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Centre for an Energy Efficient and Competitive Industry for the Future

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NEC#1 Organizing shared resources and alternative business models

Handbook: Energy Collaboration in Norwegian Industry

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Abstract

This is a draft version

This handbook is the output of *Shared Resources*, a research project aiming to explore new possibilities and enablers for resource- and energy collaborations in Norwegian industry. To do so, the project maps experiences and explores new ideas for elements to be included in such arrangements – including alternative business models, contract elements and value creating options beyond the traditional buying and selling of surplus energy. In particular, *Shared Resources* is concerned with the "low hanging fruits", that is, the cases in which collaboration is technically feasible, compatible and close to be profitable.

Executive summary

To be written in the final version

Table of Contents

1 Introduction

1.1 BACKGROUND

This handbook is the output of *Shared Resources*, a research project aiming to explore new possibilities and enablers for resource- and energy collaborations in Norwegian industry. The project has been carried out by NTNU Samfunnsforskning in collaboration with the Department of Industrial Economics and Technology Management, and funded by the Centre for an Energy Efficient and Competitive Industry for the Future (hereafter HighEFF). Industrial HighEFF partners and local stakeholders have played a very important role by sharing experiences and knowledge about energy collaborations.

HighEFF has the ambition to spearhead the development of emerging, energy efficient and cross-sectorial technologies for the industry with the purpose to: support industry to meet the EU target of 40 % reduction in greenhouse gases and at least 27 % increase in energy efficiency by 2030; increase the competitiveness of Norwegian industry through development of energy and cost efficient plant operations, energy recovery and utilization of surplus heat; enable 27 % reduction in energy use in the Norwegian industry by 2030; and enable competence building and recruiting of experts within energy efficiency. One way to meet these challenges is by better exploiting waste heat.

1.2 LACK OF RESOURCE AND ENERGY COLLABORATIONS IN NORWEGIAN INDUSTRY: FROM CHALLENGES TO ENABLERS

The project's departure point is the observed lack of energy and resource collaboration in Norwegian industry. In concrete, this project is concerned with the exploitation of industrial surplus heat, which is a common by-product from combustion and energy intensive production processes. Despite the large potential for re-utilization, surplus heat is often released into the ambient (air and water). The availability of cheap energy is seldom a sufficient incentive to establish such agreements for the reutilization of industrial surplus heat since energy costs are simply not a sufficient share to bear the additional costs of additional infrastructure needed. Moreover, geographical proximity is normally a prerequisite for resource sharing to take place. Due to the localisation of energy intensive industry in Norway, there is a relatively limited heat demand in the surrounding areas. Thus, the utilization of surplus heat across companies is rather limited.

Previous projects (ref.) have identified an array of barriers that restrain such energy collaborations in Norwegian industry, among them: organizational, technical, economic and cultural (for a detailed description of barriers see Appendix A (FME HighEFF, SOTA D5.1_2017.05). The aim of this project however is to shift the focus away from challenges towards enablers. The objective is to provide an overview of ideas/enablers that can increase possibilities for successful inter-organizational arrangements to exploit surplus energy. To do so, the project maps experiences and explores new ideas for elements to be included in such arrangements – including alternative business models, contract elements and value creating options beyond the traditional buying and selling of surplus energy. In particular, *Shared Resources* is concerned with the "low hanging fruits", that is, the cases in which collaboration is technically feasible, compatible and close to be profitable.

1.3 FROM BUSINESS MODELS TO COLLABORATIVE CONTRACT STRATEGIES

This report is inspired by **inter-organizational collaboration**, **alternative business models** and **collaborative contracting approaches**. A business model is a description of the activities of a company or organization, considering how it can create value for its business. Developing business models is a key part of the company's strategy and involves mapping out all the resources the company has available, and how they should be used in context to enable the business to achieve its goals (Aasen & Amundsen, 2011).

There are many types of business models, as companies vary greatly in production methods and how they operate in the market. Examples include models of manufacturing, distribution and franchising. The term business model came into prominence in the internet era, as many new business models are based on internet marketing strategies.

A structured process of identifying sources of costs and revenues, key activities and collaboration partners, the customer base and how to reach it, helps companies to realize their vision in an economically viable way. General theories on business model generation typically focus on finding the key partners involved in the business, what resources they have and what activities they plan together. On the demand side, the model includes how to reach out to and interact with customers (see e.g. Osterwalder & Pigneur, 2010, or Wolcott & Lippitz, 2009). The following classification is loosely based on Osterwalder and Pigneur's (1995) business model canvas, applied on cases of surplus heat.

Key partners

These may typically be industry that have excess heat, and i.e district heating companies that they wish to collaborate with to get the product out to potential consumers. Examples of partners in joint business opportunities and collaborations include:

- Financial institutions
- Public authorities – urban planners and decision makers
- Owners of large buildings, and infrastructure

Key Resources

The resources that can be shared may be both physical, financial, or intellectual. Examples include:

- Excess heat
- Electricity (produced from own excess heat)
- Waste that can be used in other processes
- Labour that can be used elswhere when idle
- Buildings that can be rented out when not used
- Expert knowledge (that can contribute elsewhere, in education etc)
- Financial resources
- Infrastructure

Key activities

This part of the canvas describes the activities that the partners plan to conduct together. In our context some examples can be:

- Deliver excess heat
- Produce electricity
- Lend out workers
- Rent out buildings
- Establish connection with (between?) stakeholders
- Preproduction and planning

Customers

Classical business theory also describes the potential customer segments that are involved:

- Other industry
    - Horticulture

        - Aquaculture
        - etc
- Building owners:
    - Public: schools, hospitals, offices etc
    - Private
        - Residential areas
        - Office buildings, shoppping centres etc
        - Airports, industry
- Local district heating (DH) utility

Channels

There are different channels through with the customer base can be targeted, for instance:

- Private agreements industry to industry or industry to public (large customers)
- Public/private coop – housing areas (small customer)
- General promotion – visits, website, emails etc
- Through DH infrastructure – invoice, customer support

Customer relations

The running relationships between the partners and their customer base. Examples include:

- Cooperation with partner industries
- Mass market
    - Electricity
    - District heating
- Cooperation with public authorities
- Degrees of assistance – automated services, personal assistance etc
- Personal assistance (large customer)
- Automated service and self-service (small customers)

Value proposition

The above mapping of stakeholders, activities and resources results in an overall value proposition, describing the total benefits of the model for the parties involved. For instance:

- Stable secure supply, long term prices, low maintenance, ease and comfort
- Political benefits: renewable, low emissions, domestic production, public health, innovation potential
- Some more potential benefits here…

The final value proposition also defines the financial flows of costs and revenues that the business model will entail.

In our context, these theoretical models, while having substantial merit, may in many cases be too general for our purpose. *Shared Resources* focus mainly on the supply side, as the stakeholders involved often may be included as partners rather than customers. The partners involved in resource sharing activities can be more broadly defined than what is most usually recognized. A DH company may, for instance, in principle be defined either as a supplier or a demander of heat, based on the chosen collaboration model. Also, the sharing of resources in a broad context often includes market that not readily exist.

Furthermore, classical business models often fail to include stakeholders that may be important in the present context. These include local interest groups, neighbours, competitors, environmental organisations, and local or central governments. These may potentially be included as partners in a resource sharing collaboration, to ensure public support for projects that may have broad societal impacts, and also may demand goodwill from planning authorities and involvement of public support schemes.

We thus focus mainly on the **key partners**, **key activities**, and **key resources** side on the canvas, and put emphasis on models of collaboration, rather than the capturing of existing markets. We choose to describe different forms of partnership, starting from the simplest situation where there is one provider and one receiver of the resource, and expanding to include several stakeholders, such as contractors, intermediaries, financial institutions, multiple customers, and the general society.

1.4 HANDBOOK STRUCTURE

This report aims to provide you (HighEFF partners) with the following:

- An understanding of what is involved in a resource and energy collaboration
- When and why such collaboration is useful to your business
- Steps required to implement collaborative contracting that meet your business
- A list of enablers that might facilitate resource collaboration with other business and make it economically profitable

The rest of the handbook is divided into two parts. The first provides a brief introduction to resource and energy collaboration. The second one outlines a step-by-step guideline to establish and perform energy and resource collaborations.

2 Resource and energy collaboration?

2.1 WHAT IS A RESOURCE AND ENERGY COLLABORATION?

Resource and energy collaboration is an arrangement in which at least two parties (e.g. industries, local authorities) exchange wastes and resources – such as surplus energy, raw materials, finished stock, by-products, packaging, waste and unwanted items and services – for the benefit of the parties. Benefits can be very varied and may comprise for instance economic savings, waste reduction, new opportunities, and reduced negative environmental impact. Resource and energy collaboration exchange is one of the key elements in the ongoing shift from linear to circular economies – from “take – make – dispose” models to forms where resources are kept in use for as long as possible.

2.2 TYPES AND DIFFERENCES IN RESOURCE AND ENERGY COLLABORATION

Resource and energy collaborations may take different forms, comprise unlike type of resources and involve varied actors. This handbook is most concerned with the reuse of surplus energy from Norwegian industries. There are four dimensions that are important for the shaping of such collaborations which are important to consider in an early stage:

Contractual aspects: from long-term joint ventures to loosely agreed short-term partnerships.

a) Non-equity collaborations: an alliance between two or more companies, aimed at achieving a common objective by coordinating efforts, while each party retains its organizational independence and no new equity entity or corporation is created.
b) Equity-collaborations: an agreement between two or more companies to enter into a separate business venture together, therefore share more equity ownership and voting power with partners. Alliances can be defined as medium and long-term agreements between companies, which involve the mutual transfer of intangible resources to take shape with or without administrative structure

Actors involved: from private bilateral collaborations to multilateral hybrid collaborations

a) Bilateral collaboration: comprising just two partners
b) Multilateral collaboration: involving more than two partners
c) Private collaboration: involving just two or more private actors (e.g industrial or commercial partners)
d) Hybrid collaboration: involving two or more actors from both, public private spheres (e.g. a municipality using industrial heat surplus for district heating)

Location: both limits and provides opportunities

a) Brownfield: a previously developed location used for industrial or commercial purposes and with existing infrastructure. This is rarely the case in situations where this handbook will be used. We include the case of one partner assessing opportunities of establishing an energy and/or resource collaboration, this means that the other part (usually the consumer) is not already located in the area which
b) Greenfield: a location that has not been previously used for industrial or commercial purposes and where infrastructure has not been developed – in the case of assessing opportunities of establishing an energy and/or resource collaboration, this means that all parties are located already located in the area
c) Urban areas: presents larger energy use needs but are usually far removed from the surplus heat sources
d) Rural areas: are often where energy intensive industry is located yet they have a relatively limited heat demand

Energy characteristics: of importance for technical and operational compatibility of partners. More on this subject is to be found in other deliverables from HighEFF (which?).

a) Type of energy:
   Energy could be split into categories defined by energy levels (high-grade to low-grade), but since technology makes it possible to move from lower to higher levels (it is a matter of costs) we rather focus on the different sources of energy surplus. Each source has its advantages and the opportunities for use are further presented in HighEFF D.X.X……
   - Hot water (typical low grade energy used in heat exchangers)
   - Steam (typical heat exchangers and electricity production)
   - Hot flue gas (typical heat exchangers, steam production)
   - Radiation
   - Work (e.g. pressure release)
b) Operational aspects which are particularly important for partner compatibility
   - Batch or continuous production

- Seasonal (or other) variations in energy supply/consume
- Predictability in operation, and consequences of unexpected stops

2.3 WHY MY COMPANY WOULD SUPPORT RESOURCE EXCHANGE?

Resource collaboration is an agreement between at least two parties. This can be a good opportunity to work together in some fashion toward a common goal, project and organisational objectives.These collaborations can range from informal to formal agreements with lengthy contracts in which the parties may also exchange equity, or contribute capital to form a joint venture. Such collaborations can bring benefits for the parties involved. Business and other relevant actors may enter into resource collaboration and/or exchange arrangement for a number of different reasons which include:

- Environmental concerns: (energy efficiency, regulations and quotas)
- Access to resources (energy, bi-products)
- Economic reasons: Potential economic benefits, including net cost savings (e.g., any change in the cost of virgin inputs, waste management, operations, transportation, and transactions) and revenue (e.g., by-product sales)
- Reputation (stakeholder pressure)
- New knowledge and critical expertise
- Local and regional development: Goodwill, job creation, local community support
- Other: learning and innovation

2.4 ENERGY COLLABORATION'S CHALLENGES AND ENABLERS

This handbook is concerned with collaborations that are technically feasible. Therefore, we are not addressing technological barriers. Unfortunately, there are other barriers limiting the large potential for utilization of excess heat and other resources. As result, only a small share of the potential is realized. Processes to establish energy surplus collaboration might be complex, comprising many different stakeholders, timelines, high costs, risk, cultures, needs, etc. that need to be orchestrated. For instance, the utilization of surplus energy might need large investments and close collaboration with financial institutions and other public authorities that can offer financial support schemes. At the same time, the necessary infrastructure, for instance to deliver heat to residential areas, requires planning and cooperation with public authorities. It might also encompass long bureaucratic processes, such as the granting of different licenses and permits. The long planning horizon and high initial investments involve risk, which is in itself costly. Indeed, such processes are depicted by uncertainties related to future marked conditions and energy prices, dependencies, stability of partners, viability, profit and survival in the long term, as well as political uncertainty. Insurance coverage and risk management solutions need to be considered.. One possible solution is to divide the risk between different partners, yet the involvement of several partners also makes the decision process and its timing more complicated.

As mentioned earlier, our intention is to shift the focus away from barriers to enablers. To do so, we conducted some case studies with some HighEFFs industrial partners to gather interesting experiences and suggestions on how to overcome these barriers. Table 1 display the main findings:

Table 1 List of enables by challenge identified in the studied cases

BARRIERS	HANDLING OPPORTUNITIES / ENABLERS
COSTS	➢ holistic mindset (long term perspective, socioeconomic profitability) ➢ expand range of exchanges and also include exchange of services (reduce costs by sharing/exchange for instance warehouse, equipment, special expertise, manpower pool, on-call services, administration services, HSE, canteen, etc) ➢ financial support schemes from public authorities (ENOVA, regional and national authorities) ➢ financial opportunities for pilot projects (industrial parks can usually help with application processes) ➢ local government as payment guaranty for loans ➢ choise of contract form, business model, and price model
LACK OF COMPETENCE IN THE LOCATION	➢ collaboration with other municipalities ➢ use R&D and university sector (to attract new graduates and summer jobs) ➢ share knowledge on special areas (i.e.: IT, logistic, automation) ➢ have an attractive municipality for potential employees ➢ flexible organization of work (shifts to commute, adjustable working load) ➢ use support from local suppliers (strength local competence)
LACK OF IDEAS/ KNOWLEDGE	➢ R&D and university sector: summer jobs for students to map needs/opportunities ➢ Analyse local conditions, competence and infrastructures to see what kind of industry can fit in ➢ include R&D within industry ➢ mainstream circular economy in education (high school, business schools, engineering, etc.)
TECHNICAL CHALLENGES	➢ alignment of available surplus energy and use (in early stage) ➢ cooperate with R&D ➢ invest in R&D
MANAGEMENT STYLE/ OWNERSHIP	➢ less conservative and de-centralized management style (risk taking, long time perspective, local autonomy, oriented on community outside industry) ➢ create a proactive local environment where to develop new ideas (meeting arenas for different actors)

	➢ let the enthusiasts grow
RISK	➢ to share it with partners ➢ public instruments for risk management
BUREAUCRACY	➢ effective case processing ➢ close dialogue between local authorities and company over time (beyond a specific case) ➢ use people with different roles (?)
PROCESS	➢ align the partners decision points at early stage ➢ open to new ideas and additional elements which brings economy to the project ➢ …. (flere?)

In the following section, the handbook provides a guideline comprising several steps.

3 A Guideline to Energy Collaboration

This section aims to describe the main stages in establishing energy collaborations, in concrete, the exchange and use of surplus heat. The handbook's premise is that such collaborations are technically feasible. This guideline is for those interested in utilizing energy surplus, both in the demand and the offer sides. Geographical proximity is normally a prerequisite for resource. However, the fact that the majority of the energy surplus in Norway is coming from the smelter industry limits the mobility of the offer side. Therefore, it is more realistic to assume that energy surplus users (demand side) are the ones with mobility capacity.

3.1 STAGE 0 – FUNDAMENTAL CONSIDERATIONS FOR COLLABORATION PROMOTION

It is important to note that there are several factors not directly related to any of the steps involved in establishing and performing resource and energy collaboration yet important in increasing awareness, promoting collaboration and/or facilitating a good background for it. These factors can also increase awareness:

- An existing, updated and proactive R&D environment is crucial, to identify and engage in new opportunities (knowledge and expertise).
- A long-term relationship with university sector: to have access to new workforce, to have master students, etc.
- An existing energy management focus for the for energy efficiency
- Type of ownership and management: Some management styles are more prone to support experimentation and projects than others.
- Long-term relationships with local community: An ongoing and good dialogue with local authorities and other important actors is very important to identify and engage with new opportunities
- Managers should also facilitate and support creativity and original thinking, an open environment for enthusiasts
- Open minded attitude and flexibility
- Updated knowledge on environmental regulations
- Updated knowledge on public support schemes

- Good overview of the situation in both private market that may facilitate or hinder resource collaborations (e.g. green public procurement requirements)
- Knowledge about societal development (trends, potential changes in regulations, plans)

3.2 STAGE 1 – OPPORTUNITIES AND POSSIBILITIES (AND POTENTIAL DOWNSIDES)

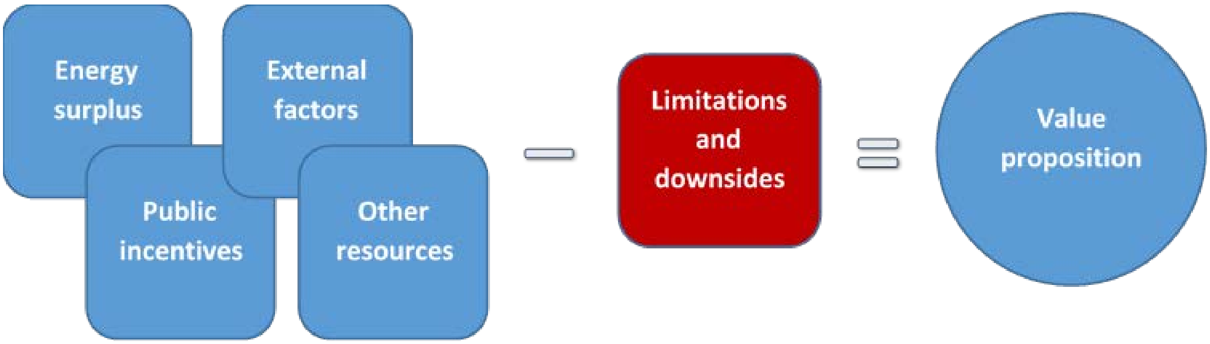


Figure 1 Value proposition in energy collaboration

Stage task: **Find out how and in which ways can the utilization of energy surplus be valuable.**

Guiding questions:

- **In which ways can this resource be valuable (ie. the kinds of opportunities the use of heat waste can bring along)?**
- **What are the potential downsides of the energy collaboration?**
- **What is the potential value of this energy surplus?**
- **How to capture the value of it?What else can bring value to a energy and resource collaboration?**

Important energy characteristics to be considered are:

- **Energy amount (best provided through mass flow and heat capacity at a potential inlet temperature)**
- **Physical form of the energy stream (gas, liquid, particles), as this dictates the used minimum temperature approach in a heat exchanger, and hence, the achievable outlet temperature for the new user.**
- **Inlet temperature to a potential heat exchanger**
- **Required outlet temperature of a potential heat exchanger (if applicable)**
- **Distance from the energy stream to a potential site of a new factory/plant**
- **Is it possible to root the stream of the site to a potential user (direct or indirect utilization of the heat)?**

The aim of this stage is to map the different ways in which the utilization of the energy surplus can create value. To do so, it is important to understand the characteristics of the energy surplus and other available resources that might be relevant in the collaboration; the value proposition, i.e the potential opportunities and downsides that the external use of energy surplus can bring along; the existing public incentives and other external issues that can both facilitate or hinder the establishment of such collaborations.
There are four key issues for value-related consideration:

- **Characteristics of the energy**: it is very important to be aware of the type of energy surplus at hand. This will define the type of collaboration that we can establish. Type of energy (low temperature heat, high temperature heat), energy amount (volume), characteristics of the energy production (continued ordiscontinued stream, variations and stability)
- Other **types of resources** available that can be relevant for the collaboration:
    - Excess heat
    - Electricity (produced from own excess heat)
    - Waste (bi-products) that can be used in other processes
    - Services (administration, cantina, fire brigade, etc.)
    - Labour (used elsewhere when not needed, second call night duty, shared control room operators, expertise, etc.)
    - Buildings that can be rented out when not used
    - Expert knowledge (that can contribute elsewhere, in education, etc.)
    - Financial resources
    - Infrastructure (storage opportunities (both area and equipment), laboratories, transportation, power, harbour, etc.
- **Value proposition**: what kind of potential opportunities and downsides can the utilization of the resource(s) bring along. For instance: economic value –selling heat waste for a x price, or by buying it for a cheaper price than conventional electricity; societal value –contributing to the local community by creating jobs; and/or environmental value – increasing energy efficiency of the company.
- **Public incentives schemes**: it is important to have a good overview of existing incentives and public schemes that can facilitate the establishment of such collaborations. Therefore, incentives and public schemes should be included in value-related considerations
- **External elements** affecting the possible process such as changes in regulations and development plans from public authorities

> Tips: Be open minded and creative towards what might be included in this kind of collaboration. These collaborative arrangements may require a flexible approach to delivering outcomes.

3.3 STAGE 2 – MAPPING OF POTENTIAL STAKEHOLDERS

Guiding questions: **What is it available in the area?/What can we bring to the area?** **What kind of industry is a good match?** **What are the opportunities for main partners? What are the consequences of establishing such collaboration for each party?** **Are there other stakeholders that might have an interest in this collaboration getting realised?**

Stage task: **Search and map and potential actors interested in the energy collaboration. Select both main partners and other relevant stakeholders interested in the potential energy collaboration.**

This stage aims to search, map and select potential partners. In particular, there are two major categories:

1. **Main partners**: energy surplus producer or user. Typical surplus heat sources are:

    - industries having excess heat
    - computer centrals

    Typical energy consumers are:

    - district heating companies
    - Owners of large buildings and infrastructure
        - Public: schools, hospitals, offices etc
        - Private:
            - Residential areas
            - Office buildings, shopping centres, etc.
    - Other industry
        - Horticulture
        - Aquaculture
        - Food industry
        - Other manufactories (clothing, …..)

2. **Other relevant stakeholders includes other actors having a potential interest in the establishment of the collaboration, and hence might contribute to the realization. Thus, it is important to have a broad overview of other possible stakeholders that can be included and their possible interests in being involved. The list below is based on the findings from our empirical data. It aims to serve as inspiration for those seeking the establishment of energy and resource collaborations, and do not intended to be an exhaustive list. It is based on the findings from our empirical data.**

Table 2 Inspiration list of potential stakeholders

Potential stakeholders	How can it help to facilitate the collaboration? Enablers
Local and regional authorities	Can facilitate the establishment of industry nearby by offering regulated and available area Can facilitate processes by having an effective bureaucracy (ie. reducing case processing time) Can undertake measures to have a good municipality-company collaboration Can serve as payment guarantee for potential loans Can take an active role in energy surplus use by promoting district heating (warm up all the public buildings for instance) Can have a very active role in community development, making the municipality an attractive place to live (infrastructure, activities, recreational paths, commerce)
R&D and university sector	Can encourage local youth to choose education related to industry's needs Collaborate with education institutions in designing programs and opportunities that

	responds to identified industrial needs
Trade unions	Can facilitate flexibility in terms of organization of work to attract labour force Push environmental concerns forward in the company (at every level) Collaborate to seek alternative solutions on sharing of personnel between partners Contributing in finding smooth solutions for operation of energy and resource exchange
Industrial parks organizations	Can help with finding potential partners, seeking funding opportunities, applications and provide support in the establishing process (e.g. towards public offices, support schemes)
Investors, enthusiasts	Local investors and enthusiasts are important contributors in establishing local support and exploring local solutions
Insurance companies	Can help by being more open to such a collaboration and adapt their product to fit the collaboration
Other suppliers of services	to be involved in local community to do the location an attractive place to live for

	potential new employees have local community in mind when accepting/looking for potential resource users (bitcoin companies do not bring anything to the local community but uses the potential advantages given for the establishment of new companies/industries) Potential partners to share/offer services

This stage draws on the input from previous stage – regarding the kind of energy collaboration we can establish (characteristics of the energy sources) and the potential value of it. The characteristics of the type of energy surplus play a very central role in the selection of main partner, since there must be an optimal **match** in terms of **temperatures and types and operational characteristics of available energy surplus**. SINTEF Energy, as part of his work within HighEFF, has explored the different possibilities (temperatures) for the different potential industries for a detailed description see:
(Deliverable 6.4_2018.01 Cross-industry exploration for external utilization of waste heat)

The report concludes than the sector *Food, beverages, and tobacco* seems to have the biggest potential for energy surplus use. Industries within this sector span a large variety of different processes and unit operations which may potentially require temperatures provided in the waste heat. It is however as well an easily scalable sector which will always be important for fulfilling national food security. The use of surplus heat for direct heating exhibits the highest levels of energy efficiency. However, in areas where the source of surplus heat is far from the heat needs, or lack of heat needs, power generation is a potential option that offers high levels of flexibility in terms of energy recycling.

Furthermore, there are also two other key aspects for potential users of energy surplus to take into consideration: the location of the heat surplus source and the costs for making use of the energy. The **location of the heat surplus producers** (i.e. smelters) has a major influence on the usefulness of external heat integration. If it is necessary to transport low-value and high-mass goods to and from the integrated, new plant (*e.g.* materials for drying which mass is mostly given by water), it may result in an even worse energy balance and increased CO_2 emissions. Hence, it is important to consider the transportation to and from the energy surplus source for the additional processes. Corresponding calculations must be considered for transportation of products. The location may further restrict the size of the additional industry process in the neighbourhood. The distance in which energy can be viably transported is limited. There exists an upper limit on the maximum distance due to the cooling to a lower surrounding temperature and the energy need for pumping. The first is especially important in Norway as the climate is colder compared to central Europe.

The feasible distance for transportation can be seen as complement to the space constraint at the smelter side[1].

It is important to identify the **operational energy costs of the potential partner in the energy collaboration**. If the energy costs during correspond to a large percentage of the overall operating costs of the process, it might be beneficial to co-locate. If these costs correspond to a small percentage of the overall costs, it may be less tempting to base the location of a plant purely on the availability of cheap waste heat - if other aspects of the collaboration does not balance this cost. Here, it would be more useful to produce either close the markets or the required resources. Therefore, there must be a balance technological match with the efforts needed to establish collaboration – and other contractual elements. If only calculating energy and operation costs, the latter is what could move the collaboration from non-profitable for the partners to profitable.

The search criteria for partners should include business with **compatible cultures**, **shared values** and **long term interests**. Compatible parties reduce possible future conflict in the execution of the collaboration.

3.4 STAGE 3 – NEGOTIATION BETWEEN (MAIN) PARTNERS

Stage task: to find out a contract form that suits the type of collaboration.

Guiding questions:
What kind of ownership type is suitable for the exchange? What opportunities do we have?
What kind of pricing model can work (best) for the exchange?
How do we regulate spillover-effects from the collaboration?
What kind of add-value elements should be included in the contract? Pricing?
Are there any existing or expected regulations affecting the exchange?
How do we deal with crosscutting issues such as risk, power, time and termination strategies?

The negotiation of energy collaboration contract between main partners should draw on an *integrative* approach. An integrative approach to contract negotiation 'considers the interests of all parties' and promotes alternative ways of attacking problems. Value is created by taking advantage of common ground, diminishing conflicts, and building long-term business relationships. It differs from the traditional distributive approach in that it strives to find solutions for all parties involved (see appendix C for a more detailed description of negotiation types and strategies).

[1] A model for calculating the energy cost for transporting hot water was developed by Kavvadias et al. [Available at:]. This model can be used to evaluate the possibility to construct processes further away from the plant location if space is not available. The actual viable distance is depending on the outside air temperature, the temperature of the heat, the used insulation, and the cost of electricity, if the heat can be instead provided by heat pumps (SINTEF).

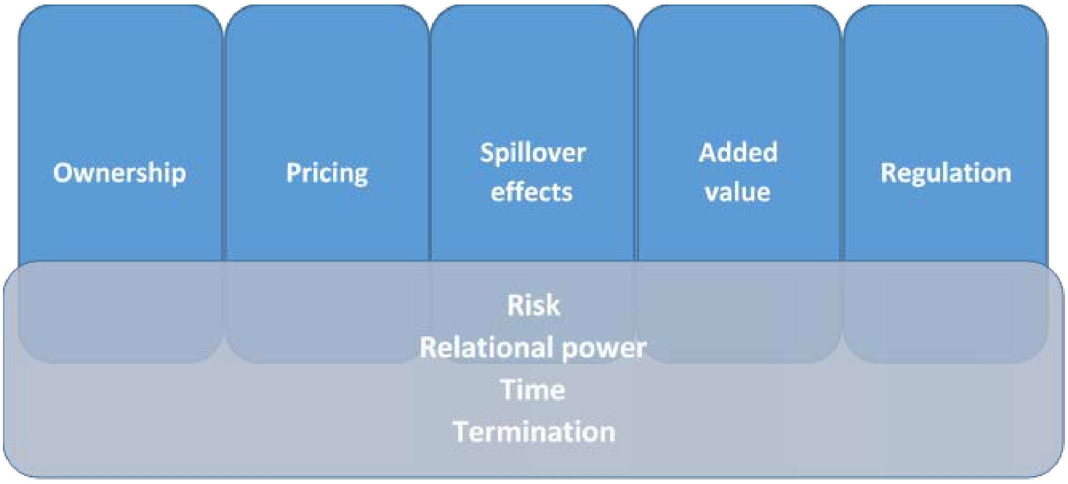


Figure 2. Contract elements to consider in the negotiation process

> The contract form comprises several and interrelated elements defining ownership, pricing, potential spillover-effects, the add-value and the regulations, as well as, crosscutting issues as risk, power and time dimensions and termination aspects.

Contractual aspects: Ownership – from loosely agreed short-term partnerships to long-term join venture partnerships
Existing energy exchange contracts can be divided according the type of the **ownership**. The most common shareholding situations are: market exchange collaboration, joint equity collaboration and third party owned equity collaboration, as shown in Figure 3. Each contract type has its own advantages and barriers, and fits into different scenarios.

a) **Market exchange collaboration** refers to an alliance between two or more companies, aimed at achieving a common objective by coordinating efforts, while each party retains its organizational independence and no new equity entity or corporation is created.

This type of collaboration is a relatively loose relationship, and the cooperation among parties is bonded by contracts. There is no sharing of equity in market exchange collaboration, thus the interdependence among parties are relatively low. The collaborative parties can terminate the collaboration rather easily, and they have high flexibility to look for new partners. Moreover, the start-up cost is relevant low, so the parties can also avoid substantial risk from having high up-front specific investment via this type of contract. Each parties needs to perform their obligations in accordance with the cooperation agreement. Moreover, this type of collaboration can avoid high management costs, and is more adaptive to the external environment changing.

However, the parties engaging in market exchange agreements generally have little control and influence to their partners, partly because of the lack of property rights bond. It is easy to terminate the relationship, but it may increase the searching cost for new partners.

b) **Joint equity collaboration** refers to the cooperation between two or more parties who jointly fund and establish a shared equity relationship, such as joint ventures and minority equity ventures (crossshareholdings and minority shareholding). Via this type of contract, an agreement between two or more companies to enter into a separate business venture together is established, therefore, the parties with more shared equity ownership have higher voting power within the collaboration. Alliances can be defined as medium and long-term agreements between companies, which involve the mutual transfer of intangible resources to take shape with or without administrative structure.

Such type of cooperation agreement forms close relationship between parties, which can help the collaborative parties to establish a link to their property rights and enhance their inter-dependency. Because of the inter-dependency among parties, they are willing to communicate and coordinate with each other, which may moderate potential contradictions and conflicts in the collaboration. Since this type of equity arrangements are rather complicated to implement as well as to dissolve, they usually exist for longer time periods compared to the market type.

However, joint equity collaboration may lead to high administrative costs and control cost, and decrease the flexibility of the collaborative relationship. Moreover, the start-up expense for joint equity collaboration is usually high, with each parties' specific investment into the collaborative relationship, which makes it difficult to end this type of contract.

c) **Third party owned equity collaboration** refers to the collaboration contract that a third party owns and runs the joint equity (infrastructure) and distributes energy and resources to the engaging parties. This type of contracting form can be usually found in industry parks.

This type of contract can be a good way to overcome financial barriers for collaborative parties, such as the high initial investment costs with a long payback period. In addition, some extra cost like operation and maintenance cost can also be avoid with the engagement of the third party. Moreover, a professional third party with advanced technological and managerial skills can also ease the risk from the collaborative parties in a joint equity contract.

However, having a third party owned equity contract usually means higher energy or resource price where the collaborative parties need to 'pay for the service'. They may also face the situation that they get over-charged when they are highly depended on the third party.

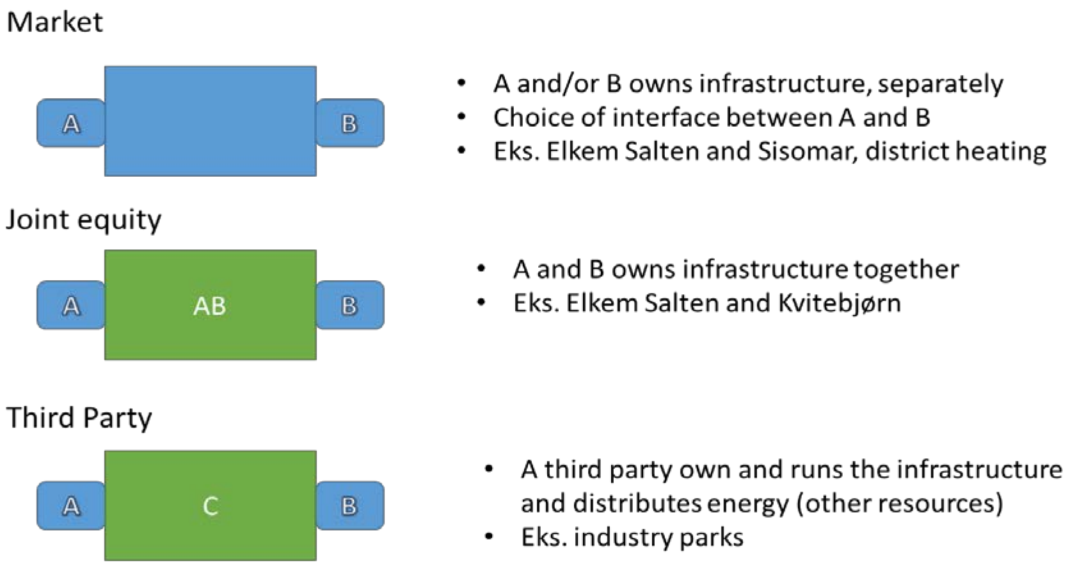


Figure 3 Examples from different contract models

Contractual aspects: Pricing models

With respect to pricing models for energy exchange, all contracts need to cover at least **two** categories of costs for the supply of energy:

1) Generation costs, i.e. the production of energy
2) Distribution costs, i.e. the transportation of energy from producer to consumer

In addition, taxes and fees are mandatory parts of the contract. There could be some fixed pricing independent on how or when energy is used during a month. In addition, there are up to **three** variable elements of a pricing contract for delivery of energy:

1) Energy-based pricing (price per kWh)
2) Power-based pricing (price per kW)
3) Volume-based pricing[2] (price per m^3)

Energy generation costs are usually covered with **energy-based pricing**. Energy distribution costs usually also include energy-based pricing, but they could in addition be fully or partly covered with **power-based pricing** and/or **volume-based pricing**. The idea of power-based pricing is to generate incentives to avoid 'rapid' extraction of energy (i.e. high energy use over short time periods). Volume-based pricing gives signals for efficient extraction of energy per volume of distribution medium, for example more expensive prices when unnecessary volumes of water is pumped through a district heating system (i.e. when the return temperature is too high).

For households/residential consumers, all variable costs (including both generation and distribution) are generally covered with energy-based pricing only, which is the least complicated way of pricing energy. With energy-based pricing, there could two categories of pricing: 1) a fixed price per kWh or 2) a time-varying price per kWh. A fixed energy-based price only requires energy metering over a measuring period *without* any time stamps (accumulated kWh). A time-varying energy-based price requires energy metering *with* a time stamp for when a certain amount of energy was used (load profile). The time-varying energy price could be fixed for certain time periods (e.g. day/night, summer/winter, etc.), usually referred to as 'time-of-use' pricing, but there could also be a more granular price change (e.g. hourly pricing).

Power-based pricing and volume-based pricing are pricing structures currently used for non-residential consumers, partly because these structures are more complicated to comprehend, administer and react to. The power-based pricing requires energy metering *with* a time stamp. Independent of whether the energy price is high or low for at a certain time period, the power price is only dependent on the extraction rate of energy per time. Power-based pricing schemes usually prices the highest extraction rate of energy per time over a measuring period, usually referred to as 'metered power' pricing. Volume-based pricing requires volumetric metering of the energy distribution medium, alternatively metering of the return temperature in a district heating system. If a lot of energy distribution medium is used to meet a small demand (i.e. if the return temperature is high), the volume price is high because a lot of potential energy in that distribution medium is not used. Note that the volume price is independent of both the energy price and the power price, as it depends on the characteristics and operation of different thermal consumption assets to utilize energy from a volume of distribution medium at a consumer site (as well as the supply temperature) rather than total energy use or extraction rate.

Table 3 sums up the different options for pricing schemes for energy trading. Note that the pricing schemes could be used in combination if required metering is present. The choice of energy pricing scheme depends on the characteristics of the energy trade, and time-varying pricing schemes will be relevant if it is

[2] Only relevant when energy is non-electric and transported through a medium (water, gas, etc.), typically a district heating system

difficult to match supply and demand in different time periods. The need to use power- and/or volume price will be relevant if the distribution system has potential to be operated and developed more efficiently.

Table 3. Summary of characteristics of different pricing schemes for energy trading

Pricing scheme	Description	Metering required	Cost coverage	Preferable if…
Fixed energy price	Equal price per kWh for all energy consumed	Energy metering w/o time stamp	Generation and distribution	Energy production and consumption is rather constant
Time-varying energy price	Time dependent price per kWh for all energy consumed	Energy metering w/ time stamp	Generation and distribution	Energy production and/or consumption does not match in time
Power price	Price per kW dependent on the energy extraction rate per time	Energy metering w/ time stamp	Distribution	Distribution network dimensions are stressed and/or under-utilized during certain times
Volume price	Price per m^3 dependent on the total volume of distribution medium used	Volumetric metering of distribution medium	Distribution	Return temperatures are too high meaning there is unnecessary distribution medium used

In terms of price quantification and determination, it depends on the fixed and variable costs for the energy product. In general, the price (together with anticipated energy consumption) must at least cover all generation and distribution costs. Further, the price for energy should not go beyond the *alternative cost* of supplying the energy (e.g. the electricity price). However, the contract could include elements that are valued beyond only the energy exchanged. If covering generation and distribution costs require it, parties could agree on a price higher than the alternative cost if compensated by other contractual elements (e.g. shared services). For example contracts for district heating supply from Statkraft Varme, see https://www.statkraftvarme.no/produkter-og-tjenester/Prismodell/

Contractual aspects: added-value and spill-over effects

Contracts can also include the regulation of other types of elements that might add value to the collaboration. As mentioned earlier, it is important to be creative and include other types of resources or services that can make it economically feasible. Some of the **added-value elements** can be:

- Sharing complimentary resources and capabilities (competence and expertise)
- other services (common manpower pool, cantina, administration, and others, …)
- (kWh, other contract elements)
- Others?!

Furthermore, the contract should also deal with **spill-over effects**, i.e. intended or anticipated positive and negative outcomes from the collaboration:

- The arrangement for different unforeseen events
- Policies and procedures for communication and determination of conflicts or issues that arise
- Intellectual Property Rights created as a result of the collaboration or background IPR will need to be managed and royalties assigned for a number of years.

Contractual aspects: Regulation and context
Finally, the negotiation of the contract should consider any existing regulation that might affect the energy collaboration, for instance:

- Any regulations on various legal matters, e.g. confidentiality and nondisclosure agreements, ownership and licensing of intellectual property rights and indemnity provisions.
- Averse action by regulatory authorities

Risk, termination, power and time
Risk, termination, power and time are cross-cutting elements affecting each of the above discussed contractual elements. **Risk** is the effect of uncertainties in every realm of the collaboration, from the technical aspects to the financial ones. A suitable collaboration model will depend greatly on the degree of risk which the partners are prepared to undertake. The acceptance of risk will also depend on the rewards that the identified opportunity can bring.

Risk can be best handled when values and culture are shared and therefore values and culture is critical as selection criteria for any collaboration partners.

Energy exchange collaborations might come to an end. Collaborations may terminate for any number of reasons:

- The collaborative relationship may break down
- Failure to achieve objectives
- Expiration of term of the collaboration
- Adverse action by regulatory authorities
- Partner strategies may change thus eliminating the need for the collaboration.

The different parties should consider their **exist strategies** from the very beginning by specifying in the initial agreement what happens to assets, customers and existing contracts at the end of the life of the collaboration.

Time is essential for duration of the contract, and also for the pricing model. The price model can be divided into time segments (separated by defined time periods or events) with different price regimes. Often long-lasting contracts are requisite to land the negotiation due to high investment costs and risks.

Power aspects are very crucial to the negotiation between parties. Power can be defined as the probability that one actor in a social relationship will be in a position to carry out his own will despite resistance. In inter-organizational relationships power is rarely equally distributed leading to power imbalances. The latter should be considered before engaging in potential energy collaborations. Furthermore, there are three different types of powers within organizations that may lead as well to power imbalances among employees (positional, relational and expertise-based).

Preliminary discussions should explain in detail each partner's commitment in terms of resources, time and efforts.
Tips: to start with small projects first to get to know each other before committing too many resources (if possible)

Tips: Be open minded and creative towards what might be included in this kind of collaboration. These collaborative arrangements may require a flexible approach to delivering outcomes.

3.5 STAGE 4 – IMPLEMENTATION AND OPERATION OF THE ENERGY EXCHANGE

Task: This stage aims to facilitate the implementation and operation of the energy exchange

Guiding questions:
What is important for a successful implementation and operation of the energy exchange?

The organization studies' literature points to three elements as key in a successful implementation and operations of new projects and processes of change within organizations, such as establishing an energy collaboration between two or more parties:

- **Understanding**: A prerequisite for all collaboration is that those who collaborate have a common understanding of goals, roles and responsibilities. When collaborating between two or more parties, it is important that central employees at every level of the organization and in each of the parties perceive reality in the same way – i.e. that they have a common understanding of the current situation, their concrete contribution to the collaboration and the expectations they may have to each other. Employees involved in the collaboration should have a good understanding and knowledge of the partner's activity, needs and operational characteristics.
- **Anchoring:** The prerequisite for good anchoring of change processes is that the overall goal of the collaboration is understood and accepted by everyone involved. At the same time, there must be consensus regarding the need to enter an energy collaboration. The work with anchoring can be time-consuming and all important players must be given enough time to understand what the changes consist of and what consequences they may have for their own work. Good anchoring requires that employees have confidence in the organization and their leaders in terms of, both, competence and intentions.
- **Commitment**: Good cooperation requires that each person feels that they have a responsibility and a role in the implementation of what is planned, and that they are made responsible by following up plans and measures. Both parties should have procedures for follow-up and feedback. It is particularly important that key roles, responsibilities and tasks are well described, understood and anchored.

The cases studies carried out for these projects are in line with the literature. They point to the importance of dedication time and other resources to the planning of the energy collaboration implementation. It is especially important to involve operators at existing facilities in early phase of the implementation planning (reducing resistance). The contract should comprise enough agreement's details so that it is possible to put it in practice. Yet, at the same time, it should be loose enough to be able to adapt and respond to unexpected events along the implementation. The establishment of arenas for interaction between different partners and employees in different positions is very important. Regular dialogue between operators across the companies is critical not only to share knowledge and important details about different processes (partner's needs, intentions, plans) but to be able to respond to ongoing operation challenges in a better way. It is also important to have a clear distribution of responsibilities, and that contact details of the responsible person for each process is given in case something happens during operation. Enthusiastic individuals can play an important role in every stage of the implementation and operation of the energy collaboration. While at the same time, it is important to enhance a sense of community and ownership.

Tips: These collaborative arrangements may require a balance between flexible and rigid approaches to implementation and operation.

4 Conclusion: Summary of enablers by stage

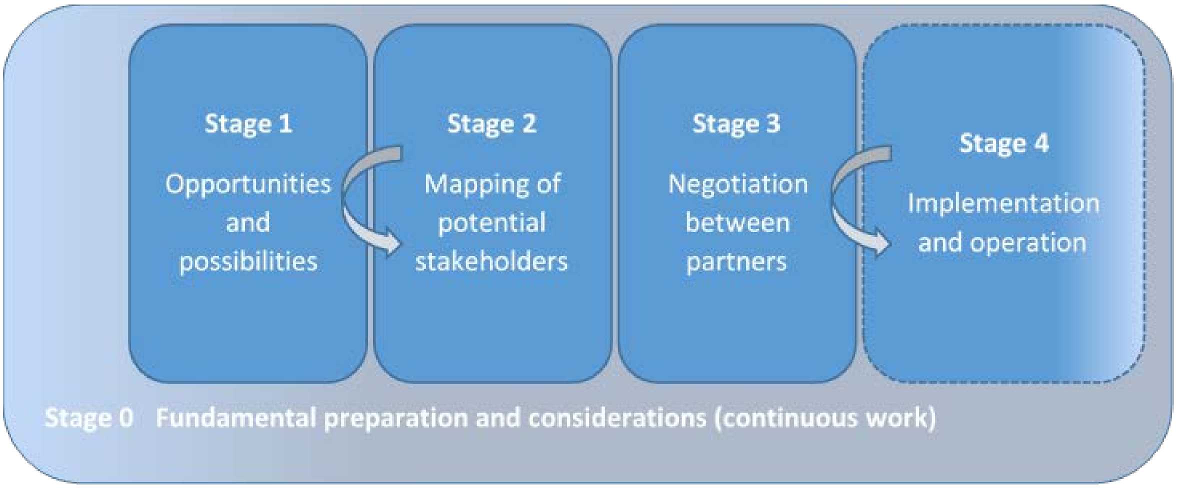


Figure 4. Important stages in energy collaboration processes

Table 4. List of enables by phase

TImeline	ENABLERS
Before establishing collaboration	➢ Technological feasible? Compatible? (this part of HighEFF research assumes so) ➢ Have a common understandings of different needs, aims, possibilities, visions, timeframes ➢ Work towards a shared project ➢ Ownership and anchorage in every level of the chain

	➢ Knowledge about the industry and the market and regulatory frameworks ➢ Assessment of location/ industry ➢ Risk assessment
During the establishment	➢ Price models: ➢ Risk management model ➢ Legal and financial liability ➢ Competition (distortion of competition) ➢ Creation of third parties ➢ Interdependent decisions (but not taken simultaneously)
After the establishment	➢ Operators communication and collaboration ➢ Close dialogue with R&D to find solutions to possible challenges and problems ➢ Understanding, commitment and anchorage ➢
OVERTIME	➢ Good dialogue with municipality and other actors ➢ Sense of ownership and anchorage in the organization ➢ Promote a creative environment to develop new ideas to optimize existing collaboration (involve employees from every level of the chain/organization not only leaders, rewards) ➢ Dialogue with universities and R&D environments ➢ Investments in R&D

5 Appendix A

In 2017 HighEFF has arranged three workshops with different industries; Food and chemical sector, Metal and materials sector and Oil and gas sector. A big part of these workshops has been to make the industries and the researchers in the different research areas communicate with each other through facilitated group sessions. Much of the thematic was about enablers and barriers for developing and implementing energy efficient technology in the industries, and we want to present the views and opinions that came up during the sessions. Since there were many coinciding views between the industries, we will not at this stage separate the findings in the three workshops, but give a summary presentation. We use Cagno, Worrell et al.'s (2013) utilized taxonomy (presented earlier) categorizing barriers inside an organization. This taxonomy does not contain categories outside an organisation. We have, therefore, added two categories; inter-organizational and external. While the taxonomy original only categorizes barriers, it will in our purpose also include enablers (and preconditions). The findings are summarized in **Error! Reference source not found.**.

What is important to bear in mind, is that several of these enablers and barriers can be placed in more than one category, and that enablers/barriers in one category influences enablers/barriers in other categories. In future work we will explore this mutual impact and look at how changes in one factor can also change other factors.

Category	Barrier	Enabler
Technology-related	Need for heat exchangers with efficient transfer of heat	Energy consuming industry is a major producer of surplus heat
	Storage of surplus heat (or transformation to electricity) without major energy losses or high cost	High potential for improved use of surplus heat
	Upgrading low-grade heat to high-grade energy	Examples of successful surplus energy storage (e.g. N-rgie Nürnberg)
	The costs in high-temperature parts are high	
	Weight limitations and lack of space is a challenge at e.g. off-shore installations	
Information-related	Many facilities are not built with appropriate sensors and logging of data to make efficient use of energy accounting.	
Economic	Cost efficiency	Economic viability is a basic premise

	The energy expenses or the utilization of heat is (still) rarely of big enough magnitude to be a decisive cost for localization of factories or plants.	The dairy industry has relatively high costs on energy expenses, and express a need to improve overall energy recovery to reduce the costs
	Limited resources lead to limited funding of R&D activities. Only the best, cost efficient ideas will be funded. Non-profit solutions will be driven by government and incentive systems.	
	The investment costs for infrastructure for shared resources in industry clusters are high	
	Area costs for low temperature solutions using huge areas	
Behavioral	The industry is aware of the danger of being "to clever" developing new technology (useful, but expensive) leading to new legislations ordering all to use this technology	
	Reluctance to handle uncertainty and risk makes it difficult to get new, groundbreaking technology to the market	
Organizational	Internal barriers and lack of communication e.g. between departments	
Competence-related	Difficult to map all possibilities, both technical and commercial	The sector believes establishing clusters is the way to go
	We need to seek "alignment" between technical and political approaches	The industry exceeds the government in competence and knowledge on future technologies and possibilities, and the government should therefore cooperates with the industry when developing legislations

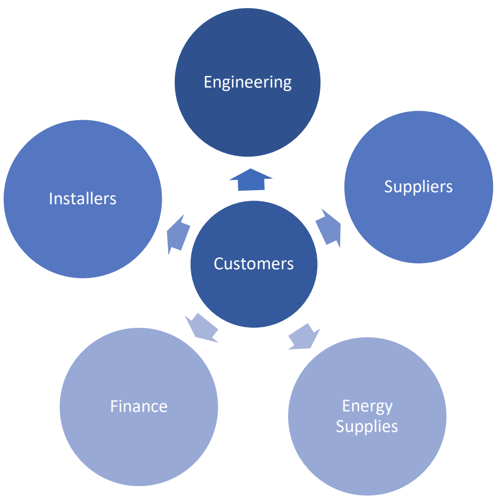
Awareness		
Inter-organizational	Most plants/factories are already situated at one place, so to be incorporated in a cluster therefor often means establishing the cluster in the nearby region, or moving the site. The latter is unrealistic. The potential savings on energy costs are not big enough.	
	Who will handle the costs “between the fences”? Who will provide the necessary backup?	
	Energy collaborations between companies is difficult to establish	
	Secrecy between companies	
External	Metal industry mostly located in rural areas where there is limited use for surplus heat	The surroundings and local means are important (e.g. county authority, municipal, local interests, other industry and commerce, demography)
	Seasonal variations affect energy use	Legislations and incentives (e.g. CO_2-tax, or the government require reduction in energy consumption)
	Political decisions hinders alternative solutions, e.g. legislation stopping the industry from giving the surplus energy away to another company because of competitive advantages, or stopping reuse of slag categorized as harmful waste	Emissions from the oil and gas industry are high, and industry clusters is one of the most important solutions to reduce emissions from the energy sector
	The legislations are different in the different countries in which a company operates. This affects the company decisions. It might also lead to companies moving their activity out of a country	A “match-making strategy or database” for co-localization of businesses

	Constant changing legislations and regulations makes long term planning difficult, and also to maintain profitability in established/implemented solutions.	It might be of importance to get the power producers onboard to succeed
	If Enova move their support schemes towards new technology rather than smarter and more efficient exploitation of what already exist	Peoples opinion / reputation

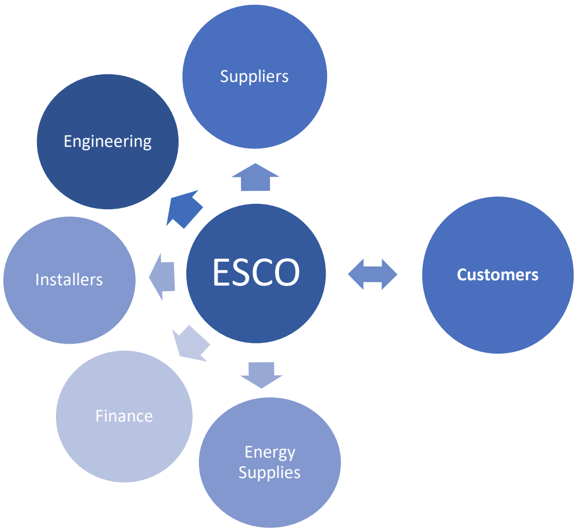
6 Appendix B Energy Management

Energy Management is the forecasting and administration of both energy production and consumption units. The main aim is resource and climate conservation, and price reduction - whilst clients have perpetual access to the energy required. *Energy Management* is based on creating collaboration within the energy supply chain through alternative approaches to contracting. Thus, it is hands-on, organized and methodical procurement, adaptation, supply and utilization of energy to meet the requirements of multiple actors. The principles pertaining to *Energy Management* are particularly vital for entities such as Energy Service Companies (ESCOs), because the performance of a contract, or implementation of a project, is grouped as a single stakeholder in regards to the final customer.

Contract without ESCO:



Contract with ESCO:

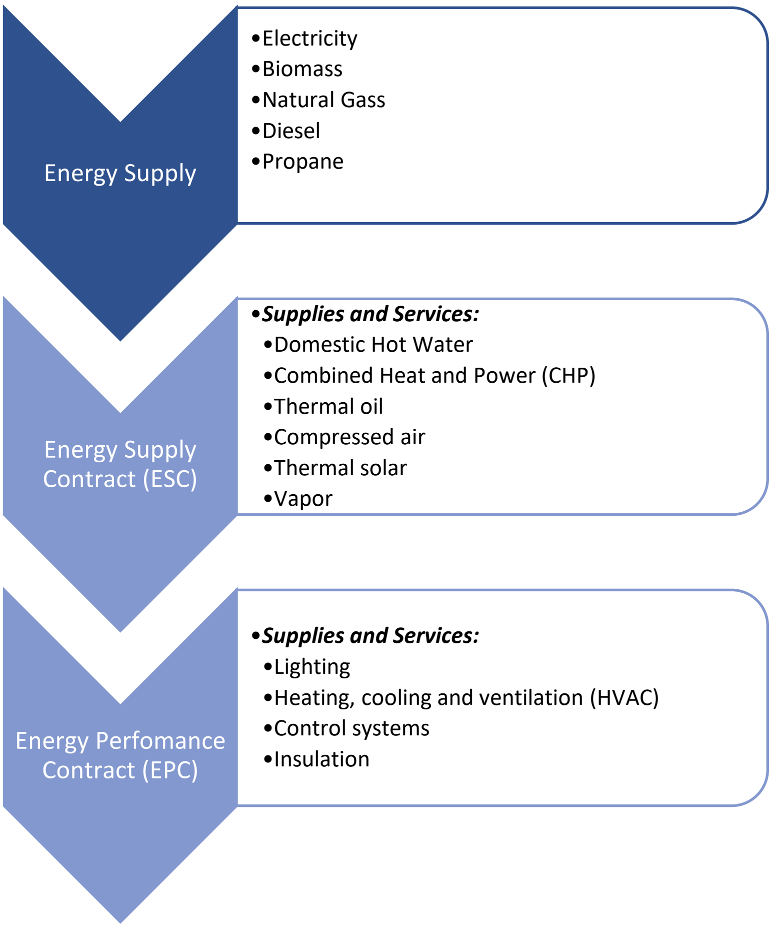


Energy Performance Contract (EPC)

EPC is a tool for consolidating energy efficiency financing. EPC comprises an Energy Service Company (ESCO) that delivers various options, such as commercial investments and energy savings. The compensation of the ESCO is contingent on the attainment of the energy savings. The ESCO is involved in the measurement and certification process for the energy savings in the reimbursement time-frame. ESCO and energy performance contracting is typically found in the public sector and to a smaller degree in commercial building sectors.

Energy Supply Contract (ESC)

ESC is the effective supply of energy. The contracting partner provides main services like heat, chilling, compressed air or electricity. The focus of the contract is not the energy rate, but the utility rate: charged per volume items of, for example, heat, steam or compressed air. Funding, industrial design, preparation, assembling, setup and upkeep of energy plants as well as administration of energy delivery is included in the whole service bundle. The ESC is a service mainly applied in the corporate and industrial areas; but residential schemes, such as district heating schemes, might also be included. This commercial framework covers the whole procedure from the buying of raw material to the transportation and billing of energy. Plants and renewable energy options are additionally incorporated in ESCs. The remunerations of ESC are a substantial improvement in productivity, improved operational costs, greater supply guarantees and the application of contemporary safety criteria. The client no longer needs to be concerned about energy supply concerns and environmental performance. The focus of the ESC framework is on the effectiveness of the energy supply with the objective to carry the effectiveness to the fullest whilst at the same time safeguarding security of supply.



The major dissimilarity between these two is that EPC is broader than ESC in scale and scope. While ESC is founded on a commercial model that guarantees energy supply, EPC is a commercial model for effective energy savings. The objective is to circumvent energy waste and to direct the savings in energy effectiveness.

Bilateral Contract

The bilateral contract model comprises generators and buyers entering into bilateral agreements for the sale of energy. Generators can also be buyers when they do not generate enough power themselves. Intermediaries can also facilitate the exchange between buyers and sellers. These trading parties generally negotiate a set of agenda items and factors that form the foundation of exchange between them. When a master agreement has been settled, energy trading can commence on contracts of any length. Contracts stipulate the amount and price of energy to be traded and when it will take place. At a set time before delivery actors disclose their net contract transactions to the system operator. Every generator chooses when to dispatch and the system operator is obligated to administer the disparities that transpire. Because the system operators do not own the generating capabilities to balance the system, a method ought to be created to recompense the imbalances. There are two possibilities: a market- or punitive price. Several elements affect the option the market implements, including pricing for retaining system security. In some markets where, for example, electricity is generated via low-cost plants and energy is sold through contracts where minor parts are sold in the spot market, the rate from the spot market is used to resolve disparities. This differs to other markets that fines shortfall disparities and incentivize oversupplies through a dual pricing system.

Time-of-Use (TOU) Contract

TOU contracts are designed to allow changed rates at different times of day that correspond to the time throughout the day when costs of power are higher. An assortment of structures can be utilised, some with off-peak, shoulder or peak-prices; others with even off-peak and peak rates. The utility offers these rates to match to differential costs of power purchases and charges the client based on use of energy when it is used. The rewards from the TOU contracts comprise the simplicity of use to the client who is aware of the rates during the day and the benefit that the service is now charging prices that reflect power purchase rates. Test cases that have implemented TOU contracts largely find that customers both change loads to off-peak times and save on energy usage, granted these results differ with the expenditures of implementation.

The subcontractor model

In this model, the suppliers will be contractually accountable for the grid service for the consumer and operations managers, such as Distribution System Operators (DSOs), will merely have a contractual responsibility towards the supplier. The legal significance is that operations managers at the onset have no independent contractual accountability in regards to consumers, and consumers have no independent contractual rights against the operations managers. The only exceptions are for obligations under a grid connection agreement where consumers experience issues with the service; where any claim would at the onset be solely against the supplier. The supplier may then have their own claim against a DSO, centered on the contractual agreements with the DSO.

7 Appendix C: Negotiation

There are two major strategies in negotiation: (1) distributive and (2) integrative. The *distributive* approach is typically viewed in the light of the 'fixed-pie' or 'win-lose' dichotomy which emphasises that there are a limited number of ways to distribute goods or settle disputes within any given area of interest. The distributive approach to negotiation relates to how the parties concerned divide the different elements between them and maintain a stringent focus on their own objectives. The concept of distributive bargaining is based on the notion that the interests of the parties are negatively correlated. From that, an increase in the value of one party's outcome is associated with a corresponding decrease in the value of the other party's outcome. In this type of a negotiation event, the respective participants have a stipulated bottom-line figure, which they will not move from for the sake of accomplishing a deal.

The *integrative* approach to negotiation is based on outcomes being reached that provide high levels of satisfaction for all parties and 'expand the pie'. This is achieved by ensuring that none of the parties concerned suffers a major loss, with the entire negotiation process being based on this fundamental objective. The two concepts fundamental to understanding this process are that participants must first create as much value as possible for the other party and themselves, and then claim as much value as possible for themselves. This aims to create 'win-win' solutions, but since all parties rarely get exactly what they want, there are trade-offs. This serves as the backdrop to the concept of integrative negotiation, which can produce sound outcomes when utilised by skilled practitioners.

An integrative negotiation approach 'considers the interests of all parties – the goal is an outcome that is based on the merits of individual claims, and that serves each party's desires as much as possible'. However, to effectively deal with the challenges associated with integrative relational negotiation and case specificity, a methodical negotiator needs to thoroughly analyse the bargaining situation, develop an overall strategy, and implement tactics in accordance with the former elements.

In essence, the notion of creating value stems from integrative negotiation, which promotes alternative ways of attacking problems, and differs from the traditional distributive approach in that it strives to find solutions for all parties involved. The quintessential reason for applying this approach to negotiation is to generate value and enable all parties to reach their objectives. This is done through a process of recognising alternative uses of assets or finding distinct and original ways of using available resources. Value creation can be accomplished in many different ways and as a result, identifying core factors of the process is important. This is done by accepting that negotiators do not always see all issues as equally important and that by exploring compatibility through communicating different concerns, the parties can unlock the conundrum of value creation. In this context, value is created by taking advantage of common ground, diminishing conflicts, and building long-term business relationships.

Key points in this framework include: separating people from the problem, focusing on interests rather than positions, generating a variety of possibilities before deciding what to do, basing results on an objective standard, and creating an environment that will not hinder future relations. This approach, also deemed principled negotiation, has been instrumental in developing interest based bargaining.

8 Appendix D: Business Models for Circular Economy

The table below comprises a very comprehensive list of main dimensions and factors that potentially affect Circular Economy Business Models. The list of factors may indicate the readiness of the country and sector for Circular Economy in order to understand the overall business context.

Dimensions	Factors	Examples
Political and legal factors	Overarching framework	Existence of CE roadmap/ initiative at the national level
		Setting of national end-goals and monitoring (CO2, noise, movements)
	Legal issues	Legality of activities, intellectual property rights, warranties, contracts
	Environmental and Industrial regulation	Resource efficiency targets, requirements of reusing percentage of components and raw materials in new products
		Waste regulation, recycling regulation, water regulation, energy regulation and choice restriction
		Effect-based control regulation
		End of life regulations
		Mandatory take-backs
		Extended Producer Responsability
		Materials and design standards (national and across industries)
	Tax policies	Fiscal measures (green taxes): land-value taxes, value-extracted tax, product levy and recovery rewards
		Resource taxes (add quantum, ad valorem)
		Differentiated VAT rates (e.g. products with high recycled content included among VAT reduced goods)
	Public procurement	Green public procurement
		Performance procurement (services instead of ownership)
Economy and market factors	Green industries	Existence of a critical mass of businesses, cluster, in CE-related activities
	Employment	Existence of a critical mass of workers in CE-related activities (green industries, engineering and science-related jobs)
	Sectoral economic trends	General economic "health" of incumbent companies in a sector (crisis, decline, stability, growth)

		CE and environmental trends among existent and new players in the sector
		Existence of companies with CSR reports and other voluntary measures in the sector
	Market geography	Existence of relevant CE/environmentally oriented market segment in the region/country
	Infrastructure	Regional infrastructure for recycling and recovery
		IT-enabled transparency and information sharing; joint collection systems,; match-maker mechanisms
		Extensive raw materials information service
	Resource prices	Sectoral stress regarding price volatility of primary and secondary raw materials, water, energy
Sociocultural factors	Urban/rural concentration	General patters of population distribution
	Age patterns	Ratio of young vs old population
	Environmental attitudes and value system	Attitudes towards waste and recycling
		Attitudes towards eco-friendly production and consumption
		Attitudes towards water use
		Public awareness of environmental problems
		Perceptions of green brands by consumers
		Perception of environmental problems by businesses
Technology and system innovation factors	Technology trends	Major technological trends in the sector; new sectoral developments
	R&D infrastructure	R&D centres: strengths in CE (Innovation agency, university research groups)
		Business parks, cluster of SMEs
	R&D funding and investment	Public support for CE-related R&D and innovation (new materials, new products/services, supply chain resource tracking)
		Venture and risk capital for environment-related investment and green tech (seeds and start-ups)
		Demonstration and commercialisation support for CE (eco-design, eco-innovation)
		Green lending programmes from banks

	High education and training	Masters and PhD programs dealing with CE, environmental and resource use
		Training courses orientated towards CE

Table from: http://www.r2piproject.eu/wp-content/uploads/2018/08/R2Pi-D3-35775-63432.2a-Case-Study-Methodology_v1.0.pdf

9 References