INTERACT

Integration of Innovative Technologies of Positive Energy Districts into a Holistic Architecture

D 5.3. Required contracting models and economic evaluation of the solution

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History

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V2	Economic valuation	Tornet	11/2022
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V4	Draft Revision	All	12/2022
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Disclaimer

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Executive Summary

The aim of the delivery was to

i. evaluate selected business cases defined in Deliverable D5.2 from an economical point of view and to
ii. define which kind of contractual agreements are necessary to realise the INTERACT EC in general and whether additional agreements are needed for the proposed business cases.

In addition to these two main objectives a brief scenario analysis is performed to evaluate the effect of external factors related market conditions, restrictions, and price levels.

Three business cases are selected for the analysis.

1. Basic Operation: sharing of renewable energy within a local energy market
2. Advanced Operation: optimization of production/consumption profiles
3. Integrated Operation: providing flexibility to the market

Both focus regions are evaluated on two main scenarios including a “stable market” scenario which uses the averaged market conditions of 2015-2019 and an “unstable market” scenario which uses the market conditions of 2022. The evaluation is based on a model with hourly granularity for both production and consumption in the focus areas (Austria and Sweden), and averaged prices where necessary.

In Chapter 4 the Deliverable describes furthermore the necessary and optional contracts needed in general to establish an INTERACT EC. For these contracts general contracting principles are described to both fulfill legal requirements and to ensure stability and trust within the EC. These principles are divided into the following three sections:

1. Procedural fairness
2. Distributional Fairness
3. Other important contractual points

From an economic point of view, the overall pattern shows that all business cases of the INTERACT EC are more favorable when applying “unstable” market conditions with in general higher prices and higher price fluctuations. The EC therefore can act as an insurance against an unstable market.

In general, the economic viability of an energy community depends on two main factors:

i. market conditions with regards to price levels and price stability, and
ii. potential grid fees reductions due to the positive impact on locally used infrastructure.

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List of Abbreviations and Acronyms

CAPEX	Capital Expenditures
CPMU	Customer Plant Management Unit
DER	Distributed Energy Resource
DSO	Distribution System Operator
EC	Energy Community
ESCO	Energy Service Company
EV	Electric Vehicle
FCR-D	Frequency Containment Reserve – Disturbance
INTERACT EC	INTERACT Energy Community
kWh	Kilowatt hour
kWp	Kilowatt Peak
OPEX	Operational Expenditures
PPA	Power Purchase Agreement
PV	Photovoltaic
PV GIS	Photovoltaic Geographical Information System
MWh	Megawatt hour
REC	Renewable Energy Community
V2G	Vehicle-to-Grid
WP	Work Package

Table of Contents

1 Introduction

1.1 Purpose of the document

The main aim of this deliverable is to estimate the viability and feasibility of fully integrated INTERACT Energy Communities using the current information from the two focus regions. This deliverable is the third and last deliverable of Work Package 5 – Contracting Models and Regulatory Framework and builds up on the previously derived and created results. Of crucial importance are described business cases from Deliverable 5.2., information on the currently available technologies and infrastructure in the focus regions from Deliverable 3.2, and the information collected regarding market structures, market access, and pricing mechanisms in the Deliverables 4.3 and 5.1.

As the energy markets are currently somewhat distorted in relation to historical values due to the energy crises related to with the Russian invasion of Ukraine, see also Figure 1 below, showing the average monthly electricity wholesale prices in selected countries in the European Union from January 2020 to October 2022 in EUR/MWh [1], we seek to perform analyse different scenarios to provide information on the viability and feasibility of the different business cases based on different economic scenarios.

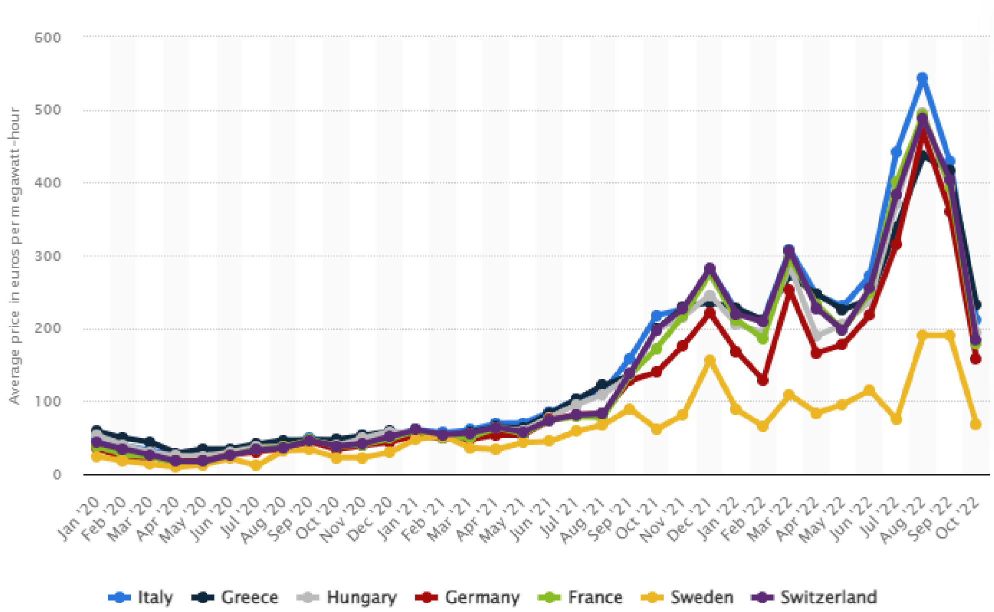

Figure 1 – Average electricity wholesale prices in selected European countries

Next to the economic evaluation of the Renewable Energy Community (REC) and its services, we also describe different contractual models currently available and their relation to a different set of functionalities of the Renewable Energy Community towards its members.

1.2 Relation to other project activities

The document is one of the final deliverables of the INTERACT project, building on all up to know developed research results. It is the final deliverable of Work Package 5 and concludes its work. The results from the evaluation and calculations shown will contribute to the roadmap for the implementation of fully integrated INTERACT Energy Communities within Work Package 6.

1.3 Structure of the document

The deliverable is divided into three main chapters and the derived conclusions. Within Chapter 2 we give information on the background in the focus-regions to understand the starting point for our work, both from a technological point of view regarding electricity flows and capacities, as well as from an economic and organizational point of view regarding contracting models and market traditions. In Chapter 3 we outline the general evaluation method of the business cases developed for the INTERACT energy community. In Chapter 4 we go into detail regarding general contractual details, and the related actors and stakeholders. Finally, in Chapter 5 we use the data from the focus regions within our explained evaluation method and present the outcoming results. Chapter 6 then tries to conclude on the results and highlights critical points and assumptions related to our work.

2 Background

In this chapter we give some background information on the electricity market and its tradition in the two focus regions, Austria (Großschönau) and Sweden (Fyllinge). We will also recap the technological assumptions for the evaluation following in Chapter 5, namely the different available technologies, infrastructure, and capacities.

2.1 Status Quo for small to medium electricity consumers in the Focus Regions

Since many of the needed contractual agreements and possible economic outcomes depend on the current situation and expected trends in the focus regions an introduction is given to the current contractual situations below.

2.1.1 Focus Region Sweden

Per definition of the Swedish energy market, small consumers and prosumers do not directly participate in the market but can participate via the DSO or other aggregators.

A regular consumer in Sweden, regardless of size, must have a minimum of two contractual agreements for its electricity supply:

One contractual agreement with the grid owner (DSO) and a second contractual agreement with an energy supplier.

As described earlier in Deliverable 4.3. there exist three main types of contractual agreements with the energy supplier in Sweden:

I. a fixed rate for 1, 2 or 3 years,
II. a monthly flexible fee based on the weighted average of the spot prices at the electricity exchange (Nordpool) combined with a generic load pattern or
III. an hourly rate following the spot prices at the electricity exchange (Nordpool).

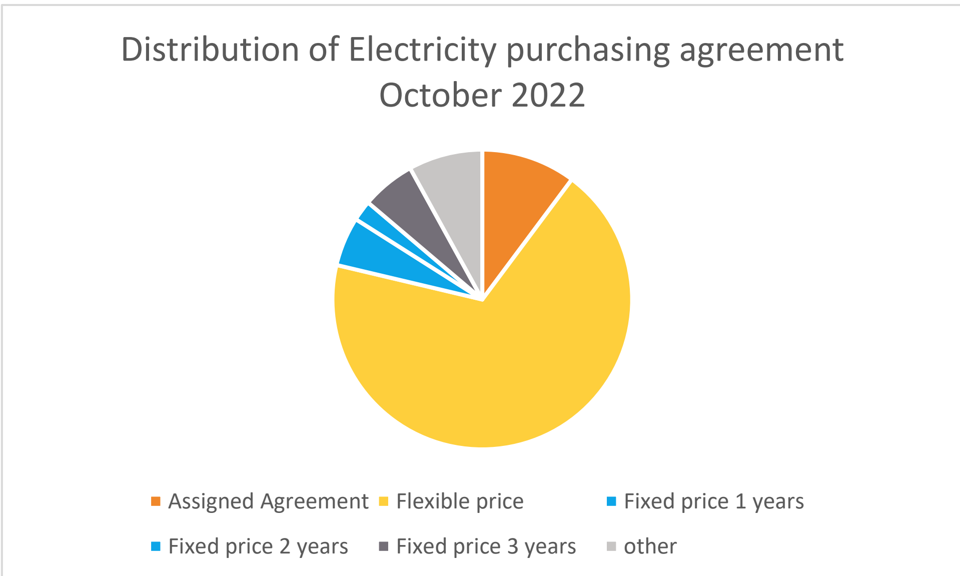

Figure 2 – Distribution of Electricity purchase agreements in Sweden (trading area SE4)

Furthermore, a special assigned agreement exists for consumers, who did not choose any of the three possibilities. This agreement is a temporary agreement that runs until further notice for clients with no other agreement. These agreements usually come at a high price and are most often used by people that just moved in or are just moving out.

As Figure 2 above shows the distribution of electricity purchase agreements in Sweden [2]. By far the most common agreement is the flexible price, which is still increasing its market share. Whether the agreement contains hourly rates is not shown separately. However, an article from Hallmann (2022) [3] show, that based on the information from Swedish energy traders there has been a significant increase in hourly rates since the beginning of 2022. Hallman also describes Tibber, a company active on the Swedish, Norwegian, Danish, and German market, which is offering only hourly rates, and has grown to over 500.000 customers from 2018 until today.

2.1.2 Focus Region Austria

Per definition of the Austrian energy market, small consumers and prosumers do not directly participate in the market. Suppliers define the price mechanisms and offer electricity to them. The small consumers and prosumers, therefore, have a contract with an energy supplier of their choice. In addition, they have an agreement with the grid provider of their region, the DSO. All fees are invoiced by the energy suppliers to the consumers: the price for the consumed energy based on the agreement with the energy supplier, the price for the usage of the grid based on the current market regulations, and all related fees and taxes.

The standard type of contract contains a fixed price throughout the whole pricing period, usually a year. Most energy suppliers also offer floating prices, which are calculated monthly depending on the Austrian electricity price index. More flexible hourly prices are sporadic and close to non-existing. The Start-up aWATTar is one supplier we identified, offering an Exchange-Market-Price based tariff which is changing hourly following the spot prices. Required for this model is a remote-readable smart meter. The company shows the hourly pricing overview on their website including amount of renewable energy production each day. Figure 3 shows the example for 6th of December 2022 [4]:

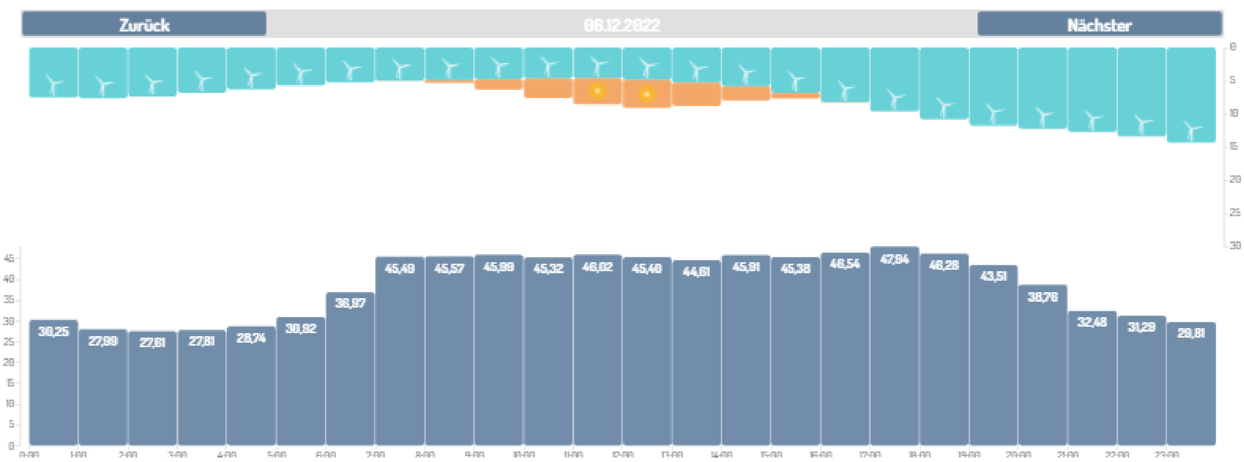

Figure 3 – Example of an hourly-pricing-based contract on Austria energy market

2.2 Summary of technology, infrastructure, and capacities of the Focus Regions

INTERACT project focuses on two pilot sites: Großschönau in Austria and Fyllinge in Sweden. While Großschönau is a complete built-up area, in Fyllinge, a new district is in planning process (green field). Therefore, information below regarding technology, infrastructure and capacities is based on current available technologies and infrastructure within Großschönau in 2022, and on the latest available planning information for Fyllinge of 2022.

2.2.1 Focus Region Sweden

In Fyllinge the plans are to build an area containing around 1500 apartments and houses divided into approximately 500 buildings. The DSO plans to provide electricity to the area through three different subsystems (see The total annual estimated consumption is at **2 610** MWh for the focus region in Sweden and is used further for the modelling.

In total, **6 500 kWp** of photovoltaic panels are planned within Fyllinge at the time of the stocktaking for the INTERACT project.

The total annual estimated production of PV is at 5 930 MWh based on PV GIS modelling (see **Error! Reference source not found.**)

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Table 1 – Preliminary form of division into subsystems and their characteristics – Fyllinge

Subsystem	Nr. of feeders	Nr. of customers	Nr. of PV plants	$Power_{PV}$ [kWp]	Total $Power_{PV}$ [kWp]
1	2	340	110	12 kWp – 40 15 kWp – 17 7 kWp – 40 30 kWp – 3 40 kWp – 10	1 503
2	3	607	189	12 kWp – 70 15 kWp – 26 7 kWp –70 30 kWp – 5 40 kWp – 18	2 583
3	3	607	208	12 kWp – 70 15 kWp – 43 7 kWp – 70 30 kWp – 8 40 kWp- 17	2 888

2.2.2 Focus Region Austria

The Focus Region in Austria consists of 5 different Low Voltage Subsystems, K, V, W, S and P, which together form the power grid of the village Großschönau.

From a **consumption** point of view 147 different loads have been identified, see below Table 2. The load modelling is described in detail in Deliverable 3.2. The total annual consumption resulting from the data is estimated at **1490,05 MWh** for the focus region in Austria.

Furthermore, 8 EV-charging stations are available within the focus region: 2x 11kW, 1x 17kW and 5x 22kW.

Table 2 – Customer Load profiles – Großschönau

Load type	Typical annual consumption [MWh]	PmaxLoad [kW]	Number of Loads per Type	Total Annual Consumption [MWh]
Residential (single family house)	4,75	1,10	119	565,25
Commercial small	15	3,0	11	165
Commercial big	30	6,0	2	60
Industrial small	40	7,4	2	80
Industrial big	200	37,0	1	200
Agriculture big	66,58	10,0	3	199,74
Agriculture small	13,17	2,25	4	52,68
Hotel	30	3,68	2	60
Kindergarten	13,38	3,24	1	13,38
Communal building	85	30,36	1	85
School-complex	9,0	2,02	1	9

Regarding **production** currently the only source for the local production of renewable electricity are several PV installations. A wind turbine is planned within the focus region, which was not installed yet when writing of this deliverable. Table 3 below shows the overview of installed PV plants per subsystem within the region.

Table 3 – Overview of installed PV plants per subsystem

Subsysystem	Nr. of PV plants	$Power_{PV}$ [kWp]	Total $Power_{PV}$ [kWp]
K	10	29,7; 5,33; 26; 5,04; 3,23; 5,39; 4,23; 8; 10,3; 72,03	169,25
V	6	6; 5,4; 25; 9,99; 9,6; 6	61,99
W	4	39,9; 5; 9,08; 6,25	60,23

S	4	1,08; 1,08;	2,16
P	1	47,79	47,79

In total, **341,42 kWp** of photovoltaic panels have been installed within Großschönau at the time of the stocktaking for the INTERACT project.

The total annual estimated production of PV is at 348 MWh based on PV GIS modelling (see Chapter 3.2.2)

3 Method

3.1 Selected Business cases

From Deliverable 5.2 There are several business cases defined in different stages of progression (see below Figure 4).

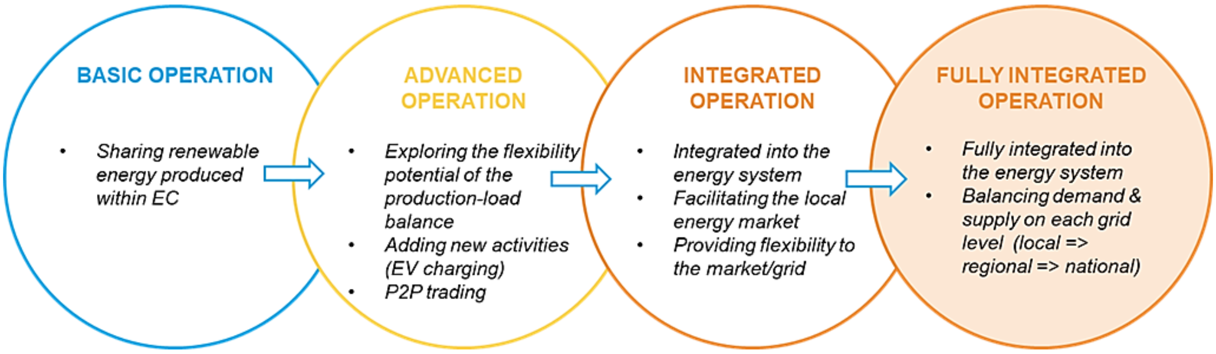

Figure 4 – Possible transition from basic towards fully integrated operation and business cases of ECs

The ambition was to evaluate several different business cases along the line of progression of the INTERACT EC. However, some criteria needed to be met to make the evaluation meaningful:

- Good enough data available to make a meaningful evaluation.
- Close enough to current situation to be able to make meaningful modelling.
- Preferably spread over different transition phases.

As a result, there has been chosen one business case from each of the first three steps of possible transition. The Fully Integrated Operation phase was deemed too far into the future and combined with too large uncertainties to perform meaningful economic evaluation.

3.1.1 Basic operation

The basic operation business case is based on the internal sale and purchase of electricity on the local market within the EC and letting members participate in the regional market through the EC. The term local market relates in this document to the internal market of the EC and the term regional market will refer to all external markets, both regional and national.

Within the Basic operation, no other changes than the switch of the contractual partner for supplying and selling electricity to occurs, e.g., no change in consumption pattern, and no communication and following alignment with needs (emergency driven or price driven) from neither the electricity market nor the power grid. These possibilities are explored in the more advanced and more integrated operational scenarios below.

3.1.2 Advanced operation

For Advanced Operation the business case of Optimization of Production/Consumption profiles was chosen. This business case is to some extent already realized on household or building scale by some European examples. With the *LINK*-based solution, the business case is expected to become much more feasible and applicable on a community scale.

The economic logic of this business case is shifting the load within the local market to avoid buying electricity from the regional market at its most expensive cost. This scenario assumes that electricity is bought at an hourly rate and not at fixed price. As the example below shows (Figure 5) the main scenario is to move consumption that occurs in 90th percentile of the price (i.e., the most expensive prices) to hours with median price. The example below is based on Swedish spot prices from January until September 2022 from Nordpool [11].

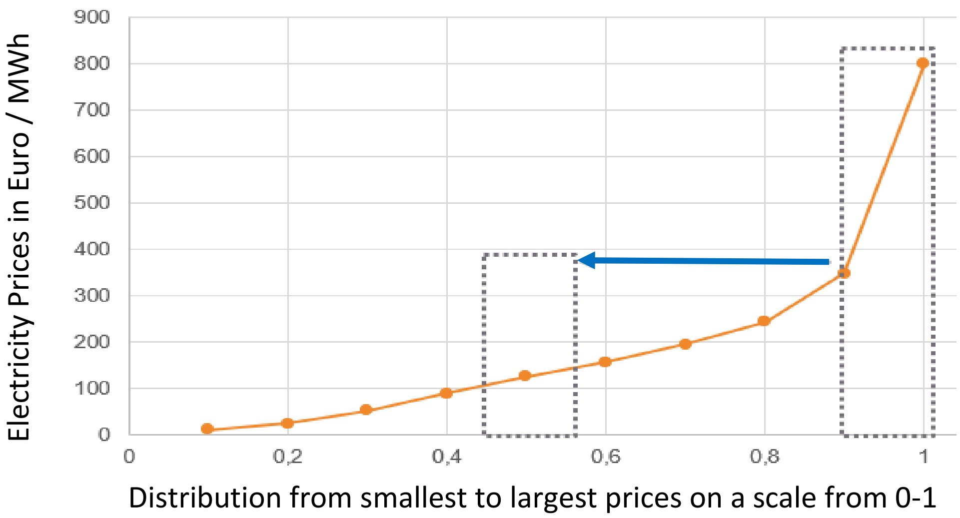

Figure 5 – Load shifting – price driven demand response

This will reduce the average cost of electricity over one year. Either demand response, storage usage or a combination thereof can do this. To enable the load-shift some investments are required in terms of a Customer Plant Management Unit, in the following CPMU, (see Deliverable 3.2 for details) for each house or storage. A CPMU is assumed to cost 100 Euros and is annualized of over 5 years. More precise technical details and cost assessments need to be achieved during a prototyping phase, where functionality and technical base of the CPMU would be defined.

3.1.3 Integrated operation

For the Integrated operation the business case of providing flexibility services is evaluated.

There are several flexibility services that could be offered to the market, which are advancing and changing still, as this is a market under rapid transformation, too. There is a possibility to sell services direct to the DSO to support the DSO in the fulfilling of obligations in a cost-efficient way. However, these types of services are not traded on a public market as of today. This makes the economic evaluation hard to perform on a general level but will be more dependent on the DSO's local conditions and willingness to pay.

We have tried to evaluate the provision of type of auxiliary service with the established EU definition named as Frequency Containment Reserve – Disturbance (FCR-D), as already described in Deliverable 5.1. This type of service is to keep the frequency of the grid within defined limits. There are some differences in the requirement to be a part of this market, described in detail in D 5.1., especially regarding the minimum required size to provide the service. For this evaluation it is assumed that the capacity limit to participate is 100 kW, which makes the market available for both Großschönau and Fyllinge. In reality, the limit for participating in the Austrian market is set to 1 MW which excludes Großschönau from participating due to size. This can however be solved by participating through a third-party aggregator, or by a shift to lower limits in the future.

Some companies have already implemented this business case, for example the Swedish Checkwatt [5]. It provides the opportunity for individuals with storage capacity to pool up their resources and participate in the flexibility market. Checkwatt can also provide a revenue simulator for a given battery capacity in a specific region in Sweden based on historical data. This will be used as a comparison.

There is limited information on historical prices and activated volumes of FCR-D from battery storage on the Austrian Energy market, much due to the fact that Austria is a part of a larger market for Flexibility services together with Germany, Switzerland, the Netherlands, the Czech Republic, Belgium, Denmark and France.

There is however one study [6] by Li (2021) that shows historical values for Sweden which gives an estimation on the activated volumes and prices. Li (2021) describes that battery storages was used in a range of 10-40% of the year hours to a price 200-450 Euro/MWh, based on data from 2016-2020. Therefore, even with good access to data the variation between years is significant. The study from Li is the base for evaluating both Großschönau and Fyllinge and is combined with available information about local conditions to deliver output from the model.

3.2 Economic evaluation

Basically, the economic evaluation aims to compare a reference scenario to a scenario with an established EC utilizing one of the business cases mentioned above. The two main factors impacting the economic evaluation is therefore the behaviour, with regards to energy flow, of the different actors within the EC and the monetary values attributed to these flows, i.e., the cost of buying and selling electricity. Since evaluating a real-life scenario is impossible, several assumptions must be made. Below we present the different actors, their presumed behaviour, the related data, and the used assumptions.

As shown in Figure 6 above the EC consists of four main types of actors:

i. Consumers, for example households without own electricity production, or EV-chargers which cannot provide electricity back to the grid, see below Chapter 3.2.1.,

ii. Prosumers, for example households with own electricity production, see below Chapter 3.2.2.,

iii. Producers, for example wind power plants or photovoltaic power plants, see below Chapter 3.2.3., and

iv. Storages, for example batteries, or specific electrical cars having the feature to provide stored electricity back to the grid (V2G), see below Chapter 3.2.4.

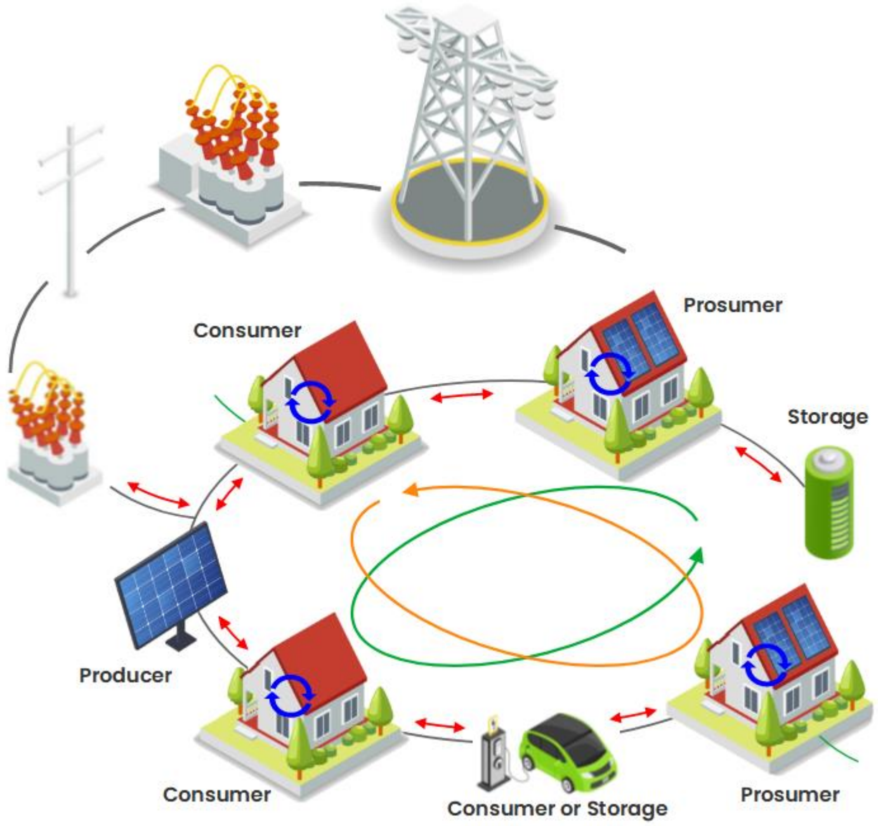

Figure 6 – The INTERACT Energy Community including its different types of actors

3.2.1 Consumers.

A consumer is a connection point to the grid that only consumes electricity. Since both focus regions in Sweden and Austria are predominantly residential the consumption pattern (i.e., consumption load) is based on the same data as that for a residential building in the Deliverable 3.2., see Figure 7. This consumption pattern is a rough estimation and might somewhat underestimate the local market since the presence of industrial and commercial buildings tends to shift the load curve and increase the load in midday (when there is higher PV production), also shown in Figure 7.

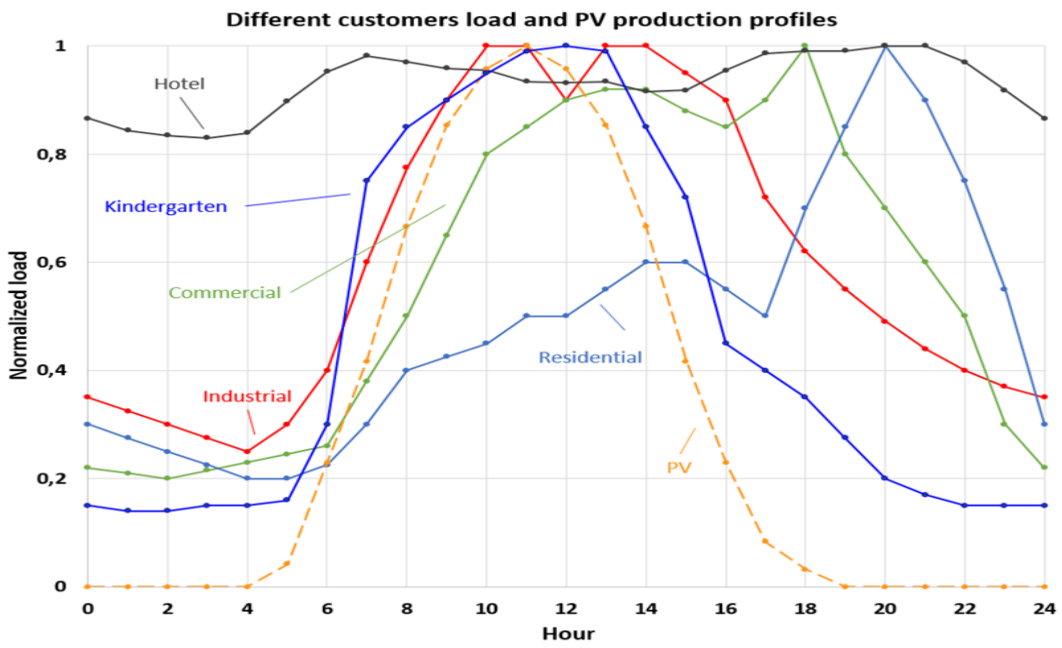

Figure 7 – Different customers load and PV production profiles

It is assumed that are no seasonal variations in the load curve.

The normalized load is used to calculate the average load for a household using the average consumption of the area (see Figure 8).

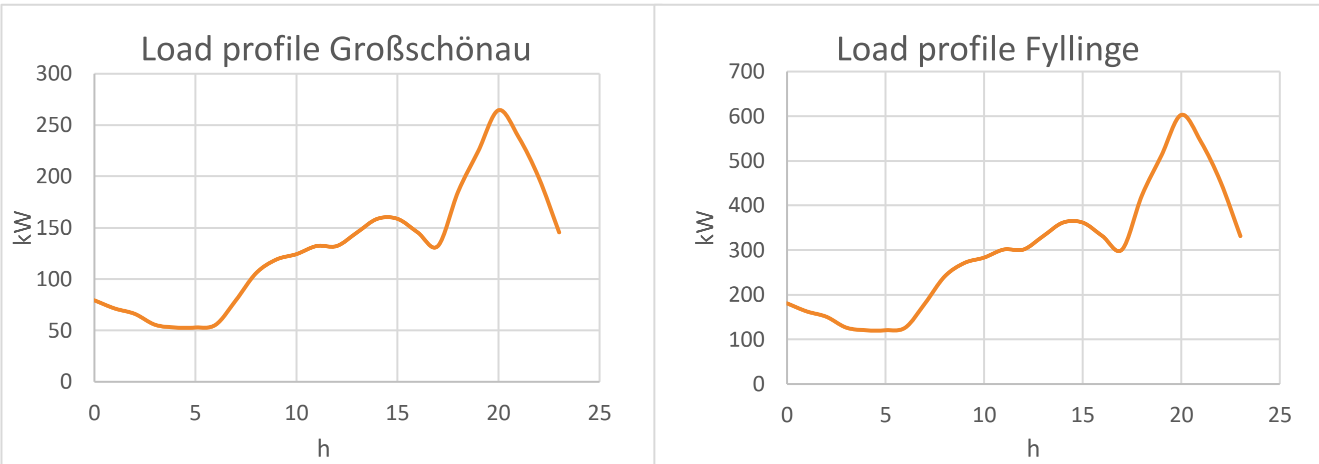

Figure 8 – Load profiles for the Focus regions

3.2.2 Prosumers

Prosumers are assumed to consume electricity with the same pattern as consumers. In addition to this, it is assumed that the production of prosumers within the EC is evenly distributed among the Prosumers. The production is based on the given installed kWp and the modelled photovoltaic production according to the publicly accessible PV GIS model provided by European Commission [7] for two Focus regions. For modelling there was used following assumptions of PV GIS model: respective GPS coordinates for Großschönau and Fyllinge, roof added mounting position of PV, System losses 12%, Radiation database: PVGIS-SARAH2, PV Technology: Crystalline Silicon.

It is assumed that produced electricity is firstly used to cover the households, after that, sold to the local market and, when the needs of the local market are met, sold to the regional/external market.

Production and consumption are calculated on an hourly basis.

3.2.3 Producers

Producers are treated in the same way as prosumers, but without any consumption. The producers follow the same production pattern based on the installed kWp. The electricity produced is firstly sold on the local market. If the need on the local market is met, the remaining electricity is sold on the regional/external market.

3.2.4 Storages

Storages can be either separately built storage facilities or a distributed storage in the form of EV's. The storages can be used in two operational principles with regards to this evaluation:

i. for storing electricity to optimize the time of consumption, or
ii. as an emergency backup.

3.2.5 Prices for local market and regional market

The evaluation of different pricing models in the Deliverable 4.3 gives two possible prices for buying and selling on the local market, depending on the chosen pricing model.

The **Merit Order** is based on unregulated price offers of producers, prosumers, and consumers. With standard market behaviour, this leads to bids based on marginal prices, to maximize the chances of receiving the order, which is then valued not on the bidding price, but based on the Merit Order system. (D 4.3)

The pricing model **Power Purchase Agreement** (PPA) reflects a basic agreement between the producer and the consumer to use the production facility over its lifetime together at predefined conditions, securing the investment for the producer and securing the supply at defined prices for the consumer. The agreed price should be based on a cost-plus approach, taking into consideration CAPEX and OPEX of the production facility. As the partnership is agreed over a predefined lifetime of the investment, risk is reduced, and prices for the consumer should be lower than otherwise, are kept stable and predictable. (D 4.3)

In the Deliverable 4.3 the advantages and disadvantages of these two pricing models are discussed. For this evaluation however, the outcome of the pricing model is important: the reached price on the local market. The used prices for the different pricing models are shown in Table 4 below. At this point, we want to highlight, that these are notional numbers based on assumptions described in D 4.3. They are not supposed to show precise results but shall bring insight into connections and key points regarding the viability of ECs. More about this within the results section in Chapter 5, and the sensitivity analysis performed within each business case. The same goes also for the relation between local buying price and regional selling price, assumed in this deliverable as a percentual relation, as indicated below in Table 4.

Table 4 – Possible pricing models for local market with the EC

	Order Of Merit	Producer Purchaser Agreement
Buying on local market [Cents/kWh]	20	12
Selling on local market [Cents/kWh]	14	11
Selling on regional market [Cents/kWh]	70% of buying price	70% of buying price

3.3 Reference Scenario

To reference the performed economic evaluation a scenario with an implemented INTERACT EC is compared to a reference scenario. The reference scenario is assumed not to have an EC in place, and hence no local market or possibility to organize locally with regards to energy production or consumption. This reference scenario is calculated both for a historical period 2015-2019 and for 2022. The historical period is chosen to represent a market with lower and more stable electricity prices.

3.3.1 Reference Price Set

As main reference price, we are using the available dataset from Eurostat: Electricity prices for household consumers [8]. The dataset covers the household sector and final non-household sector (industry, services, offices, agriculture, etc). The prices are reported in national currencies per kWh and according to different bands of consumption. For the household sector, these bands are customers consuming less than 1000 kWh, 1000 kWh to 2500 kWh, 2500 kWh to 5000 kWh, 5000 kWh to 15000 kWh, and more than 15000 kWh. Industrial bands start less than 20 MWh and go to more than 150000 MWh but have not been taking into consideration for the analysis in this document.

Regarding the prices, we choose annual prices for 2017 until 2021, and available second semester prices for 2015 and 2016. The prices cover only the following component:

- Energy and supply: generation, aggregation, balancing energy, supplied energy costs, customer services, after-sales management, and other supply costs.

The prices therefore exclude

- network cost,
- Value added taxes (VAT),
- renewable taxes,
- capacity taxes,
- environmental taxes,
- nuclear taxes and
- all other taxes.

The resulting table from our custom data [9] set is shown in Table 5 below:

Table 5 – Average electricity prices for household consumers, custom Eurostat dataset [Euro/kWh]

	2015	2016	2017	2018	2019	2020	2021
EU average (27 countries)	0,1283	0,1235	0,1264	0,1352	0,1132	0,1167	0,1255
Belgium	0,1136	0,1172	0,1335	0,1412	0,1647	0,1434	0,1288
Czechia	0,1046	0,1047	0,1094	0,1128	0,1317	0,1359	0,1710
Austria	0,0902	0,0877	0,0800	0,0832	0,0911	0,0989	0,1005
Sweden	0,0475	0,0552	0,0526	0,0620	0,0677	0,0519	0,0979

The prices from Table 5 above were used within the economic valuation according to the below described steps.

3.3.2 Stable Market: 2015 – 2019 Scenario

The selling price on the local market is set close to the Producer Purchaser Agreement price, which reflects the average price needed to cover the investment in the PV installations within the focus region. As PV installation prices are reducing over time [10] and the PV installations in the focus region in Austria have been built over several years in the past, whereas the PV installations in the focus region in Fyllinge are going to be installed in the future, a different price is stated for each focus region. For Fyllinge we took the current available price for 2021, which is **6 Cents per kWh**. For Großschönau the resulting value is **12 Cents per kWh**.

For this scenario the price for buying on the regional market is set to the average calculated over the five years from 2015 until 2019 for Austria and for Sweden.

- Austria average 2015-2019 buying price: 0,08644, rounded to **9 Cents per kWh**
- Sweden average 2015-2019 buying price: 0,057, rounded to **6 Cents per kWh**

Keeping the same assumption as for the regional market in the Energy Community scenario above, we set the selling price for the regional market at 70% from the selling price to the regional market.

With respect to the grid fee, most relevant for our economic evaluation is a potential support for Energy Communities with a reduced grid fee, as it is done in Austria. Therefore, we took current grid fee prices for the scenario 2015-2019 as well as for 2022, and the reduced grid fee where applicable. More details to the grid fee support in Austria for Energy Communities can be found in Deliverable 5.1.

Within the evaluation we assume, that there is no curtailed production, meaning that the grid at all times supports the intake of the complete electricity production of the installed DERs. Different curtailment percentages however are used and discussed in Chapter 5.

In case for any operational scenarios hourly rates are needed, available data from 2019 is used. Austrian hourly prices are taken from aWATTar [4]. Swedish hourly prices are taken from Nordpool [11].

3.3.3 Unstable Market: 2022 Scenario

For the 2022 scenario, we keep the assumptions described above in the 2015-2019 scenario with two exceptions:

i. In case of needed hourly rates, available data for January 2022 to November 2022 is used. Austrian hourly prices are again taken from aWATTAr [4]. Swedish hourly prices are again taken from Nordpool [11].

ii. The selling price to the regional market is based on the average hourly prices taken from January until November 2022 described above.

3.3.4 Summary of the key inputs

The parameters for the pilot regions basic scenarios are shown in Table 6 below.

Table 6 – Summary of the key inputs for economic valuation

	Großschönau		Fyllinge	
	2015-2019	**2022**	**2015-2019**	**2022**
Buying/selling local market [cent/kWh]	12	12	6	6
Buying regional market [cent/kWh]	9	25	6	13
Selling/Buying Ratio	70%			
Selling regional market [cent/kWh]	6	17,5	4,2	9,1
Grid fee [cent/kWh]	4,45		4	
Grid fee for ECs [cent/kWh]	1,91		4	
Curtailed production [%]	0,00%			
Number of consumers	90		50	
Number of Prosumers	19		455	
Installed production capacity prosumers (kWp)	202		6 500	
Installed production capacity producers [kWp]	139		0	

These are the input parameters going into the model. These parameters are altered with different sensitivity analysis for each business case (see Chapter 5) to bring up critical points showing when and how an EC becomes economically favourable in the different business cases. They are not intended as a profitability analysis of the given focus regions.

3.4 Model calculations

3.4.1 Basic operation - Sharing Electricity on a local market

For the basic operations case the total cost of energy for an area is calculated according to

$$Total\ Cost = Eb_{rm} * Pb_{rm} + Eb_{lm} * P_{lm} - Es_{rm} * P_{rm} + \ Gridfee_{l} * Eb_{lm} + Gridfee_{r} * Eb_{rm}$$

Where:

Eb_{rm}	=	Electricity bought on the regional market [kWh/year]
Pb_{rm}	=	Buying price on the regional market [Cents/kWh]
Eb_{lm}	=	Electricity bought on the local market [kWh/year]
P_{lm}	=	Price on the local market [Cents/kWh]
Es_{rm}	=	Electricity sold on the regional market [kWh/year]
P_{rm}	=	Price on the regional market [cents/kWh]
$Gridfee_{l}$	=	local grid fee [cents/kWh]
$Gridfee_{r}$	=	regional grid fee [cents/kWh]

The amount of energy sold and bought on the regional and local market is calculated on an hourly basis based on the production and consumption described in 3.2.1.

For the respective reference scenario there is no local market. The electricity bought from the regional market is calculated according to:

$$\sum_{1}^{8760} Ecp_i - Epp_i + Ec_i \qquad\qquad (Ecp_i - Epp_i) \geq 0$$

Where:

Epp = Electricity produced by prosumers

Ecp = Electricity consumed by prosumers

Ec = Electricity consumed by consumers

The condition (Ecp-Epp) > 0 means that even if this term is negative, it is still counted as zero since there is no local market.

The energy sold to the regional market in the reference scenario is calculated according to:

$$\sum_{1}^{8760} Epp_i - Ecp_i + E_p$$

Where E_p is electricity generated in local production from producers.

For the INTERACT EC scenario there is a local market and the energy bought from the regional market is therefore calculated according to:

$$\sum_{1}^{8760} Ecp_i - Epp_i + Ec_i - Ep_i$$

In this equation with the introduction of the local market the restriction (Ecp-Epp) > 0 is lifted and the term Ep is added.

In the INTERACT EC scenario the energy sold to the regional market is assumed to be the electricity available when all needs within the local market are met and therefore calculated according to

$$\sum_{1}^{8760} Epp_i - Ecp_i - Ec_i + Ep_i$$

The amount of electricity sold on the local market is the surplus electricity of prosumers and producers. This is calculated according to

$$\sum_{1}^{8760} Epp_i - Ecp_i + Ep_i$$

The amount of electricity sold on the local market cannot exceed Ec for any given hour.

3.4.2 Advanced Operation - Optimization of Production/Consumption

Here, the optimization of production/consumption is evaluated as a separate business case. Therefore, no local market is assumed.

For the reference scenarios the cost is calculated using a weighted average according to

$$\sum_{1}^{8760} Eb_{rmi} * Pb_{rmi}$$

Where Eb is the electricity bought on the regional market and Pb is the hourly rate of electricity for that hour and year.

For the load shifting case the hours of the year are sorted according to electricity prices where 1 equals the cheapest hour and 8760 the most expensive. The calculation for shifting P % of the hours is then given by

$$\sum_{1}^{8760*(1-P)} (Eb_{rmi} * Pb_{rmi}) + \sum_{P*8760}^{8760} (Eb_{rmi} * Pb_{Med})$$

Where Pb_{med} equals the median of hourly electricity rates the modelling year.

The assumed profit is the calculated as the difference between the reference and load shift case when the annualized cost of the CPMU is deducted.

3.4.3 Integrated Operation – Providing flexibility services

The revenue from providing flexibility services is calculated based on three factors according to

$$R = n * V * p$$

Where R is the revenue, n is the number of times the service is procured during a year, V is the volume sold in MWh, and p is the average price the volume is sold at.

4 Contractual models

After performing economic evaluation of the different business cases the required contractual agreements are defined, with regards to a set of general principles of contracting. These principles are important to ensure the long-term operations of the EC and are formulated to build trust and transparency within the EC.

4.1 General contracting principles

As contractual law is not unified within the European Union, the detailed contract design will differ from country to country. Nevertheless, some basic information can be generalised. For an Energy Community to be viable and a long-term actor there needs to be trust in the community and between the actors. Contractual agreements that are designed with this in mind have the possibility to strengthen trust. For this to come into effect there are some contracting principles that needs to be applied.

4.1.1 Procedural fairness

Procedural fairness deals with the perceptions of being just regarding outcomes. It reflects the extent in which an individual perceives that outcome allocation decisions have been fairly made. The use of fair procedures helps communicate that single actors are valued members of the group. Procedural fairness can be examined by focusing on the formal procedures used to make decisions. Based on [12], perfect procedural fairness has two characteristics: an independent criterion for what constitutes a fair or just outcome of the procedure, and a procedure that guarantees that the fair outcome will be achieved.

Regarding Energy Communities, selected aspects may be:

- Transparent criteria and accessibility towards becoming a member of an EC:

There is an inherit conflict between openness and accessibility versus fairness in use and effort towards other members (protection of property, overburdening efforts). For example, open access to ECs might create a burden towards initial EC members who lose benefits within their EC, and/or receive more work than they signed on to. On the other hand, when accessibility of membership is very much restricted/limited, the local community building sense of ECs will most likely be lost.

- Principles of fairness for internal decision making:

Fairness and transparency in decision making among members according to assigned roles with assigned organisational type should prevent mistrust and short-change.

- Process for possible decision making i.e., for joint investments, joint expenditures, given mandates, etc.

4.1.2 Distributional fairness

Distributive fairness concerns the socially just allocation of resources, which is especially important for rather new types of organisations as Energy Communities are one. Among the key topics of interest are the following:

- Clarification on the use of property
- Clarification on pricing

- Fiscal consideration
- Securing benefits
- Financial benefits and their distribution
- Ensuring positive collective impact
- Definition of the common good and utilisation of potential revenues
- Principles for the use of potential revenues
- Distribution of risks and responsibilities: taxes, liabilities

With respect to the outcomes of the stakeholder mapping done in Deliverable 2.2., it was stated as a clear requirement from the stakeholders of the focus regions, that benefit must be given. At least equal or reduced costs are a prerequisite for membership. Having this in mind, distributional fairness gets even more important.

4.1.3 Further Contractual Points

Next to the general principles described above, some challenging points with regards to legal differences from country to country and special rules in the broader field of Energy Communities shall be mentioned as well:

- Consumer Protection: some of the participating members will be consumers in the definition of consumer law. These members will have special rights which are given by law and must be considered when setting up the contracts.
- Liberalized Market: electricity is a key resource of our times, and therefore regulated in several ways. Regulation in general aims to protect rights and safety of citizens, to ensure the delivery of public goods and services, and to underpin markets [13]. With respect to electricity, a wave of market liberalization was happening in line with general principles of the common European marketplace. This leads to certain restrictions for organizations offering this kind of good, for example in Austria not being allowed to close contracts for more than 1 year.
- Charges, Taxes and Fees: Taxes are basically not harmonized within the European Union, and lots of different special rules and/or exemptions are to be considered from country to country.

4.2 Type of actors

As shown in WP4, Deliverable 4.1, there are different external and internal actors with different roles relevant for the functioning of the EC, see Figure 9. The relationship between these actors requires in most cases implicit or explicit rules, whereas the explicit rules are normally written down in the form of laws, directives, procedures, bylaws, or mutual contractual agreements.

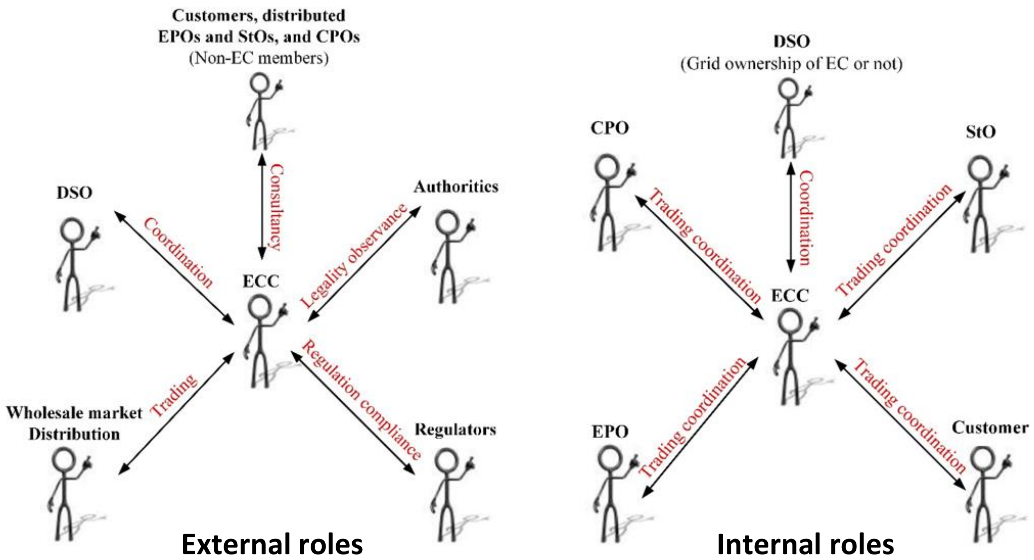

Figure 9 – External and internal Roles of the INTERACT EC

Regarding the actors that might be involved in contractual agreements special attention should be given to the different potential owners of assets used within the operation of the EC, as shown in the Deliverable D5.2., and below Table 7.

Table 7 – Potential owners of assets used within the operation of the EC

	Prosumers							INFRASTRUCTURE			
Ownership	Consumer	Elect. production	Heat pump	Energy storage	Charging station	EV	Household appliances with contr. load	Metering device	CPMU	EC commu-nication platform	Cables and lines
INTERACT EC members	✓	✓	✓	✓	✓	✓	✓	(✓)	✓		✓
INTERACT EC (itself)		✓	✓	✓	✓	✓		(✓)	✓	✓	✓
3rd party sponsored ownership (lease/rent)		✓	✓	✓	✓	✓	✓			✓	✓
3rd party direct ownership						✓		✓			✓

4.3 Types of contractual agreements needed for EC operation

For the operation of Energy Communities in general 5 different contractual agreements are obligatory, the other agreements shown are possible options depending on the configuration of the individual EC:

1. The articles / bylaws of the EC
2. Grid Usage Agreement between the EC and the Grid Operator (DSO)
3. Grid Usage Agreement Amendment between the EC members and the Grid Operator (DSO)
4. Membership agreement including Buying / Selling contract for traded electricity within the EC and its members
5. Buying / Selling contract for missing / exceeding electricity between the EC members and their respective ESCOs (may be the existing agreements)

These agreement and other potential contracts are visualized in Figure 10 below. The picture is based on graphical illustration of contracts and agreements from the Austrian coordination point for Energy Communities [14], extended by the inclusion of the regional energy market in line with the fully integrated INTERACT EC.

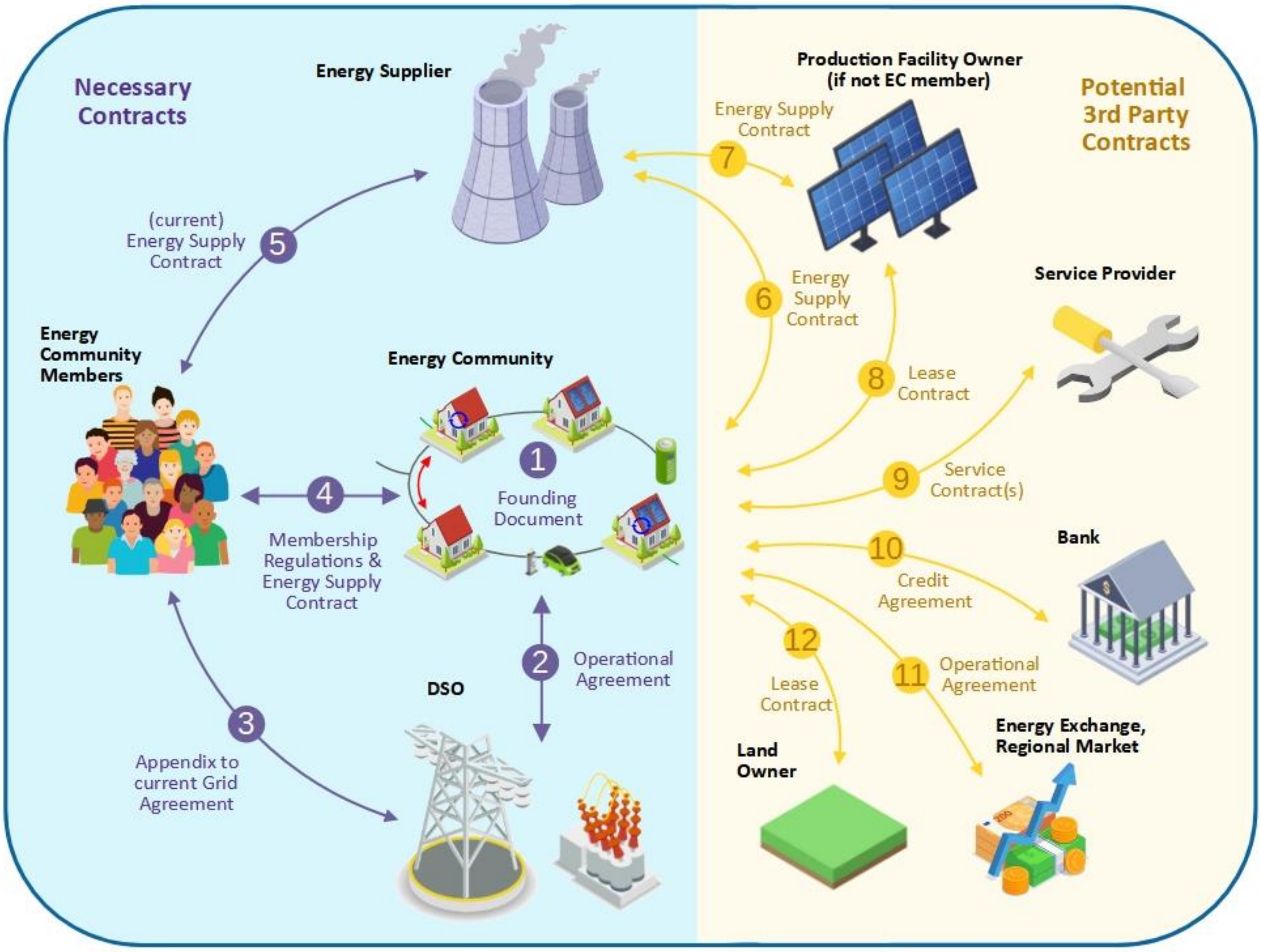

Figure 10 – Necessary and potential contractual agreements of the INTERACT EC, based on [14]

For most necessary Contractual agreement there are several standard topics that needs to be considered, which are normally depending on national law. To support the creation of Energy Communities, the European member states are called to create a central supportive organisation as point of contact for interested persons. The Austrian point of contact (Österreichische Koordinationsstelle für Energiegemeinschaften) offers four sample contracts to be downloaded [15], including explanatory side information to the chapters:

i. Founding Document: By-Laws for the creation of an Energy Community
ii. Energy Supply Contract for the purchase of electricity
iii. Energy Supply Contract for the sales of electricity (all produced energy)
iv. Energy Supply Contract for the sales of electricity (only produced energy exceeding self-consumption)

Most important is the founding document – the by-laws of the Energy Community, as they define the operational rules of collaboration. The sample by-laws offered by the Austrian point of contact regarding the creation of an Energy Community [16] covers the following chapters:

1. Name, Location, Field of Operations
2. Purpose and Aims of the Association
3. Means (immaterial and financial) to reach the Purpose of the Association
4. Types of Membership
5. Gain of Membership
6. Loss of Membership
7. Rights and Obligations of Members
8. Obligations regarding Deposits and Membership Fees
9. Organs of the Association
10. General Assembly and Voting Rights
11. Tasks of the General Assembly
12. Executive Board
13. Tasks of the Executive Board
14. Special Tasks of specific Board Members
15. Financial Auditor
16. Data Protection
17. Court of Arbitration
18. Voluntary Liquidation of the Association
19. Usage of Assets with regards to membership withdrawals, liquidation of the association, lapse of the purpose of the association

We recommend, that all these topics should be addressed in accordance with the general contracting principles described in chapter 4.1, to create a solid foundation for a viable and sustainable organisation.

5 Results

5.1 Großschönau

5.1.1 Business case 1

Buying and selling on a local market.

5.1.1.1 Economic evaluation

Based on the input parameters from Chapter 3.3.4, the results for the basic scenario for this business case are shown in Table 8Table 8below for the basic business case in Großschönau.

Table 8 – Results from basic scenario Business case 1 for focus region Austria

	Reference 2015-2019	Interact EC 2015-2019	Reference 2022	Interact EC 2022
Electricity bought on the regional market [MWh]	1062	839	1062	839
Electricity bought on local market [MWh]	0	223	0	223
Electricity sold on the regional market [MWh]	267	44	267	44
Cost [kEuro]	142	143	312	278
Revenue [kEuro]	17	8	47	13
Net Cost [kEuro]	126	141	266	265

The results are reflecting the fact, that in the 2015-2019 period, locally produced energy was more expensive (12 Cents) than regionally offered energy (9 Cents), therefore showing higher overall costs for the INTERACT EC when using local prices as defined in Chapter 3.3.2. In the 2022 period, locally produced energy was cheaper than regionally offered energy (25 Cents), but regionally offered purchasing prices for local production (17,5 Cents) where higher than local prices, almost eliminating the positive effect of lower local prices in the basic setting.

As shown in Table 7, net cost for the INTERACT EC is slightly less than that from the reference scenario under period 2022 conditions but unfavourable given the 2015-2019 average. Even with 2022 conditions however the profitability is largely dependent on the grid fee reduction, which is 2,54 Cents per kWh in accordance with chapter 3.3.4.

Figure 11 below shows an impact analysis of grid fee reduction on the profitability of the Energy Community. It is visible, that the EC becomes the more profitable alternative at a grid fee reduction of around 2,2 cent given 2022 conditions and prices. For the 2015-2019 period however not even a reduction of grid fees by 3 Cents/kWh makes the EC the profitable alternative given the stated conditions and prices.

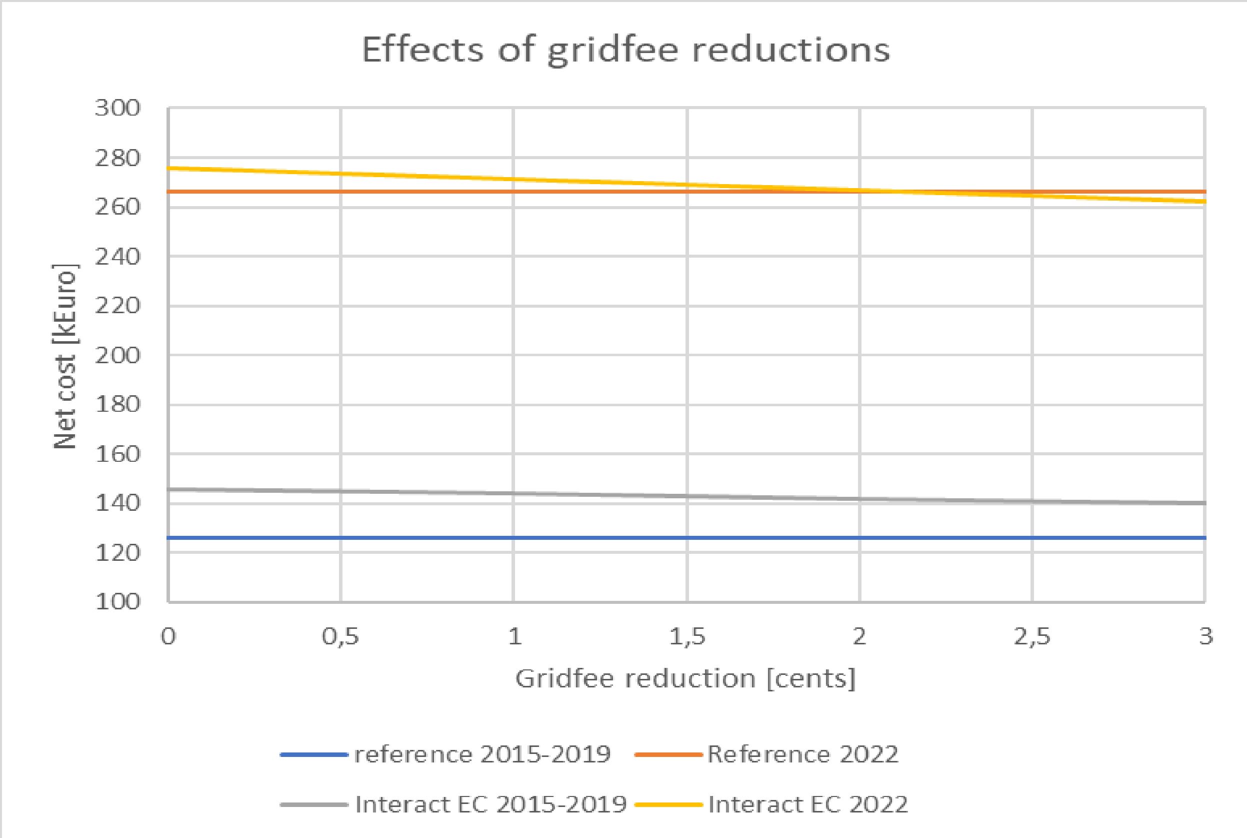

Figure 11 – Effects of grid fee reduction on the Austrian focus region

Another critical parameter for the basic business case is the relation between local selling price compared to regional market selling price. The difference between buying and selling on the regional market sets the boundaries for the price on the local market. This is shown by the model output in Figure 12 below. As the figure shows the INTERACT EC scenario becomes economically favourable at a selling price of approximately 70% of the buying price or less for the 2022 scenario. It follows common sense, that less received money for sold electricity on the regional market is improving the economic attractivity of the local market. On the other hand, for the 2015-2019 scenario no profitability is seen even if the selling/buying ratio drops to 10%, as the price difference between local market and regional market in combination with consumption versus production ratio is too unfavourable.

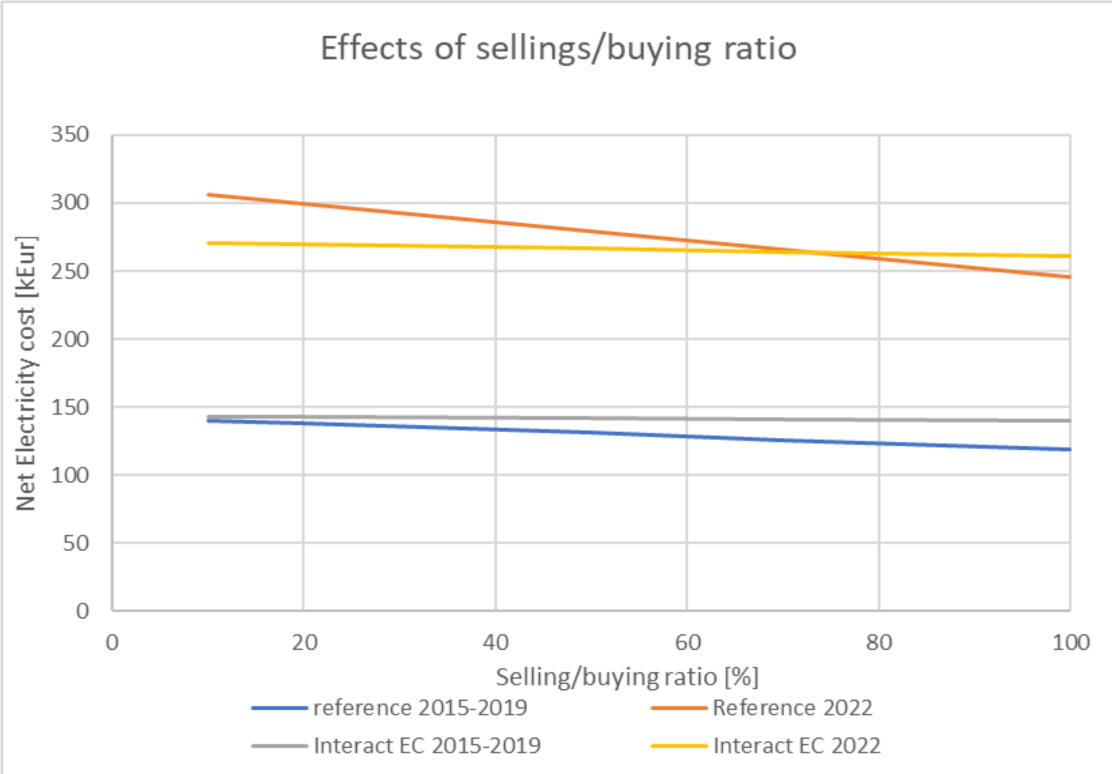

Figure 12 – Impact of Buying/Selling ratio on the Austrian focus region

One benefit of selling on the local market is to reduce the risk of production curtailment due to restrictions in the transmission capacity of the overlaying grid.

Assuming, that the local market removes this risk of curtailment implicates that without the local market a risk of production curtailment exists. Therefore, net cost for scenarios with a local market will be constant, while net cost will increase for the reference scenarios where

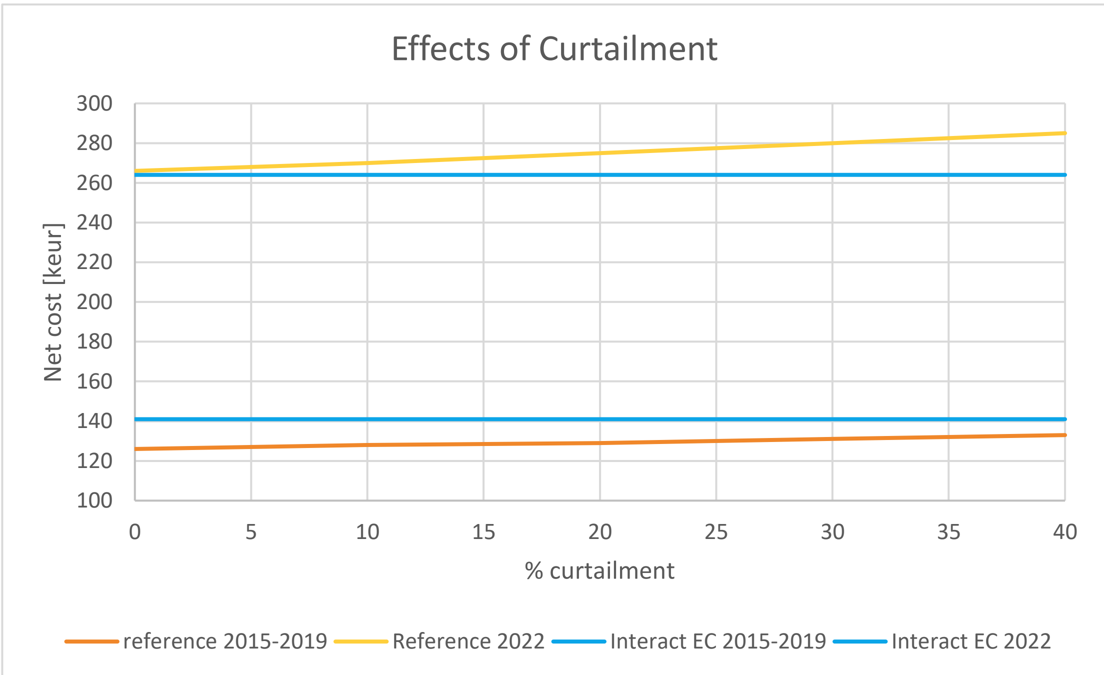

Figure 13 – Effects of curtailment on the Austrian focus region

curtailment occurs. The economic effect of this is shown in Figure 13 above. Given the 2015-2019 scenario even a 40% curtailment does not make the local market profitable, with similar reasoning as explained for the selling/buying ratio above. For the 2022 scenario the local market is profitable from the 0% base scenario curtailment and its profitability increases with higher curtailment as shown in the figure.

5.1.1.2 Specific contractual agreements and topics

In this business case no further contractual agreements than those listed as 1-5 within Chapter 4.3 are needed. However, the internal pricing model is a crucial point to be aligned within the community, since it has significant impact on both the willingness to sell on the local market and the overall profitability of the EC.

5.1.2 Business case 2

Load shifting or price driven demand response.

5.1.2.1 Economic evaluation

As described above in Chapter 3.1.2. a shifting of 10% of the consumption from the highest percentile to the median price is assumed. The annual savings after annualized investment costs from the installed CPMUs will be approximately 15 000 Euro given the 2022 scenario. Increasing the percentage of load that gets shifted is increasing the cost savings. From a theoretical point of view, the maximum savings are reached when moving 50% of the hours to median price, ignoring any hardware costs. Further load shift towards the median price would only increase the cost, as the shifted electricity would be already cheaper than the median price. Taking investment costs into account, the peak cost reduction already occurs before due to the necessary amortisation costs.

Figure 14 below shows the results in cost savings for different shifted percentages for 2019 and 2022 scenarios.

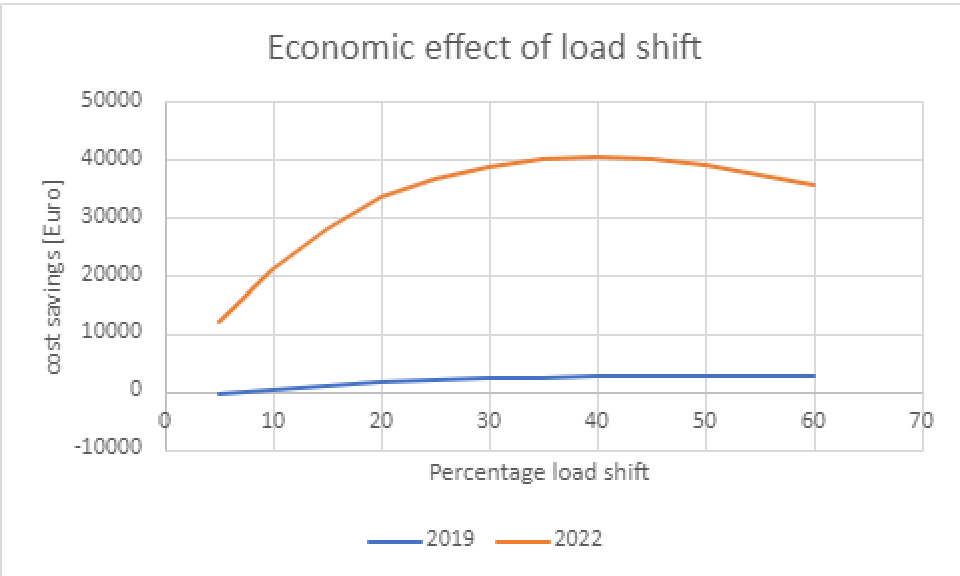

Figure 14 – Economic effect of load shift on the Austrian focus region

The economic outcome of this business model is to a large extent dependent of the characteristics of the hourly electricity prices. In a market with high prices and high volatility the business model becomes more profitable. For this evaluation 2019 represents a market with low and stable spot prices and 2022 represents a market with high prices and high volatility. Table 9 below shows the differences in more detail. For 2022 hourly prices only represents Jan-Nov, as already explained above in Chapter 3.3.3.

Table 9 – Hourly electricity price characteristics for Austria

	2019	2022
Average spot price [cent/kWh]	4,01	24,95
Standard deviation (σ)	1,31	14,35

The load shift can be obtained for example by behavioural changes, which might enable approximately shifting of 10% [17]. Additionally, load shift can be achieved by energy storage, using controllable loads, or a combination thereof. Automated load shifting will be enabled by using the CPMU in line with the pre-set rules and conditions.

Installing additional storage to facilitate load shifting is profitable if the storage costs per kWh discharged is lower than that of the assumed savings.

Based on data above the saving per shifted kWh was calculated at different percentiles and is presented in Figure 15 below.

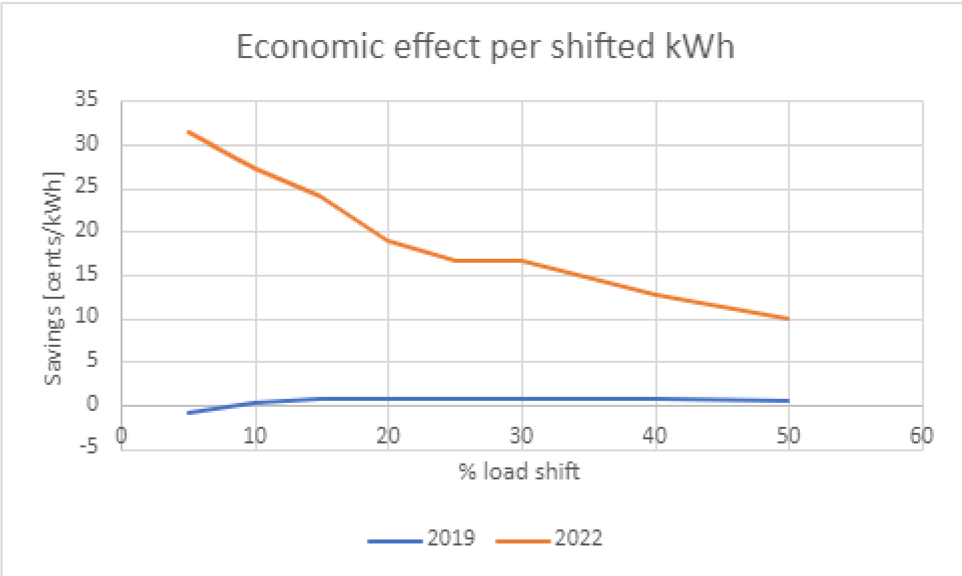

Figure 15 – Possible Savings from load shifting towards median price in Cents/kWh in Großschönau

This should be compared to the cost of storage which is approx. 10-15 cents/kWh discharged [18]. This indicates that in a market like 2022 an increased storage would be economically motivated with respect to the entire life cycle of the battery, and up to 30% of shift of load economically beneficial compared to hourly spot prices.

5.1.2.2 Specific contractual agreements and topics

To obtain the economic benefits of load shifting a change in electricity purchasing deals needs to be made. The price of electricity from the regional market must be based on the current hourly spot price. There might be an individual resistance towards a shift like this. To deal with such a possibility, the EC might purchase on an hourly price while leaving a fixed price to its members, taking over a risk of balancing unforeseeable market trends. This also requires good knowledge about general price developments and local load shifting potential.

With respect to the overview of contractual agreements shown in Chapter 4.3. as Figure 7, in this case the Energy Supply Contract numbered 6 would replace the Energy Supply Contract numbered 5 since the EC would be the single supplier of electricity. Furthermore, the Operational Agreement numbered 11 would get activated, as the EC needs to purchase at hourly prices at the regional market.

Within the Membership Regulations numbered 4, the conditions, rights, and duties regarding the usage of EC members flexibility, such as heat pumps or batteries, needs to be specified.

5.1.3 Business case 3

Providing flexibility services.

5.1.3.1 Economic evaluation

For the case of providing flexibility services to the market it is assumed that 50% of the storage capacity is dedicated to bids on the FCR-D market. In Figure 16 below the potential revenue from FCR-D is presented based on the available input data for the focus region in Austria:

i. Storage Capacity: 250 kWh
ii. Percentage available for FCR-D: 50%

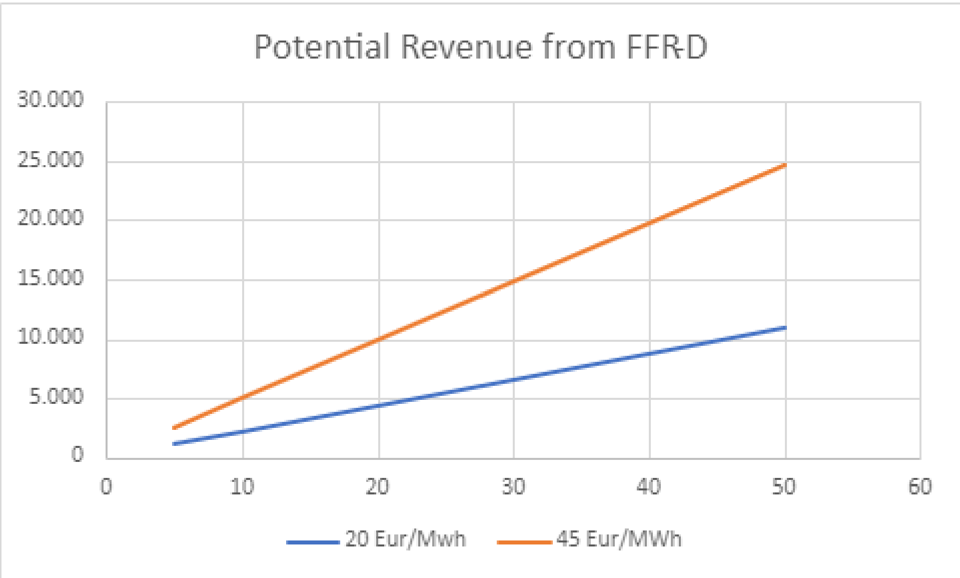

Figure 16 – Potential Revenue from FCR-D for focus region Austria

According to the market analysis supported by Checkwatt [5], Großschönau has the potential to make revenues of about 4 500 to 5 000 Euros given historic Swedish prices and conditions. This correlates well to the lower spectrum of the potential shown above.

5.1.3.2 Specific contractual agreements and topics

For this business case either a contract is needed with an aggregator that can aggregate the flexibility potential of Großschönau with others to reach the 1 MW potential. Otherwise, a change within the rules of the flexibility market is needed, allowing Großschönau to participate directly, by setting up a contract directly with the flexibility exchange. Furthermore, in a similar way as described in 5.1.2.2., the Membership regulations must specify the rules of how and when to use flexibility provided by EC members.

5.2 Fyllinge

5.2.1 Business case 1

Buying and selling on a local market.

5.2.1.1 Economic evaluation

Since the plans for Fyllinge includes a significant amount of PV's the production is assumed to excess the consumption on a yearly basis. This means that instead of comparing the reduction in cost as done above, it is the increase in profit that is analysed.

The results for the basic scenario for this business case is shown in Table 10 below for the input parameters for Fyllinge presented in Table 6 from Chapter 3.3.4.

Table 10 – Results from basic scenario Business case 1 for focus region Sweden

	Reference 2015-2019	Interact EC 2015-2019	Reference 2022	Interact EC 2022
Electricity bought on the regional market [MWh]	1 699	1 574	1699	839
Electricity bought on local market [MWh]	0	95	0	95
Electricity sold on the regional market [MWh]	4 995	4 900	4 995	4 900
Cost [kEuro]	150	151	300	292
Revenue [kEuro]	175	171	489	480
Net profit [kEuro]	25	20	189	187

The numbers above do not include any grid fee reduction for ECs, since this is not applied on the Swedish market and is not expected to be implemented soon. The grid fee is having a lesser effect in Fyllinge since the local market is assumed to be a smaller portion of the overall electricity flows, as shown in Table 10.

Following the same logic, since the trade on the local market is very small compared to the trade on the regional market, the buying/selling ratio does not have a significant effect on the profitability of the EC, too. The impact is shown in Figure 17 below, where both 2022 scenarios are almost at the same place, and both 2015-2019 scenarios as well.

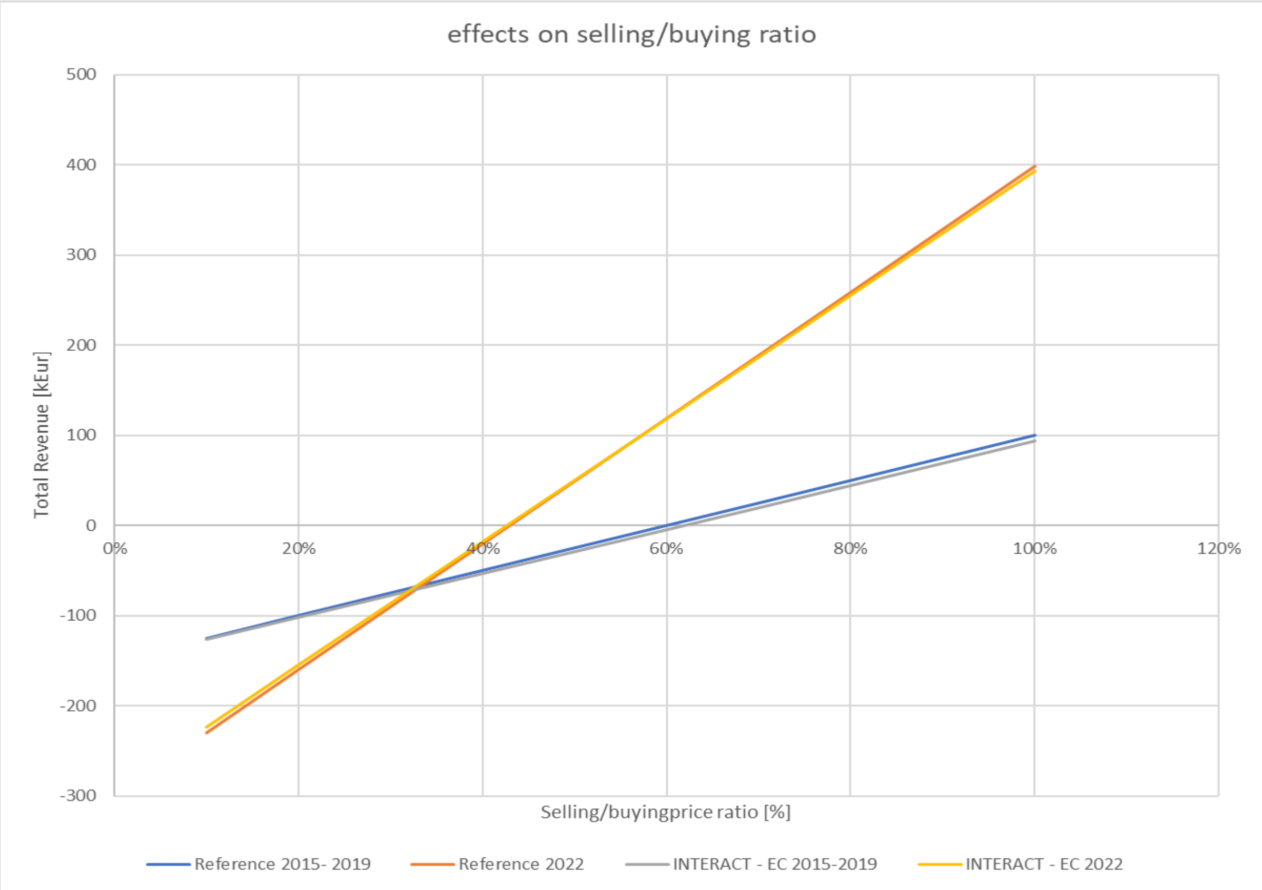

Figure 17 – Impact of Buying/Selling ratio on the Swedish focus region

Nevertheless, the buying/selling ratio has a significant impact on the profitability of Fyllinge as a whole. However, the presence of a local market does not change the profitability significantly, the lines for the reference scenario and the interact EC scenario are nearly superimposed. The maximum difference is reached with 2022 conditions when the buying/selling ratio is at 10 %. In that case the INTERACT EC scenario shows reduced cost of about 6 000 Euros for the entire area.

As mentioned above, one benefit of selling on the local market is the possibility to reduce the risk of production curtailment due to restriction in the transmission capacity of the overlaying grid. This is not an aspect for Fyllinge for two main reasons. First and foremost, as Fyllinge is a greenfield project, the grid including its transformer stations are designed with regards to the local production. Secondly, there is a legal obligation of the DSO to reinforce the grid to avoid curtailment within an appropriate time frame. This transfers the costs to the DSO in the form of additional investments. A well functional local market could therefore reduce the investment costs for the DSO and possibly reduce grid fees in the area. This must however be specified within a bilateral agreement between the EC and the DSO and is not evaluated in this context.

5.2.1.2 Specific contractual agreements and topics

No additional contractual solutions above the contracts mentioned in Chapter 4.3. are required.

5.2.2 Business case 2

Load shifting or price driven demand response.

5.2.2.1 Economic evaluation

For the base case of shifting 10% of the consumption as described above the annual savings after annualized investment costs will be approximately 22 000 Euro. Increasing the percentage of load that is shifted will increase the cost saving, peaking latest at 50% as described above in Chapter 5.1.2.1.

The economic outcome of this business model is to a large extent dependent of the characteristics of the hourly electricity prices. As shown in Table 11 below, Sweden is a market with lower prices and less volatility compared to Austria, therefore the business model is not as profitable.

Again, for this evaluation 2019 represents a period with low and stable spot prices and 2022 represents a market with high prices and high volatility.

Table 11 – Hourly electricity price characteristics for Sweden

	2019	2022
average spot price [cent/kWh]	4,06	12,71
Standard deviation (σ)	1,07	12,68

In below Figure 18 the economic effect of load shift is shown for 2019 and 2022 spot prices.

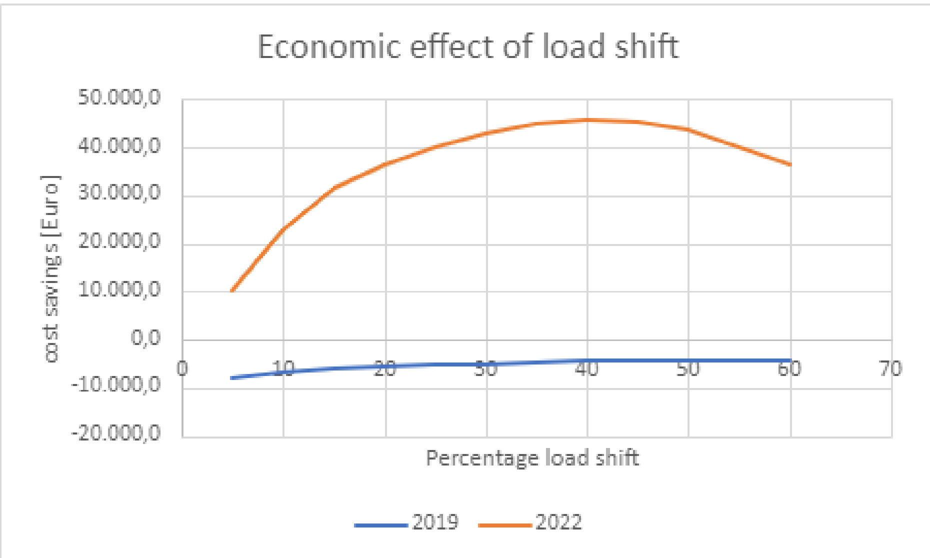

Figure 18 – Economic effect of load shift on the Swedish focus region

The significant difference in savings between the 2019 and 2022 case is immediately visible. With stable prices as recorded in Sweden during 2019, load shifting is not economically due to the investment costs of 100 Euros per CPMU. With an increase in volatility in 2022 however the business case gets profitable.

Same as for Austria, based on input data above the saving per shifted kWh was calculated at different percentiles and is presented in Figure 19 below.

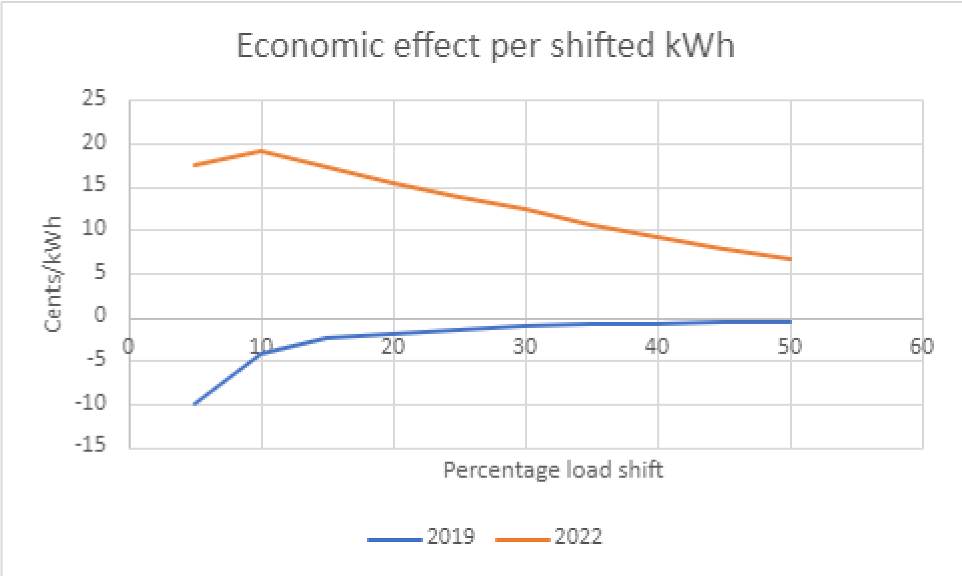

Figure 19 – Possible Savings from load shifting towards median price in Cents/kWh in Fyllinge

When we compared this again with storage costs of about 10-15 cents/kWh discharged, only at the most expensive percentiles and given the 2022 situation, an investment into load-shifting is profitable but will rather quickly cost more than the expected revenue.

5.2.2.2 Specific contractual agreements and topics

To obtain the economic benefits of load shifting a change in electricity purchasing deals needs to be made. The price of electricity from the regional market must be based on the current hourly spot price. This transformation is already occurring in Sweden and will likely be even further along when Fyllinge is built. The EC can in this case offer supporting services to its member or coordinate storage capacity to maximize the outcome of the load shift. Therefore, in the Swedish context, no additional contractual agreements other than 1-5 mentioned in Chapter 4.3 are needed. Nevertheless, the Membership Agreement must specify how and when to access EC members storages, as described in Chapter 5.1.2.2.

5.2.3 Business case 3

Providing flexibility services.

5.2.3.1 Economic evaluation

For the case of providing flexibility services to the market it is assumed that 15% of the storage capacity is dedicated to bids on the FCR D market. The storage in this case is made up of the

EVs connected within the area. The following input data is used for the evaluation of the business case:

i. Storage Capacity: 6 240 kWh

ii. Percentage available for FCR-D: 15%

In Figure 20 below the potential revenue from FCR-D is presented.

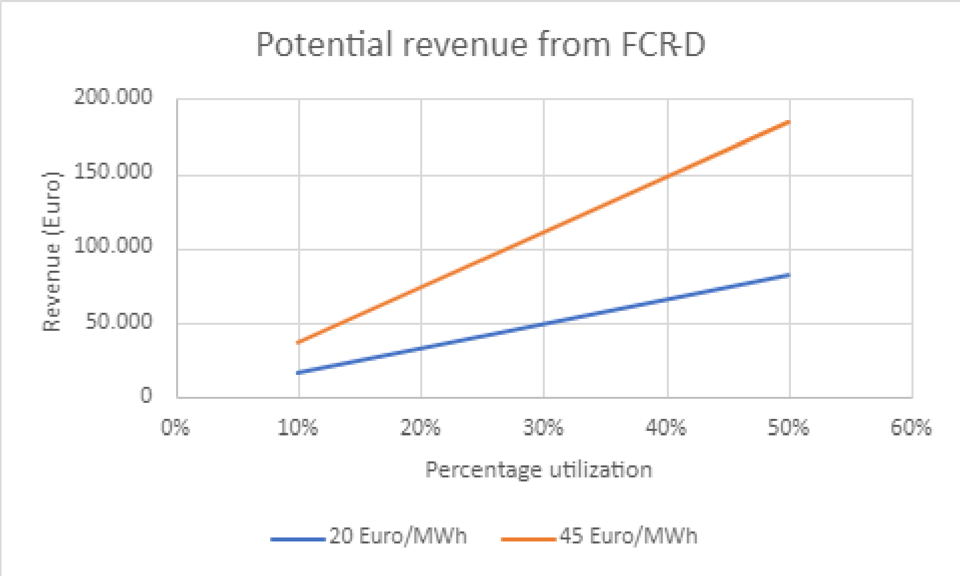

Figure 20 – Potential Revenue from FCR-D for focus region Sweden

According to the market analysis provided by Checkwatt [5], Fyllinge would have the potential to make revenues in the order of magnitude of 15 000 – 20 000 Euros given historic Swedish prices and conditions. This correlates with the very low part of the potential shown in Figure 20 and seems to be a conservate estimate.

5.2.3.2 Specific contractual agreements and topics

To applicate this business case a contract is needed with the Swedish TSO, Svenska Kraftnät, which is the procurer of flexibility services in Sweden. 15% of the available 6.240 kWh storage capacity is very close to 1 MWh, therefore we do not foresee the need of any aggregator.

6 Conclusions

From a contractual point of view, five agreements are needed to establish an Energy Community: i) founding documents of the EC, ii) grid agreement of the EC, iii) grid agreements of the EC members, iv) membership agreements of the EC members, and v) energy supply agreements of either the EC members or the EC. To create an organization based on trust and justness, keeping the contractual agreements based on distributional fairness and procedural fairness is highly recommended. For specific more advanced business cases, further contractual agreements are needed, and ultimately, for a full integration of Energy Communities to both the power grid as well as the electricity market, changes in the currently market rules are to be made.

Regarding economic conclusions, the provided outcome shows directions and interconnections rather than specific economic valuations. Due to given uncertainties regarding input data assumptions as well as model accuracy in respect to different country specifics, results are to be interpreted as framework information rather than absolute values.

Furthermore, in the models no taxes or other fees, except grid fees are included since they are assumed to be equal to both EC and non-EC situations. Also, the results are shown on an EC-level, and not on an EC-member level. Individual motivations and preferences may lead to different results, especially given a topic, which is perceived as a good cause in addition to expected monetary effects (see D2.2 Stakeholder Needs).

6.1 General conclusions

The results show that the profitability of the business cases depends both on the region where the EC is placed, whether a greenfield or upgrade project is discussed, and at a large extend on the development of the electricity markets and its entry barriers.

The described results indicate that a local market could be a profitable solution for an upgrade project in whereas the economic benefit of the local market decreases when the number of prosumers exceeds the needed consumption at a given time. Also, for an upgrade project either a meaningful spread between regional selling and purchasing price or a reduction of grid fees is needed for profitability.

All business cases show a higher economic potential in market conditions with high and volatile prices and a need for balancing services to stabilize the power grid. In that sense the described business cases can be seen as a sort of countermeasure to a dysfunctional and instable electricity market. In an electricity market with low prices, stable supply, and low degree of disturbance an EC is harder to sustain economically viable.

On the other side, other possible services generated by ECs are not quantified in this report that might become more important in the future. Here, ECs should have a positive impact with regards to local balancing of reactive power and optimizing of grids and transformer stations. A mutual cooperation between the DSO and the EC in planning and operation is needed for these services, together with an effort to define prices for such services currently not traded.

6.2 Focus Region Austria: Großschönau

For the focus region in Austria, regulations and incentives to establish ECs have been implemented during 2021, including the necessary legal prerequisites to create ECs, the obligation for DSOs to accept ECs, and the rules how ECs shall work in Austria on a local and regional level. A coordination point is providing all interested persons with important information, and facilitates the founding of ECs. Even though Austria is relatively better for ECs from an economic point of view versus Sweden (higher electricity prices with higher volatility), current market habits are in 2022 playing against the foundation of new ECs: individuals are used to conclude electricity supply contracts with fixed prices for normally a year, monthly floating prices are perceived as flexible pricing agreement. Therefore, business cases founding on hourly price differences throughout the day and the week are not applicable as long as the EC does not have direct access to the electricity market.

On the other hand, Austrian benefits for ECs in terms of reduced grid fees are bringing initial room for ECs to operate in a sustainable and viable way, given that there exists a margin between regional purchasing and selling prices of electricity. With respect to the initial request from stakeholders, that economically the ECs should not cost more than it brings (see D2.2 Stakeholder Needs), and the here described possibilities for ECs in Austria to establish monetary benefits by different services, it can be concluded that within the Focus Region in Austria ECs can sustain on an economically viable level given that no large central costs for administration and upholding of the EC appear.

6.3 Focus Region Sweden: Fyllinge

The business cases most profitable for Fyllinge are load shifting (price driven demand response) and the sale of flexibility services. These opportunities already exist for individuals in Sweden but are not facilitated or magnified by energy communities yet. As Sweden has a very low entry barrier to granular electricity prices, a high level of renewable energies in place, and rather low and stable electricity prices, results show that it is more difficult to motivate the operation of Energy Community based on monetary benefits. Of course, individual benefits are available for prosumers and producers, but not much room is left for monetary improvements on a community level. Other benefits to the members in the form of community services, such as simplified administrative tasks or shared know-how might be more important in the case of Fyllinge.

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