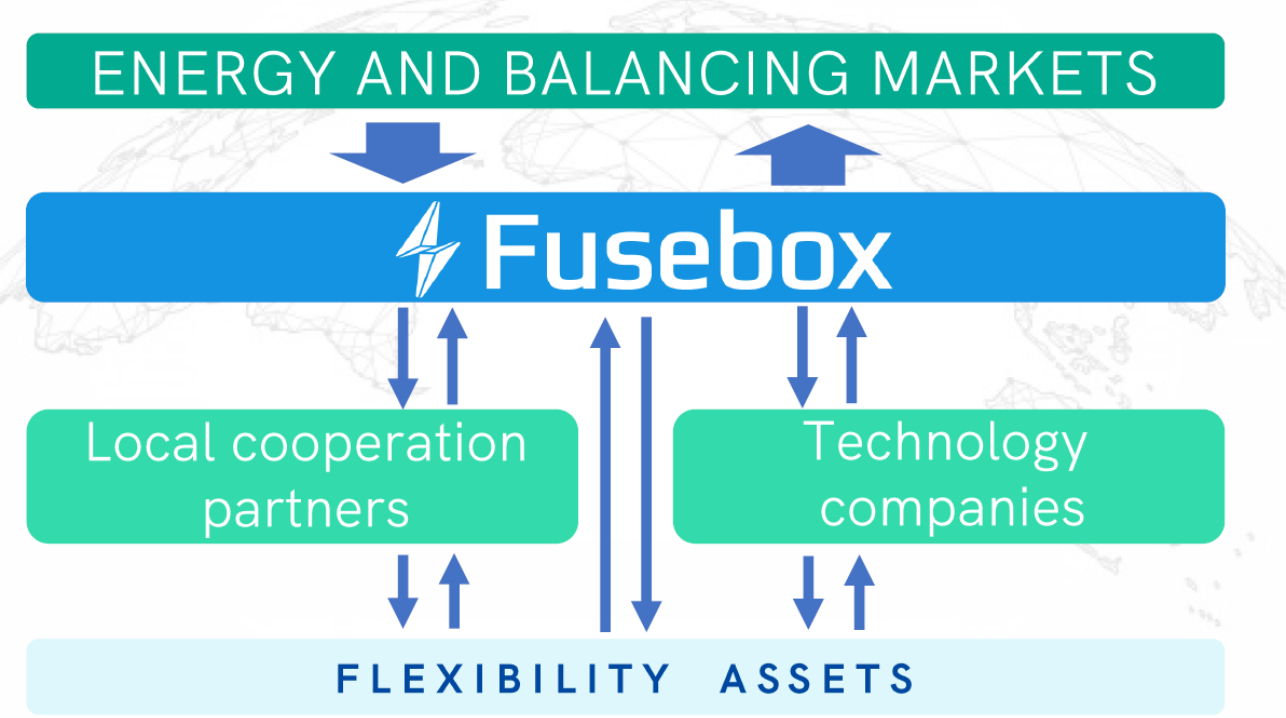

Figure 2. Fusebox platform positioned to enable market transformation

Electrical energy value chain in Malaysia

Malaysian TSO company is Tenaga Nasional (TNB). Everything works the same as described above. The only difference is whether the company can provide the service directly or whether it has to cooperate with an electricity seller and offer it through it, that is, be dependent. The latter works better in Malaysia.

TNB has a monopoly of the Malaysian grid and thus power generation has not been liberalized. The target is to find a local partner who will handle the marketing, distribution, and after-sales service, possibly one partner in the residential development sector and one in the industrial sector. The goal for the Fusebox is to be the technology and knowledge provider to a local partner company in Malaysia.

Analysis

We will give three examples of revenue projections and CO2 emissions calculations. All revenue forecasts are priced according to the Baltic market and CO2 is also calculated based on the Baltics.

<u>Commercial Building, 10,000m2, Flexibility 50 kW</u>

Total annual revenue € 9,000, total revenue in 5 years € 54,000
Forecast of CO2 emissions reduced: annual 18.8 t in 5 years 93.84 t

Cold Storage, 10,000m2, Flexibility 200 kW

Total annual revenue € 36,000, total revenue in 5 years € 216,000
Forecast of CO2 emissions reduced: annual 46.9 t in 5 years 234.6 t

Industrial client, Flexibility 1000 kW

Total annual revenue € 150,000, total revenue in 5 years € 975,000
Forecast of CO2 emissions reduced: annual 234.6 t in 5 years 1173 t

* Revenue is shared between Fusebox and the customer according to the agreement.

Conclusions

There are currently strong trends in Finland and in Estonia (and the whole European Union) to lower carbon emissions, where heat energy production/consumption and electrical energy production/use plays a significant role. This can be partly done by utilizing more renewable energy or improving the efficiency of the DH systems. Another promising way is the smart electrical consumer/supply response. This all brings new opportunities to energy sector companies in Scandinavia.

A similar trend is expected to increase in China as the climate neutrality goal 2060 has been exposed in 2020. A significant existing resource to utilize is the industrial surplus heat sources. For the DH market in China, there are opportunities for FIN and EST companies. It is important to take into account the controlling influence of the government and local authorities as well as other differences which were presented

earlier. One should approach the market by a correct path, using local specialists. In addition, due to the huge size of the China DH sector, it is wise to consider which cases and where to focus. At the Asian large-scale markets, smaller players can utilize a niche market in the very core of their products/service competitive edge: exactly where are you the best in the world?

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