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Bio-FlexGen

5.3 Analysis of local stakeholders and engagement plan

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[1] PU = Public
PP = Restricted to other programme participants (including the Commission Services)
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Summary

Summary of Deliverable

This document contains the Deliverable D5.3. "Analysis of local stakeholders and engagement plan" of the Bio-FlexGen project. This deliverable aims to identify the main local stakeholders, meaning local key interest groups that may have an impact or may influence the deployment of the technology developed in the project.

This deliverable corresponds to Task 5.2 (Social Assessment) of Work Package WP 5 (Sustainability Studies). The overall objective of this task is to estimate the potential social impact of the Bio-FlexGen technology in local communities surrounding the new energy production plants and the environments where raw material (biomass) will be collected from. The task will start with the identification of the main local stakeholders.

As the TRL the project is targeting by the end of the project is low (TRL5), the consortium has not planned any implementation of the whole technology in a real environment. Therefore, ZABALA, together with the coordinator and other consortium partners will build two theoretical scenarios where the technology may potentially be deployed in the future. These communities will be representative of future local communities and will enable the consortium to understand potential social benefits and risks while fostering the future social acceptance of the technology.

ZABALA has conducted a pre-identification of potential local stakeholders, including, but not limited to workers, people living in the neighbourhood, NGOs, Civil Society Organisations (CSOs), local authorities and local business owners. In a later stage, representatives of these groups will be interviewed to determine their interest and influence in the new technology, their willingness to contribute to drafting experimental local communities and identify the main communication channels.

Disclaimer

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1 Analysis of stakeholders

The term stakeholder refers to individuals and organisations who are actively involved in the project, or whose interests may be positively or negatively affected as a result of a successful project completion.

The analysis of stakeholders is the process of identifying these individuals and organisations at the beginning of any project or business activity, grouping them according to their levels of interest and influence in the project, that is, their power, legitimacy and urgency, and how they may be impacted. This will allow to define how to best engage them and communicate to each of these stakeholder groups. The more stakeholders can be identified early on, and the more the communication can be tailored for the approval and support from various stakeholders, the more likely the project is to succeed from an economic and social perspective.

The analysis of stakeholders helps to understanding their perspectives, viewpoints, needs and demands. The analysis also helps to identify possible risks and requirements as well as to share the appropriate level of information with them. If the main stakeholders are well identified, this allows to communicate with them more effectively and select a suitable communication strategy at an appropriate time. The analysis of stakeholders ultimately helps to build trust. The more a project engages and involves its stakeholders, the better it builds trust.

There are three steps to conduct the analysis: 1) Identify the stakeholders; 2) Prioritise the stakeholders; and 3) Understand the stakeholders.

1. **IDENTIFY the stakeholders**. List of all the individuals/organisations who are affected by the project, who have influence or power over it, or have an interest in its successful or unsuccessful conclusion.

2. **PRIORITISE the stakeholders**. Some of the stakeholders identified may have the power either to block the project or to advance it while others may only be interested in the project, and others may not care. Thus, once obtained a list of individuals/organisations which are affected by the project, they will be categorized according to their salience, interest, influence and level of participation in the project in order to assess which stakeholder needs to be prioritised. This prioritisation can be performed through a Power/Interest Grid (Mendelow, A.L. (1981). 'Environmental Scanning - The Impact of the Stakeholder Concept') that allows to map and classify the stakeholders according to their power over the project and their interest in it (see Figure 1).

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Figure 1 Power/Interest Grid for Stakeholder Prioritisation

The position allocated to each stakeholder on the grid provides the actions that should be taken to each of them:

- HIGH POWER + HIGH INTEREST (Manage Closely). These stakeholders must be fully engaged in the project and the greatest efforts must be made to satisfy them.
- HIGH POWER + LESS INTEREST (Keep Satisfied). The project should make sufficient efforts to keep these stakeholders satisfied, but not to the point of an information overload.
- LOW POWER + HIGH INTEREST (Keep Informed). These stakeholders need to be adequately informed and should be contacted to ensure that no major issues will arise.
- LOW POWER + LESS INTEREST (Monitor). These stakeholders need to be monitored but in a moderate way, so they do not feel bothered by excessive communication.

3. **UNDERSTAND the stakeholders**. The final stage is to get a thorough understanding of the stakeholders' motivations which will allow to define the communication with them. Therefore, a profile of each stakeholder can be built based on these three questions:
   a) What motivates the stakeholders?
   b) How does this project align with their priorities? What other priorities might they have?
   c) If they have a negative view of the project, what can we do to change that?

Once these three steps are carried out, the stakeholder communication and engagement plan will be developed.

A proper stakeholder analysis is key to ensure the social sustainability of the project and to plan a social impact assessment methodology which is relevant and useful for interest groups. The analysis provides an overview of the main interests of stakeholders to pre-identify impact indicators meaningful for them.

2 Societal Readiness Levels (SRL)

The ultimate goal of the analysis of stakeholders and social impact estimation is to ensure the social acceptance of the technology by tackling any harmful impact. Social acceptance, however, needs to be addressed in the early research stages and keeps advancing in parallel to the research and technology development. The concept of "Societal Readiness Level" (SRL) permits to identify the different stages to advance towards the social acceptance of a new technology/development.

According to the "Innovation Fund Denmark", the Societal Readiness Level (SRL) is the way to assess the level of societal adaptation of a particular social project, a technology, a product, a process, an intervention, or an innovation (whether social or technical) to be integrated into society. Thus, if the SRL for the project is expected to be low, suggestions for a realistic transition towards societal adaptation are required. Naturally, the lower the societal adaptation is, the better the plan for the transition must be. SRL 1 is the lowest and SRL 9 is the highest level.

SRL	DESCRIPTION SRL
SRL 1	Identifying problem and identifying societal readiness
SRL 2	Formulation of problem, proposed solution(s) and potential impact, expected societal readiness; identifying relevant stakeholders for the project
SRL 3	Initial testing of proposed solution(s) together with relevant stakeholders
SRL 4	Problem validated through pilot testing in relevant environment to substantiate proposed impact and societal readiness
SRL 5	Proposed solution(s) validated, now by relevant stakeholders in the area
SRL 6	Solution(s) demonstrated in relevant environment and in cooperation with relevant stakeholders to gain initial feedback on potential impact
SRL 7	Refinement of project and/or solution and, if needed, retesting in relevant environment with relevant stakeholders
SRL 8	Proposed solution(s) as well as a plan for societal adaptation complete and qualified
SRL 9	Actual project solution(s) proven in relevant environment

Stages SRL 1 - 3 reflect the early work in a research project, including suggesting and testing on a preliminary basis a technical and/or social solution for a technical or a societal problem. Here reflections about the general societal readiness towards the idea and its proposed solution(s) are required, including identifying relevant stakeholders and how to include them (such as end users, the involved communities, etc.).

Stages SRL 4 - 6 represent the actual solution(s), the research hypothesis, and testing it/them in the adequate context in cooperation with relevant stakeholders, while keeping a focus on impact and society's readiness for the technology. In these stages expectations on the societal adaptation must be described in specific terms and, if possible, be part of the test phase.

Stages SRL 7 - 9 include the final stages of the research project, including refining the solution(s), implementation and dissemination of results and/or solution(s). Here the plan for addressing the societal readiness on a practical level to gain impact, creating awareness, disseminating results, etc., will be carried out.

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3 Description of Bio-FlexGen Deployment Scenarios

The main objective of Bio-FlexGen is to develop and validate a reliable, cost-efficient, secure, and flexible CHP system. It is based on the combination of highly efficient utilisation of local biomass with renewable hydrogen production which is adaptive and scalable to variations in energy demand and energy supply (Biomass-fired Top Cycle technology, BTC). Bio-FlexGen understands the relevance of developing reliable renewable systems for combined heat and power (CHP), thus expanding their role in the energy system. To that aim, the project has identified **two Deployment Scenarios - residential and industrial -, and within each scenario different Business Use Cases (BUCs) will be defined,** to implement the Bio-FlexGen BTC technology and to evaluate the sustainability impact.

The Bio-FlexGen consortium has been structured so that future opportunities for the exploitation of the different project technologies and results' exploitation are maximised. The industrial involvement in the project is key to ensure the exploitation of the results will serve as validators of the project.

As the TRL the project is targeting is low (TRL5), the consortium has not planned any implementation of the technology in a real environment. Therefore, ZABALA, together with the coordinator will build **two examples of local communities (experimental communities)** that may potentially be located in the surrounding of this new technology in future deployment scenarios. These communities will be representative for future local communities and will enable the consortium to understand potential social benefits and risks while fostering the future societal acceptance of the technology. To that aim, Bio-FlexGen has engaged **District Heating (DH) companies (TVaB and Gothenburg Energy)** and **industrial end users (SULQUISA/CEMEX)** who will provide with their requirements in terms of energy solutions and their specific process expertise, business perspectives and strategic targeting of new business models.

These two types of scenarios have been identified because they are suitable and complementary for the purposes of the project. Both scenarios are homogeneous to allow comparisons, and at the same time they present distinctiveness among them to enrich the conclusions.

3.1 District heating scenario

One of the deployment scenarios comes from the deployment of DH systems in Nordic regions to address the climate targets for the coming years. The massive electrification will lead to additional local grid and production capacity challenges where the existing electric grids do not have enough capacity to transfer the required amount of electricity. This is already happening in several Swedish metropolitan areas and can have major consequences on employment, housing, infrastructure, and economic growth. In this respect, DH systems can solve the issue by both decreasing the need for electricity for heating and providing local electricity generation in CHP plants. Furthermore, sector coupling units in DH systems such as CHP plants, heat pumps and electric boilers can contribute with flexibility in heat and local electricity networks. To that aim, the Bio-FlexGen technologies can contribute to the electrification of the energy system by both decreasing the need for electricity for heating and providing local electricity generation in combined heat and power (CHP) plants. Therefore, the BUCs in Sweden investigates the utilisation of the new BTC CHP technology in the production portfolio of DH companies from both technical and economical perspectives. Within this scenario, two BUCs based on Swedish DHCs will be developed: **Tekniska Verken in Linköping** and **Gothenburg Energy.**

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3.1.1 Tekniska Verken in Linköping (Sweden)

The Swedish DH Company, Tekniska verken will test the BTC CHP technology both in technical and economical perspectives. Tekniska verken is a regional and municipally owned utility company with approximately 1,000 employees and annual net sales of € 550 million. Tekniska verken supplies electricity and heat to large parts of the Östergötland region in the southeastern parts of Sweden, in which cogeneration plants have for a long time been essential for providing the company with heat and power. The company is also building new plants for energy recovery, quality assuring the production of drinking water, developing waste management processes and much more. Furthermore, Tekniska verken produces biogas, electricity, and supplies DH and cooling in various number of locations.

DH production

In Linköping, DH has been around for over 60 years for small and large customers. DH supplies heat, for residential houses, apartment buildings, schools, shops and industries. In addition to central Linköping, Tekniska verken holds DH centers in Berg, Ljungsbro, Sturefors, Vikingstad and Linghem. In Linköping, Tekniska verken supplies 1,500 GWh of DH with different types of waste, i.e., with energy from resources that would otherwise have been lost. In Tekniska verken's CHP plants, the company produces both DH and electricity at the same time, achieving high levels of fuel efficiency. In an average year, 85% of the DH in Linköping and Mjölby is produced by waste.

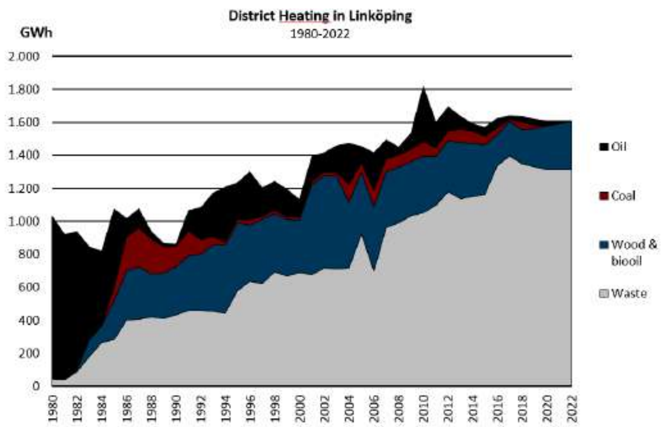

Figure 2 Sources of DH in Linköping

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DESCRIPTION AND DEMOGRAPHICS OF LINKÖPING

Tekniska verken is located in Linköping, one of Sweden's fastest-growing municipalities, home to about 160,000 inhabitants and is in many ways a major center in the region. Linköping is the fifth largest city in Sweden being the capital of Östergötland County. Linköping boasts a high technology and new-thinking university, with over 27,000 students including its Campus Norrköping. Founded in 1969, the university is known for its interdisciplinary principles and its creative approach to education and research. Linköping is also known for its high technology industry. One of the biggest employers in Linköping is Saab and the city also has a strong presence in information technology with the headquarters of IFS AB, Sectra AB and Cambio Healthcare Systems AB, as well as the presence of Motorola, Ericsson, Infor, and many others. Toyota Industries Sweden AB has a presence in Linköping, as one of its subsidiaries, BT Industries, is located in nearby Mjölby.

Figure 3 Location of Tekniska verken in Linköping

Linköping strives to become a sustainable city and commits to implement the Goals and the 2030 Agenda. The municipality has undertaken a number of big investments in order to secure sustainable development. The region has an extensive and efficient waste management system and has become an international role model for its largely zero-waste cycle. Linköping is home to Sweden's largest biogas facility, converting organic waste from the food industry and households into biogas and biofertilizer. Production of biogas in Linköping started in 1997, and in 2017 Tekniska verken produced 120 GWh of energy from biogas, equivalent to 13 million litres of petrol, in the largest biogas facility in Sweden. The biogas production fuels public transport in Linköping and biofertilizer in agriculture. Another big investment addressed to fight climate change has been the construction of Sweden's largest solar park which opened in summer 2020. Located on the E4 highway next to the Gärstad plant in Linköping, it can produce annual electricity for 2,300 households.

Recycling stations for used household goods is the latest addition in striving for a circular and resource-effective society. Citizens in Linköping are encouraged to contribute to a sustainable environment and there are numerous second-hand shops and flea markets in Linköping. The region´s fertile farmland also provides local and organic food, sometimes sold at farmers´ markets in the area.

The municipality of Linköping was formed during the municipal reform in 1971 by the city of Linköping and the rural municipalities of Norra Valkebo, Södra Valkebo, Vreta kloster, Vårdnäs and Åkerbo. In 2021 the **population** in Linköping Municipality numbered 165,547 people, 931 more than in 2020 and 797 more than in 2019. The majority of the population in the Linköping municipality is between 20 and 29 years old. The urban area of Linköping had 2.878 inhabitants per square kilometer in 2020. The population density is highest in the central town within the municipality. The second most densely populated part of the municipality in 2020 was Malmslätt followed by Sturefors, Linghem, Ekängen and Ljungsbro. In 2020, the urban area of Linköping amounted to 41.3 square kilometers. The areas where the population is expected to increase the most in the coming decade are Berga, Ekängen, Skäggetorp, Västra Valla and the new district Djurgården. Areas with a reduced population are Vidingsjö, Lambohov and Malmslätt.

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According to the Linköping Municipality[1], the **gross regional product (GDP)** in 2018 amounted to SEK 84.1 billion (8.1 billion EUR) for the municipality of Linköping (GDP in Sweden in 2018 was 519,9 billion EUR). This was 3.9% higher than the year before and in a decade, GDP in current prices has increased by 75% for Linköping municipality. GDP per capita in 2018 amounted to SEK 526,000 (EUR 50,809) in Linköping municipality, which was SEK 11,000 (EUR 1,062) higher than in 2017 (GDP per capita in Sweden in 2018 was EUR 45.908). In 2019, 16% of the population in Linköping municipality lived in households with a low economic standard, a 1% higher than the year before. 20% of children aged 0-17 years lived in households with a low economic standard, i.e., they were at risk of relative child poverty. In 2018, 3.4% of the population in Linköping had financial assistance at some point during the year and the districts closest to that level were Tannefors and Lambohov. Earning income was highest in 2019 for those living in Ekängen, Slaka and Hackefors. The districts where earned income is highest are Hackefors, Jägarvallen, Hjulsbro and Ullstämma. In student-dominated districts such as Västra Valla and Ryd, the median of earned income is lowest.

The areas where the highest proportion of the population has a **long post-secondary education** are Lambohov västra, Vreta and Hagaberg. The highest proportion with upper secondary education is in Sågareholmen, Arnebo and Sjögestad. The highest proportion with pre-secondary education is in Saab, Rosendal and Stångebro östra.

The **age distribution** varies greatly between Linköping's districts and urban areas. In central districts such as Innerstaden and Vasastaden, there are a large number of young people, young adults and pensioners, while in relation to the population size, there are many preschool children and school children in areas such as Hjulsbro, Ullstämma and Ekängen.

The **employment rate** for people with long post-secondary education amounted to 90.6% in 2019 for those aged 30-64 and to 57.4% for those with pre-secondary education in the same age group. For people with upper secondary and short post-secondary education, approximately the same employment rate is shown. The difference between the sexes decreases with rising education level and amounted to only 0.4% points for those with long post-secondary education. In the age groups 20-64 years and 16-74 years, the employment rate among those with long post-secondary education is higher for women than for men.

In May 2021, 5.1% of the population aged 16-64 were unemployed, which corresponds to an **unemployment rate** of 6.6% of the labor force. Of the foreign-born population, 13.8% were unemployed, which can be compared with an unemployment rate of 19.8% for the foreign-born labor force.

The most common **household size** in Linköping municipality is one person. 43% of all households consist of one person and 30% of households consist of two people. Just over 5% of all households in the municipality consist of five people or more.

The **demand-based housing shortage** in Linköping municipality in 2019 amounted to 2.118 homes. This meant that 2.8% of all households in the municipality did not have a reasonable housing that corresponded to their need for housing. 10.5% of the households with a reference person with a foreign background were in need of housing that would better suit the household's needs, which can be compared with 0.9% of households with a reference person with a Swedish background being in the same situation.

[1] https://www.linkoping.se/kommun-och-politik/

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3.1.2 Göteborg Energi in Göteborg (Sweden)

Göteborg Energi is an energy company owned by the City of Gothenburg created 160 years ago, with more than 1,000 employees and net sales in 2021 of SEK 7,302 million (EUR 705 million) (Goteborg Energi). Through its ownership of Göteborg Energi AB, the City of Gothenburg wants to integrate and develop energy and urban fiber operations in urban development, and at the same time participate in the development of a sustainable Gothenburg society. The mission of the company also consists of ensuring environmentally and climate-sustainable, delivery-safe and affordable energy and infrastructure for communication for the city's citizens and companies.

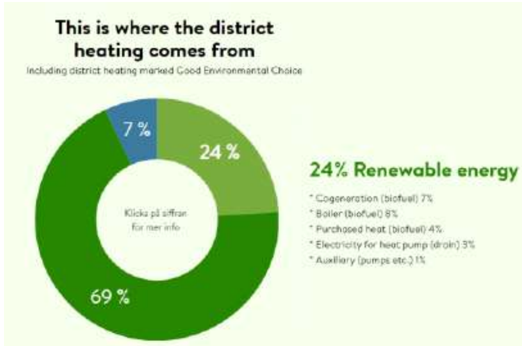

Figure 4 Sources of DH in Göteborg (Göteborg Energi)

24% of the DH comes from renewable energy: cogeneration (biofuel, 7%), boiler (biofuel, 8%), purchased heat (biofuel, 7%), electricity for heat bump (drain, 3%), auxiliary (pumps, etc., 1%). 69% comes from recovered energy (cogeneration of waste, industrial surplus heat, wastewater, and flue gas condensation), 7% comes from fossil energy (natural gas cogeneration) and boiler (natural gas, oil).

DESCRIPTION AND DEMOGRAPHICS OF GOTHENBURG

Gothenburg (in Swedish Göteborg) is Sweden's second largest city, after Stockholm, and the Nordic region's fifth largest with 604,829 inhabitants (2020) in the urban area and 1,060,000 inhabitants (2021) in Greater Gothenburg (Statistics Sweden). Gothenburg is located on the west coast, in southwestern Sweden, about halfway between the capitals Copenhagen, Denmark, and Oslo, Norway. The city area is 721.64 square kilometers, of which 271.41 square kilometers is water (Statistics Gothenburg).

Figure 5 Location of Gothenburg

Due to Gothenburg's advantageous location in the centre of Scandinavia, trade and shipping have always played a major role in the city's economic history. At a key strategic location at the mouth of the Göta älv, where Scandinavia's largest drainage basin enters the sea, the Port of Gothenburg is now the largest port in the Nordic countries. The archipelago of Gothenburg consists of rough, barren rocks and cliffs, which also is typical for the coast of Bohuslän. Due to the Gulf Stream, the city has a mild climate and moderately heavy precipitation.

Apart from trade, the second pillar of Gothenburg has traditionally been manufacturing and industry, which significantly contributes to the city's wealth. Major companies operating plants in the area include SKF, Volvo (both cars and trucks), and Ericsson. Volvo Cars is the largest employer in Gothenburg, not including jobs in supply companies. The blue-collar industries which have dominated the city for long are still important factors in the city's economy, but they are being gradually replaced by high-tech industries. Banking and finance are also important, as well as the event and tourist industry. Gothenburg is the terminus of the Valdemar-Göteborg gas pipeline, which brings natural gas from the North Sea fields to Sweden, through Denmark. Historically, Gothenburg was home the base of the Swedish East India Company in the 18th century. From its founding until the late 1970s, the city was a world leader in shipbuilding,

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with such shipyards as Eriksbergs Mekaniska Verkstad, Götaverken, Arendalsvarvet, and Lindholmens varv.

Gothenburg has two universities, both of which started as colleges founded by private donations in the 19th century. The University of Gothenburg has about 38,000 students and is one of the largest universities in Scandinavia, and one of the most versatile in Sweden. Chalmers University of Technology is a well-known university located in Johanneberg, 2 km south of the inner city, lately also established at Lindholmen in Norra Älvstranden, Hisingen. In 2015, there were 49 high schools in Gothenburg. Some of the more notable schools are Hvitfeldtska gymnasiet, Göteborgs Högre Samskola, Sigrid Rudebecks gymnasium and Polhemsgymnasiet. Some high-schools are also connected to large Swedish corporations, such as SKF Technical high-school owned by SKF and Gothenburg's technical high-school jointly owned by Volvo, Volvo Cars and Gothenburg municipality.

Gothenburg has performed extremely well in international rankings: The Global Destination Sustainability Index has named Gothenburg the world's most sustainable destination every year since 2016. In 2019 Gothenburg was selected by the EU as one of the top 2020 European Capitals of Smart Tourism. In 2020 Business Region Göteborg received the 'European Entrepreneurial Region Award 2020' (EER Award 2020) from the EU.

A FAST-GROWING REGION

According to Business Region Göteborg AB, a non-profit subsidiary owned by the City of Gothenburg, Gothenburg is one of the **fastest growing regions in Europe**. The region accounts for just over a fifth of Sweden's total export value and more than a third of the country's total R&D expenditure in businesses. The large investments by businesses in R&D have transformed Gothenburg from a heavy industrial city to the country's innovation engine and a world-leading city with a strong knowledgebase. Major investments are being made in infrastructure and urban development, which in turn have increased commuters and new inhabitants rapidly.

For many years, the Gothenburg region has had **birth and migration surpluses**. 1,049,592 residents live in the Gothenburg region in 2020 and every year since 2000, the Gothenburg region's population has increased by around 1%. During the Covid-19 pandemic in 2020, the region's population increased by about 8,000 residents. By 2035, the region is expected to be home to just over 1.2 million people.

A comparison with Sweden's **average age breakdown** in 2020 shows that the Gothenburg region has a relatively young population. The share of the age group 0-44 is larger than the national average, while the share for the age group 45-65 is smaller. Compared to Sweden as a whole, a larger proportion of the 25-64 age group in the Gothenburg region has a post-secondary education, up to the level of doctoral studies/research education.

Regional GDP per capita in the municipality of Gothenburg in 2018 was SEK 699 thousand (EUR 67.558) while in Sweden was SEK 475 thousand (EUR 45.908) (Statistics Sweden, Department of National Accounts). The **total wage sum** in the Gothenburg region is growing at a faster rate than Sweden as a whole. Above all, this growth is most prominent within construction and services. Overall, employment in the region is growing at a faster rate than the national average. A rapidly expanding knowledge-intensive business services sector supports the manufacturing companies, and the region's business environment is gaining further nuance through growing businesses within information and communication, construction and real estate.

The **labour market area**, which today encompasses 1.2 million people, is expected to grow to 1.8 million people by 2030. The **average annual growth in total wage** sum in the Gothenburg region during the period 2010-2020 was 3.4%. In terms of individual sectors, the largest growth has been seen in the construction sector, followed by the services sector. In 2019, more than 550,000 people were working

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in the Gothenburg region. This represents an increase of 38% since the year 2000, or 152,000 employed persons. In 2019 business services was the sector with the most employees in the Gothenburg region (85,143 employees), followed by healthcare and care. Although most sectors in the Gothenburg region have seen an increase in the number of employees, Swedish manufacturing and mining has experienced negative growth.

During the Covid-19 pandemic year of 2020 the **unemployment** increased throughout all of Sweden. In the Gothenburg region the unemployment averaged 7.5% in 2020, which is still the lowest among the country's metropolitan regions, and 1% lower than the national average. During the Covid-19 pandemic year of 2020 the unemployment increased throughout all of Sweden. Since 2000, the number of **newly started companies** in the region has doubled. In 2020, over 8,200 new companies were started in the Gothenburg region, corresponding to 11% of all newly started companies in Sweden.

The Gothenburg region boasts world-leading competence in solutions for reduced CO^2 emissions and cleantech. The region has numerous partnerships involving energy, smart urban development, transportation, and waste management aiming to reduce the impact on the environment. An area that has been very successful for the region is the shift to a fossil-free transportation system and energy solutions, and to create living testbeds for innovative sustainable solutions. Green bonds have played an important role in financing the investments and Gothenburg was the first city in the world to issue green bonds.

3.1.3 Identification of local stakeholders in DH deployment scenario

After analysing the business and local context of the DH deployment scenario, we will provide the categorisation of the main local stakeholders (see Table 1) who may be impacted or may influence the deployment of the new BTC CHP technology in the production portfolio of DH use from both technical and economical perspectives. To do so, the following assumptions have been considered after obtaining the feedback of the local partner.

- The introduction of the BTC CHP technology in the DH system may not have any notable impact on the heat customers.
- The additional power production would replace other fossil power production, which would be of great benefit regarding climate impact in the municipality.
- The introduction of the BTC CHP technology would imply a partial fuel switch from the current suppliers to forest residues, thus causing a change in these supply flows.
- The operation of a BTC plant is more complex, requiring hiring additional staff for maintenance and for operation.
- Forest residues are more expensive than other fuels.
- Public authorities can have a great influence in supporting the implementation or deployment of the new technology or in the contrary, they can put regulatory barriers to complicate its deployment.

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Table 1 Stakeholder prioritisation in DH scenario

		YES	1	NO	0		
Stakeholder category	**Stakeholder description**	**Does this stakeholder exert a great influence on the technology?**			**Is this stakeholder greatly affected by the technology?**		
		ECON	**SOCIAL**	**ENVIRO**	**ECON**	**SOCIAL**	**ENVIRO**
Suppliers	**Forest residues supplier**	1	0	1	1	0	0
	Current suppliers	0	0	0	1	0	0
Local communities		0	1	0	1	1	1
Local authorities		1	1	1	0	1	1

Method of estimation of Table 1: Local partners have been asked to assess the influence and impact of each group of local stakeholders in the deployment of the technology. When it is considered that the stakeholder has an impact on the project in an economic, social or environmental dimension, it is given the value '1'; if not it is given '0'. Likewise, when it is considered that the stakeholder is affected by the project in one of the three dimensions, it is given the value '1', if not it is given '0'. The sum of all the values allows us to prioritise the main stakeholders of this scenario. These stakeholders will be those who will affect the project the most and who will be most affected by the project. These stakeholders will be thus the ones with whom we will have to interact the most.

3.2 Industrial scenario

CHP technology can be also applied to industrial processes to increase energy efficiency. Energy intensive industries have already CHP units integrated in their processes. In this sense, Bio-FlexGen will evaluate the potential of the new BTC technology in comparison with existing CHPs and with other energy carriers in one company of the cement industry and another one from the chemical industry sector. To this aim, three BUCs based on industrial applications in Spain will be developed: **Cement industry (CEMEX)** for two CEMEX factories in Spain (Alcanar and Alicante) which currently do not have CHP installations and **Mining and cement industry (SULQUISA).**

3.2.1 CEMEX in Alicante and Alcanar (Spain)

CEMEX is a global building materials company for the construction sector with more than 110 years of history that provides high-quality products and services to customers and communities in more than 50 countries with more than 40,000 employees. CEMEX España Operaciones is a leading company with a major presence in the cement, concrete, aggregates and mortar businesses with more than 1,000 employees, 6 cement plants, 65 concrete plants, 13 mortar plants, 21 aggregates quarries, 9 maritime terminals, 15 land terminals. In the last 2 years CEMEX has invested more than 8 million euros improving its processes to reduce the impact of its industrial activity and making it more sustainable, as well as to manufacture products with a lower CO2 footprint. In this sense, CEMEX has set the goal to achieve a **reduction of emissions of at least 55% by 2030 and zero-emission concrete by 2050**[2]. This decision is in line with the European Commission as a goal for all its member countries.

With an annual production of 179.8 Mt (2018), cement is the most produced basic material in Europe. Thermal energy demand for its production process ranges between 3000 and 4000 MJ (833 – 1111 kWh) per ton of cement clinker, whereas electrical energy represents up to 20% of the overall energy

[2] https://www.cemex.com/sustainability/future-in-action

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demand, ranging from 90 to 150 kWh per ton of cement. A wide variance of fuel types such as petroleum coke, coal, natural gas, domestic waste, nontoxic industrial waste, or biomass are used in order to generate the heat required in the cement kiln. Fuel choice varies based on local availability, associated direct emissions, and cost.

Due to its high thermal and electric energy intensity, cement production is a natural fit for combined heat and power (CHP) applications. Heat produced by CHPs could be used for the **drying process of alternative fuels and other raw materials** used in the plant. Use of hot gases produced by BTC unit for the drying of raw materials and fuels would make the process in the kiln more energy efficient and potentially increase the share of biobased fuels.

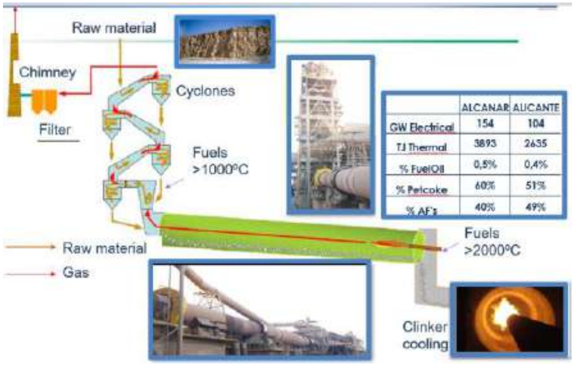

Figure 6 Source of electricity in CEMEX Alicante and Alcanar

In addition, hydrogen produced by an on-site electrolyser in a cement plant could **either fuel a high-efficient cogeneration plant** or be used as an **additive in the cement kiln** to increase the share of biobased fuels.

The CEMEX Alicante cement plant started in 1975 and produces 1.6 Mton/yr of cement and 1.1 Mton/yr of clinker. CEMEX Alicante hires 110 direct employees and more than 130 indirect ones. CEMEX Alicante currently uses 49% of alternative fuels, which has led to reduce 67,000 CO2 tons. The total electrical consumption in the CEMEX Alicante cement plant is 104 GWh.

The CEMEX Alcanar cement plant started in 1969 and produces 1.8 Mt of cement and 2 Mt of clinker. CEMEX Alcanar hires 140 direct employees and more than 130 indirect ones. CEMEX Alcanar currently uses 40% alternative fuels, which has led to reduce 59,000 CO2 tons. The total electrical consumption in CEMEX Alcanar cement plant is 154 GWh.

DESCRIPTION AND DEMOGRAPHICS OF ALICANTE

CEMEX Alicante is located in Barrio Rabasa in Alicante. Alicante is a city and municipality in the Valencian Community, Spain. It is the capital of the province of Alicante and a historical Mediterranean port. The population of the city was 337.482 in 2020, the second largest in Valencian Community, and 768.194 in the metropolitan area "Alicante-Elche", and 1.863 million in 2019. In 2020, about 20–25% of the population were immigrants from North Africa, South America and Eastern Europe. Alicante forms a conurbation of 468,782 inhabitants with many of the towns in the Campo de Alicante region: San Vicente del Raspeig, San Juan de Alicante, Muchamiel and Campello. Statistically it is also associated with the Alicante-Elche metropolitan area, which has 757,085 inhabitants. It is one of the most important tourist destinations in Spain.

The **economy of the city of Alicante** is mainly based on the **services sector**, which employed 85.7% of the active population in 2007. The latest data published by the Spanish Statistical Office places the **unemployment rate** in the city of Alicante at 19.8% for the month of April 2018. Among the **economic activities** carried out in the city, trade stands out, which historically had the port of Alicante as its support point. The commercial activities of the city have a great power of attraction for most of the province, and it reaches through the Vinalopó axis to Almansa. Currently, the city of Alicante holds the fifth position at the national level in importance in terms of trade, only surpassed by cities such as Madrid, Barcelona, Valencia or Seville. **Tourism**, already present in the mid-nineteenth century, but mainly developed since the 1950s, is also another important factor for the city, supported by the mild climate, the beaches, the historical heritage (Santa

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Bárbara castle, Santa Bárbara church, María, San Nicolás co-cathedral, old town, Torres de la Huerta, etc.) and its leisure offer.

Real estate activity is also an important part of Alicante's economic activity. The real estate market is an auxiliary engine for the tourism industry, not only because of its economic value, but also because of its social value as a generator of employment. The **University of Alicante**, located in San Vicente del Raspeig, has more than 33.000 students and attracts a significant number of foreign students. The Miguel Hernández University, whose headquarters are in neighboring Elche, has its health sciences campus in the municipality of San Juan de Alicante, part of the Alicante conurbation. **Industry** employs 5.7% of the active population of the municipality. The aluminum and tobacco factories stand out (Altadis, closed in December 2009, heir to the old Tabacalera factory, was for several centuries of great economic importance in the city, having hired more than 4,000 employees), machinery, construction materials and food products. Within the metropolitan area, manufacturing activities are very important in the municipality of San Vicente del Raspeig (a place that has served as an area for expansion and decongestion in manufacturing for the capital). There, the cement production factory, CEMEX, the largest factory in the Alicante agglomeration is located. The main industrial estates in the municipality are the Las Atalayas estate, the Pla de la Vallonga estate, the Agua Amarga estate and the Florida industrial area. Lastly, one of the leading elements in the Alicante economy is the port of Alicante. The port is in full expansion phase, with the aim of being among the tenth most important in terms of freight transport. Currently, some 15.000 people work directly or indirectly in these facilities.

DESCRIPTION AND DEMOGRAPHICS OF ALCANAR

Alcanar is a Spanish municipality of the Catalan comarca of Montsià, in the Tarragona province, halfway between Barcelona and Valencia. It is a coastal town on the Mediterranean Sea with 9.579 inhabitants (2021), covering an area of 47.1 km², and a population density of 203 inhabitants per km². It is the southernmost municipality in Catalonia, located on the border of the Valencian Community.

Figure 8 Location of CEMEX Alcanar

The **GDP of Alcanar** was EUR 136,6 million in 2019, this is, EUR 14,300 per habitant, 123,000 per family. Tourism and second homes are a prominent factor in the Alcan economy. Near the Alcanar Beach, many housing developments have been built to increase the number of tourists during the summer months. Agricultural activity continues to develop in the northern town, the furthest from the coast, mainly growing crops of oranges and clementines. Fishing remains important in Alcanar's smaller villages, and they are especially dedicated to catching prawns. The Port of Alcanar is a facility serving the cement plant on the southside of the town.

In 2021, the number of **unemployed people** in Alcanar was 503,9 (45% men and 55% women). Regarding age, adults between 60 and 64 years old are the most affected group. The sector with the largest unemployment rate is Services (63,9%) followed by Agriculture (14,9%), Industry (8,7%), Construction (7,4%). Regarding the **educational level**, Alcanar counted in 2019 with 21,9% of primary education, 33,1% of first stage of secondary education, 23,3% of second stage of secondary education, and 21,8% of higher education (position of 800 of 947 in the whole of Catalonia).

ENGAGEMENT WITH LOCAL COMMUNITIES

CEMEX Spain seeks to promote and contribute to the development of the communities in which they work, believing that dialogue and transparency are key to achieving this. CEMEX believes that strong, long-term relationships with community members also contribute to their social and economic development.

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To convert these relationships into a framework of dialogue and transparency, CEMEX Spain has created the Sustainability Commission, a formula that allows for periodic meetings between CEMEX and the representatives of the neighbours. In these meetings, the economic, environmental and social activities carried out by CEMEX Spain in the area are reported and social concerns related to the development of the CEMEX activities are collected in a completely transparent manner. Through these meetings, bonds of commitment and transparency are established that contribute to strengthening the company's relationship with the environment, sustainable development and corporate social responsibility.

Therefore, the assessment of the social impact of the project is especially important for CEMEX to continue developing this framework of dialogue and transparency.

3.2.2 SULQUISA in Madrid (Spain)

SULQUISA is one of the lead mining companies in the production and commercialisation of Anhydrous Sodium Sulphate of natural origin, obtained through the exploitation of deposits of sodium salts used in many different industrial applications (detergent, glass, cellulose pulp, textile) and in animal feed (monogastric and multigastric animals). Since its foundation in 1978, SULQUISA has become a leading company in the Natural Anhydrous Sodium Sulfate market, currently being the third largest European producer, with a capacity of 300,000 tons/year of finished product and exporting to more than 30 countries on 5 continents.

The anhydrous sodium sulphate produced by SULQUISA is of mineral origin and is characterised by its high purity of Na2SO4 and the absence of heavy metals. Thus, it is consumed in a great diversity of applications, such as powder detergents, flat glass and bottle, paper pulp, colouring of textile garments, products destined to human and animal food, as well as in the elaboration of chemical and pharmaceutical products.

SULQUISA has three equal lines of sodium sulphate production, both in its design, process and capacity (100,000 tons/year/line). The production operation regime is 365 days/year and 24 hours/day. Likewise, since the production process is intensive in both thermal and electrical energy, it has three cogeneration lines, formed by a gas turbine and a recovery boiler. The steam consumption per line is 7 t/h and the electricity consumption of 1,950 kWh. As it is a continuous process and at full production load on a permanent basis, the indicated energy consumption is very stable over time.

The turbines use natural gas as fuel: SOLAR TAURUS 60 two of 5.5 MW and one of 5.67 MW. The recovery boilers of each line have the following capacities without afterburner: 10 t/h and with afterburner: 21 t/h. With the current demand for steam from the three plants, two of the three available Turbines are in operation, one of them with afterburner. The turbine that is not in production is left in a back-up or replacement situation to cover incidents and maintenance of the other two. The Biopower BTC could potentially replace one of the existing CHP units.

DESCRIPTION AND DEMOGRAPHICS COLMENAR DE OREJA (MADRID)

SULQUISA's facilities are located in the town of Colmenar de Oreja, a Spanish municipality and town in the southeast of the Community of Madrid, 40 km from Madrid capital. Located in the so-called Las Vegas region, it has a population of 8.303 inhabitants (2021). It has an area of 126.3 km2 and a population density of 63/km2. Colmenar de Oreja has a population growth rate of 1,83%.

Figure 9 Location of SULQUISA in Colmenar de Oreja (Madrid)

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GDP of Colmenar de Oreja is EUR 126 million and GDP per capita is EUR 15.720. The sector with the largest GDP contribution is Mining, Industry and Energy (27,6%), followed by Business and Financial Services (18,1%), Distribution and Hospitality Services (17,6%), Other Services (17,3%), Construction (17%), Agriculture and Livestock (2,4%). Colmenar de Oreja counts with an unemployment rate of 8,33% (2021), where 62% corresponds to women and 38% to men.

3.2.3 Identification of local stakeholders in industrial scenarios

After analysing the business and local context of each of the industrial scenarios, in this section we provide the categorisation of the main local stakeholders (see Table 2) who may be impacted or may influence the deployment of the new BTC CHP technology in industrial processes that use heat and electricity currently produced by CHPs and other energy carriers. To do so, the following assumptions have been considered after obtaining the feedback of the industrial partners.

- Employees of the industrial companies would be the ones most in contact with the new technology. They can feel proud and personally engaged to work there and feel part of a broader sustainability effort.
- More investors recognise environmental, social, and governance factors as drivers of value affecting a company's performance and market value.
- Local communities are the main affected by a company performance. If the company performance is more sustainable, this will have a direct positive environmental impact on the surrounding local communities surrounding.

Table 2 Stakeholder prioritisation in industrial scenario

	YES	1	NO	0		
Stakeholder category	**Does this stakeholder exert a great influence on the technology?**			**Is this stakeholder greatly affected by the technology?**		
	ECON	**SOCIAL**	**ENVIRO**	**ECON**	**SOCIAL**	**ENVIRO**
Employees	1	1	0	1	1	0
Investors	1	1	1	1	1	0
Public Authorities	1	1	1	1	1	1
Local communities	0	1	1	1	1	1
Suppliers	1	0	1	0	0	0
Media	0	0	0	0	0	0

Method of estimation of Table 1: Local partners have been asked to assess the influence and impact of each group of local stakeholders in the deployment of the technology. When it is considered that the stakeholder has an impact on the project in an economic, social or environmental dimension, it is given the value '1'; if not it is given '0'. Likewise, when it is considered that the stakeholder is affected by the project in one of the three dimensions, it is given the value '1', if not it is given '0'. The sum of all the values allows us to prioritise the main stakeholders of this scenario. These stakeholders will be those who will affect the project the most and who will be most affected by the project. These stakeholders will be thus the ones with whom we will have to interact the most.

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4 Conclusions

4.1 Main stakeholders in DH and industrial scenarios

The TRL of Bio-FlexGen is low (TRL5), thus the project does not involve any implementation of the technology developed in a real environment. ZABALA, together with the coordinator has therefore built two examples of local communities that may potentially be located in the surrounding of this new technology in future implementations. To that aim, Bio-FlexGen has analysed two DH scenarios (TVaB and Gothenburg Energy) and two industrial end users (SULQUISA and CEMEX) that will provide their requirements in terms of energy solutions and their specific process expertise, business perspective and strategic orientations of new business models.

These two types of use cases involve different types of stakeholders. In the case of a DH scenario, the main stakeholders are the global citizens and the local communities who will benefit regarding climate impact in the municipality thanks to the replacement of fossil fuel power production with two renewable energy sources. Local communities would also benefit economically since the new plant and its new technology would require recruiting more employees to cover new maintenance and operation positions (see Table 1).

In the case of the industrial scenarios, the main stakeholders are the internal ones, employees of the industrial companies and the investors. While employees would be the ones most in contact with the new technology deployed, investors can both exert a great influence in the environmental, social or governmental performance. At the same time, they are being greatly affected by a company's performance, especially economically. Furthermore, local communities are mainly affected by a company performance in terms of environmental, economic and social dimensions (see Table 2).

4.2 Engagement strategies for DH and industrial scenarios

Having identified the main types of stakeholders for each scenario, we can now define **two different engagement strategies**. The first strategy would engage mainly external stakeholders, the citizens of the local communities. To do so, the main communication channels could be conducted through the official website of the local and regional authorities, the local and regional media (newspapers, radio) and social media. Also, DH companies could use local or regional events to communicate the new technology. In addition, DH companies could organise specific workshops or meetings with citizens to provide information about the new technology from a non-technical perspective and putting a focus on its positive impacts on the community.

The second engagement strategy will be focused on internal stakeholders, mainly the own employees of the industrial companies and on the use of internal communication channels such as internal newsletters, intranet and posters in the workplace. Also, investors will be addressed to highlight advances towards sustainability, specifically via CSR and sustainability reports.

Throughout the project, when we will identify **indicators to measure the social impact**, concrete **communication and engagement actions** will be developed to enrich these engagement plans.

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4.3 Towards estimation of Bio-FlexGen technology deployment social impact

This preselection of stakeholders is the starting point for the selection of indicators to estimate the potential social impact of this technology, which will be collected in deliverable **D5.4 Selection of social impact indicators and methodology for measurement**.

It is essential when selecting social indicators, in order to be meaningful for the main stakeholders and be used as reference to accept of decline a new technology deployment, to meet the expectations of the main local stakeholders and answer to offer an answer to their main concerns.

For this reason, the present deliverable is the cornerstone for the identification and selection of main social impact indicators that should be measured before the actual deployment of the Bio-FlexGen technology in order to avoid any social conflict and ensure this project results have a positive impact in European citizens.

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