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Abbreviations

LHV	Low Heating Value
NUTS	Nomenclature of territorial units for statistics
EU	European Union
EUBIA	European Biomass Association
DM	Dry Matter
BtL	Biomass to Liquid
RES	Renewable Energy Sources
NECP	National Energy & Climate Plan
IATA	International Air Transport Association
IMO	International Maritime Organization
VLSFO	Very Low Sulfur Fuel Oil
EUA	European Union Allowance
EU ETS	European Union Emissions Trading Scheme
ICAO	International Civil Aviation Organization
IEA	International Energy Agency
UCOs	Used Cooking Oils
HVO	Hydrotreated Vegetable Oil

Contents

Executive Summary

This deliverable set the sceneries of the commercial application of BioSFerA concept by determining the boundary conditions of it. Primarily the replicability and scalability of BioSFerA concept at industrial level in terms of feedstock capacities is assessed and secondly, some preliminary techno-economic data are gathered in order to define the framework of a potential BioSFerA-based biorefinery operation that will be used in the scale up (WP6) and impact evaluation (WP7) activities.

This is achieved via the development of potential commercial BioSFerA case studies across Europe. The development of four (4) case studies relied on the BioSFerA feedstock selection, that took place in Deliverable D2.3, on available platforms and tools from previous projects and research studies as well as on the consortium origins and relative experience. In particular, the scenario of Greece was based on olive tree prunings, the scenario of Italy was based on straw-derived residues, the scenario of Spain on mixed prunings (olive, vineyard, orchards) and finally the scenario of Finland on logging and wood residues.

The key factors for each developed case study were initially the strategic identification of suitable candidate locations for a commercial plant establishment and subsequently the calculation of an average feedstock supply cost. Aiming to ensure financially sustainable scenarios, the latter was intended to be below 10 €/MWh. Moreover, it was investigated how the potential involvement of biogenic wastes, as feedstock in the developed case studies, affects the average feedstock price.

Finally, some basic techno-economic data including current biofuels status, current energy mix and 2030 expectations according to National Energy and Climate Plans (NECPs) are collected for each selected country as well as some preliminary operational costs (e.g. electricity/water/labor costs, carbon taxes, etc.). All the gathered information within this document will act as benchmark for the complete techno-economic analysis that will take place within Task 7.1 of the project.

1. Introduction

The present document aims to structure hypothetical sustainable scenarios for the commercial replicability of the BioSFerA concept across Europe. The developed case studies are guided by the BioSFerA feedstock selection, which took place at an earlier stage of the project, and are enriched with some basic techno-economic data from the selected countries.

1.1. BioSFerA feedstock selection

The case studies, that are developed within this deliverable, were largely based on the feedstock screening and selection that took place within the deliverable D2.3 [1]. In particular, The BioSFerA feedstock selection, after taking into consideration the availability (capacities), the technical requirements (gasification performance) as well as the market competitiveness (feedstock price), and aiming to involve the widest possible spectrum of biogenic residues from various European regions, contains:

- **Olive and vineyard <u>prunings</u>** from Greece & Spain
- **Cereal <u>straw</u>** from Italy
- **Logging residues from final fellings & thinnings/ <u>wood</u> residues** from Finland
- **Airports & ports biogenic <u>wastes</u>** from all around Europe

Figure 1. BioSferA feedstock selection and elected countries for the case studies

Therefore, one case study for each of the selected countries (Greece, Italy, Spain, Finland) is developed in the present document. The origin of consortium members from these countries will strengthen and elaborate the assumed developed scenarios with realistic and up-to-date data.

1.2. Biomass plants across Europe

Aiming to structure hypothetical scenarios for full-scale plants establishment like a BioSFerA-based biorefinery, it is meaningful to have an overview of the current commercial biorefineries and biomass utilization across Europe. After adopting the biorefinery definition, given by [2] and employed also by the Bio-based Industry Consortium, which describes biorefinery as a facility that performs sustainable processing of biomass into a spectrum of marketable products (food, feed, materials, chemicals) and energy (fuels, power, heat) using a wide variety of conversion technologies in an integrated manner, the part of the definition that refers to energy production was isolated and the focus has been given particularly to plants that produce liquid biofuels.

With the assistance of an online interactive visualization platform developed by the Joint Research Centre JRC (https://datam.jrc.ec.europa.eu/datam/mashup/BIOBASED_INDUSTRY), 94 commercial biorefineries that exploit agriculture, forestry and waste derived feedstock to produce liquid biofuels, were located (Figure 2). However, the vast majority of them refer to the production of the so-called first generation conventional liquid biofuels like biodiesel & bioethanol sourcing from sugar-, starch- and oil plants.

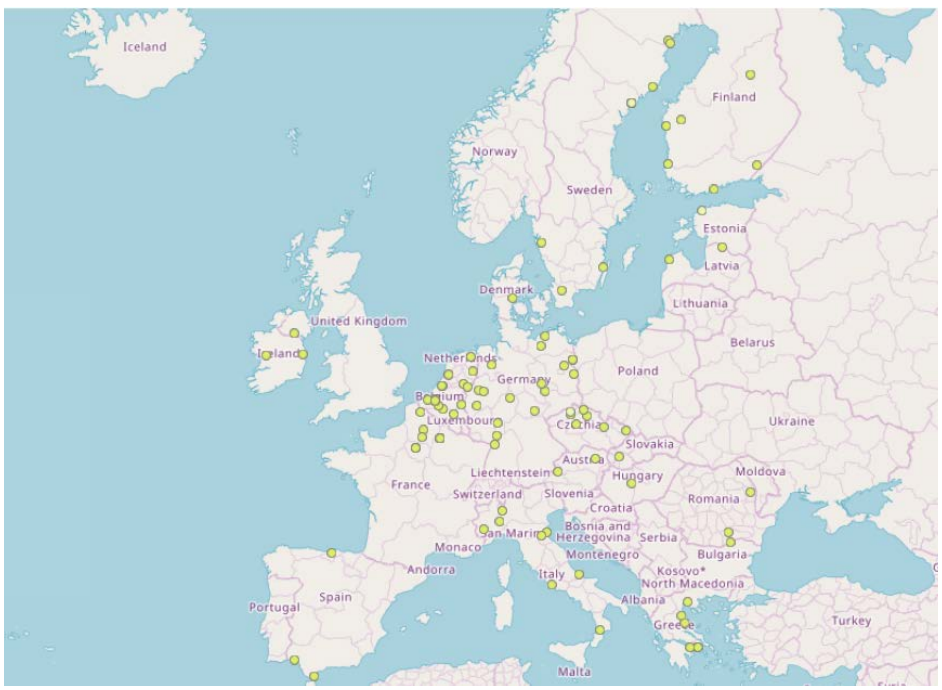

Figure 2. Current commercial first generation liquid biofuels production across Europe according to JRC database

The BioSFerA concept, on the contrary, is based on biogenic residues that do not come in conflict with food production and tent to avoid land use restrictions, targeting to the so-called second generation biofuels. The exploitation of biogenic residues for the production of liquid biofuels is still immature. This type of feedstock, mainly wood in pellet or chip form, is used up to now in commercial scale mainly for heat and power production. In particular, the Drax's[1] power station in the UK, the Orsted's[2] 4 CHP stations

[1] www.drax.com
[2] www.orsted.com

in Denmark, the Fortum's[3] 7 CHP stations across Finland, Poland and Sweden as well as the ENEA's[4] 2 biomass plants in Poland stand out. Therefore, the feedstock supply chains developed and being utilized for these kind of plants with the huge annual feedstock requirements, prove the commercial eligibility of the feedstock suggested from the BioSFerA project and on which the case studies of the present document will be based. Of course, it is a matter of crucial importance the ability of the selected feedstock to be collected locally and ecologically sustainably.

As for biomass availability across Europe, considering production and net trade in the EU-28, agriculture is the biggest supply sector providing approximately 65% of the biomass, followed by forestry with 35%. Data reported by EUBIA[5] refer that the total annual biomass production for EU is estimated at 1466 million tons (Mt) in dry matter, as averaged from 2006 to 2015, from which, 956 Mt account for agriculture and 510 Mt for forestry. The major part of the agricultural biomass production (54%) is referred to the primary products, the so-called economic production, while the rest 46% is referred to residue production. Concerning the woody biomass derived from forestry, 68% accounted for stemwood while the remaining 32% accounts for branches, stumps and tops. Total residue biomass in the EU has increased slightly over the period of 1998-2015.

France, Germany, Poland, Italy, Spain, the UK and Romania take over the 75% of the European agricultural biomass production, including economic as well as residue production. In the field of forestry-derived biomass, countries once again from central-west Europe (i.e. Germany, France, UK) along with countries from the north (i.e. Finland, Sweden) are the main providers [3].

1.3. Methodological framework and objectives of the study

Main aim of this deliverable is on the one hand to assess the BioSFerA concept replicability all around Europe at commercial scale in terms of feedstock supply sustainability, and on the other hand to collect some preliminary techno-economic data regarding the potential plant operation that will primarily elaborate the developed hypothetical scenarios and secondly will be the basis for the complete techno-economic analysis that will take place in Task 7.1. It has to be clear that scope of this study is not to present a detailed scheme of commercial plant operation, but to identify suitable candidate locations where the upscaling of the BioSFerA concept could be facilitated by the available feedstock capacities around these regions. In other words, priority has been given to the identification of locations that seem to have the potential to ensure sustainable commercial plant operation and in no case the exhaustive description of a full-scale BioSFerA scenario. The latest would be rather unfounded at this stage of the project.

Therefore, the first prerequisite for the development of the case studies is the tracking of locations that could potentially ensure the required feedstock capacities. The case studies were based on the hypothetical establishment of a 200 MW_{th} plant, that corresponds to feedstock annual needs of around 250 kt/year (considering LHV of 18-20 MJ/kg and annual operational time of 7500 h) [4]. It has to be mentioned that coastal areas have been preferred since they are easily accessible for low-cost massive feedstock transport (shipping) and strengthen the potential for synergies between different countries as

[3] www.fortum.com
[4] www.enea.pl
[5] www.eubia.org

well as future more sophisticated scenarios than those developed in the present document which involve exclusively local road transport within the selected region. The feedstock screening will be performed with the use of S2Biom platform (see section 2.1) and taking into account the 2030 expectations since the BioSFerA concept will be applicable at commercial scale in at least 10 years from now.

After electing the suitable locations with the required potential capacities, then an average feedstock supply cost should be estimated for each case study targeting an average cost of <10 €/MWh. Indicatively, a typical feedstock supply chain from start to end, as regards the case of agricultural residues, is illustrated in Figure 3. The annual pruning or tree felling/thinning are activities that would take place either way from farmers and therefore the corresponding costs are already included in their annual expenses. Then, the collecting/harvesting costs as well as the transportation costs are the two costs that basically form the final average feedstock price which will be used within the developed scenarios and intended to be less than 10 €/MWh. The feedstock storage costs (i.e. storage facilities) are costs that included in the CAPEX of any plant of this kind and consequently are not taken into consideration for the formation of the feedstock price. To sum up, the average feedstock price for each case study has been assumed as the sum of only the harvesting & transportation cost (red line in Figure 3) and are obtained with the assistance of BIORAISE GIS platform (see section 2.1).

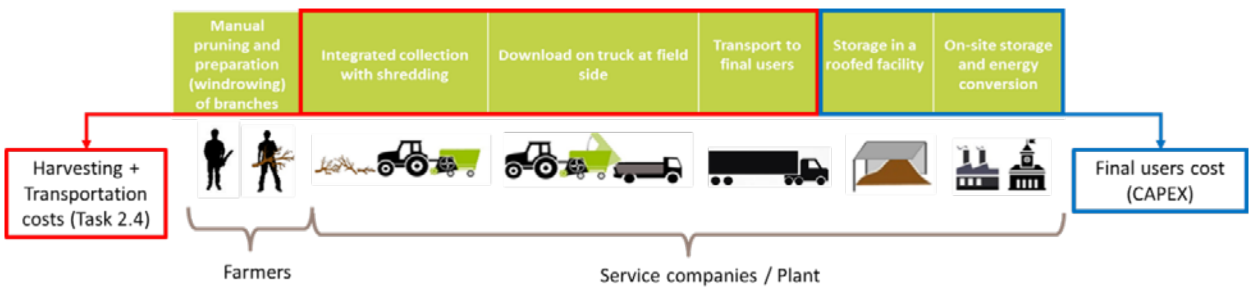

Figure 3. Typical feedstock supply chain of agricultural residues

After taking into consideration the energy contents (i.e. LHV) of the selected feedstock, as measured within D2.3 but also from literature data [5] in order to increase the reliability of the results, a price range for the average feedstock cost is concluded for every case study. Finally, it is presented how the gradual involvement of biogenic wastes from ports & airports in Europe affects the developed scenarios and the average feedstock price. In general, gate-fees are charged for waste materials supplied to energy plants. The wastes pre-treatment costs are at least balanced from the gate-fees, something that immediately turns biogenic wastes into an economical fuel, and subsequently potential wastes involvement in the elected scenarios remarkably decreases the average feedstock price.

The described methodology in a step-by-step formation that has been followed for the development of the case studies is presented in Figure 4.

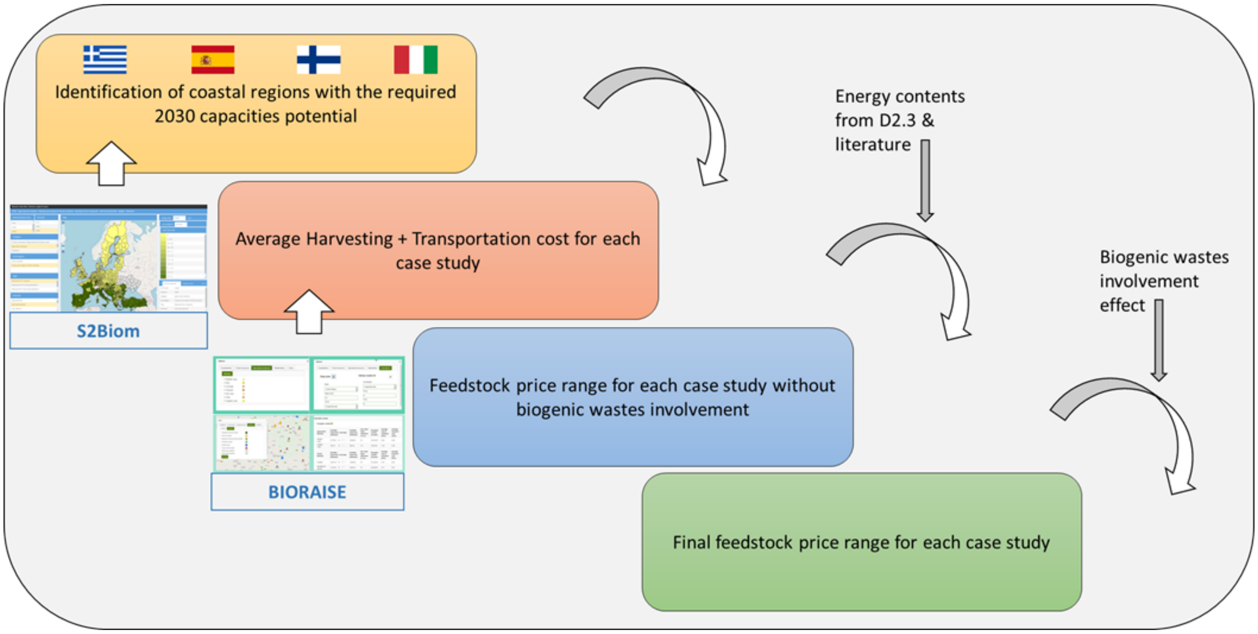

Figure 4. Step-by-step methodology applied for the performed BioSFerA case studies

2. Case studies & feedstock supply chains definition

2.1. Platforms and tools used

As described in section 1.3, the first step for the development of the case studies is the identification of suitable locations (i.e. coastal areas with high 2030 feedstock potential) in the selected countries. Always having on mind the initial feedstock screening performed within D2.3, this time a more focused screening was carried out aiming to locate specific regions that seem able to host a commercial plant in terms of feedstock capacities. The NUTS classification (Nomenclature of territorial units for statistics) is a hierarchical system for dividing the economic territory of the EU and the UK for the purpose of:

a) The collection, development and harmonisation of European regional statistics as well as,
b) Socio-economic analyses of the regions.
   - NUTS 0/NUTS 1: major socio-economic regions
   - NUTS 2: basic regions for the application of regional policies
   - NUTS 3: small regions for specific diagnoses

In particular, it was used the NUTS 3 (small regions for specific diagnoses) administrative level of the S2Biom platform [6] based on 2030 expectations.

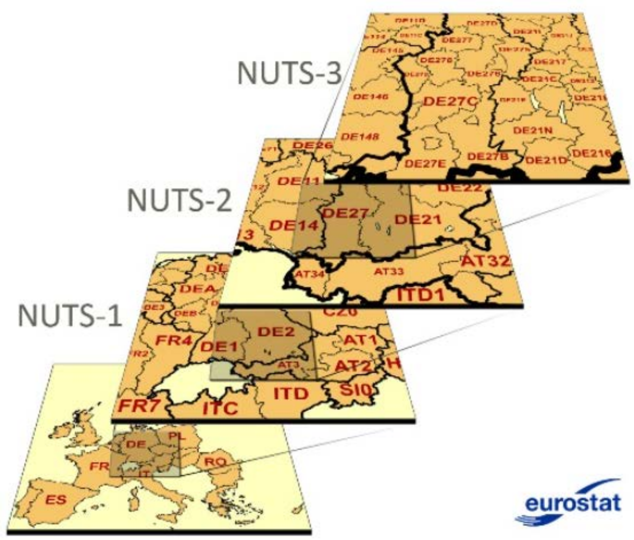

Figure 5. NUTS 2016 classification [7]

The S2Biom platform, which was used also for the BioSFerA feedstock selection (D2.3) [1], is an on-line and user-friendly toolset with updated datasets at local, regional, national and pan European level for EU28, Western Balkans, Moldova, Turkey and Ukraine. An indicative screening in NUTS 3 level is shown in Figure 6.

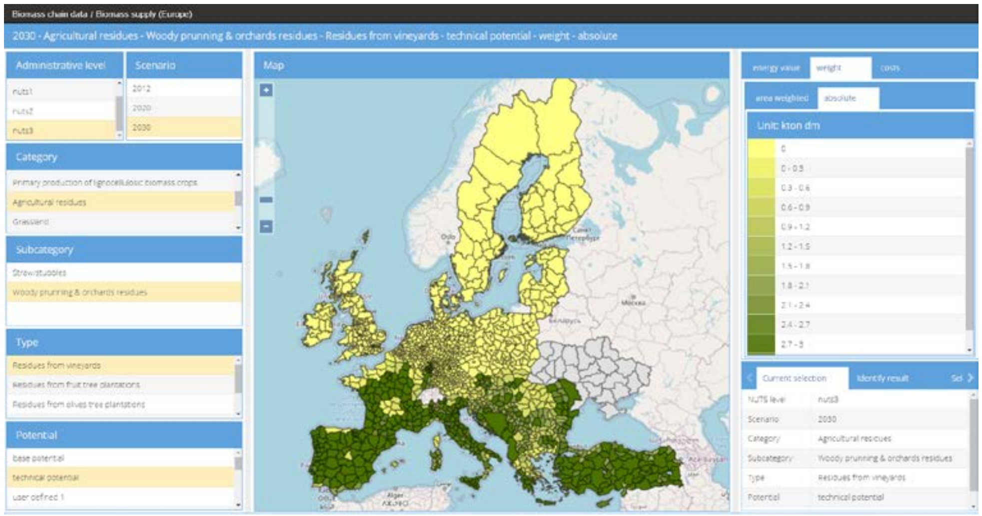

Figure 6. Indicative feedstock screening with the S2Biom platform at NUTS 3 administrative level

The NUTS 3 screening that was performed all around Europe came up with the election of some coastal regions from each selected country that are capable of covering the assumed feedstock requirements. It was decided the case of Greece to be based on olive tree prunings, the case of Spain on a mixture of prunings (olive, vineyard, orchards), the case of Italy on straw and finally the case of Finland on logging/wood residues. Taking the above mentioned points into consideration, the results are presented in Table 1.

Table 1. Identification of suitable regions with appropriate capacities in the selected countries

CATEGORY	COUNTRIES		
Administrative level: NUTS 3, Scenario: 2030	**Weight: Absolute (kton dm)**		
Agricultural residues	**GREECE**		
Woody pruning & orchards residues	**EL651**	**EL652**	**EL653**
Residues from vineyards	9	3	9
Residues from olive tree plantations	125	44	126
Agricultural residues	**SPAIN**		
Woody pruning & orchards residues	**Granada**	**Almeria**	**Murcia**
Residues from vineyards	3	2	19
Residues from olive tree plantations	288	200	35
Residues from fruit tree plantations	26	18	88
Residues from citrus tree plantations	29	20	90
Agricultural residues	**ITALY**		
Straw/Stubbles	**Venezia**	**Pordenone**	**Udine**
Cereal straw	72	45	96
Maize stover	186	147	312
Sunflower straw	6	3	7
Primary residues from forests	**FINLAND**		
Logging residues from final fellings &thinnings	**Helsinki**	**Varsinais**	**Satakunta**
Logging residues from final fellings from conifer trees	322	265	251
Logging residues from thinnings from conifer trees	132	124	91

The region of Peloponnese from Greece, a region in the south-east of Spain, a region of northern Italy as well as a part of south-west Finland have been identified as locations suitable to host a commercial BioSFerA-based biorefinery. Three closed to each other sub-regions form each region and in most of the cases, each sub-region is able to cover the annual requirements of 250kt/year. In the case of Greece, more than one sub-regions are required to guarantee a sustainable supply chain.

Concerning the cost calculations, and in particular for the harvesting and transportation cost, the BIORAISE GIS platform [8] was used. BIORAISE is another user friendly tool that embeds sustainable biomass resources, energetic contents, costs and environmental risks visualization for most of the Mediterranean countries. The first version of BIORAISE was developed in the EU VI Framework Program 'CHRISGAS' for Spain (except of Canaries), Portugal (except of Azores and Madeira), France, Italy and Greece and was updated in 2012, in the framework of the H2020 Project BIOMASUD [9] in which CERTH has participated. The current version of the platform estimates georeferenced information about agriculture & forestry potential on an annual basis in a selected location, calculates the harvesting and transportation costs from the field to a user-choice destination and displays market related stakeholders locations as shown in Figure 7 .

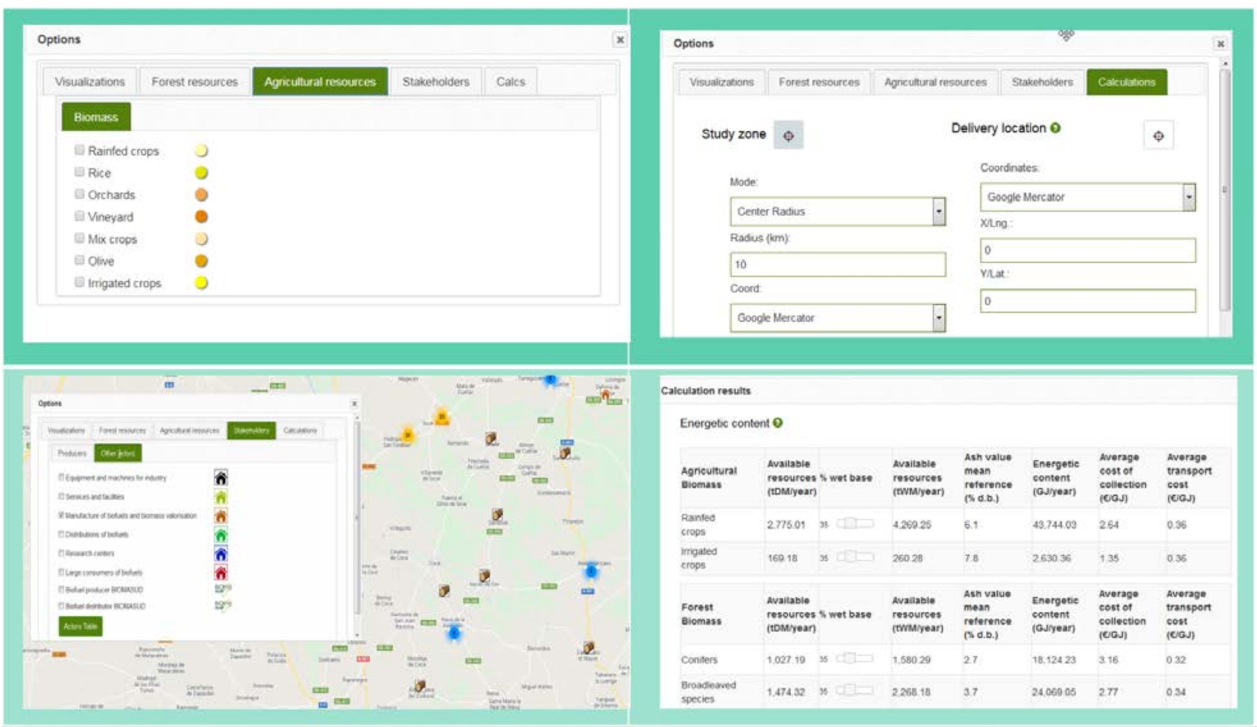

Figure 7. Screenshot from the BIORAISE GIS platform involving land uses, the calculations tab and the stakeholders tab

2.2. The scenario of Greece

It has already been mentioned that the case study of Greece was based on olive tree prunings. For this reason, a concentrated area of olive groves is needed in order to secure the capacities of residual biomass locally and at the same time to minimize the transportation costs. This area, with the assistance of the S2Biom platform, was selected to be the area of Peloponnese as mentioned in Table 1 and as illustrated in Figure 8. Peloponnese seems to be the biggest olive region in Greece and capable of covering the required amounts of feedstock. CERTH has previously performed studies related to another Greek olive rich region, the area of Central Greece, where the estimated capacities according to S2Biom platform seem to not be enough to cover the requirements of a full-scale plant locally.

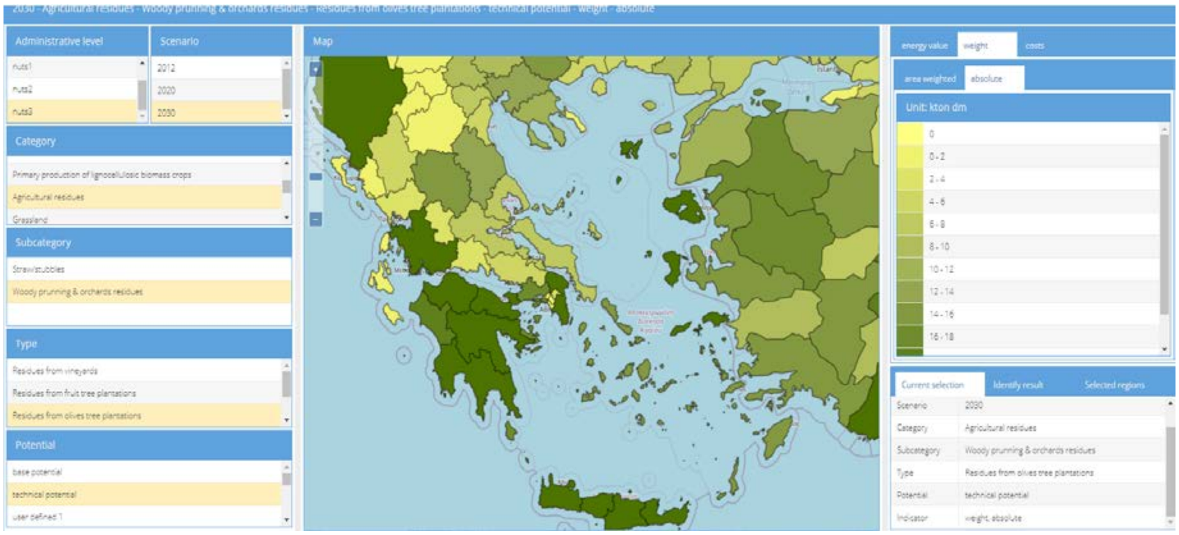

Figure 8. S2Biom NUTS 3 Greece screenshot for the distribution of olive tree prunings according to 2030 expectations

In particular, the three sub-regions named by the S2Biom platform as EL651, EL652 & EL653 form the selected region for the scenario of Greece and their overall capacities as shown in Table 1 seem able to fulfill the feedstock requirements of a commercial plant locally. Sub-regions EL651 and EL653 are by far the main pruning providers of the case and theoretically might be able to cover the required amounts of 250 kt/year on their own, however EL652 is considered to slightly boost the region capacities (Figure 9).

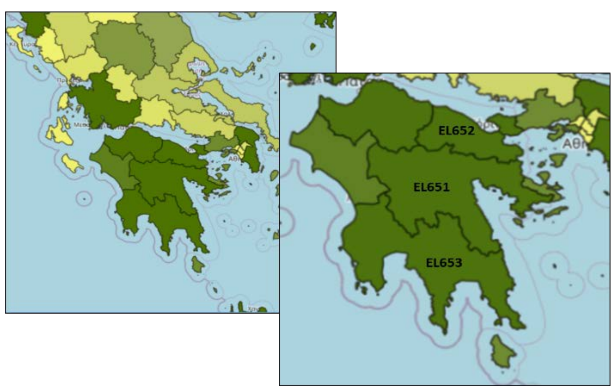

Figure 9. Peloponnese administrative sub-regions according to S2Biom platform

Once the area to be used for the case study has been defined, an average price range for the selected feedstock has to be given. This calculation has been performed with the assistance of the BIORAISE GIS platform. In particular, after entering the willing study zone and a hypothetical delivery location within this zone, the platform returns an average collection/harvesting cost as well as an average transportation cost for the selected feedstock. The harvesting cost includes pruning, chipping, stocking, extraction and loading costs, while for the transportation cost an average calculation is provided that takes into account road distances, local fuel costs, consumptions, etc.

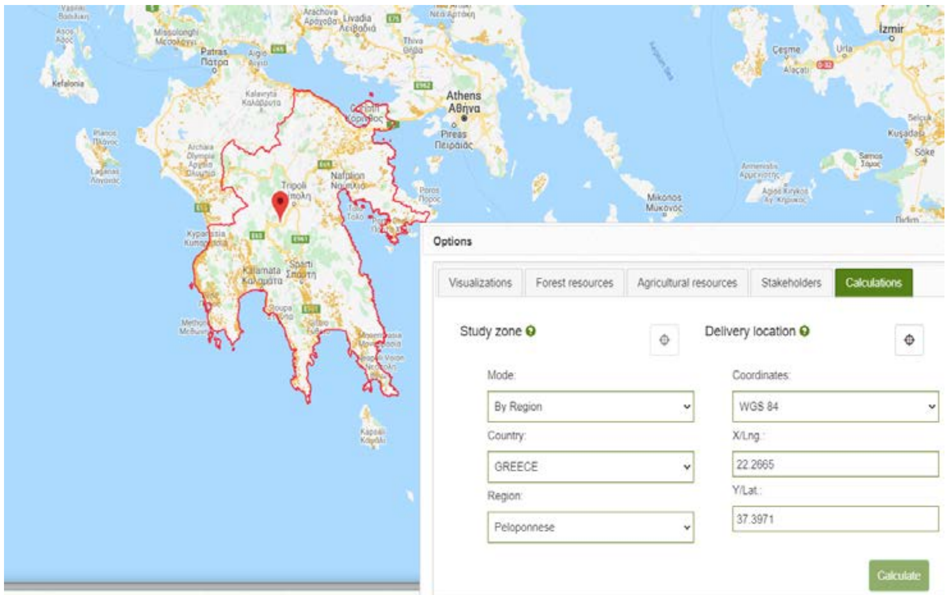

Figure 10. BIORAISE calculation tab; the user selects a location in the map for on the fly computations of costs

For the case of Peloponnese, the average costs of 38 €/t (DM) and 14.86 €/t (DM) were obtained for the collection and the transportation cost respectively (Figure 11). However, for the reliability of the results, these values had to be validated against literature data. Indeed, reported values from similar studies on valorization and utilization of residual biomass from olive tree prunings match those extracted from BIORAISE [10].

Agricultural Biomass	Average cost of collection (€/tDM)	Average transport cost (€/tDM)
Rainfed crops	41.65	11.93
Irrigated crops	22.17	13.34
Rice	37.79	12.03
Vineyard	47	15.82
Orchards	50	14.31
Olive	38	14.86

Figure 11. Collection and Transport costs for the region of Peloponnese (Greece) according to BIORAISE platform

Therefore, taking into consideration that within this study only collection and transportation costs participate in the formation of the average feedstock price of each assumed scenario, the feedstock cost for the case of Greece is estimated at 38 + 14.86 = **52.86 €/t (DM)**. In order to compare this value with the target of 10 €/MWh, the energy content (i.e. LHV) of the selected feedstock is needed. Utilizing the feedstock characterization of Task 2.3 as well as literature data, the LHV range of different olive tree varieties from Greece is placed at 17.74 – 18.95 MJ/kg that is translated to 4.928 – 5.264 MWh/t (DM) and finally corresponds for the calculated feedstock cost to **10.04 – 10.73 €/MWh**.

The case of Greece is presented briefly in numbers in Table 2:

Table 2. The case study of Greece

Case (Country)	Greece
Feedstock	Olive prunings
Region	Peloponnese
Average collection cost (€/t DM)	38
Average transport cost (€/t DM)	14.86
Feedstock LHV (MJ/kg) / (MWh/t)	17.74 – 18.95 / 4.928 – 5.264
Estimated average feedstock price (€/MWh)	10.04 – 10.73

2.3. The scenario of Italy

For the case of Italy, it was decided to focus on straw-derived residual biomass. The Italian cereal cultivation plays a significant role as one of the active sectors of the national economy, including wheat, rice, maize, sunflower, etc. The straw screening for Italy is presented in Figure 12. It can be observed that the higher straw quantities can be found in areas of northern Italy, where the expansion of Po Valley (Pianura Padana) facilitates the cultivations.

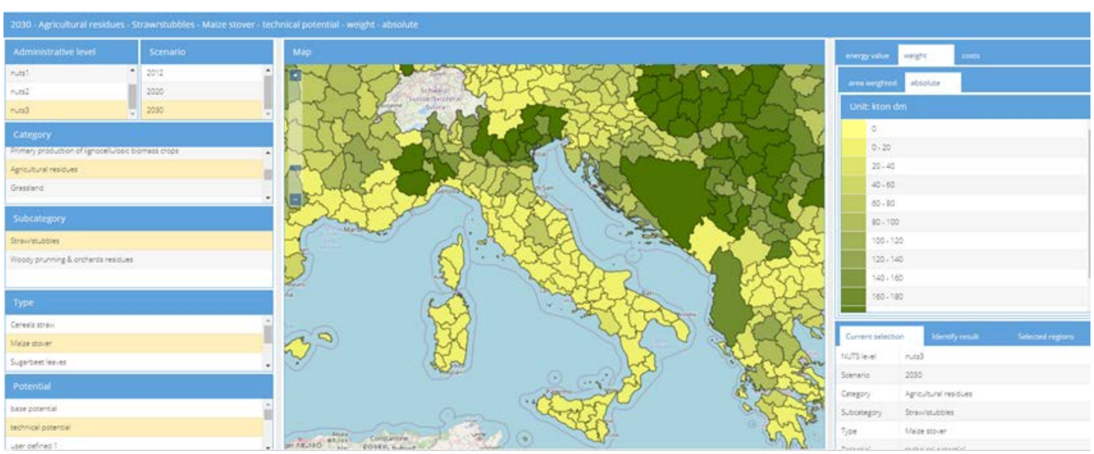

Figure 12. S2Biom NUTS 3 Italy screenshot for the distribution of cereal straw according to 2030 expectations

In particular, the sub-regions of Udine, Venezia and Pordenone were chosen to form the selected region for the Italian case study (Figure 13). As shown also in Table 1, Udine is the major sub-region of the scenario and according to the database potentially able to guarantee the functionality of a commercial plant on its own. However, Venezia and Pordenone as well present remarkable straw capacities that offer flexibility and feedstock assurance locally.

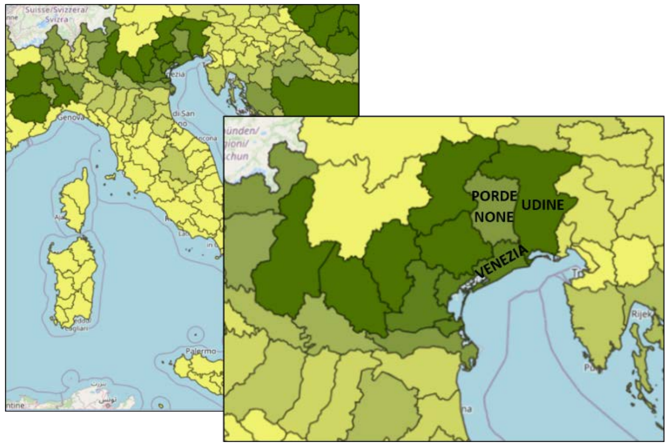

Figure 13. Three selected sub-regions of northern Italy (Udine, Venezia, Pordenone)

Following the same pattern, as for the Greek case study, the BIORAISE platform was used in order to extract estimations for the local average harvesting and transportation costs of the selected region and especially for Udine (Figure 14).

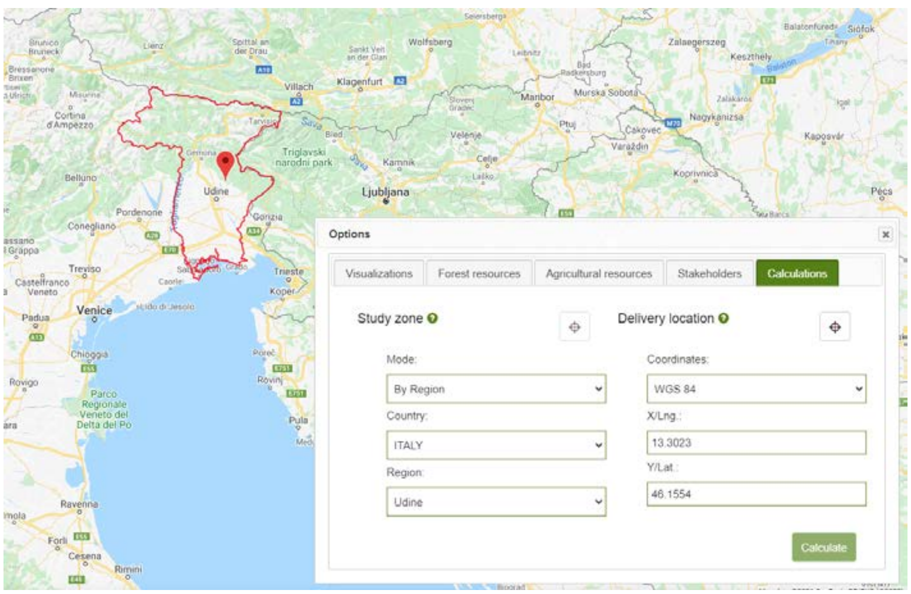

Figure 14. BIORAISE calculation tab; Udine (Italy)

Therefore, for the region of Udine an average straw collection cost of 30.05 €/t (DM) has been obtained while for the transportation cost the average value of 12.59 €/t (DM) was used (Figure 15). As expected, the corresponding costs for straw collection are lower in comparison with the pruning costs involved in the Greek scenario, however, once again, a validation of these numbers has been performed for the reliability of the results. Reported values from past studies on the logistics costs of residual biomass from cereal crops confirm the extracted numbers [11],[12],[13].

Agricultural Biomass	Average cost of collection (€/tDM)	Average transport cost (€/tDM)
Rainfed crops	30.05	12.59
Vineyard	47	8.84

Figure 15. Collection and Transport costs for the region of Udine (Italy) according to BIORAISE platform

Thus, the average feedstock price for the case of Italy is estimated at 30.05 + 12.59 **= 42.64 €/t (DM)**. Utilizing the cereal straw characterization of Task 2.3 as well as literature data, the LHV range of Italian straw is set at 16.48 – 17.73 MJ/kg that is translated to 4.578 – 4.925 MWh/t (DM) and finally corresponds for the calculated feedstock cost to **8.66 – 9.31 €/MWh**.

The case study of Italy is presented briefly in numbers in Table 3:

Table 3. The case study of Italy

Case (Country)	Italy
Feedstock	Straw (cereal, maize stover, sunflower)
Region	Udine
Average collection cost (€/t DM)	30.05
Average transport cost (€/t DM)	12.59
Feedstock LHV (MJ/kg) / (MWh/t)	16.48 – 17.73 / 4.578 – 4.925
Estimated average feedstock price (€/MWh)	8.66 – 9.31

2.4. The scenario of Spain

Even though Spain is the biggest olive oil producer in the world and consequently a scenario based only on olive prunings would have sense and would be sustainable, it was selected to take advantage of the variety of permanent crops that are present in this country and mix prunings. In particular, the Spanish case study will be based on olive, vineyard and orchard prunings as well. A general overview of woody prunings capacities across Spain was obtained and is presented in Figure 16.

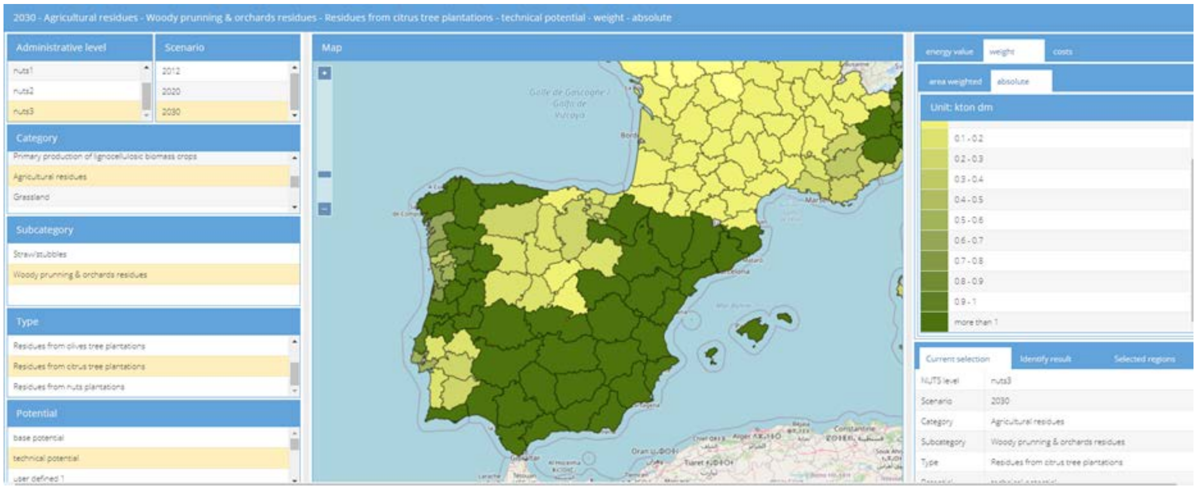

Figure 16. S2Biom NUTS 3 Spain screenshot for the distribution of fruit tree prunings according to 2030 expectations

As expected, enough sub-regions of Spain have the feedstock potential to support a commercial biorefinery, however an area in the south-east of Spain was elected to 'host' the Spanish scenario and more specifically the sub-regions of Granada, Almeria and Murcia. These three are coastal territories with great feedstock potential (Figure 17) and favorable location. Another point that should not be ignored concerning the elected region for the Spanish scenario, is the presence of Morocco in the south of Spain. While Spain is the largest olive oil producer in the world, Morocco is the second biggest and consequently feedstock synergies between the two countries could come up with feasible scenarios. In this perspective, regions in the southern Spain should be preferred.

Figure 17. Three selected sub-regions of southern Spain (Granada, Almeria, Murcia)

Utilizing once again the BIORAISE platform and electing Granada as the dominant sub-region of the case study (Figure 18), the average collection and transportation costs of the territory for multiple crops have been obtained.

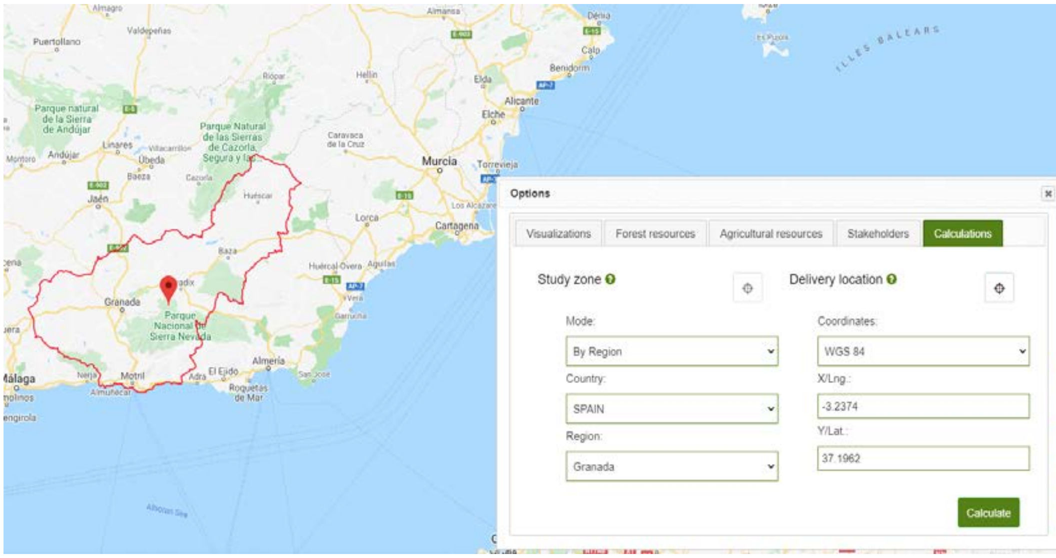

Figure 18. BIORAISE calculation tab; Granada (Spain)

After the extracted values (Figure 19) have been validated against literature data and previous relative studies [14], an average collection cost as well as an average transportation cost were calculated taking into consideration all the selected crops (vineyard, orchards and olive). In particular, the average collection cost for the mixed feedstock was calculated equal to 45 €/t (DM) and the average transport cost equal to 13.81 €/t (DM).

Agricultural Biomass	Average cost of collection (€/tDM)	Average transport cost (€/tDM)
Rainfed crops	45.25	16.41
Irrigated crops	20.12	14.41
Vineyard	47	12.76
Orchards	50	14.29
Olive	38	14.37

Figure 19. Collection and Transport costs for the region of Granada (Spain) according to BIORAISE platform

Thus, the average feedstock price that will be used for the Spanish case study is estimated at 45 + 13.81 = **58.81 €/t (DM)**. Utilizing the feedstock characterization of Task 2.3 as well as literature data, an average LHV from all the involved crops from Spain is set around 17.8 – 19 MJ/kg that is translated to 4.944 – 5.278 MWh/t (DM) and finally corresponds for the calculated feedstock cost to **11.14 – 11.90 €/MWh**.

The case of Spain is presented briefly in numbers in Table 4.

Table 4. The case study of Spain

Case (Country)	Spain
Feedstock	Prunings (olive, vineyard, orchards)
Region	Granada
Average collection cost (€/t DM)	45
Average transport cost (€/t DM)	13.81
Feedstock LHV (MJ/kg) / (MWh/t)	17.8 – 19 / 4.944 – 5.278
Estimated average feedstock price (€/MWh)	11.14 – 11.90

2.5. The scenario of Finland

The case of Finland was based on logging and wood residues (e.g. bark, sawdust). In Finland, forests are a natural and abundant source of bioenergy, from which vast amounts of wood-based fuels are produced annually either as primary residues derived from silvicultural and harvesting operations or as by-products of the forest and wood industry. Indicatively, in 2019, 37% of the energy consumed in Finland was produced from renewable energy, while 74% of the renewable energy accounted from wood energy [15]. The large forestry potential of the country and consequently the high forestry residues potential is illustrated in Figure 20.

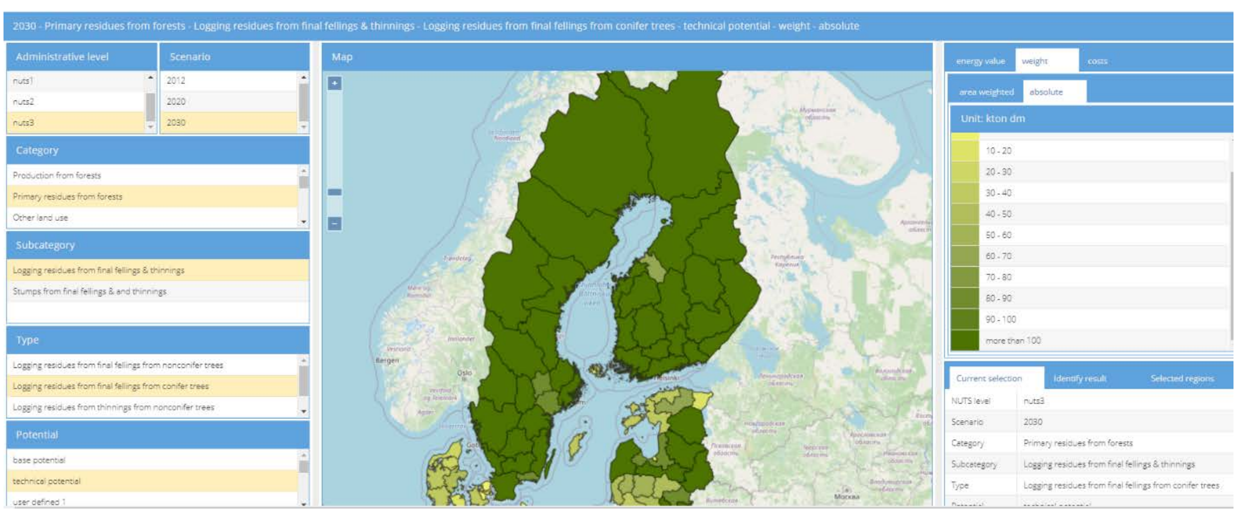

Figure 20. S2Biom NUTS 3 Finland screenshot for the distribution of forestry residues according to 2030 expectations

The candidate sub-regions that seem capable of covering the feedstock requirements of a 200 MW_{th} were many, but three sub-regions of south-west Finland, named as Satakunta, Varsinais-Suomi and Helsinki from the S2Biom platform, were selected for the Finnish case study (Figure 21). These coastal areas were preferred since their location let them 'communicate' with the Baltic states and in general have greater potential for synergies with central Europe rather than areas of central or north Finland. Moreover, it is probably no coincidence that these areas host the majority of the current commercial bioenergy plants of Finland.

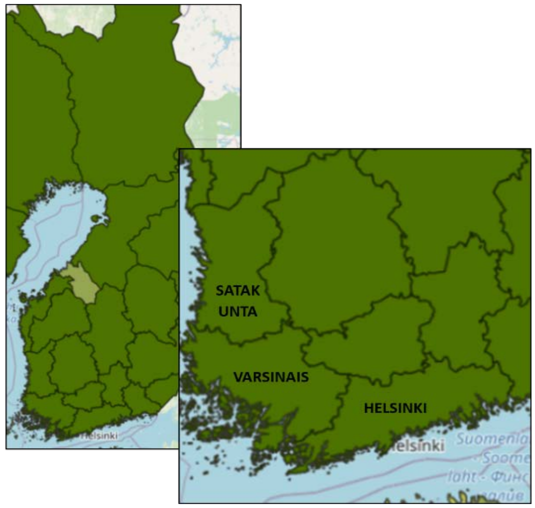

Figure 21. Three selected sub-regions of south-west Finland (Satakunta, Helsinki, Varsinais)

Since the BIORAISE GIS platform is dedicated to Mediterranean countries, the feedstock cost calculation for the Finnish case study could not be performed with this way. However, the presence of VTT in this area and its experience on an active bioenergy market like Finland's one, allows a reliable feedstock price assumption for the specific region. Finland has become a global leader in the exploitation of forest-based biomass for energy production including logging residues as well as by-products of wood industry. Some lower quality wood residues (e.g. demolition wood) can be available at less than 10 €/MWh while other residues of higher quality (e.g. logging residues) might exceed 10 €/MWh. Finland's relative maturity in biomass utilization might offer a high-level of expertise and 'know-how' in commercial feedstock supply chains, but at the same time the accumulation of bio-based plants, that claim the same energy resources, creates increases in feedstock demand and consequently in feedstock prices [16],[17].

After taking into account the capacities of the region, the fuel flexibility that DFBG technology offers, the competition of other biomass-based plants and the future expectations regarding the selected feedstock prices, an average feedstock price range is set for the case study of Finland at **10-15 €/MWh**.

The case of Finland is presented briefly in numbers in Table 5:

Table 5. The case study of Finland

Country	Finland
Feedstock	Logging & wood residues
Region	Helsinki, Satakunta, Varsinais-Suomi
Estimated average feedstock price (€/MWh)	10 - 15

2.6. Biogenic wastes involvement

May the access to airports and ports have been impossible in order to evaluate from closer range the produced wastes there as well as their management systems, due to COVID-19 outbreak, but the biogenic wastes from these grounds remain among the BioSFerA feedstock selection and the investigation of the effect of their potential involvement in the developed scenarios is necessary. This kind of feedstock was selected because a potential 'wastes-to-energy' scheme will not only open up new possibilities in the immature and disproportionate waste management system of these very waste-productive fields ([18],[19],[20],[21]) but also will decrease the average feedstock price of the plant.

Concerning the latter, wastes are considered as a very economical feedstock and this is mainly due to the so-called gate-fees which are the fees charged by the operators of waste management facilities for disposal of received waste. For example, gate-fees will be charged for waste materials supplied to energy plants (e.g. BioSFerA biorefinery). Pre-treatment costs covering collection, separation, shredding and baling as well as transportation costs are at least recovered from the gate-fees (Equation 1), since aim of the gate-fees is to generate profit that will encourage investors from the private sector to be involved. In other words, the gate fee is the driving force for waste management [22],[23].

$$Biogenic\ wastes\ cost = Pre - treatment + Transport - Gate\ fees\ \leq 0\ €/t \qquad (1)$$

In a competitive market, gate fees tend to be set at the level which the market imposes, and are strongly influenced by the cost of nearby methods of waste disposal. For example, the fee charged by an energy plant may be set just below the fee charged by nearby landfill sites or incineration plants. Gate fees price set is a function of many factors (policy, competition, legislative framework, etc.) and therefore gate fees vary widely across the EU but also even within countries. For this reason, it would be rather generic to set a specific range for them, even though there are references that locate them on average at 30 – 70 €/t.

For the present study, the most unfavorable terms of the wastes management market were selected. This means that the gate-fees were assumed at the required level only to cover the pre-treatment and transport costs, forming a biogenic wastes cost equal to zero, instead of assuming higher gate-fees that form negative waste supply prices and profit element. Therefore, the airports and ports biogenic wastes will enter the developed scenarios with a price of **0 €/t**.

The exact possible extent of involvement of wastes fraction in the gasification unit from the technical eligibility point of view, will be defined from the gasification tests. Within this deliverable, in order an estimation for the biogenic wastes impact on the feedstock price to be carried out, a modest assumption of 20% biogenic wastes involvement in the developed scenarios will be applied. Therefore, it is assumed that the feedstock requirements of each case study are covered 80% from the forestry/agricultural feedstock and 20% from airports & ports derived biogenic wastes while the feedstock costs are calculated accordingly (Equation 2):

$$Average\ feedstock\ price = 80\%\ \cdot Biomass\ price\ (Forestry, Agricultural) + 20\%\ \cdot 0 \qquad (2)$$

Figure 22 illustrates the hypothetical 20% wastes involvement effect in the developed scenarios for Greece, Italy, Spain & Finland:

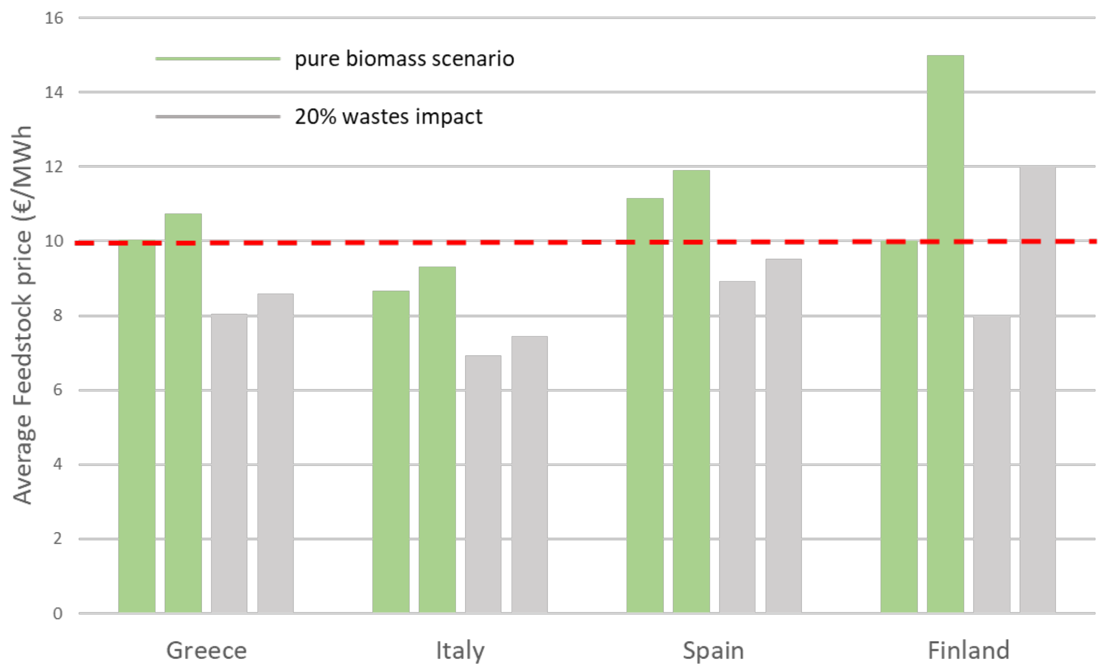

Figure 22.Wastes effect in the average feedstock price of the developed scenarios

It can be observed that even with the most conservative predictions (i.e. only 20% involvement & zero cost) for the biogenic wastes, the average feedstock price range of almost all the case studies falls below 10 €/MWh. Only the case of Finland remains a question mark, since as it has been already mentioned, the Finland biomass market is more mature and active in comparison to the other selected countries involving more stakeholders and consequently presenting higher feedstock price and demand. However, in general the results can be regarded as encouraging and the biogenic wastes involvement, especially with even favorable terms (negative cost), could be a 'game-changer' in terms of feedstock cost.

3. Preliminary techno-economic information for the biorefinery plant

Apart from the feedstock supply chains scenarios, developed in section 2, for the selected countries, another objective of this deliverable is to orient the preliminary techno-economic data that will act as a benchmark for the subsequent techno-economic analysis that will take place in later stages of the project. In particular, the focus will be given on the current status of biofuels in each country, on the current energy mix as well as the expected mix in 2030, and on some basic operational costs involving labor costs or water, electricity and catalysts pricing as well as revenues sourcing from avoided CO_2 emissions. Moreover, some fundamental parameters like the plant size or the targeted biofuels (aviation/marine) for each country will be put under the microscope.

3.1. Plant size

All the developed case studies were based on the establishment of around 200 MW_{th} plant. Commercial capacity classes are divided into small (50-100 MW_{th}), medium (101-300 MW_{th}), large (301-500 MW_{th}) and very large (>500 MW_{th}) plants [24]. Taking into account that the financial feasibility of a commercial BioSFerA-type biorefinery starts from at least 100 MW_{th}, the medium scale of 200 MW_{th} was selected to navigate the developed scenarios.

The size of the plant is regulated by the available feedstock capacities. It was selected not to involve in the case studies overambitious scenarios based on very large plants (>500 MW_{th}), because on the one hand, it would be inherently arbitrary to assume such a large plant of a currently developing technology and on the other hand, the feedstock supply chains were based only on local road transport ensuring the feedstock requirements locally. However, the election of the regions has been performed taking into consideration also the suitability of the area for further upscaling and supply chains upgrading.

Finally, also other similar projects, involving biomass gasification for liquid fuels production (BtL), like 'COMSYN[6]' or 'FLEXCHX[7]' assume a plant of 200 MW_{th} to support their techno-economic analysis. This fact will also facilitate the benchmarking with other similar or competitive gasification based technologies.

3.2. Targeted biofuels

As it is already known, the BioSFerA concept aims to produce drop-in biofuels for aviation as well as the maritime sector. However, it should be noted that jet-fuel and marine fuel markets are two different markets with different demand, price and legislative framework that differ from one country to another. The presence of metabolically engineered oleaginous yeast strains offers to the BioSFerA value chain the flexibility to be either an aviation fuel oriented process or a marine fuel oriented process depending on the produced lipids content and profile.

[6] https://www.comsynproject.eu/
[7] http://www.flexchx.eu/

Within this study, it has not been attempted the identification of the targeted type of fuel (aviation or marine) that would facilitate the BioSFerA concept establishment in each selected country according to their singularities and market characteristics, since the project is still found in a very early stage and not enough techno-economic data are available. Therefore, for every case study it has been assumed the establishment of a commercial plant according to the standards of the default BioSFerA concept which targets both aviation and maritime biofuels.

However, the potential inclination of the process to only one type of fuel may be critical to ensure sustainability of the plant in a country where the production of both type of fuels is not favorable. The final value chain definition, the pilot tests as well as the techno-economic analysis that will take place at later stages of the project are expected to shed more light concerning the concept adaptability to each country.

3.3. Operational costs & parameters in the selected countries

3.3.1. Greece

Liquid biofuels in Greece are involved in transport mainly via sunflower oil-derived biodiesel and in particular in a maximum blending rate of 7% in conventional diesel. From January 2019, Greece mandated producers and distributors of petrol to blend their gasoline with 1% of bioethanol also [25]. The RES share in transport is 6.6%, while the 2030 target according to the NECP (National Energy and Climate Plan) is set at 19% RES share in final consumption for transport [26].

Biofuels involvement in aviation & marine sector are still not recorded, however the NECP states:

‘*Given that Greece is a leader in shipping, it is important to promote emission reduction technologies in shipping in compliance with the decision of the International Maritime Organization of April 2018 for a 50% reduction in emission by 2050, compared to 2008, and eliminating emissions by 2100*’

…

‘*Actions for the development of innovative technologies will also be supported in the case of biofuels as renewable fuels for sustainable transport (fuels for road transport, air transport), which include developing advanced liquid and gaseous biofuels through biochemical/thermochemical/chemical conversion from sustainable biomass and/or autotrophic microorganisms and primary energy from RES*’

…

‘*Promoting dispersed RES generation and advanced biofuels in transport are some of the priorities laid down in the NECP, and specific targets are being set in that context*’

Electricity mix

RES share in gross electricity consumption for 2020 was measured at 29.2%, while coal and natural gas still have the major share of total electricity production. The expectations for 2030 is RES share regarding electricity consumption to reach 61%. Electricity generated from wind and from photovoltaics will play a dominant role in this direction, but due to their stochastic nature, Greece should emphasize also on other

RES that can lessen severe price fluctuation. Electricity generation from biomass for example is expected to be 5 times greater in 2030 [27]. The average daily emission factor for electricity consumption in Greece, as measured for 22/1/2021, based on the ongoing electricity mix was 310 g CO_2/kWh [28].

Labor cost

The gross salary range for people working in Greece in Chemical Industry is typically from 1169 to 2543 €/month [29].

Water cost

Based on commercial water suppliers' statistics for industrial use [30],[31]: 0.4 - 0.7 €/m^3

This value will be applied also for the rest European selected countries (Italy, Spain, Finland).

Electricity cost

By 2019, the industry electricity prices for Greece were 0.106 €/kWh for annual consumption below 2000 MWh and 0.083 €/kWh for annual consumption greater than 20000 MWh [32].

Conventional (fossil) fuel cost

The reported from IATA jet fuel average price for 2020 was 0.38 €/kg, but this value has been visibly affected from the COVID-19 outbreak and the 'short-circuit' that caused in the aviation industry. Therefore, the reported jet fuel average price for 2019, that is 0.61 €/kg seems more indicative and closer to the next years expected values [33]. The reported value of VLSFO (Very Low Sulfur Fuel Oil) for the port of Piraeus is 0.38 €/kg (20 January 2020) [34].

These values will be applied also for the rest European selected countries (Italy, Spain, Finland).

EU Allowances (EUA) auction revenues

European Union Allowance (EUA) means the tradable unit under the European Union Emissions Trading Scheme (EU ETS) [35], giving the holder the right to emit one tone of CO_2, or the equivalent of two more powerful gases, nitrous oxide and perfluorocarbons (PFCs). The average EUA price for 2019 was 24.72 €, reflecting the introduction of Market Stability Reserve (MSR) and the political agreement on reforms to the EU ETS for the fourth trading period (2021-2030) [36].

Allowances auctioning is an efficient way of getting allowances to those who value them most. The auctioning of EUAs generates an income stream for governments through which they can achieve other energy policy goals or priorities. The revenue obtained from Greece during the EU ETS third trading period (2012-2019) by auctioning EUAs was 1.8 billion € [36].

3.3.2. Italy

According to the most recent findings of GSE (Gestore dei Servizi Energetici) [37], Italy has increased its consumption of biofuels for transport 607% from 2005 to 2019. This remarkable increase is largely associated with an increase of biodiesel consumption, much larger than the one registered for other biobased fuels. In 2018, biofuels represented a share of 3.2% on total fuel consumptions (gasoline and diesel). No biofuels consumption is recorded for aviation or maritime transportation.

Overall, around 40% of biofuels consumed in Italy are produced in Italy (with a sharp increase from 2018, when the self-produced biofuels were 33% of the total consumption), which stands as the major contributor to the national market. The remaining share is almost totally produced in European Countries. ENI, Gruppo HERA and Snam are among the main players in the biofuel industry.

According to the NECP until 2030 [38], the renewable energy share in the transportation sector shall reach 22% within this period. Biofuels are expected to contribute with a share of 39% (based on energy content) to the overall renewable energy consumption in the transportation sector.

Aviation and maritime biofuels are seen to contribute to the optimum mix for attaining the renewable fuels target, despite difficulties in quantifying their potential. With respect to biofuels use in transportation NECP states:

'*The aviation sector's contribution to decarbonization is expected to be realized through the use of low-carbon renewable liquid fuel, which can be blended with traditional aviation fuel (under the ASTM D 7566 standard). The International Energy Agency (IEA) predicts that by 2050 around 60% of aviation fuel consumed globally will be biokerosene. This new type of fuel, which meets the sustainability criteria set out in EU directives, enables* CO_2 *emissions to be reduced, depending on the raw material used, by as much as 80% over the entire life cycle compared with traditional aviation fuel.*

The International Civil Aviation Organization (ICAO) has involved operators in the sector (aircraft producers, airports and fuel users) in the Carbon Offsetting Reduction Scheme for International Aviation (CORSIA), which aims to pursue emission reduction in the sector from 2020 onwards. Joining CORSIA is voluntary, but membership will become mandatory in 2027.'

...

'There are plans to introduce measures to promote the use of biofuels in the railway, aviation and maritime sectors.'

'The funds available from CO_2 *auctions (Legislative Decree No 30/2013) will cover experimental development, in particular in order to ensure that demonstration projects (first-of-a-kind) are supported, with the results being passed on to the production system. In particular, research centres and public administrative bodies have agreed to work together in order to develop the production and use of biofuels in the aviation and maritime sector.'*

Finally, a quota system for biofuels is currently in place in Italy. Its compliance is controlled through a biofuel certificates system. The obligations on the percentages of biofuels in Italy have recently changed. The GSE provides a series of indications on the system of mandatory release for consumption of biofuels for transport. The Ministerial Decree of 30 December 2020 provides, among other things, a 10% share for 2021. Advanced biofuels receive special incentive through a simplified sale of biofuel to GSE [39]. Illustrating the contents of the decree, the GSE highlights that in addition to the two obligations to introduce advanced biofuels which can also be fulfilled through the mechanisms provided for by the

Ministerial Decree of 2 March 2018, a new one is introduced which must be '*through the introduction of advanced biofuels other than bio-methane*'.

Electricity mix

According to Snam and Terna, the RES share in the electricity mix in 2018 was of 18.3%, while the renewable energy share in the electricity national mix in 2030 will be 30% [40]. The emission factor for electricity consumption is 308.1 g CO_2/kWh, which takes into account imports as well as integration of RES in the energy mix. The share of 30 % would correspond to an emission factor of 263.9 g CO_2/kWh assuming that the same energy demand is kept [41].

Labor cost

According to national sectoral statistics, labour cost in the chemical sector ranges from 1960 €/month to 2530 €/month (December 2020) [42].

Electricity cost

Gross electricity costs for industrial users in 2019 vary from 0.37 €/kWh (consumption below 20 MWh/year) to 0.10 €/kWh (consumption between 70000 and 150000 MWh/year) [43].

EU Allowances (EUA) auction revenues

The revenue obtained from Italy during the EU ETS third trading period (2012-2019) by auctioning EUAs was 5 billion €, the second highest for EU, only below Germany (10.5 billion) [36].

3.3.3. Spain

In 2019, biodiesel was the main biofuel consumed in Spain and representing 73% of the total liquid biofuels' consumption in transport. HVO and bioethanol accounted for 16% and 11% of the country's biofuel consumption, respectively. Imported palm oil has traditionally been the dominant biodiesel feedstock in Spain, the raw material for virtually all HVO in-country production. The in-country supply for biodiesel production is limited to animal fats and UCOs. Spain's advanced biofuels production capacity consists of HVO co-processing by petrol companies in seven refineries [44]. The RES share in transport is 11.3%, while the NECP aims for a 28% percent share in transport for 2030, well beyond the 14% required at the EU level [45].

The NECP states for advanced biofuels involvement in the next decade:

'*Biofuels are currently the most widely available and widely used renewable technology in transport. Furthermore, in some sectors, such as heavily vehicles (whose consumption is a significant share of the total for road transport) and aviation, they will continue to be the only way to reduce the use of fossil fuels over the coming years.*'

…

'*In order to achieve the objectives for consumption of advanced biofuel, advanced biofuel production must be boosted, as it is still very low. Energy efficiency measures will be promoted for air and maritime transport.*'

…

'*The main aspects of decarbonization in the transport sector are the modal shift, the deployment of electric mobility and the boost to the manufacture and use of advanced biofuels. Aid programs for advanced biofuel production facilities.*'

Electricity mix

The RES share in the current generation electricity mix is accounted at the impressive 43.1%, mainly based on wind, solar, and hydroelectric energy, while nuclear and fossil fuel based power plants gradually recede [46]. The expectations for 2030 according to the NECP is 74% share of generation from renewable sources in the electricity mix. The average daily emission factor for electricity consumption in Spain, as measured for 22/1/2021, based on the ongoing electricity mix was 81 g CO_2/kWh [28].

Labor cost

The gross salary range for people working in Spain in Chemical Industry is typically from 1326 to 2924 €/month [47].

Electricity cost

The industrial electricity price in Spain for 2018 was 0.106 €/kWh for annual consumption of less than 2000 MWh and 0.091 €/kWh for annual consumption of more than 20000 MWh [48].

EU Allowances (EUA) auction revenues

The revenue obtained from Spain during the EU ETS third trading period (2012-2019) by auctioning EUAs was 4.6 billion € [36].

3.3.4. Finland

In 2020, the total share of liquid biofuels in transport is assumed to be 13.5%. The presence of advanced biofuels like renewable diesel by Neste [49] & UPM [50] as well as bioethanol by St1 [51] are signs of an already experienced market in renewables sources exploitation. According to the NECP, the aim is to increase the share of transport biofuels in all transport fuels consumed in Finland to 30% by 2030 [52]. Moreover, Neste aims to become the world's largest aviation biofuel producer since it has already signed agreements with several airline and airports to supply HVO aviation biofuels in the near future [53].

In general, the country's current energy mix allows Finland to target to be the world's first fossil-free welfare society. The NECP states regarding transport biofuels:

'*Aid is primarily targeted at the commercialization of new technologies including plants producing advanced biofuels for transport. Policies and measures for the dimension of decarbonization, such as* *biofuels/bioliquids quota obligations for the transport and heating sectors, requires the development of new technologies.'*

…

'*The use of wood-based fuels in Finland is mainly based on industrial side streams and such energy fractions created in connection with forest management work and felling for which there is no demand in the forest industry processes. The aim is to direct these biomass fractions to power and heat generation and to the manufacture of transport biofuels.'*

…

'In the dimension of internal energy markets, the quota obligation of biofuels is expected to foster a joint Nordic biofuel market.'

Electricity mix

The RES share in the electricity generation mix of 2019 was estimated at 47%, mainly based on biomass and hydroelectric power. The fossil fuel derived power is accounted only at 13%, while 35% of the electricity production is covered from nuclear power plants [54]. According to NECP, electricity and heat production in Finland must be made nearly emissions-free by the end of the 2030s while also taking into account the perspectives of security of supply. The average daily emission factor for electricity consumption in Finland, as measured for 22/1/2021, based on the ongoing electricity mix was 171 g CO_2/kWh [28].

Labor cost

The gross salary range for people working in Finland in Chemical Industry is typically from 2812 to 4402 €/month [55].

Electricity cost

In 2019, electricity price for industries with an annual consumption of 20000 to 70000 MWh was at 0.071 €/kWh in Finland [56].

EU Allowances (EUA) auction revenues

The revenue obtained from Finland during the EU ETS third trading period (2012-2019) by auctioning EUAs was 1 billion € [36].

3.3.5. Summary data and information

Some numerical data, extracted from the current energy status of each country, along with other preliminary estimations for operational costs and parameters are collected and presented in Table 6. These values are expected to contribute in the techno-economic analysis that will take place in later stages of the project. However, since many of them are time-dependent, they will be continuously refreshed and reevaluated during the project implementation. Furthermore, it should not be ignored that many of them also reflect the pandemic impact on the market and societies in general. Taking the above mentioned points into account, the reported values may serve as a benchmark for the subsequent techno-economic orientation of the project, but in no case could describe accurately a potential 2030 commercial establishment. The purpose of this section is to provide each country's general energy overview and partially decipher the future trends.

Table 6. Preliminary techno-economic parameters to be considered in the techno-economic analysis (Task 7.1)

Country	Greece	Italy	Spain	Finland
Operating hours per year	7500			
Plant lifetime, years	25			
Labor Cost, €/month	1169 - 2543	1960 - 2530	1326 - 2924	2812 - 4402
Process water price, €/m^3	0.4 -0.7			
Industrial Electricity price (>20000 MWh/year) , €/kWh$_e$	0.07 - 0.11			
Current grid electricity footprint* , gCO_2/kWh	310	308	81	171
ATR Catalyst price, €/kg	7.7 [57]			
Hydrogenation Catalyst price, €/kg	224.9 [58]			
EUA average price for 2019 (€)	24.72			
EUA auction revenues for 2012-2019 (billion €)	1.8	5	4.6	1
Discount rate, %**	5%			
Current conventional fuels* (aviation & maritime) price, €/kg**	0.38 & 0.38			

*Current grid electricity footprint was obtained from live electricity mix for each country. Therefore, the values are temporary and refer to 22/1/2021 measurements. Grid fluctuations will come up with new numbers.

** With the term of discount rate is defined the interest rate used in discounted cash flow (DCF) analysis to determine the present value of future cash flows. It is assumed that the interest rate of any loan may be needed will have the same value.

*** The current fuel prices reflect the pandemic outbreak and price increases are expected next years, especially for jet fuel

4. Conclusions

Within this deliverable, an initial assessment concerning the BioSFerA concept replicability across Europe at commercial scale was carried out. This has been achieved with the development of assumed commercial scenarios in selected European countries. The elected countries were Greece, Italy, Spain and Finland. Each assumed commercial scenario contained for each country the identification of suitable candidate locations in terms of feedstock capacities to host a 200 MW$_{th}$ plant as well as the calculation of an average feedstock cost for the selected region.

In particular, the case study of Greece was based on olive tree prunings and the selected region was Peloponnese, the case study of Italy was based on straw-derived residues and the selected region was the province of Udine, the case of Spain was based on mixed prunings (olive, vineyard, orchards) and the selected region was the area of Granada, while the case of Finland was based on forestry and industrial wood residues from south-west Finland focusing more on the Helsinki area. After the mentioned case studies have been formed, it was investigated the impact of potential involvement of biogenic wastes as feedstock on the developed scenarios and in particular how the average feedstock price will be set. Wastes are considered as a very economical feedstock and this is mainly due to the gate-fees which are the fees charged by the operators of waste management facilities for disposal of received waste and usually cover any required pre-treatment cost.

In order to ensure the financial sustainability of the assumed scenarios, the target of <10 €/MWh has been set for the average feedstock price of each case study. Indeed, the calculated feedstock costs for each case study were all around 10 €/MWh, while even with the most conservative assumptions for biogenic wastes in terms of involvement and cost, the feedstock prices fall below 10 €/MWh. Only the case of Finland can be characterized relatively unpredictable and this is due to the fact that Finland biomass market is more mature and active in comparison to the other selected countries involving more stakeholders and consequently presenting higher feedstock demand and price.

The developed case studies are summarized and presented in numbers in Table 7:

Table 7. The developed case studies in numbers

Country	Greece	Italy	Spain	Finland
Feedstock	Olive prunings	Straw (cereal, maize stover, sunflower)	Prunings (olive, vineyard, orchards)	Logging & wood residues
Region	Peloponnese	Udine	Granada	Helsinki, Satakunta, Varsinais-Suomi
Estimated average feedstock price (€/MWh)	10.04 – 10.73	8.66 – 9.31	11.14 – 11.90	10 - 15
Average feedstock with 20% biogenic wastes involvement (€/MWh)	8.03 – 8.58	6.93 - 7.45	8.91 – 9.52	8 - 12

Finally, some basic techno-economic and policy information is collected for each selected country including biofuels status, energy mix, 2030 expectations along with preliminary estimations of operational costs (e.g. electricity, water, labor, etc.). All the gathered information will be continuously refreshed and reassessed during the project implementation. The objective of this information and of this deliverable in general was not to describe a commercial BioSFerA plant exhaustively, since it would be rather unfounded at such an early stage of the project, but to investigate the concept commercial replicability in terms of feedstock and lay the foundations of the complete techno-economic analysis that will take place in Task 7.1.

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