Symbiotic business development at Kalberg

Summary

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Håkon Broch, Chiona Chirico, Agathe Bjelland Eriksen,
Tobias Haukeli Skretting, Ida Vinningland

Håkon Broch

Electric power - NTNU
Tel.: 959 43 031
Email: hakon@broch.as

Agathe Bjelland Eriksen

Energy - UiB
Tel.: 900 95 617
Email: agathe.bjelland@hotmail.com

Ida Vinningland

Industrial Economics and Technology Management - NTNU
Tel.: 928 23 304
Email: ida.vinningland@gmail.com

Chiona Chirico

Finance and administration - NHH
Tel.: 482 58 716
Email: chiona.a.chirico@hotmail.com

Tobias Haukeli Skretting

Renewable energy - UiA
Tel.: 481 82 841
Email: thskretting@gmail.com

Preface

This is an abbreviated business plan for how a sustainable business area can be developed and established on Kalberg, using industrial symbiosis. This business plan is based on a a more comprehensive report, and therefore only takes the most important conclusions into account. If you want to read more, you can contact one of the authors, and we can send you the complete report.

This abbreviated business plan addresses the background of the Kalberg symbiosis, the driving forces behind the desire to develop industry at Kalberg, and where the possible barriers and risk factors arise. Furthermore, the business plan will look at possible actors who can establish themselves in the area at an early stage, and what infrastructure is needed to realize the development. The plan will then address whether the symbiotic relationships will be profitable for the actors involved. Then it will look at how it is appropriate to organize the business development, in order to utilize the available resources in the most efficient and sustainable way. Finally, the business plan will address which actors will be responsible for financing the industrial symbiosis.

This business plan focuses mainly on how to establish a sustainable business area on Kalberg through an industrial symbiosis in the short term. This means that the business plan has a five-year timeline, and thus only focuses on one data center operator; Green Mountain. In the long run, it will be desirable for even more data center operators to establish themselves at Kalberg, together with other power-intensive industries. Nevertheless, this report puts less emphasis on that aspect.

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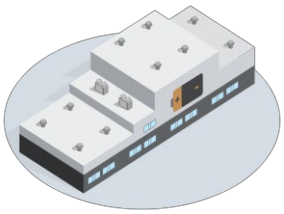
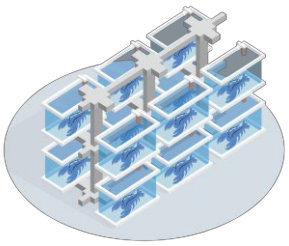
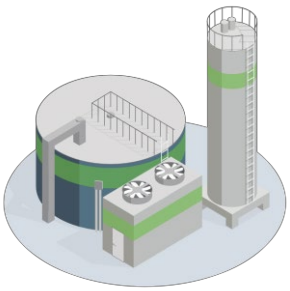




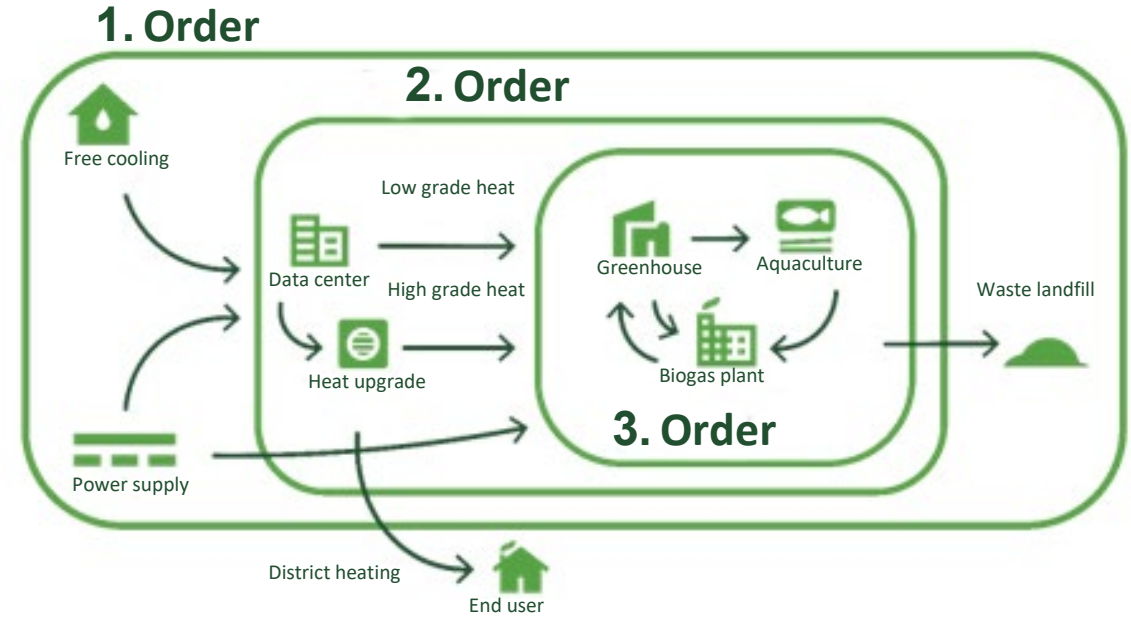


Purpose and business idea

In the wake of a new transformer station at Fagrafjell, as well as a recent land use decision by the Time municipal council , Kalberg has been identified as a well-suited location for industrial development. Lyse, together with several other players, therefore wants to establish a sustainable business park in this area. Furthermore, Green Mountain has stated that Kalberg is a suitable location for the development of a new data center. Their customers' sustainability requirements aswell as the opportunity to use the data center's waste heat by other parties in the area, lays the foundation establishing an industrial symbiosis at Kalberg.

An industrial symbiosis means "*a strategy for achieving circular economy through companies / enterprises within a geographically defined area collaborating on the use of resources such as materials, energy, water and/or by-products. Waste from one industry can be a resource in another industry*".

By establishing an industrial symbiosis at Kalberg, the parties will be able to minimize the use of virgin resources (first-order resources). They will rather use waste (second- and third-order resources) that other parties in the symbiosis generate. This is illustrated in the figure below. In this way, the project will contribute to a more sustainable development. In addition to the environmental benefits that a symbiosis will provide, economic gains are also created for the parties.



Green vision

Circular economy is about transitioning from consumption to reuse. Both the resources that are brought into the economy and the actual use of resources must be reduced. This can be done in many stages. First, the products in the economy must be produced with less resources, by either streamlining the end product or the production process. Moreover, the waste products from these processes must be utilized by other industries, and the end product must be repaired or recycled when its lifetime comes to an end.

One of the goals of the symbiosis is to contribute to a circular economy. In the development of industry at Kalberg, it is the facilitator's responsibility to ensure symbiotic resource utilization. With a focus on efficient use of resources, the business area will also benefit from the symbiosis, as residual products otherwise can be difficult to utilize in large quantities.

The Kalberg symbiosis' vision is to facilitate a business area that is carbon neutral, or even carbon negative in operation. Compared to the rest of the world, Norway is unique in its access to renewable energy all year round, which means that data centers in Norway have low emissions. With good utilization of surplus heat from the data center, you can replace conventional heating needs in the surrounding industry.

An industry cluster with a focus on efficient resource utilization facilitates a good flow of knowledge and commitment within sustainable operations. By facilitating that the players in the cluster cooperate in the resource cycle, the goal is to reduce the region's contribution to Norway's total emissions.



Sustainable development that drives industrial symbiosis at Kalberg

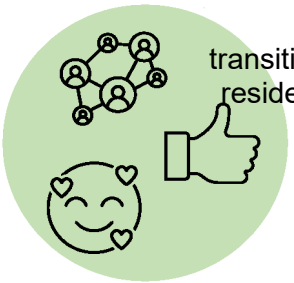
The driving forces behind the Kalberg symbiosis are based on the transition to the green shift. To contribute to this change, it is important to establish a solid sustainability profile. The driving forces are thus based on the desire to contribute to sustainable business development in the region.

Environmental driving forces

The environmental dimension of sustainability is about stopping climate change and preserving nature as a renewable resource. An important driving force for an industrial symbiosis at Kalberg is that it will have lower greenhouse gas emissions and lower consumption of natural resources for players who establish themselves here, compared with the symbiosis' competing companies. This will further contribute to the players' sustainability profile, which will give them a competitive advantage. For example, customers of data centers are concerned about how sustainable the operation of the data center is. The use of surplus heat, as well as the location of the data center in a cool climate, are two aspects that will contribute to sustainable operation. As a result, the Kalberg symbiosis can contribute to sustainable industry in the region, in addition to making actors who take part in the symbiosis more attractive.

Social driving forces

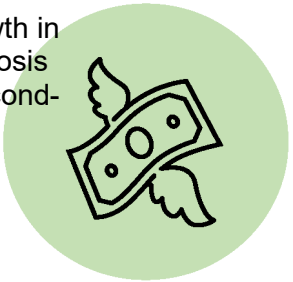
The social part of sustainable development is about ensuring that all people have a good and fair basis for a decent life. An industrial symbiosis at Kalberg will be able to contribute to safe jobs in a region currently undergoing a comprehensive energy transition. The new and future-oriented jobs will preserve, as well as attract new young residents to the district. This will counteract centralization and contribute to population growth in Time municipality and surrounding municipalities.



In addition to increased employment, sustainable business development of the Kalberg area will also bring opportunities for a focus area within technology and innovation, where innovative players can establish themselves. A technology cluster here will function as an area for research and testing of new industries. This can also have positive ripple effects in the form of strengthening the position of the University of Stavanger.

Economic driving forces

The economic dimension of sustainable development is about ensuring financial security for people and society. Higher employment in the region will in turn increase value creation and the tax base. This helps to increase economic growth in the region and in Norway. In addition, the implementation of an industrial symbiosis will also result in lower costs related to input factors, due to the utilization of second- and third-order resources that the symbiosis generates.



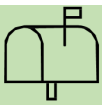
Lower emissions also prove to be a competitive advantage that can help make the products manufactured in the symbiosis more attractive to consumers. Overall, this means that the players who establish themselves in the symbiosis have good conditions for operating profitably, which will contribute to both increased tax revenues and economic growth.

Business model

An industrial symbiosis generates both economic and environmental value.The former benefits the individual companies and investors, while the latter benefits the whole of society. The business model for a system that is planned to be established at Kalberg will be based on the value creation of working together as an alliance rather than working separately.
The business model addresses:

Valuation

Valuation includes what the company will deliver to its customers, the basis for the willingness to pay, as well as the company's basic approach to competitive advantage. For waste-producing companies, the value will derive from higher production efficiency as a lower amount of waste is deposited or disposed of per production unit generated by the actor. For the company that uses the waste, the increased production efficiency is gained by a lower amount of first-order material inflows to produce a unit. This can make otherwise unprofitable businesses in Norway profitable again, due to free input resources.



Value creation and delivery

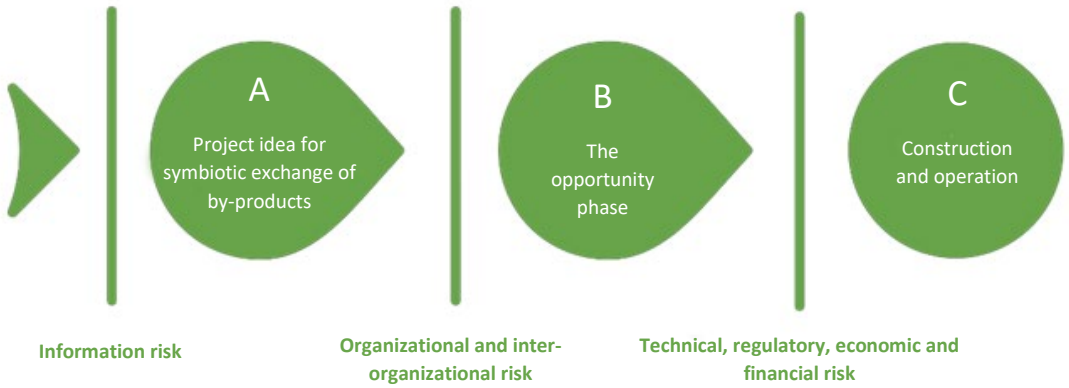
Once you have assessed the value produced by the company, you can continue to elaborate on how the company will create and deliver that value to its customers, as well as the source of competitive advantage. If the waste-producing companies pass the waste on to another company in the symbiosis, the value is created in terms of producing waste with properties that make them suitable for use by other companies. The companies who receive the waste can create value by innovating the production process from a technical standpoint, by making it possible to use waste as a resource.

Value capture

Finally, business models show how the company should generate revenue and profit. Waste-producing companies in the Kalberg symbiosis can create value in the form of lower costs for waste management. The companies who use second- and third-order resources will be able to capture value through lower production costs.

Risk

The most central risks associated with the implementation of the Kalberg symbiosis can be divided into three categories, where each category belongs to different phases depending on where in the symbiosis' life cycle one is.



Information risk before phase A

Industrial symbiosis is an innovative business model, which involves risks associated with a lack of information and knowledge. This includes knowledge of the possibilities for various stakeholders to initiate symbiotic relationships with other suitable stakeholders. This phase may overlap somewhat with the feasibility study, as some stakeholders have more information than others. Therefore, it is important to gather information about the processes and resource flows of potential stakeholders, in order to identify good collaboration opportunities in the Kalberg symbiosis. One challenge is that information will either not be publicly available at all, or will be partially available through climate reports. It is therefore necessary to make this information known, so that one can best find favourable symbiotic relationships.

Organizational and inter-organizational risk before phase B

After the available information has created a clearproject idea (phase A), the organizational and inter-organizational risks will be critical for further development of the symbiosis. These risks are related to a potential player's core business focus and an associated lack of motivation and commitment regarding symbiotic cooperation. The workforce of the various potential actors in the symbiosis tends to concentrate on the performance of the core business, and thus some symbiotic opportunities are often overlooked. Organizational risk factors before a feasibility study (phase B) may involve low motivation among the actors, not enough willingness to collaborate and share information, and fear of losing their core business focus. Reduction of this risk is therefore dependent on the information risk being minimized.

Technical, regulatory, economic and financial risks before Phase C

After a feasibility study has been completed, the Kalberg symbiosis is only considered technically feasible if it does not face major technical and regulatory problems that cannot be easily solved. Here, it is important that relevant infrastructure is in place. Furthermore, economic risk will consider the risk associated with economic profitability of the symbiosis project, while financial risk refers to capital availability for the symbiosis project. The reason why the financial risk is so important is due to long repayment periods for infrastructure, which together with variations in materials and energy markets, means high risk.

Potential actors in the Kalberg symbiosis

In the Kalberg symbiosis, the data center will be a gate opener for a number of other industries. The surplus heat will be able to provide free heating to, for example, greenhouses and fish farms. In addition, a biogas plant and a battery factory will be able to connect to the symbiosis. The transformer station, which will be completed at Fagrafjell in the beginning of 2023, will also be able to supply secure electricity to power-intensive industries that are established in the symbiosis. Companies in the industrial symbiosis at Kalberg must contribute to the utilization of available resources, and be operational in the symbiosis in the short term.

Second-order companies - gate openers

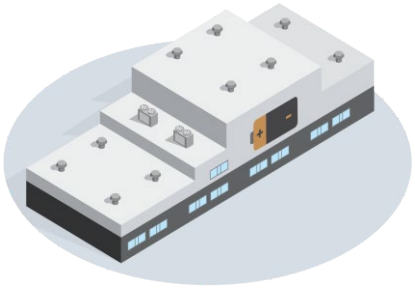
Data Center - Green Mountain

Data centers generate huge amounts of heat during operation, where around 80% of the power needed to run the computers becomes heat. Therefore, the data center must be cooled down for the components to function optimally. This generates surplus heat that data centers want to use for something productive. However, the heat is low grade value at 20 ° C – 25 ° C, and will not be able to be used for district heating. Therefore, only a specific selection of players can use the heat.

Green Mountain is a data center operator that wants to establish itself on Kalberg. The surplus heat from Green Mountain is a resource that many industries in the area can benefit from. The data center is therefore defined as a second-order player. The data center provides a resource that can benefit the entire area, and facilitates to meet the needs of several of the third-order actors. At Kalberg, the data center is thus a form of core business and prerequisite for the rest of the industrial symbiosis.

Battery Factory - Beyonder

A battery factory can be categorized as a power-intensive industry, and will therefore benefit from the new transformer station at Fagrafjell. Furthermore, there is plenty of space, with few buildings in the area, as well as the possibility of utilizing overlapping resources in a symbiosis. A factory will also be able to generate new jobs for the region, and in this way contribute to value creation.



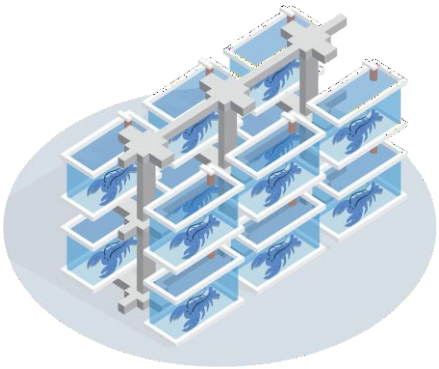
Battery manufacturer Beyonder has expressed a desire to establish itself in the area. They also have a need for free cooling from a body of water. The optimal solution would be free cooling from Gandsfjorden. Beyonder's production involves the carbonization of sawdust in a process at at high temperatures. (100 °C – 140 °C.) At these temperatures it is possible to extract heat at a temperature level needed by a biogas plant.

Potential actors in the Kalberg symbiosis

Third-order actors

Fish farming - Norwegian Lobster Farm

Kalberg can be afavourable location to establish fish farms. Here you can use surplus heat from Green Mountains data center at approximately 20ºC, which is the optimal temperature for most fish farms. In addition, waste products such as fish sludge can be used further in a potential biogas plant in the area. Establishing fish farms can be done rather quickly which makes it sensible to include in the start-up phase of the symbiosis. In addition, the lobster producer Norwegian Lobster Farm has already potential plans for business development in the area.

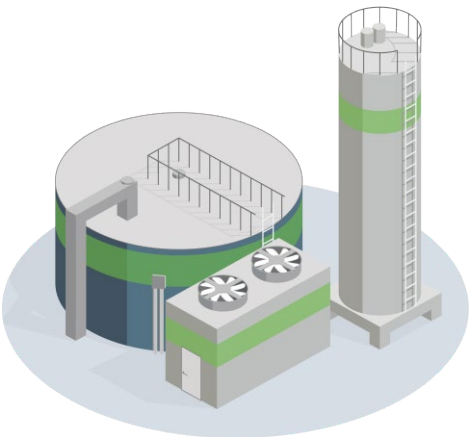


Greenhouse

In addition, a greenhouse can fit well into the symbiosis at Kalberg. This is, like lobster farming, a third-order player that needs surplus heat of 20 ºC - 24 ºC. In addition, CO2 from other industries in the symbiosis can be used in the greenhouse.
Plant waste from the production of fruit and vegetables can also be used in combination with fish sludge for the production of biogas. As a result, one can run food production at Kalberg in a more environmentally friendly way by utilizing the available second- and third-order resources.

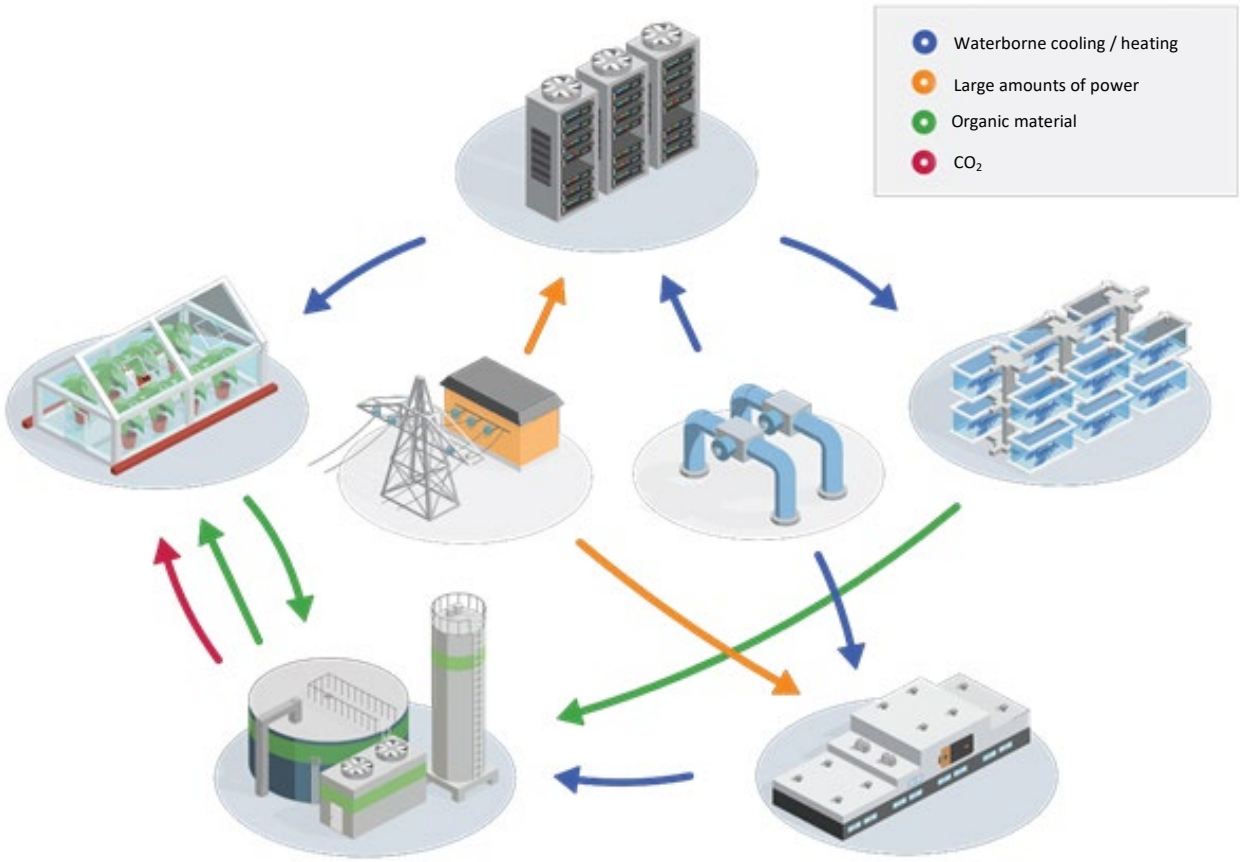
Biogas plant

In the Kalberg symbiosis, there will be plenty access to organic substrates from greenhouses, fish farms and nearby farms, as well as surplus heat, for biogas production. Production occurs at 37ºC, a temperature that can be supplied from high-value surplus heat from the battery factory. The produced biogas can be connected to the existing gas network in the area, and be a contributor to phasing out the use of natural gas in the region. In this way, a biogas plant will be a good addition to the symbiosis at Kalberg.



Kalberg Symbiosis

The figure below shows a sketch of the industrial symbiosis. In the symbiosis, there are a number of resources that can be exchanged between the actors. This contributes to the business area being sustainable, in that available resources are utilized rather than using first-order resources. In addition, this resource utilization could give the individual players a competitive advantage, both in the form of a stronger sustainability profile and reduced costs.



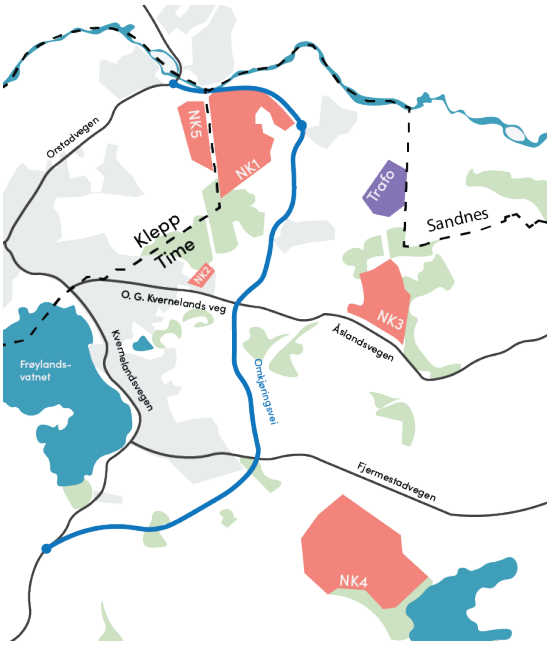
As can be seen in the figure, both greenhouses and fish farms will require low-grade surplus heat which can be delivered from the data center. Furthermore, the greenhouse and the fish farm produce plant waste and sludge that a biogas plant can use. A biogas plant will also produce CO2, which can be utilized by greenhouses.

The processes in the battery factory will be able to supply small amounts of high-quality surplus heat to industries in the area. This means that the biogas plant can be connected to the battery factory and have excess heat supplied with a temperature of 37 ° C. A battery factory will also be considered a power-intensive industry, which can be supplied through the transformer station at Fagrafjell.

Infrastructure

In order to realize the Kalberg symbiosis, it is necessary to facilitate relevant infrastructure. The infrastructure will mainly concern pipe routes that carry the material flows around the symbiosis. In addition, it will be important to implement a cooling method for the data center and the other actors who need this.

Location of the actors in the Kalberg symbiosis



The map on the left shows the areas that have been approved for industrial development, and the table shows the size of the various plots.

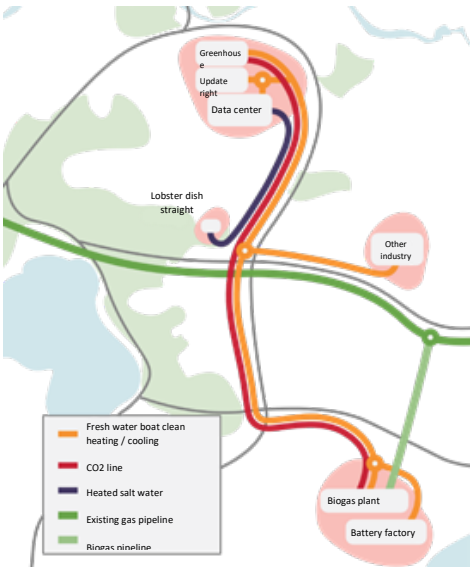
Empty	Area [daa]
NK 1	412
NK 2	23
NK 3	189
NK 4	568
NK 5	200

The data center operator, Green Mountain, is expected to establish on NK1. They plan to start constructions already at the beginning of 2022, and the first module will be operational in mid-2024.
At this point the surplus heat will be available to other players. Furthermore, it is desirable to establish fish farms and greenhouses on the same plot. In this way, the excess heat from the data center can be utilized from early stages.

As Norwegian Lobster Farm has shown great interest in establishing itself at Kalberg, NK2 will be a suitable site. This is because the NLF will require an area of 15-20 daa, which can be delivered by NK2. Furthermore, this plot is closest to the residential buildings at Kalberg.It would therefore be best to avoid establishing potential disturbing power-intensive industres at this plot.

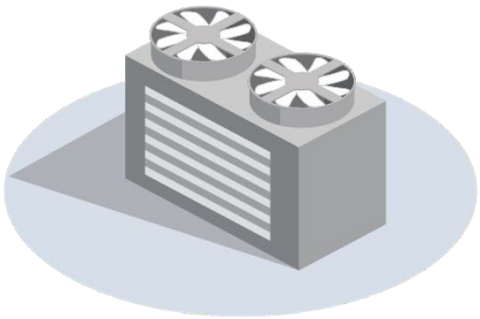
At NK4, a biogas plant, together with a battery factory, will fit well. This is an area that is relatively far from the population, and the biogas plant and battery factory will therefore not disturb any neighbours here. In addition, data from a local weather station shows that the wind on Kalberg will mainly go north and south. This is also a reason why a biogas plant fits into NK4, as this will minimize the risk of bad smells from the plant.

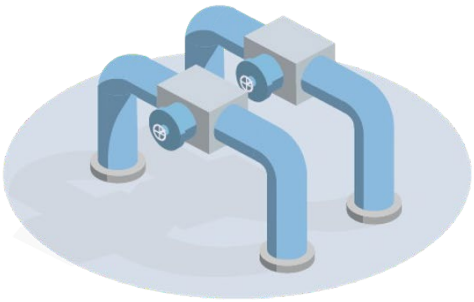
In order to connect the players at Kalberg, it will be necessary to establish pipelines that can transport the surplus heat from the data center and CO2 from the biogas plant to the players who can benefit from these resources. In addition, the biogas produced on NK4 can be connected to the existing gas pipeline in the area. The map to the right illustrates how this can be solved.



Free cooling

An important factor in the development of infrastructure at Kalberg is free cooling. Free cooling is about moving the heat energy away from the medium to be cooled down, and deposited elsewhere. As mentioned earlier, the data center in the symbiosis will require cooling, where free cooling with seawater from the Gandsfjord is the most desirable.





Lyse AS, together with Aarbakke Innovations, has initiated a study on connecting free cooling through a 7 kilometer long pipeline route from Kalberg to Gandsfjorden. The report will consider two different connection methods; the conventional method by laying pipe routes in trenches, and by using drilling technology and establishing a “no-dig” route to the sea. If the report turns out to be positive, there will be a need to lay a double pipe connection to ensure the data center's security of supply. The seawater that is pumped into the data center will cool the facility. The heated water can then be distributed to other actors who needs it.

As the study has not yet been completed, it may be necessary for the early modules of the data center to make use of free cooling to air. It is worth noting that this cooling method is less efficient, compared to free cooling to water. On the other hand, the cooling method will require much lower investment costs, in addition to being easier to implement at Kalberg.

As it may not be realistic for free cooling from Gandsfjorden to be available in the first construction stages of the data center, free cooling from air may be more suitable. When using cooling to air, the outdoor temperature will be an essential parameter, as this should always be kept below 20 °C. Weather data from the Kalberg area show that the temperature has only exceeded 20 °C 1.7% of all hours from 2010 to 2021. As there are only a few hours in the year where the temperature is above 20 °C, the data center will not need to compensate with further measures often. This means that free cooling to air is a good alternative to free cooling from Gandsfjorden.

Profitability

One of the goals of industrial symbiosis is to increase profitability both for the system as a whole, but also for each individual actor. Available infrastructure in the industrial symbiosis at Kalberg will be able to facilitate mutual exchange of resources between actors, which can create economic benefits for the individual actors.

The financial benefit is determined by calculating the opportunity cost if the players would not be in the symbiosis. This means, among other things, what costs the players would have had for waste management and the purchase of virgin resources.

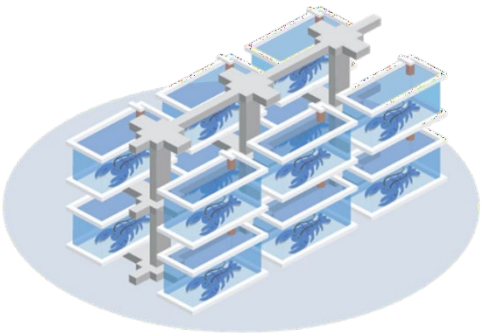
Economic advantage

raw material costs + waste management costs

The threshold value is a measure of whether an actor will want to take part in the Kalberg symbiosis. It can be assumed that this threshold value is lower for actors who are more concerned with circular economy and / or reputation. In addition, the individual actors will not have to be responsible for the infrastructure in the area. On the basis of this, it is possible that the actors will want to be part of the symbiosis as long as the economic benefit is positive.

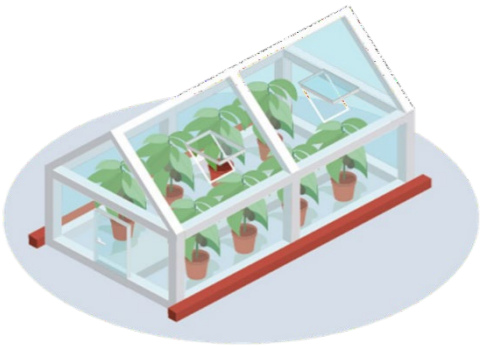
Threshold value <Economic advantage

Due to a lack of information, it has been difficult to calculate the economic benefits of participating in the symbiosis for all potential actors. Lobster farms and greenhouses are the players for whom it has been possible to calculate the financial benefit.



Economic advantage:
NOK 21,570,000 per year

For lobster farms of 15-20 daa that deliver 900 tonnes of lobster a year.



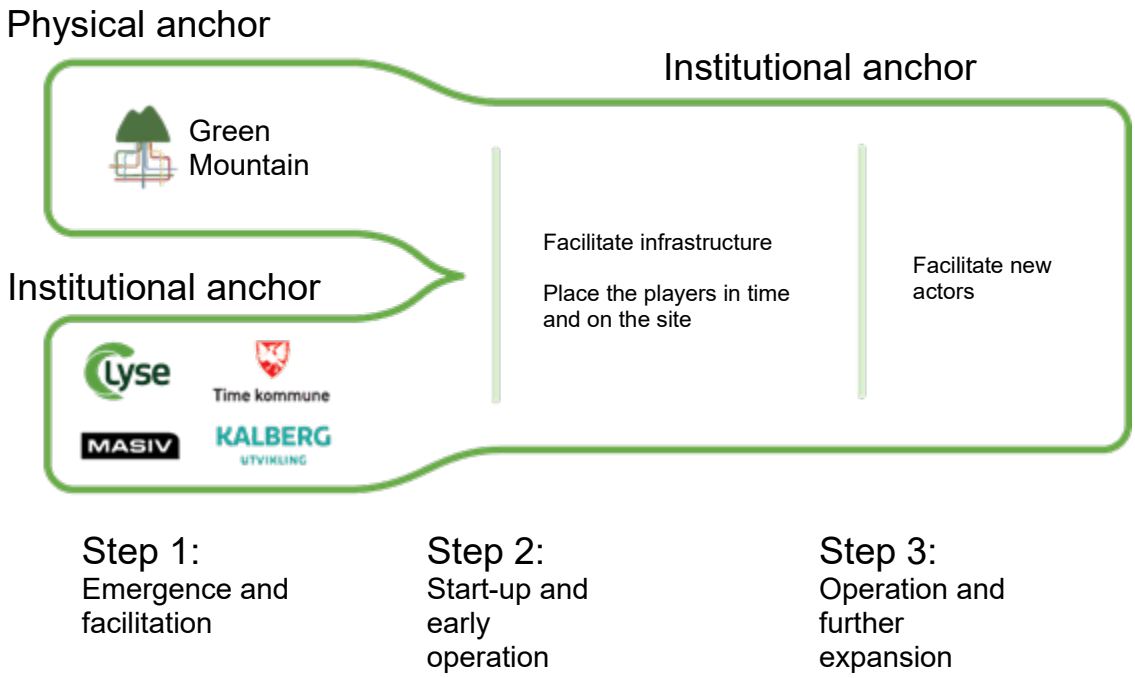
Economic advantage:
NOK 2,540,500 per year

For a greenhouse of 50 daa that produces 5700 tons of crops a year.

Organization

In order to realize the plans for implementing an industrial symbiosis at Kalberg, it will be necessary to look at how the symbiosis can be organized and managed. This can be done through two forms of anchoring: physical and institutional.

Physical anchoring: second-order actors that offer a key by-product of the symbiosis.
Institutional anchoring: the role of facilitating social and institutional conditions that contribute to the emergence and development of industrial symbiosis.



The figure above shows which actors the project group envisages taking part in the institutional anchor, as well as the first physical anchor of the symbiosis.

As it is Green Mountain that has first shown the interest in sharing the surplus heat, it will be natural that they become the Kalberg symbiosis' first physical anchor. They must therefore be involved in sharing the information on which players can benefit from their surplus heat.

Furthermore, it will be natural for Masiv to play a central role in the institutional anchor. This is because Masiv owns several of the available plots. By contributing to the facilitation of symbiotic business development of the area, the plots will become more attractive, which in turn increases their value.

It is also appropriate that Lyse has a role in this institutional anchor. This is attractive for Lyse because symbiotic business development will provide value creation to the region. As they are owned by municipalities in Rogaland, this will be highly desirable.

For Time Municipality, it will be highly relevant to take part in the institutional anchor, as this will have positive ripple effects within the social and economic conditions. The development of symbiotic businesses in the area will provide increased employment, which in turn can make the municipality attractive to new residents. Furthermore, this provides an increased tax base, which the municipality can use for services in the local community.

Organization

Information sharing

In **step 1**, the institutional anchor will mainly cooperate with the physical anchor to share information about the symbiosis, as well as the current plans. Green Mountain will have a central role in distributing information to potential actors, since they are the first physical anchor of the symbiosis, and therefore would like to share a free resource with potential actors. Actors who do not have a symbiotic relationship with Green Mountain will receive information and support from the institutional anchor.

Important information about the Kalberg symbiosis can, for example, be shared on a public website. A contact page can be implemented on the website, so that new players can easily get in touch with the anchor for any questions related to the project. This will help reduce the information risk.

Facilitate infrastructure. Plan actors.

In **step 2**, the role of the physical anchor and the institutional anchor will be merged, where their tasks will involve facilitating the necessary infrastructure and planning of new actors. It is proposed that the institutional anchor may include Lyse, Kalberg Utvikling, Time municipality and other actors.

As the plan is for new players to join the symbiosis several years after the start-up, it will be beneficial to facilitate which players will fit in at what time. This is because some actors would like to depend on the existence of certain types of resources, and therefore should wait for actors with these waste resources. In order to have a good flow in the development of the symbiosis, the institutional anchor should set up a schedule and loosely allocate potential new actors time periods where it will be beneficial to start up. The work of the institutional anchor in this step will help reduce the organizational and inter-organizational risk.

Facilitate for new players. Maintain sustainability focus

In **step 3**, the institutional anchor will mainly facilitate the upscaling of established players and new players who want to set up at Kalberg. Therefore, it is important that the institutional anchor is helpful in linking new actors with the available second- and third-order resources that have already been generated in the symbiosis. In addition, it will be necessary for the infrastructure in the area to be expanded.

Further in the operational stage, it will be essential that the symbiosis maintains its focus on environmental, social and economic gain. The institutional anchor can do this by assisting with courses, expertise, and initiatives to establish common goals and contracts between new and established actors in the symbiosis.

Financing

Not much emphasis will be placed on exact figures on investment costs for the individual player, but rather a design of a financing model for investment costs related to symbiotic business development. Guidance on who should finance both the physical infrastructure and the work of the institutional anchor is essential. Furthermore, the responsibility will often lie with the same actors who have an organizational responsibility for the symbiosis.

The societal benefit of industrial symbiosis means that the public sector can finance part of the costs, for example through Innovation Norway. More about how the public authorities can support is described in detail in the report.

Innovasjon Norge

Stakeholders

Lyse

Time kommune

MASIV

KALBERG UTVIKLING

Second-order actors

Green Mountain

BEYONDER

The institutional anchor consists of stakeholders and second-order actors with a desire for synergy effects in the area. Consequently, it will be appropriate to shift the financial risk from third-order actors to the institutional anchor.

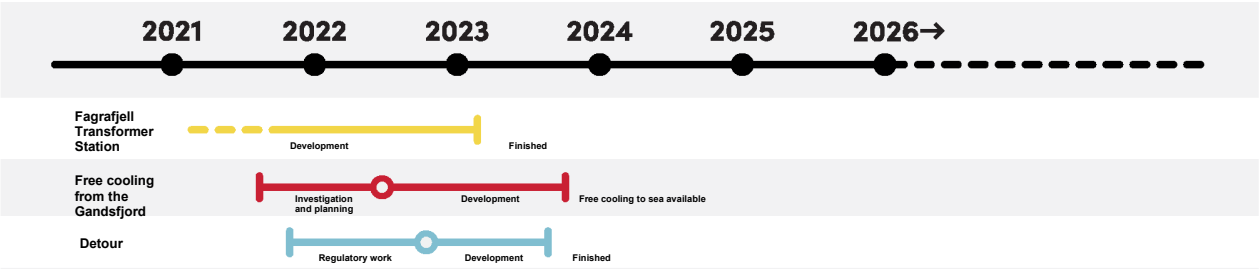
Second-order actors are often willing to pay to get rid of by-products and may thus wish to pay third-order actors to receive their waste. Alternatively, second-order actors can invest in infrastructure, to enable free exchange between them and third-order actors. Eventually, new second-order players with a willingness to pay will probably come to the area, which can thus contribute to the development of new infrastructure.

Free cooling to Gandsfjorden will, for example, have high investment costs, and in order for this to be realized, actors who need the cooling must be willing to contribute. This means that Green Mountain and Beyonder are seen as natural contributors to this investment cost. An investor, who in the long run will see a possible business area in selling cooling to players in the area, can also contribute.

Implementation plan for the Kalberg symbiosis

In order to realize the Kalberg symbiosis, a step-by-step implementation plan for business development has been presented. The implementation plan is divided into three different steps, which categorize where you are in the development. Step 1 is related to the emergence and facilitation of the symbiosis. Furthermore, step 2 is defined as the start of the symbiosis. This step is triggered by the establishment of the data center and the access to surplus heat that this entails. Finally, step 3 will address further expansion in the Kalberg area. This applies both to the upscaling of the actors who are already in the symbiosis, but also to the addition of new actors.

Step 1 - emergence and facilitation (2021 - 2023)

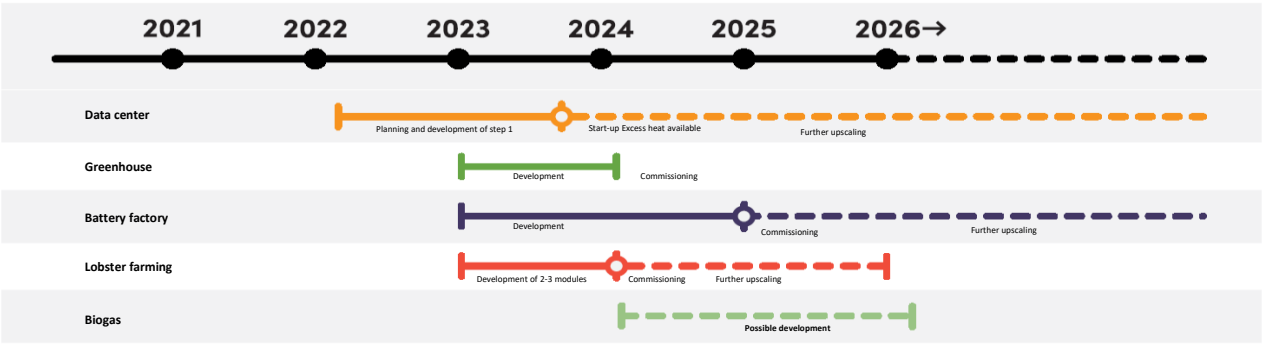


A key guideline in stage 1 is the development of Fagrafjell transformer station. The station enables power-intensive industry in the area, and after its completion at the beginning of 2023, it will be possible for the mentioned players to establish themselves here.

Furthermore, work has already begun in the summer of 2021 to study the cost of free cooling from the Gandsfjord. The study is estimated to be completed by the end of 2021. The result of this study will be a milestone when it comes to further implementation of the Kalberg symbiosis. If free cooling from Gandsfjorden can be carried out, another six months of planning is required before the actual development can begin. This means that the drilling work for the micro tunnels will start no earlier than the summer of 2022. It is assumed by the project group that these micro-tunnels will be able to be operational by the end of 2024.

Furthermore, regulation work for the previously mentioned bypass road will start in the autumn of 2021. Such regulatory work usually takes one year. If the result shows that the bypass road will be developed, the construction process can be underway during 2022. At this point, it will then be beneficial to lay pipe routes for surplus heating, cooling and CO2.

Step 2 - start of the symbiosis (2023 - 2026)

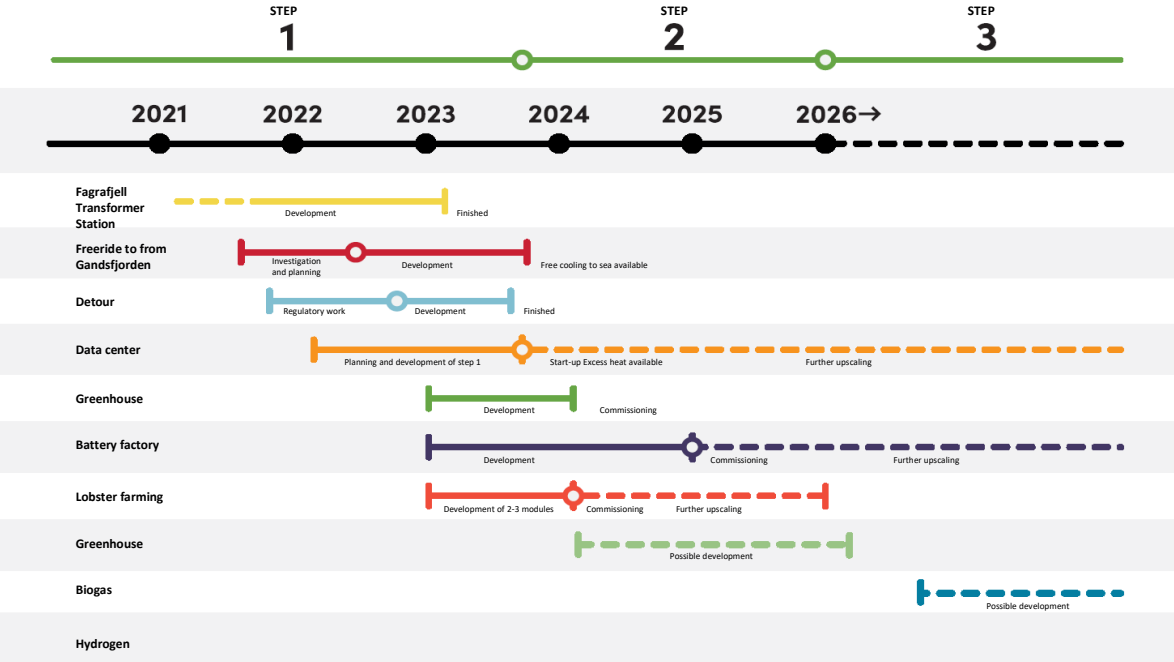


By the end of 2023, or possibly the beginning of 2024, the data center will, according to Green Mountain's plans, be completed and ready to supply surplus heat to interested players. This marks the transition to step 2, which categorizes the start of the symbiosis. Here, the establishment of the data center is a critical milestone, as the available surplus heat this brings is the springboard for the development of the industrial symbiosis.

Greenhouses are one of the industries that at this time will have the opportunity to establish themselves on Kalberg as part of the symbiosis. However, assuming a planning and development phase of one and a half and one year, respectively, planning must start in the near future if the greenhouse is to use the surplus heat from the time it is available. Furthermore, the surplus heat also enables the establishment of fish farming. The NLF wants to start a module-based development of lobster farms in the beginning of 2023. The plan is compatible with the access to surplus heat from the data center. However, the NLF is also dependent on the establishment of free cooling from the Gandsfjord, as this will provide a supply of necessary salt water. The study of free cooling in stage 1 will therefore be vital to the realization of the fish farm.

The battery factory also belongs in step 2. The factory is not directly connected to the surplus heat to the data center, but will be placed in this step as Beyonder may seem to start development on NK4 at the beginning of 2023. With a step-by-step development and an approximate time horizon of two years, the factory can be partially operational from 2025. The battery factory will further trigger the possibility of a biogas plant at Kalberg, as the factory can possibly supply the necessary heat of 37 ° C to the plant. In addition, greenhouses and fish farms have already been established in the symbiosis that can provide organic material for the production of the gas. Following the establishment of a battery factory at the beginning of 2025, this will thus be a favourable time for the start-up of biogas plants. Assuming a planning and development phase of one and two years, respectively, a biogas plant can be operational no earlier than three years after relevant actors come on board.

Step 3 - further expansion (2026 -)



The last step in the implementation plan for the Kalberg project takes into account the arrangements for further expansion of the symbiosis. Further expansion means both upscaling of already established players, but also the addition of new players who can have a natural place in the symbiosis.

When facilitating new actors in the symbiosis, it is important that the institutional anchor takes over the entire role from the physical anchor regarding marketing of the opportunities I the Kalberg symbiosis. In addition, it is important that the institutional anchor is helpful in implementing the new actors in the existing symbiosis. This means connecting new players to existing infrastructure and facilitating new necessary infrastructure.

Development of hydrogen production will have a natural location in stage 3. If production based on biogas is facilitated, this is an available resource in the symbiosis at this time. This can facilitate the production of red hydrogen. It can also be assumed that the demand for hydrogen will increase towards 2030 and that a hydrogen producer can therefore become a possible future player after the start-up stage.