D6.3: Flagship success cases update v1

uP_running

Take-off for sustainable supply of woody biomass from agrarian pruning and plantation removal

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ABBREVIATIONS

APPR: Agrarian Pruning and Plantation Removal

CERTH: Centre for Research and Technology Hellas

CHP: Combined heat and power

CIRCE: Research Centre for Energy Resources and Consumption

EC: European Commission

EuroPruning: Development and implementation of a new and non existent logistics chain for biomass from pruning

HPK: Croatian Chamber of Agriculture

SCDF: Service Coop de France

SECB: Scientific Engineering Centre “Biomass”

UCAB: Association “Ukrainian Agribusiness Club”

UFG: University of Foggia

uP_running: Take-off for sustainable supply of woody biomass from agrarian pruning and plantation removal

WP: Work Package

EXECUTIVE SUMMARY

The level of Agricultural Pruning and Plantation Removal (APPR) biomass utilization in Europe is very low and far behind that of wood coming from forest. Even though the overall utilization level of APPR biomass is low in Europe, at local or regional level there are successful cases of biomass value chains based totally or partially on APPR biomass. 18 such cases have already been identified by the uP_running project and are recorded in the "Observatory", the web-based tool developed for recording APPR experiences.

uP_running project intends to select a number of value chains for further study and mark them as "flagships" of APPR biomass utilization. A flagship case has the capacity to be thoroughly documented, present a good degree of technological innovation and has the capacity to serve as an example to replicate / imitate in other sites. Success cases showcase the models that can be followed to make APPR use feasible, and are a unique source for extracting lessons learnt and keys for success. Moreover, uP_running flagship cases selection intends to cover as wide a range of end uses and business model formulations as possible, while also considering an appropriate geographical coverage in Europe.

The present report focuses on five flagship cases following the targets described above. They are briefly presented in the table below.

Flagship case	Country	APPR type	Type of value chain	Main reasons for consideration as flagship case
Domaine Xavier Muller	France	Vineyard prunings and uprooted plants	Self-consumption (domestic heating)	Example of farmer self-consumption business model, interesting innovations in the supply chain, constant re-focus and adaptations
Vineyards4heat	Spain	Vineyard prunings	Municipal / agro-industrial heating	Example of private-public partnership business model
ITC Shabo	Ukraine	Vineyard prunings	Agro-industrial heating	Example of agro-industrial business model, first case of APPR biomass use identified in Ukraine
Pélets de la Mancha (Athisa Group)	Spain	Vineyard prunings	Upgraded biomass (pellets, chips) to market	Example of biomass-to-market business model, unique case of large-scale production of pellets from vineyard prunings

Flagship case	Country	APPR type	Type of value chain	Main reasons for consideration as flagship case
Fiusis	Italy	Olive tree prunings	Electricity production	Example of biomass-to-power business model, first known case of power production using only olive tree prunings as fuel

Each of the flagship cases mentioned above is described in great detail in annexes to this report. The following information of the success cases mentioned above is available:

- Summary of the case
- Business model
- History and reasons for initiating
- Biomass availability, harvesting and logistics arrangements
- Soil management and impact on agronomic practices
- End use of APPR biomass
- Success factors and obstacles
- Lessons learned
- Future of the value chain

Potential initiators of APPR biomass value chains can study the detailed flagship reports and, after identifying the one most suitable to their needs, can transfer the lessons learned from its experience and start designing and making arrangements for their own cases.

By comparing the flagship cases, some general remarks can be made for APPR value chains, which are summarized as follows:

- APPR biomass value chains can be very versatile and cover the needs of quite different end-uses.
- Low biomass productivity is not an obstacle in the development of an APPR chain, although it has to be carefully considered for its implications.
- The intangible benefits usually play a role for most of the value chain actors of new APPR value chains (e.g.: green image of a company; better air quality in rural areas by avoiding disposal of residues through open fires, etc.).
- APPR biomass value chains operate mostly on local level and the radius of operation is low (often less than 10 km).
- The utilization of APPR biomass creates jobs and promotes rural development.
- APPR value chains are always adapting depending on market developments, opportunities and threats.

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INTRODUCTION

The current report constitutes **Deliverable D6.3 "Flagship success cases update v1"** of the uP_running project. The report is the result of work undergone in **Task 6.3 "Registry of collection experiences and value chains"**.

One of the goals of Task 6.3 is to improve the knowledge regarding successful value chains that are based (totally or partially) on APPR biomass. Several such cases have already been detected throughout Europe and recorded, using the templates developed in Task 6.1, in the uP_running Observatory website.

uP_running project aims to identify at least 10 cases which should correspond to best practices regarding APPR biomass utilization. The definition of such a "flagship" cases of APPR value chain is not strict. Generally, a flagship case should consider the following:

- Ability to be thoroughly documented, through publicly available materials and reports, as well as through interviews from the key actors of the value chain.
- Good degree of technological innovation along the value chain, e.g. use of mechanized harvesting for APPR collection, high energy conversion efficiencies, production of upgraded products such as electricity or biomass pellets, etc.
- Ability to serve as an excellent example for replication in other locations.

Deliverable D6.3 covers 5 APPR utilization "flagship" cases located throughout Europe. These are the following:

Flagship case	Country	Type of value chain	Main reason for consideration as flagship
Domaine Xavier Muller	France	Self-consumption (domestic heating)	Example of farmer self-consumption business model, interesting innovations in the supply chain, constant re-focus and adaptations
Vineyards4heat	Spain	Municipal / agro-industrial heating	Example of private-public partnership business model
ITC Shabo	Ukraine	Agro-industrial heating	Example of agro-industrial business model, first case of APPR biomass use identified in Ukraine
Pélets de la Mancha (Athisa Group)	Spain	Upgraded biomass (pellets, chips) to market	Example of biomass-to-market business model, unique case of large-scale production of pellets from vineyard prunings
Fiusis	Italy	Electricity production	Example of biomass-to-power business model, first known case of power production using only olive tree prunings as fuel

This Deliverable report is prepared in English. The text of the cases shown in the appendices is the input to prepare structured, well edited and visual descriptions of each flagship case, which will be translated in 7 European languages (Croatian, French, Greek, Italian, Portuguese, Spanish, and Ukrainian) at a later date.

Deliverable D6.4, foreseen for November 2018, will present at least five, additional APPR flagship cases.

1 APPR BIOMASS VALUE CHAINS AND THE UP_RUNNING OBSERVATORY

uP_running project focuses on woody biomass originated from permanent crops: agricultural prunings and plantation removal material, APPR biomass for short. Previous investigations suggest that the potential in Europe is huge: 20 to 25 Mt (of fresh biomass) per year from prunings (CIRCE, 2014; Elbersen et al., 2012), 15 Mt of plantation removal wood. Overall, the annual dry matter production can reach 20 Mt/yr (García-Galindo et al., 2016).

Despite this large potential, the actual utilization rate of APPR biomass is very low compared to other types of solid biofuels, such as those originating from forest biomass (widely used for a variety of applications, from domestic heating to large-scale power production) or even herbaceous agro-biomass (examples of cereal straw utilization in power production are relatively few but quite well known and relatively large in size). Technical issues in harvesting and managing APPR biomass are an issue that has been well addressed by previous initiatives, such as **EuroPruning project** (www.europruning.eu); for pruning harvesting, several technical solutions from different manufacturers are available in the market. The prevalence of non-technical over technical issues in the initiation of APPR biomass value chains was highlighted as a final result of the EuroPruning project and it has been reconfirmed in the sector analysis undertaken by the uP_running project (UFG et al., 2017).

In order to promote the energetic utilization of APPR biomass in Europe, uP_running project has designed and is implementing a series of actions, aiming to address the non-technical issues of using APPR biomass. A key message that the uP_running project intends to deliver to stakeholders interested in initiating value chains based on APPR biomass is that, although they may be the first in their region or even country, they are not the first to work in this direction before; others have tried in the past, have succeeded and their example can be a valuable lesson and experience for imitation or improvement.

There are several ways in which uP_running is assisting to achieve this goal: one is the organization of twenty short-term, yet complete demonstrations of APPR biomass value chain options, five in each of the four uP_running demonstration countries (Spain, Italy, Greece, Ukraine). Another is through the uP_running “Observatory”, an online tool for recording and displaying “experiences” related to APPR biomass: field measurements of biomass potential from APPR biomass, mechanized collection of APPR biomass and, finally, actual, operating APPR biomass value chains.

The full functionalities of the uP_running Observatory are described in great detail in uP_running Deliverable D6.1 (CERTH et al., 2016), available on the project website. In the following sections, the questionnaire used for recording APPR value chains will be presented in greater detail, along with the actual cases already included in the Observatory.

1.1 Recording APPR value chains

The questionnaire used by the uP_running Observatory to record APPR value chains aims to record the most important and interesting information for the initiation and operation of the value chain. For this reason, its emphasis is not on technical issues, such as the APPR biomass productivity or the machines used for harvesting, but rather on non-technical aspects, such as the role of actors involved, the reasons for initiating the value chain, etc.

The main informational sections of the APPR value chain questionnaire are as follows:

Prime mover and main characteristics

An APPR value chain may involve several kinds of actors; in most cases however, it is initiated by one "**prime mover**". The prime mover is usually the most active actor in the value chain, the one who engages the other and makes things happen. **Usually, the prime mover is also the one that takes the most risk from the involvement in an APPR value chain**. The proper acknowledge of this entity is important, both on the grounds of ethics, but also to understand why and how an initiative took place.

Other important, general information for an APPR value chain are related to the **type of APPR biomass involved** (prunings, plantation removal or both), the **crop species used**, the **start date of the value chain** (as an indicator of its maturity) and also the **volume of APPR biomass mobilized annually** (as an indicator of its size).

Key success factors

The success of an APPR value chain can be a result of several reasons. For practicality and ease of comparison, the success factors are grouped in different categories in the APPR value chain questionnaire. Several specific factors are listed in each category.

- **Project planning:** effort dedicated to feasibility / planning prior to execution, consideration of target consumers and quality requirements, market analysis and contract preparation.
- **Product quality:** biomass labeling / certification, adoption of quality assurance process.
- **Community:** extended area of permanent crops and community support, information campaign to promote social acceptance, prior policy debate.
- **Market:** maturity of biomass market, shortage of other biomass resources, increased biomass demand, local price increase of biomass, stability and security of local biomass market.
- **Local capacities:** re-orientation of local economic sectors to biomass, existence of service companies / persons with capacities to start new initiatives, biomass procurement information campaigns,
- **Pruning management:** expensive standard pruning management, previous experiences in APPR biomass mobilization, high density of permanent crops in local area.
- **Regulation:** strict regulation on APPR biomass handling adopted, policy changes adopted due to lobbying.

- **Support:** new support measures adopted, placement of environmental funds, expansion of biomass consumption sector, availability of financial support, combination with other supporting initiatives (e.g. LIFE+ funding).
- **Policy:** clear biomass strategies / roadmaps, vision for utilization of APPR biomass, public investments fostering the use of APPR biomass, reduced taxation for APPR biomass, public campaigns, integration with other environmental/public strategies, ban of open-field burning.
- **Logistics chain:** pre-existent collaborations between value chain actors, introduction of new technologies, incentives for private investment.

The description of the success factors is an elaboration of an initial categorization performed within the EuroPruning project. Each specific factor can be labelled as a) irrelevant, b) of likely influence, b) important, c) crucial or d) unknown. It is suggested to mark the three most crucial factors for the whole chain in order to have a better understanding of the keys for success leading to a real implementation of the new value chain.

Actors and roles in the value chain

From a process point of view, an APPR biomass value chain requires the implementation of a logistics chain which includes a series of steps, tailored to the specific requirements of the end-use: harvesting and initial condition of APPR biomass from the field, a first haulage / transport, pre-treatment and storage, further processing (e.g. pelletization), transport to the end user and final energy conversion.

From the point of view of actors, APPR biomass value chains always start with one or more farmers, as suppliers of the raw material. Depending on the business model and the scale of the value chain, other actors may be involved: cooperatives that pool the resources of the members, agro-service companies that provide specific equipment and operations, energy service companies that perform a further processing of the biomass and can distribute it to end-users and biomass consumers / energy users that own the equipment for the final energy conversion (e.g. boilers, power plants, etc.).

The simplest business model of APPR biomass is the self-consumption one: a single farmer is mobilizing part of the APPR biomass produced, organizes the required harvesting operations, haulage and storage steps, and use the APPR biomass for heat production at his / her own home or farm. In more complicated business models, several actors participate in the logistics chain and are responsible for one or more process steps.

In order to capture the information related to the logistics chain organization (e.g., who does what), the questionnaire for the APPR value chains uses a matrix which presents on one axis the possible actors involved and on the other axis the process steps. By ticking the appropriate box, the assignment of roles in the logistics chain becomes clear. The result can be visualized in a graph; this approach was also followed in other tasks of the uP_running project (UFG et al., 2017).

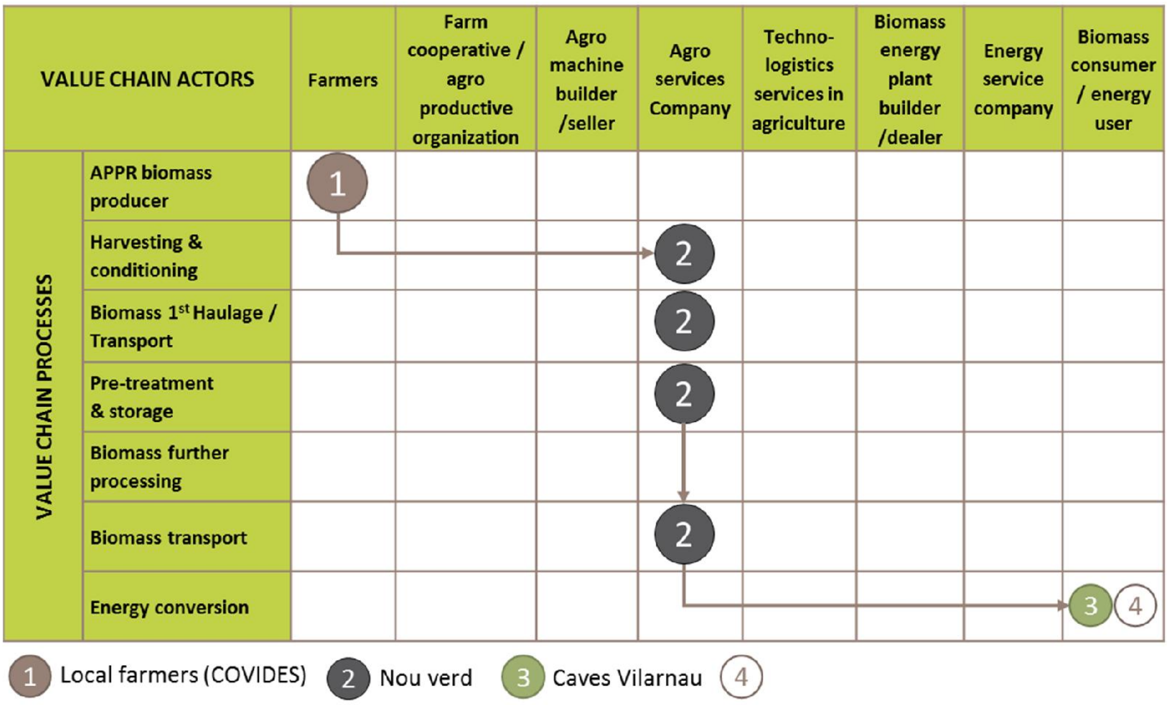

Figure 1. Example of interactions of key actors in the formulation of an APPR biomass value chain (based on the Vineyards4heat case).

An additional approach to categorizing business models for APPR biomass value chains was employed in **Deliverable D2.1** of uP_running project (UFG et al., 2017); each initiative can be represented as a point on a Cartesian plane in which the vertical axis discriminates between agriculture and industrial sector of the proposed business, while the horizontal one divides projects conducted by single companies from those conducted in partnership with public entities. While this approach has not been included in the Observatory, it is used to compare the business models for the flagship cases later in this report.

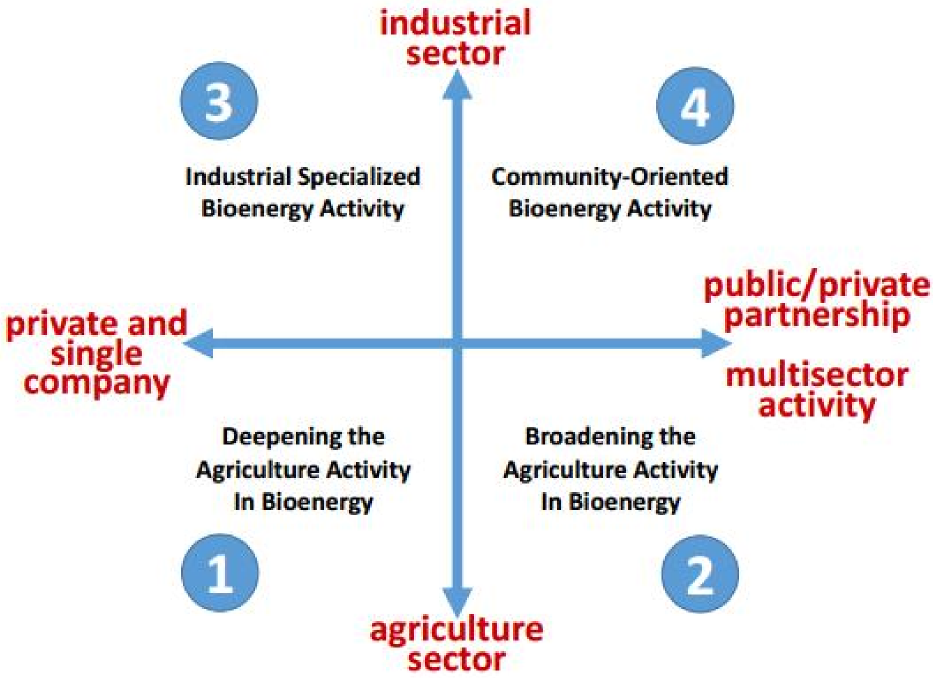

Figure 2. Cartesian plane for APPR biomass business models (Source: UFG, 2017).

Fuel specifications

Fuel specifications of APPR biomass prior to energy conversion are influenced by the implementation and the technical steps adopted for the logistics operation; the limitations of the energy conversion equipment have also to be taken into account.

The following parameters are considered for describing this aspect of a value chain:

- **The form of APPR biomass prior to exploitation.** The following categories are considered: bales of branches, wood chips, hog (or shredded fuel), pellets and other types if applicable.
- **The maximum moisture content** (% as received). The maximum allowable water content depends on the specifications of the energy conversion system. Lower moisture increases the heating value and the performance of the combustion system. The moisture content can be controlled to some extend by integrating natural drying steps in the logistics chain: for example, leaving the material on the field for some time before collection or drying of piles of branches. Such operation can bring the moisture content down to 20 – 25 %. In cases where lower moisture content is required, artificial drying steps have to be implemented. This is always the case in pellet production, where the process itself and the end product specifications require moisture content below 10 % on an as received basis.
- **The maximum ash content** (% dry basis). Again, this parameter is greatly influenced by the specifications of the energy conversion system. The large the scale, the more tolerant a boiler is in terms of the maximum ash content, provided it is known in its design and appropriate measures to control dust emissions are implemented. The ash content of woody APPR biomass is generally higher than that of forest biomass, but some measures

to reduce the ash content can be adopted during the design of the logistics chain, e.g., by avoiding operations that result in soil intrusion.

- **The minimum low heating value** (kJ/kg as received)**.** This parameter usually falls under specific ranges depending on the moisture and ash content of the wood biomass, but it is often listed as an important technical parameter for the operation of a conversion system or an economic parameter for the fuel sourcing.

Other value chain details and price data

In each value chain some additional organization details and price data can often be described with standardized terms. The Observatory questionnaires considerers the following:

- **End-use of APPR biomass**: usually, each value chain model incorporates one major type of end-user(s) of APPR biomass. They have been grouped in the following categories: self-consumption, industrial heating, public-private buildings, distributed heating networks, biomass to market and, finally, other cases, e.g., power plants.
- **Radius of operation (in km)**: this term gives an indication of how far the APPR biomass extends. Usually, the more APPR biomass is mobilized, the larger the radius of operation is. The radius of operation can also be extended if the APPR biomass is upgraded in such a way, e.g., through pelletization, so that transportation over large distances to end-users becomes economical.
- **Storage options**: the storage of APPR biomass can be necessary in order to ensure an even supply of fuel throughout the year. The questionnaire investigates whether this storage is performed on the farm, in intermediate storage points, directly at the end-user or if APPR biomass is consumed directly, without any long-term storage taking place.
- **Ownership of harvesting equipment**: the harvesting equipment can be a significant investment in APPR value chains, especially for farmers. Therefore, it is interesting to note if such a machine is owned by the farmers themselves, the community / municipality, 3rd parties, if it is leased or other arrangements have taken place.
- **Price information**: detailed cost information may be restricted for reasons of business confidentiality but cost information are often available. The comparison of the final price of APPR biomass (in €/t) compared to other fuels available in the area (e.g., "regular" wood chips, ENPlus pellets, domestic heating gasoil, etc.) can provide some indications about the attractiveness of APPR biomass compared to market alternatives.

It should be noted that no APPR biomass value chain initiative can be fully captured with a standardized questionnaire; its evolving nature and its complexity means that it can only be understood in full through a narrative description drafted after discussions and interviews with its prime mover and other involved actors. Some aspects of the value chain, such as the specifics of the logistics formulation (e.g., types of machines used) have also not been considered as part of the APPR value chain questionnaire. Both would complicate the creation of a standardized template and would go beyond the technical capacities of an Observatory-type tool; however, an extended description of such aspects is precisely the target of the present report.

1.2 APPR value chains identified

The EuroPruning project had already identified 16 existing APPR biomass value chains in Europe (SLU et al. 2016); 2 more have been identified by the uP_running project partners. Material collected through surveys performed by the EuroPruning project and additional data collection from the uP_running project partners allowed the completion of 18 questionnaires related to APPR biomass value chains; these have been uploaded on the Observatory website, as Figure 3 depicts. A short overview of the value chains identified is also presented in Table 1.

The majority of the value chains and the ones largest in size (in terms of APPR biomass mobilized) are located in Spain; there are also two other large cases in Italy and Ukraine (more than 1,000 t of APPR mobilized per year) as well as several other smaller cases in Italy, Germany, France, Poland and Denmark.

The most common business model is the self-consumption one: farmers who mobilize a quantity of their own prunings and use them as fuel for heating their own households or farms. Relatively small-scale heating applications in municipal buildings is also observed in a few other cases. On the other hand, there are also cases of mobilization of large volumes of APPR biomass (up to 84,000 t/y in a Spanish case) for large-scale applications, mostly for power production.

Regarding the type of APPR biomass, all value chains but one focus exclusively on prunings. In most cases, prunings from a single tree species (most commonly olives or vineyards) is used as raw material. In some of the smaller in size cases, the prunings from whatever trees are available in the farm or area are used.

Finally, it should be noted that most of the value chains reported are fairly recent, with the oldest one having a start date in 2008 and the newest ones in 2015.

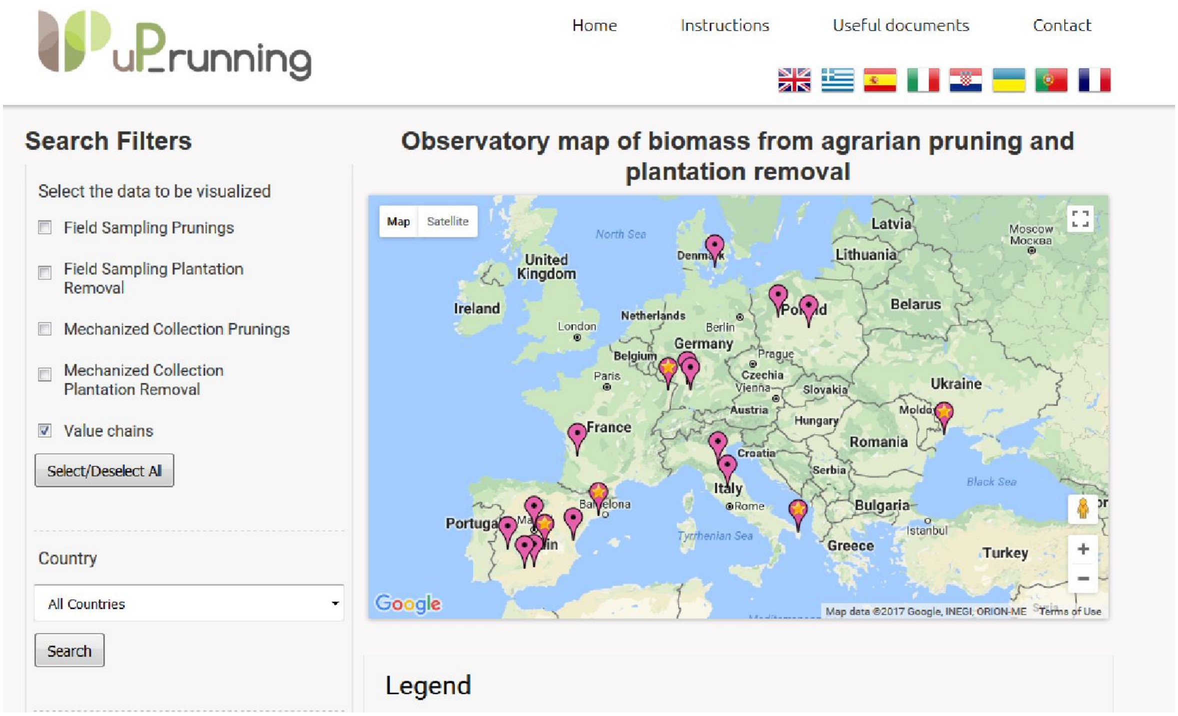

Figure 3. Screenshot of uP_running Observatory displaying identified APPR biomass value chains and flagships (as of October 2017).

Table 1. Overview of the APPR value chains recorded in the uP_running Observatory.

#	Country	Prime mover name	Prime mover type	APPR type	Crop species	Final form of Biomass	Year of initiation	Typical volume of APPR mobilized (t/y)	End use
1	Spain	Pellet Combustibles de la Mancha	Pellet producer	Prunings	Vineyards	Pellets & wood chips	2011	20,000	Biomass to market
2	Germany	Stadt Land Fluss	Agro-services	Prunings	Apples, pears, plum, cherries	Wood chips	Not reported	500 -2,100	Fuel for CHP plants
3	Germany	Land-und Forstwirtschaftiches Lohnunternehmen	Agro-Services	Prunings	Apples, pears	Wood chips	2011	43	Fuel for heating plant, greenhouses
4	France	SCEA Vignobles Jean-Marie CARRILLE	Farmer	Prunings	Vineyards	Bales of branches	Not reported	26 - 50	Self-consumption (domestic heating)
5	France	Domaine Xavier Muller	Farmer	Prunings & plantation removal	Vineyards	Pellets & wood chips	2010	12	Self-consumption (domestic heating)
6	Italy	Stefano Barbieri	Farmer	Prunings	Vineyards, olives, apricot	Wood chips	Not reported	0.2	Self-consumption (domestic heating)
7	Poland	Rolniczo Sadownicze Gospodarstwo	Agriculture Research Farm	Prunings	Apples, pears, plum, cherries, nuts	Bales of branches	Not reported	100	Self-consumption (heating)
8	Spain	S.C.A. Ntro.Padre Jesus	Agrarian Cooperative	Prunings	Olives	Wood chips	2011	Not reported	Biomass to market
9	Poland	Gospodarstwo Sadownicze	Farmer	Prunings	Apples	Bales of branches	Not reported	120	Heating of municipal buildings

#	Country	Prime mover name	Prime mover type	APPR type	Crop species	Final form of Biomass	Year of initiation	Typical volume of APPR mobilized (t/y)	End use
10	Spain	Oleícola EL TEJAR	2nd degree cooperative	Prunings	Olives	Wood chips	2008	93,500 (45,000 35,000, 7,500, 6,000 respectively)	Fuel (along with olive pomace) for electricity production in the Vetejar S.L., Agroenergética de Baena, Agroenergética Palenciana and Algodonales power plants
11	Denmark	Vesterled frugtplant	Farmer	Prunings	Apples, pears, plums	Hog fuel	Unknown	Not reported (biomass from 70 ha mobilized)	Self-consumption (domestic heating)
12	Spain	Valoriza Energia O&M	Other (power plant)	Prunings	Olives	Hog fuel	2008	84,000	Fuel (along with olive pomace) for electricity production in the Biomasa de Puente Genil and Bioeléctrica de Linares power plants
13	Spain	AREX Medio Ambiente	Biomass supplier	Prunings	Olives	Wood chips	2015	1,000	Fuel (along with forest wood, straw and plantation removal wood) for electricity production in the Biomasa Miajadas power plant of ACCIONA ENERGIA

#	Country	Prime mover name	Prime mover type	APPR type	Crop species	Final form of Biomass	Year of initiation	Typical volume of APPR mobilized (t/y)	End use
14	Spain	Vineyards4heat	Service company	Prunings	Vineyards	Wood chips	2015	225	District heating network for municipal buildings and heat production for agro-industry (winery)
15	Italy	Fiusis	Other (power plant)	Prunings	Olives	Hog fuel	2010	8,000	Fuel for electricity production (only from olive prunings)
16	Ukraine	ITC Shabo	Agro-industry	Prunings	Vineyards	Hog fuel	2015	1,000 – 1,500	Fuel for steam production in agro-industry
17	Spain	Serra city council	Public institution	Prunings	Cherries, almonds, carobs, olives, vineyards, oranges, lemons	Pellets	2011	60	Production of pellets and use for heating of municipal buildings
18	Italy	Cantine Giorgio Lungarotti	Agro-industry (winery	Prunings	Vineyards	Wood chips	2009	150	Self-consumption for heat, steam and cold water production

2 THE uP_RUNNING FLAGSHIP CASES

Out of the total APPR value chains identified, uP_running project aims to select at least 10 **"flagship" cases** which should correspond to **best practices** regarding APPR biomass utilization.

The definition of a flagship case of APPR value chain is not strict. Generally, a flagship case should have the following characteristics:

- Ability to be **thoroughly documented**, through publicly available materials and reports, as well as through interviews from the key actors of the value chain.
- Good degree of **technological innovation** along the value chain, e.g. use of mechanized harvesting for APPR collection, high energy conversion efficiencies, production of upgraded products such as electricity or biomass pellets, etc.
- Ability to serve as an **excellent example for replication / imitation** in other locations.

Additionally, the selection of the value chains should be such so as to cover **as wide a range of end uses and business model formulations as possible**.

Based on the 18 APPR value chains currently identified, the project consortium agreed on an initial selection of 5 flagship cases, which are included in this report. At least 5 more, coming from the already identified ones or new ones to yet been recorded will be presented in an upcoming project deliverable (due for November 2018).

The following paragraphs provide a short description of each flagship case presented in the current report and the reasons for their selection. Also, the common approach and methodology for developing each flagship case report is presented.

2.1 The self-consumption case: Domaine Xavier Muller

As aforementioned, self-consumption is the most common and easiest-to-implement business model for APPR biomass utilization: a single farmer, mobilizing the resource from their own fields, investing in some type of harvesting / pre-treatment equipment and using the collected biomass as fuel for heating their own homes or farms.

The APPR biomass mobilized in such cases is relatively small and rarely goes beyond 50 tons per year. It may also be combined with other types of biomasses found in the market as part of a wider fuel mixture.

In any case, the decision to initiate the value chain depends on external factors, such as the fuel prices, but ultimately depends on the vision of a single person, who is responsible for the organization of all logistics arrangements. Such solitary visionaries often operate in environments where there are limited or no chances of support. Therefore, they have to make clever use of technologies and be always in search of for opportunities to adjust or modify their arrangements.

The Domaine Xavier Muller in France was chosen as a representative flagship case for this type of business model. It is particularly interesting, since its logistics arrangement can also include a mobile pelletizer unit, along with the more conventional chipper. Along the years, it has also evolved to include not only vineyard prunings, but also uprooted vineyard plants. Hence, it is a good example for changing focus depending on the seasonal availability of biomass resources.

Preliminary information for this value chain was already collected and recorded in Deliverable D5.1 of EuroPruning project (SLU et al., 2016); an update based on interviews with the initiator of the value chain, Mr. Xavier Muller, was performed by the uP_running project partner SCDF.

2.2 The public / private partnership case: Vineyards4heat

Due to the little-known opportunities for APPR biomass utilization, initiatives with this kind of resource can often be seen as quite risky from the point of view of private entrepreneurs. Since farmers usually have other means of disposing the APPR biomass and often no knowledge of the possibilities of APPR utilization, this creates a bottleneck for further development.

In such cases, public institutions can become a catalyst for the development of “unconventional” initiatives based on APPR biomass. These entities can assume a higher degree of technical and financial risk than private actors. Moreover, they can create significant centers of consumption of APPR biomass, e.g., for heating of public buildings, and thus a “pull market”. Finally, they can act as the bridging entity that brings together the other market actors that can be involved.

The Vineyards4heat initiative is a well-known example of such an arrangement and for this reason it was considered as an uP_running flagship case. It was initiated by the municipality of Vilafranca del Penedés in Spain, which formulated a Sustainable Energy Action Plan for the Covenant of Mayors for Climate & Energy. The Action Plan was based on the utilization of an abundant local resource, vineyard prunings. With the financial support of a LIFE+ project, the municipal authority implemented a district heating system operating on APPR biomass and brought on board several local actors: a farmer association (biomass providers), a social cooperative managing most of the logistics operations and a winery which also uses part of the biomass collected.

Preliminary information for this value chain was already collected and recorded in Deliverable D5.1 of EuroPruning project (SLU et al., 2016); information is also available through reports from the LIFE+ project that has supported this initiative (www.vineyards4heat.eu/). Further data has been collected by the uP_running project partner CIRCE through interviews with actors involved in the value chain.

2.3 The agro-industrial heating case: ITC Shabo

APPR biomass is found in rural areas, where large, industrial centers of energy consumption are infrequent. There is an exception to this rule: agro-industries which produce food, feed, fibers or other materials from raw materials coming from agriculture. Several such agro-industries operate with fruits coming from permanent plantations and thus form operative, “organic” pairs with farmers growing such species: olive oil mills & olive trees, wineries & vineyards, juice factories & citrus / apple / other trees, fruit canneries & peach / apricot trees, nut crushing plant & almond trees.

Agro-industries, depending on their type and technology, require energy inputs of different types. Especially in the case when heat production is required, APPR biomass can be utilized and assist agro-industries to reduce their energy costs by substituting more expensive fossil fuels. At the same time, agro-industries improve their environmental image and close the loop with the agricultural sector by using both the primary product and the residue as inputs.

ITC Shabo is a winery in southern Ukraine that has worked towards this direction and is currently using vineyard prunings as fuel for steam production within its facilities. It is the first such known example in Ukraine and an excellent representative of the business model where an agro-industry takes the lead. For these reasons, it was selected as an uP_running flagship case.

ITC Shabo is one of the new APPR value chains reported by the uP_running project. Information has been compiled by project partner SECB in a series of interviews with company representatives.

2.4 The large-scale biomass upgrade case: Pelets de la Mancha

Pellets are compressed, cylindrical particles of standard dimensions which can be made from various types of biomasses or other materials. Since they have a higher energy density than chipped biomass, they can be transported over longer distances more economically. Additionally, their standardized dimensions allow them to be fed without issues in various boilers. Overall, the production of pellets from a type of biomass can assist in the expansion of its market, both in terms of geographical coverage and in terms of number of end-users. For these reasons, pellet production from APPR is often seen as a way to expand the APPR biomass market.

On the other hand, pelletization is an energy intensive process which increases the cost of the biomass to the final end-user. Moreover, APPR biomass pellets have to compete with other types of biomass fuels, including forest wood pellets, which usually exhibit better fuel properties, e.g. lower ash content.

Pelets de la Mancha (Athisa Group) is the largest known producer of pellets from APPR biomass, in their case vineyard prunings. The large scope of this initiative – along with its very interesting history and constant business re-focus – were key factors in selecting it as an uP_running flagship case.

The business model and technologies adopted by Pelets de la Mancha had to be constantly reformulated in order to balance between the company's suppliers (the farmers) and customers (energy end-users). On the one hand, a large number of farmers were convinced to get on-board this initiative as raw biomass providers; however, they have opted for simpler biomass extraction systems which affect the collected biomass fuel quality. This created the need for Pelets de la Mancha to invest in specific cleaning and pre-treatment equipment. On the other hand, it has proven more difficult to meet the requirements of small-scale biomass consumers and the current trends of the biomass pellets market; a shift towards larger scale consumers and other tradeable forms of biomass, e.g., chips, was followed.

Despite this change of focus, Pelets de la Mancha still operates in the pellet market and the lessons learned from its experience can be useful to all entrepreneurs interested to embark on a similar path. Moreover, the exploration of several niche markets for their APPR pellets (from horse bedding to “gourmet” pellets for barbeques and cooking) are characteristic of a general trend in the biomass market, from fuel to bio-commodities production.

Preliminary information for this value chain was already collected and recorded in EuroPruning Deliverable D5.1 (SLU et al., 2016); an update based on interviews with contact persons from Pelets de la Mancha (Athisa Group) has been performed by uP_running project partner CIRCE.

2.5 The electricity production case: Fiusis power plant

The electricity production from biomass is usually supported in EU countries through feed-in tariffs, feed-in premiums or green certificates; electricity can be sold to the grid, hence the market for the final product in secure. In areas with extended permanent crop areas, power production is often proposed as a solution for APPR biomass utilization, either through their combustion in newly built units or by extending the fuel sourcing of existing units to APPR biomass.

Two cases for large-scale power production from APPR biomass in Spain have been recorded in the Observatory; the volume of APPR mobilized is very high (93,500 t/y for the power plants of the Oleícola EL TEJAR, 84,000 t/y for the powers plants of Valoriza Energia). However, APPR is not the only fuel source in these cases; it is co-fired along with olive pomace.

For the uP_running flagships, a smaller example of APPR utilization in the power sector was chosen: the case of the Fiusis power plant, located in Puglia, Italy. It is considered the first plant of its kind to use exclusively APPR biomass (olive tree prunings) as a fuel source. Its smaller size compared to the aforementioned Spanish cases[1] makes it easier to replicate in other areas.

Fiusis is one of the new APPR value chains reported by the uP_running project. Information has been compiled by project partners CERTH and UFG in a series of interviews with the plant owner.

[1] We note that one of the two Spanish cases (Oleícola EL TEJAR and Valoriza Energia) shall be considered as a possible flagship in the second such report to be produced by the project (Deliverable D6.4), since in their case a combined utilization of residues generated from the olive oil production process (prunings and pomace) takes place.

2.6 Outline of the flagship reports

Each of the five flagship cases described briefly above is presented in greater detail in a specific annex to this document (the "flagship reports"). In order to have a streamlined and comparable presentation of the flagship cases, a standardized structure for the reports was used. The main contents of each section are presented below.

Introduction

The first, introductory section presents a short overview of the flagship value chain and a map showing its location in Europe. The main reasons for its consideration as a flagship by the uP_running project are summarized. A standardized table (Table 2) is used to provide some basic information for the value chain, giving some ideas for its size and impact.

Table 2. Explanation of the "flagship case at a glance" table.

Parameter	Explanation
Location	Municipality and country where the flagship is based.
Type of APPR involved	Prunings, plantation removal or both
Crop species used	Olives, vineyards, etc.
Year of initiation	Year when the production line based on APPR biomass started operation
Volume of APPR mobilized	Primary volume of APPR biomass used for the value chain. Not equivalent with the quantity of final marketable biomass products in the case of pellet production.
Surface area with permanent crops mobilized	Area (in hectares) from which the flagship case can source biomass. Along with the previous value, gives an indication of the average field biomass productivity.
Maximum radius of operation	Maximum distance between fields that produce APPR biomass and energy conversion / upgrade site
Main product	Usually heat, electricity or biomass to market, e.g. pellets or chips
CO_2 emissions avoided (tonnes per year)	Usually calculated according to the Staff Working Document SWD(2014) 259, using an appropriate fossil fuel comparator depending on the final product (heat or electricity); the emissions related to the value chain are not considered
Number of jobs created	Total number of jobs created for the value chain
Total level of investment	Considers harvesters, logistics components, energy conversion equipment, etc.

Business model

An APPR biomass value chain is built around a specific business model. For a business model to operate smoothly, two requirements should be met.

The first requirement is organizational: each actor involved should have a clear role and responsibility in the value chain. The extend of its involvement can vary depending on the case: for example, in some models farmers have no role other than providing the raw material on which the case is built, in others farmers undertake actions in the logistic arrangements, such as harvesting and transport of biomass. The organizational aspect of the business model for each flagship case is presented in graph form (Figure 1); this provides to reader a clear and easy to understand picture of the overall arrangements.

The second requirement is that each participant in a value chain should have a clear benefit from its involvement. If this is not the case, then there is no motivation to participate. This section of the report presents the benefits to the actors participating in a simple table form. Two types of benefits are outlined: tangible, which can be quantified with specific indicators (e.g., time, money, etc.) and intangible benefits, which are qualitative and/or difficult to measure accurately (e.g., reduced risk of fire, "greener" image, etc.).

The number of jobs created through the value chain is also reported in this section.

History / reasons for initiating

APPR biomass value chains started as an idea and gradually evolved to reach their current status. This section of the flagship report looks into the history of each case. The reasons for initiating the value chain are presented and a short overview of their development is given.

Availability, harvesting and logistics of APPR biomass

Any APPR value chain starts from the field and the biomass generated there. Biomass productivity and harvesting methods used are critical for the overall economics of the value chain; the harvesting techniques employed also have a direct impact on fuel quality and its potential end-uses. The actual steps needed for getting biomass out of the field is often one of the first questions asked when one starts thinking about APPR value chains; therefore, this section provides an in-depth view of these characteristics of the successful flagship cases: typical biomass productivity in t/ha, measures to reduce the moisture content of APPR biomass, harvesting methods and equipment used, storage and transport arrangements.

Soil management and agronomic practices

The management of APPR biomass generated from a permanent crop plantation is an issue faced by farmers. The typical practice for prunings is open-field burning; on-field mulching and incorporation in the soil is employed in several cases.

Despite this fact, the removal of APPR biomass for energetic utilization has been associated with concerns regarding the depletion of organic carbon from the soil and removal of nutrients. The issue is a quite complicated one; the uP_running project is developing some simplified guidelines in order to assess the impact of APPR removal on soil quality.

In this section of the flagship report, the views of the actors involved in the value chain regarding soil management are presented. Moreover, the removal of APPR biomass for energy production is compared with the typical agronomic practices of the area and possible impacts are discussed.

End use of APPR biomass

APPR biomass is quite versatile and can be used as a fuel for different process and at different scales. Heat production can take place at small-scale, domestic boilers or in medium / large scale systems for district or industrial heating. It can be upgraded to tradable forms, such as pellets or chips, and marketed. Or it can be used for power production in units of sufficient size. This section of the flagship report provides an overview of the conversion technologies adopted in each flagship case. Information about the final fuel properties of APPR biomass can be found along with some technical characteristics of the conversion systems, e.g. efficiencies.

Success factors and obstacles

The uP_running flagship cases managed to come to full operation due to several factors that contributed to their success. In all cases, obstacles had to be overcome through the combined efforts of the stakeholders involved. This section of the report gives an overview of both, which can be of great use to new initiators of APPR value chains.

Lessons learned

From the detailed analysis of each flagship case, some valuable lessons can be "distilled". Again, this can be of immense value to initiators who wish to embark on a similar path. The lessons learned are presented in their specific section of the report.

Future prospective

Value chains are rarely static endeavors; they tend to evolve based on the vision of their participants and are influenced by the market conditions. Within the years, a value chain may change focus to other types of resources, consider upgrades in the logistics arrangements or expand to cover new markets and new products. This section of the flagship reports presents the plans for the future of each value chain, as expressed by their main stakeholders.

Contact information

The contact details for the prime mover of the value chain are presented in this section.

3 General Remarks and Lessons from the uP_running Flagship Cases

The five uP_running flagship cases have been intentionally selected to be quite different from each other. The business models employed, level of investment required, logistics arrangements implemented, end-uses targeted and success factors, obstacles and lessons learned vary widely and can be understood from the study of each individual report. By comparing the cases, some general remarks can be made however, which can be of value to initiators of new cases.

APPR value chains can be versatile

One clear feature for the comparison of the flagship cases is that APPR biomass value chains are very versatile and can be deployed in a variety of ways in order to meet local conditions and demands. APPR biomass can be used directly for energy production (heat, electricity) in appropriate conversion sites or used to produce upgraded energy carriers (pellets, chips) for the market. It can even be used to produce bio-commodities for other markets (e.g., pellets for horse bedding). The role and level of involvement of different stakeholders is also quite varied. The key lesson is that there is not a "one-size-fits-all" model for such value chains: initiators and participants should choose carefully from a variety of options, while also considering local conditions and limitations, opportunities and market developments.

Low biomass productivity is not necessarily an obstacle but has to be considered

Biomass productivity is indeed a major factor in the overall economics of an APPR biomass value chain and can have a significant impact on its design. However, a low biomass productivity in an area is not necessarily a limiting factor. Out of the five flagship cases investigated, four operate with vineyard prunings as a feedstock despite the fact that the pruning biomass productivity from vineyards is lower than olive trees or many other tree types. It is worth noting though that in those cases, the main use of APPR biomass was to replace fossil fuels for heating applications; as long as biomass fuels are sourced cheaper than fossil ones, then these schemes can demonstrate – at least theoretically – concrete savings. In the Fiusis case, the economics were more restrained by the level of the feed-in tariff; a high biomass productivity was more critical in this case in order to keep costs low and reduce the payback time. Overall, the APPR biomass productivity should definitely be considered but a low value is not prohibitive for many applications.

APPR value chains are mostly local

Most biomass value chains tend to be quite local in order to avoid high transportation costs. A typical rule-of-thumb is that distance from the point of production till the conversion site should be less than 50 - 80 km. The APPR flagship cases investigated in this report operate in an even smaller scale. For the self-consumption case of Domaine Xavier Muller, the radius of operation is only a few kilometers and for three other cases (Vineyards4heat, ITC Shabo, Fiusis) it has a maximum range of 10 – 15 km. Only in the Pelets de la Mancha case does the biomass sourcing extend to a wider area of 30 km; due to the higher energy density of the pellets produced, the final destination does not have the same limitations.

Surely, the relatively small size of the APPR value chains makes it sensible and meaningless to avoid sourcing over long distances. This means that such initiatives – at least for the time being – have a local character. Thus, the involvement of local actors is necessary.

APPR value chains create jobs and promote rural development

Due to their operation at a local level, APPR value chains should ensure the collaboration of local actors as well as the support of the local public. In order to achieve this, they should demonstrate clear benefits for the area. And, indeed, the flagship cases presented in this report can deliver this. With the exception of the self-consumption case, the other four cases investigated have led to the creation of a number of new jobs. It is important to note that many of those are permanent ones, a significant feature in rural areas, where several jobs related to the agricultural sector are seasonal. Moreover, by avoiding polluting practices such as the open-field burning of prunings, quality of life increases. Additional, tangible or intangible benefits can also arise depending on the case. The Vineyards4heat one for example resulted in reduced municipal taxes for the residents of Vilafranca del Penedés. A "greener", more sustainable image of the community and of the enterprises involved in the value chain emerges. Thus, the utilization of APPR biomass is in-line with the European goal and vision for rural development.

APPR value chains are constantly developing

The flagship cases investigated are all fairly "young" value chains; the ones initiated the longer time ago (Domaine Xavier Muller, Pelets de la Mancha, Fiusis) have less than a decade of operation. This in itself is an indication that full maturity has not been reached. Yet, it is interesting to note that none of the flagship cases investigated stayed static since its inception nor have plans for its further development stopped. Adapting to changing local and market conditions means that the stakeholders behind the value chains often have to rethink and modify their approach. In some cases it means expanding the types of biomass sourced (Domaine Xavier Muller) or expand the area of sourcing (ITC Shabo, Vineyards4heat). The logistics operation are also evolving to include new harvesters and pre-treatment steps (Domain Xavier Muller, ITC Shabo) or adapt the business model to make them more profitable (Fiusis). New products for the energy (Pelets de la Mancha) or other, niche markets (Pelets de la Mancha, Fiusis) have been produced or are under consideration. These adaptations might seem daunting at first, but usually they emerge quite naturally as the participants gain in experience. And since the initiators of the flagship cases have already demonstrated a great sense of initiative and innovation, they are well suited to meet these challenges.

Skeptical thinking is a typical starting reaction in all cases

Through the discussions with the prime movers and value chain actors consulted for each case, it has arisen that the prime movers have a vision which runs contrary to the general thoughts and established practices of other farmers or companies. Most local actors tend to assume that the new APPR value chain will fail. It is evident that most people do not know of existing cases; for them, general skepticism is a first reaction to a new business on something that is considered as a full novelty. However, as shown in Pelets de la Mancha and Fiusis cases, once the initiative starts, and the first batches of APPR biomass are mobilized and the benefits to farmers, intermediaries and final consumers become known, others early adopters join. Soon, they are followed en masse by the remaining targeted actors. Therefore, a snowball effect is caused once the value chain is demonstrated in practice.

Utilization of APPR biomass starts from a change in the agronomic practices and farmer attitudes

The management of the APPR woody residues is part of the agronomic practices performed by farmers. Each farmer chooses the option that better fits to its personal case. Starting new APPR biomass value chains cannot happen without the collaboration of farmers who should change their usual practices. This is one of the primary barriers to overcome before mobilization of the APPR biomass can become a reality. The demonstration of the feasibility of the new agronomics in practice, and the clear illustration of the benefits is crucial. Moreover, the mode of collaboration and business transactions between the farmer and the actor to whom the biomass has to be transferred further down the value has to be agreed: given for free, sold for a price, or service paid. Pelets de la Mancha and Fiusis cases show that, in order to make possible a large mobilization of biomass and meet the requirements of all farmers involved, different value chain models have to be organized. In this way, farmers and companies find the most suitable solutions to make the supply chain feasible, and to bring tangible or intangible benefits to all actors.

4 CONCLUSIONS

The utilization rate of APPR biomass is still very low in Europe; however, 18 actual value chains have been already identified so far and reported in the uP_running Observatory web-tool (www.up-running-observatory.eu). 5 of these value chains were marked as "flagship" cases by the uP_running project; a flagship case is considered as a good model to imitate when an actor or group of actors wish to initiate their own APPR biomass value chain.

The flagship cases have been selected so as to be representatives of different business models, end-uses of APPR biomass and sizes of the value chain. The models considered in this report were the following: a) self-consumption for domestic heating (Domaine Xavier Muller), b) integration of public / private actors in a value chain (Vineyards4heat), c) industrial heating in agro-industries (ITC Shabo), d) large-scale pellet production (Pelets de la Mancha) and e) power production (Fiusis power plant).

The comparison of the flagship cases suggests that there is no single model to adopt in order to promote the energetic utilization of APPR biomass: the selection depends on local conditions, the presence and the willingness of local actors, the ability to mobilize finance, external factors and opportunities and other parameters. In all cases, it is crucial to agree on a business model in which every participant has a benefit; farmers, as suppliers of APPR biomass, should clear understand these benefits in order to get on board. A careful consideration of the final end-use and its requirements should also be taken into account in order to properly design the logistics chain and implement the appropriate technical measures.

More specific lessons for each case can be learnt by studying the flagship reports, which are included as annexes to this deliverable. In November 2018, an additional report including at least more five flagship cases will be released by the uP_running project, bringing even more information and useful experiences to light.

5 REFERENCES

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6 ACKNOWLEDGEMENTS

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Flagship case	Person	Position / Department
Domaine Xavier Muller	Mr. Xavier Muller	Owner
Vineyards4heat	Mr. Jordi Cuyàs Soler	Coordinator of Strategic Projects / Vilafranca del Penedés City Council
Pelets de la Mancha (Athisa Group)	Mr. Jose Antonio Huertas	Project Management Director
Fiusis	Mr. Marcello Piccinni	Owner & Plant Manager

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ANNEXES

Annex list	**Title**
Annex I:	Domaine Xavier Muller flagship report
Annex II:	Vineyards4heat flagship report
Annex III:	ITC Shabo flagship report
Annex IV:	Pelets de la Mancha (Athisa Group) flagship report
Annex V:	Fiusis flagship report

D6.3: Flagship success cases update v1
Annex I: Domaine Xavier Muller flagship report

uP_running

Take-off for sustainable supply of woody biomass from agrarian pruning and plantation removal

Grant agreement: 691748

Prepared by: SCDF, CIRCE & CERTH

Date: 20.10.2017

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Introduction

Mr Xavier Muller is farmer and winery owner of Domaine Xavier Muller in Alsace, France. Mr. Muller has been collecting the prunings from his own vineyards already for 7 years (from 2010 onwards). He has used the pruning as energy source, both as pellets, or as shredded wood. Mr Muller started recently the use of up-rooted vine stocks from his farm and from neighbouring fields, showing to be a good alternative to pruning wood.

The initiative of Mr. Muller is considered as an uP_running flagship success case since it reflects the story of singular and local pioneers that can be the seed of real changes. Pioneers like Mr. Muller usually start alone, motivated from their different vision and from the thought that an alternative use of APPR biomass is possible. These pioneers have to face an environment where there is usually no chances of support, neither for scoping their new activity/business, nor as personal assistance. Therefore their stories, not always coming to fruition, usually gather some key elements. Firstly the strong convincement and perseverance of the pioneer. But also clever moves to align the vision of other companies or farmers, performing technical or social innovations, synergizing with other local companies and farmers or adapting to errors after each trial. These persons become a referential point in their neighbourhood to drive changes. Mr. Muller represent the spirit of this prime moving.

This success case represents one of the straightforward models to implement APPR value chains: self-consumption by single farmers. Compared to other flagship cases, the investment required in terms of harvesting, pre-treatment and conversion equipment is lower in absolute amounts. But in comparison to other cases of self-consumption, the Domaine Xavier Muller case illustrates the adaptation, along several years, from the original idea of a pioneer, to a more reliable final solution, where the innovation and the appropriate selection of technologies (multi-fuel boilers, mobile pelletizers, adequate chippers) is a cornerstone. The path experienced by Mr. Muller is of unique value to make other potential entrepreneurs understand some key elements when scoping their new activity. It also depicts the relevance of alliances, and the difficulties to drive changes in rural areas towards a new management of APPR residues.

Domaine Xavier Muller

Figure 1. Location of Domaine Xavier Muller (left) and logo of the winery (right).

Table 1. The Domaine Xavier Muller flagship case at a glance.

Domaine Xavier Muller at a glance	
Location	Marlenheim, France
Type of APPR involved	Prunings Recently vine stocks
Crop species used	Vineyards
Year of initiation	2010 (pruning), 2016 (vine stocks)
Volume of APPR mobilized	12 t/y
Surface area with permanent crops mobilized (ha)	8 ha (out of a total of 25 ha of the Domaine Xavier Muller) / other neighbouring fields
Maximum radius of operation	Less than 2 -3 km
Main product	Energy for self-consumption (heat)
CO_2 emissions avoided[1]	13 tCO_{2eq} per year
Number of jobs created	N/A
Total level of investment	25,000 € for the CAEB pruning round baler 35,000 € for the Heizohack HM8 400 static chipper 17,700 € for the POWERCHIP 50 GUNTAMATIC boiler

Business model

The mobilization of APPR biomass performed by Xavier Muller has changed during time, developing several options for the biomass procurement. Thus, even if the self-consumption scheme is fairly simple, several alternatives and technologies are currently under operation.

The business model of Domaine Xavier Muller has two versions: one for the collection of pruning (the first one developed by Mr. Muller) and a second one for vine stocks (including roots) (developed gradually the last 2 years to become the only resource used in 2017). In case of the pruning, Mr. Muller performs the harvesting in his own fields, and bales the biomass, but only from the hectares required to cover the heating needs of his facilities. The machinery owned is a CAEB Quickpower which produces round bales of 40 cm diameter, and 60 cm width (average weight 25 to 35 kg). Mr. Muller currently utilizes the machinery in his own fields. To make the business profitable, he may rent the machinery to neighbouring farmers willing to harvest their own biomass. This model has not still been extended. Indeed, even if local farmers are really interested in developing similar business models, the lack of local support slows down initiatives.

[1] For the estimation of the CO_2 emissions avoided in the Xavier Muller case, the following assumptions are made:

- The vineyard pruning pellet consumption is 12 t/y. The average moisture content during combustion is 15%, with a typical LHV of 15.8 MJ/kg.
- No GHG emissions for the operation of the logistics chain are considered.
- The boiler efficiency is considered equal to 85% (heat production).
- CO_2 Savings are calculated using the Fossil Fuel Comparator for heat production found in Staff Working Document SWD (2014) 259, which is equal to 80 gCO_{2eq}/MJ.

The biomass bales have to be processed to a particle size compatible with the boiler installed at Domaine Muller facilities. This boiler, one of the keys for success for this case, is a multi-fuel one, able to work with woodchips, irregular wood pieces, and as well with non-conventional pellets. The initial approach of Mr. Muller was to go for a processing of the prunings into pellets. Mr. Muller found a synergy and offered his collaboration with another innovative company located in Alsace, H-energy. This company has produced a mobile pelletizing truck which was awarded with the first prize of the Lepine contest Association of French Inventors and Manufacturers on 2015. It is interesting to note that Mr. Muller has shares in this company, so the pelletization service is offered free of charge. A second alternative for the use of pruning wood, has been the direct use of the comminuted bales. Depending on the availability of the pelleting unit and the type of APPR biomass treated (prunings or stocks), Mr. Muller also has the technical capacity to produce chips in his own static chipper. In this case, he has complete control over all steps of the value chain. Figure 2 depicts the overall organization of the value chain; the detailed operations are presented in Figure 7 and Figure 8 further below.

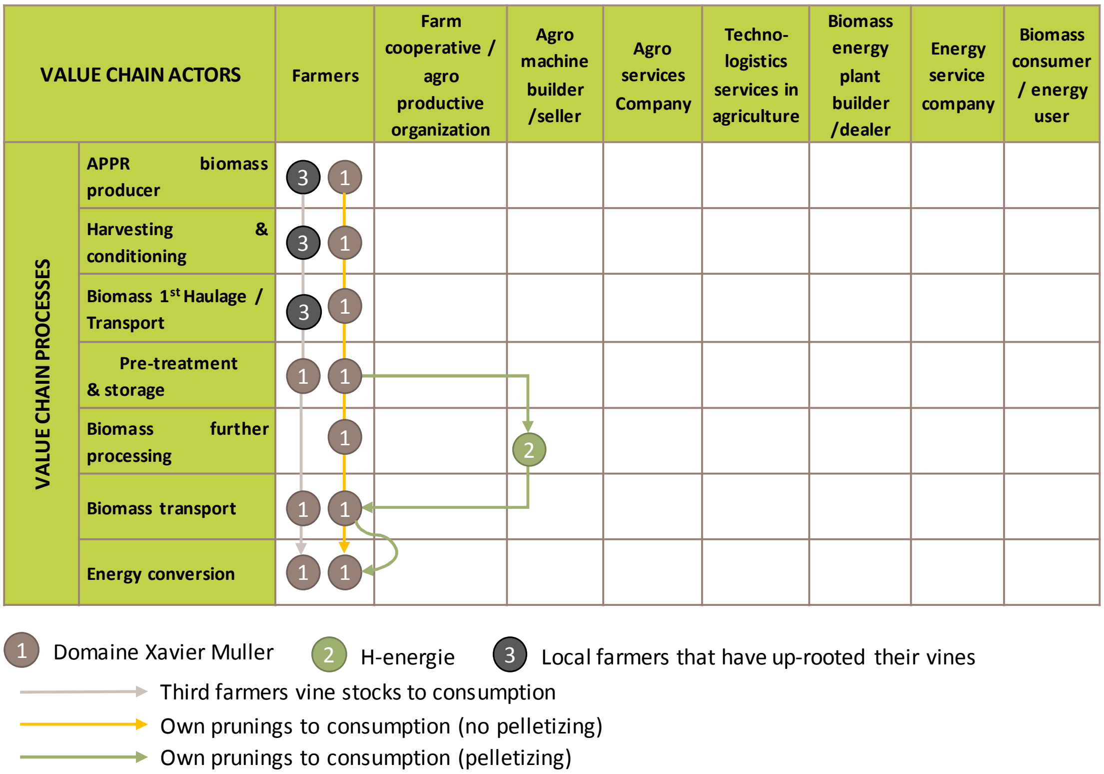

Figure 2. Role of actors in the Domaine Xavier Muller case: pruning wood (column placed at right side) and vine stock wood (column at the left side).

The business model based on vine stocks up-rooted started recently, 2 years ago. Mr. Muller owns a Heizohack chipper able to process vine stocks. He offers local farmers to bring him the material for free, and he treats and accumulates (as shredded wood or as pellets). In this case, neighbouring farmers save money and time in the management of their residues. Vine stocks (with roots) are air dried during 1 year.

In any of both cases, either wood from pruning, or from vine stocks, Mr. Muller does not produce currently biomass for marketing or for other local consumers. But in case that the local biomass market takes-off, he is positioned for an incipient delivery of APPR biomass to local consumers, or to participate by leasing his machinery to complete the investment amortisation.

Table 2. Benefits for the actors participating in the Domaine Xavier Muller case.

Value Chain Actor	Tangible benefits	Intangible benefits
Farmer (Xavier Muller)	Saves time and money in pruning management Saves money in fossil fuels Gets free pelleting service	Avoids vine diseases "Greener" image of his high quality wine business Acknowledgement and prestige Open opportunities for small business on biomass procurement (machinery renting)
Agro-machine builder (H-Energie)	Providing pelleting service (for this case, only to Mr. Muller)	Testing of prototype machine with other types of materials Gains a position locally for providing future services
Third farmers in the area	Reduce the costs for pruning management or vine stock disposal	Getting a better public image Being part of a new trend Reducing risk of disease propagation

History / Reasons for initiating

Mr. Muller owns a 25 ha vineyard in Alsace, in Marlenheim, producing wine and crémants (sparkling wine) from different vine species. Although used to bring prunings out of the fields because of diseases, Mr. Muller was convinced that it would be wise if such agricultural residues could be used for energy production.

Some years ago, he decided to work with H-Energy, which was developing a Pelletizing Mobile Unit in the area. This truck was able to pelletize biomass directly on the field and received the most prestigious prize in the Lépine national awards 2015 (organized by the French society of Inventors and Manufacturers). Xavier Muller took the opportunity and decided to join this project, acting as a beta tester of this mobile unit.

He is now producing around 12 tons of pruning woodchips or vine pruning pellets per year (depending of the year) for his own consumption. For the moment, he just produces the quantity needed and does not want to develop any market but can think about it in next years, depending on the local market development and local support to develop the sector.

Availability, harvesting and logistics of APPR biomass

Xavier Muller is collecting 30 % of its vineyard (around 8 ha) of pruning on his 25 ha scattered fields vineyard, using this resource as energy source for its own boilers. He is also using vine stocks from his own farm and from neighbouring winemakers. Age of the vine is quite variable, depending on the field, from 4 to 35 years with a density of 5,000 trees /ha. The form of vine is guyot (espalier) simple or double, depending on the field, without any irrigation. Several local grape variety are planted: pinot noir, pinot gris, riesling, muscat, etc.

Figure 3. Crop form of vines growing on the Domaine Xavier Muller fields.

The production of pruning is annual, and is performed mainly manually in winter and can last till end of March. The only mechanical operation consists in a mechanical pre-pruning for the upper vine shoots (topping).

After one month on the soil, Mr. Muller collects the pruning residues left on the plantation soil with his own integrated windrowing – harvest – baling machine (CAEB Quickpower). The bales are collected on the field using a tractor with fork and then loaded manually on a trailer to be transported till the storage place. The CAEB machine is normally able to directly collect the bales but this equipment is too heavy for the hillside and thus not used by Mr. Muller. 2 people load the wood of 1 ha in 1 hour. A 25,000 € investment was realized to buy the round baler, which is able to produce between 40 and 60 bales of 25 kg each per hectare. Thus, the biomass productivity is 1 to 1.5 t/ha of prunings, depending on the vine vigour. The choice of this equipment was done as the vineyard is a sloping vineyard, which was not compatible with other solutions available in the market, like integrated machineries collecting the pruning, shredding it and storing on portable big bags. Moreover, the loses of material through fermentation are lower when the material is baled and then left to dry for several months under cover as compared to storing shredded moist wood pieces obtained when using directly an integrated harvester and shredder. The baler from CAEB was, according to Mr. Muller, the most efficient one available for this type of process.

Figure 4. CAEB Quickpower for baling pruning wood (Source: CAEB).

Figure 5. Left: Windrowing of vineyard prunings. Right: pruning bales on the field (Source: EuroPruning).

Mr. Muller is collecting 12 tons of pruning yearly. These tons sink their moisture content down to 15 %. To achieve such low moisture content Mr. Muller follows next strategy: firstly to leave the pruning one month on the soil after the annual pruning, and then, by storing the bales under cover for several months. So, the biomass collected in one winter is actually used in the boiler during the next one.

Bales are transported with on a trailer towed by a tractor. Then, the bales are placed in a storage place, 1 km from house and some few kilometres from the fields. This place is a paved closed bay.

Once a year, the pruning wood is treated. When available, the mobile pelletizing truck of the H-Energy company (see Figure 6) is brought to the storage place to transform the bales into pellets. Pellets are stored in 500 kg big bags. Xavier Muller do not pay for this service of the mobile unit truck for the moment as he is member of the company. Finally, pellets are transported with the tractor or a simple van in big bags till the boiler site (1km).

Figure 6: Production of pruning wood pellets. Up: mobile truck unit developed by H-Energy (Source: www.h-energie.fr). Down: vineyard pruning pellets obtained by the mobile pelleting unit (Source: bfmtv.com broadcast on YouTube).

An alternative process consists in shredding the wood. A first shredder UNTHA RS 30 was bought, with an investment of 6,000 €; however, it turned out to be quite slow in processing the pruning wood. A more efficient, new chipper from Heizohack was recently bought. The purchase of this device amounted to a 35,000 € investment, and is able to treat 30 m^3 of wood in 3 or 4 hours when coupled with a 90 CV tractor. Mr. Muller's boiler (Guntamatik Powerchip) is able to burn either wood chips or pellets, and thus has allowed Mr. Muller to adapt the operations performed to produce his own fuel, and does not fully depend on the availability of the mobile unit truck. As well the new chipper is suitable for chipping not only pruning bales, but also vine stocks, and thus allows Mr. Muller to base on any of both fuels.

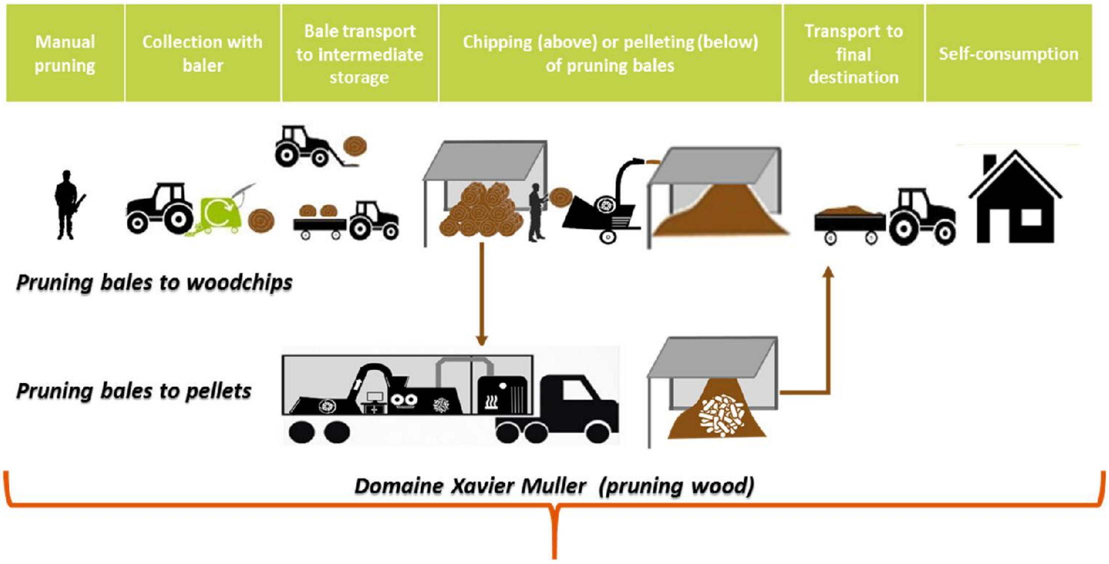

Figure 7. Logistics operations for the Domaine Xavier Muller case (pruning wood).

Nevertheless, gradually a new form of use for APPR biomass has being started by Mr. Muller. Every year, neighbouring farmers terminate the cultivation of some hectares of vines. Mr. Muller offered to get the vines and thus, the other farmers were released from the expenses of managing the residue. Third farmers are organising field management (uprooting vine stocks) and deliver for free the wood on a trailer till Xavier Muller storage place. Mr Muller is also using its own vine stocks.

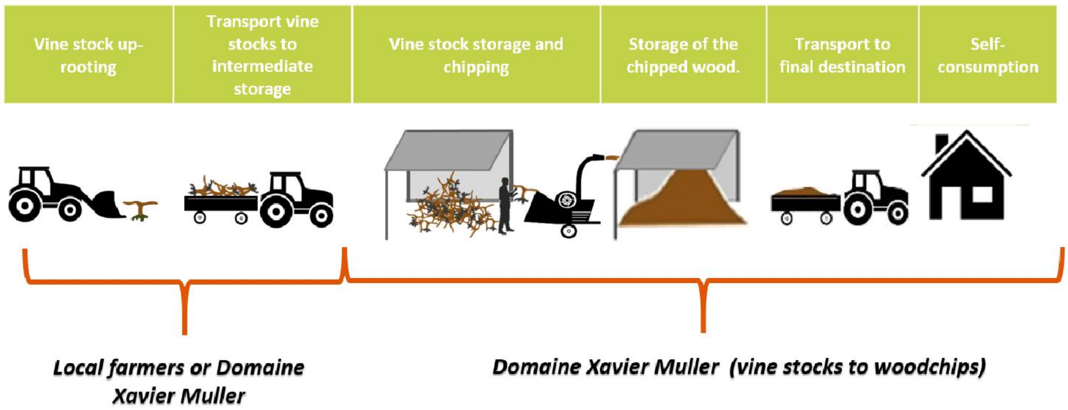

Figure 8. Logistics operations for the Domaine Xavier Muller case (vine stock wood).

Mr. Mullers' initiative has made him to get a unique position as a potential catalyser of agronomic changes in the management of APPR residues in his area. He owns the knowledge as well as the technologies needed to produce woodchips from bales and vine stocks. Additionally, he has a good connection with H-Energy. The question is that, at the moment, there is no biomass consumption in the area. Thus, he cannot proceed with plans for renting machineries, providing services, or establishing an alliance with other local actors (farmers, service companies, etc.). Therefore, his investment is not being recovered on the base of new incomes. And the savings in energy obtained by the switch from fossil fuels to APPR biomass, are not enough for an amortization of equipment in short term. Anyway the investment were not done with an aim of short term recovery, but as personal bet in favour of APPR biomass and more sustainable practices. Depending his capacity to promote others to follow his path, the local consumption of biomass could rise, and then his initiative recover sense in terms of economics.

Soil management and agronomic practices

The usual maintenance of the soil cover along the year was grass mower cutting (2 to 3 time per year). The standard practice that Mr. Muller implemented in his field was the removal of vineyard prunings in order to avoid wood diseases. Nevertheless, when prunings are not used for energy, they are shredded and let on the soil to maintain the organic carbon.

According to Mr. Muller, wood decomposition is consuming nitrogen (so fertilizer is generally need) and is propagating diseases. With the pruning extraction, both problems are managed and some natural compost replaced former fertilization process.

End use of APPR biomass

The vineyard pellets produced by the mobile pelletizing machine or the shredder are used by Mr. Muller in his own boiler for heating his house and farm. The boiler is located 1 km away from the storage place and has an outside silo for the storage of the pellets. The 45 kW boiler was manufactured by Guntamatik and is capable of using standard wood pellets, wood chips or straw pellets if required. The typical consumption of pruning pellets is 12 tons per year.

Success factors and obstacles

The value chain developed by Mr. Muller is operating now for several users. This success was made possible due to several factors, which are listed below:

- The determination of the prime mover himself, who managed have to find on his own most of the solutions.
- The management of the pruning/plantation removal is recognised to be expensive. This is a general vision of farmers in the area, and one of the reasons for Mr. Muller to start his initiative.
- The collaboration established between farmers sector and agro-machine builders (Mr. Muller as partner of H-Energy).
- The introduction of new technologies supported the implementation of new chains. More specifically:
    - The multi-fuel biomass boiler, as it allows regular wood, APPR wood and pellets.

  - The baler, as it allows good drying while preserving wood properties.
  - The appropriate choosing of the chipper.
- Finally, some public funds were available for the boiler purchase through FEADER. However, it has to be noted that they covered only a small part of the total investment.

Mr. Muller managed to overcome several barriers to the implementation of his value chain, thanks in great part to his own determination. Nonetheless, the barriers are real limiting factors that other potential initiators can meet; a list of them is presented below:

- No other APPR biomass consumers exist in the area in order to motivate local winemakers to produce fuels for the supply of boilers. That is why major projects are not developing in Alsace region.
- Without human and financial local support, it will be impossible to develop pruning (or more generally agricultural residues) uses, since the initial investment is quite substantial.
- Financial support was only available for the boiler purchase but not for the purchase of additional equipment required, such as shredders and silos.
- Time is a real constraint. Mr. Muller is, before all, a winemaker and his priority is the development of his domain. The same is the case for other wine makers.
- Information about available equipment and their efficiency is usually unknown, and it would be very useful for this kind of project development. Winemakers are locally interested in developing a project but without any local support, no major project is under development, at least for the time being.

Lessons learnt

The Xavier Muller case is very interesting since it shows what a single farmer / owner of an orchard can do to utilize the APPR biomass than is available from his own fields.

Public funds were used only to a limited scale to mobilize this investment; their availability can reduce the payback time and offer incentives, but often projects are mobilized by the personal visions of prime movers.

Another lesson learned is that changing the practices of farmers take time and tailored actions, even if they have seen the results. Therefore, the case teaches that before starting any initiative or investments where local farmers are needed to participate, it is necessary to pave the way before, with specific actions to raise awareness, re-shape the local perceptions, and identify the early adopters with whom it will be needed to build alliances.

The current case, at the present status, could not be driven by economic forces. The investment are not being covered with the annual savings. The 60,000 € investment in harvesting and pre-treatment machinery cannot be paid back with savings from about 8 hectares. Sharing, renting, leasing, or other formulas to reduce the weight of the fixed costs per ton of material finally utilized are needed.

Flexibility also offers advantages in such small-scale projects: the boiler used can switch from pellets to chips, thus adapting easier to what is available depending on technical or other restraints. The ability to switch to other types of APPR biomass - in this case from prunings to stocks - also allowed a greater degree of flexibility, once the advantages of the latter were recognized. In a broader sense, investing in multi-fuel boilers allows end-users to select the most economical and/or readily available biomass type in each heating season.

Future prospective

Even if the initial project focused on the use of prunings, for the moment, Mr. Muller is more likely to favour the use of the uprooted vine stocks as their constraints are less important and the resource is available. The local support for vine wood utilization will be essential for the continuity of his initiative. In such a case the 25,000 € pruning baler shall not be utilized anymore, and the residual value could be recovered from its sale.

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D6.3: Flagship success cases update v1
Annex II: Vineyards4heat flagship report

uP_running

Take-off for sustainable supply of woody biomass from agrarian pruning and plantation removal

Grant agreement: 691748
From April 2016 to June 2019

Prepared by: CIRCE

Date: 20.10.2017

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 691748.

Introduction

The Vineyards Virtuous Cycle (VVC) is an initiative promoted by the municipality of Vilafranca del Penedés (Spain) as a political commitment to set an efficient low carbon economy through the use of an abundant source of biomass in the area, currently underused: prunings from vineyards.

It is considered an uP_running flagship success case since this initiative has created a demand for pruning in the area, boosting a new activity in the local agrarian sector. For this purpose, multiple local public and private actors have been involved to create a new and sustainable value chain guaranteeing the profitability of the energy production from vineyard prunings: farmers, a harvesting service company, an energy service company, several consumers and the municipality.

VINYES XCALOR

AJUNTAMENT VILAFRANCA DEL PENEDÈS

Figure 1. The logo of Vineryards4heat project co-financed by Life Programme and coordinated by the municipality of Vilafranca del Penedés.

Figure 2. Location of Vilafranca del Penedés.

Table 1. The Vineryards4heat flagship case at a glance.

Vineryards4heat at a glance	
Location	Vilafranca del Penedés, Spain
Type of APPR involved	Prunings
Crop species used	Vineyards (in espalier)
Year of initiation	2015
Volume of APPR mobilized (tons per year)	225 t/y on average during the project although the potential can be up to 30,000 t/y in the area
Surface area with permanent crops mobilized	375 ha in total (several scattered fields) (25,000 ha of vineyards in Penedés county)
Maximum radius of operation	< 15 km
Main product	Heat production from APPR
CO_2 emissions avoided[1]	125 t saved in 2016
Number of jobs created	4 (permanent)
Total level of investment	0.6 M€

Business model

The business model involved by the VCC initiative is as follows:

The biomass is provided by around 50 farmers, grouped under the association COVIDES (composed by more than 600 local farmers who represent around 2,200 ha of vineyards).

Current consumers of vineyard prunings are: Cavas Vilarnau winery and the district heating of "La Girada". Concerning the winery, it is part of INNOVI cluster of Catalonian wine industry, a non-profit organization registered as an Innovative Business Association (AEI) and it currently uses part of the APPR biomass to generate thermal energy in its facilities. Other local wineries are expected to follow its example. With respect to the district heating, it has been built to provide heating and hot water to four public buildings (one more is expected to be connected to the network in the near future).

Two companies link the interests of resource providers (at the top of the supply chain) and consumers (at the bottom), making the whole value chain economically feasible, due to a careful planning of the logistics:

- A gardening service social cooperative (NOU VERD), which carries out the operations of biomass harvesting, pre-treatment, transport, storage and final transport to the consumers.
- The Municipal Water Company of Vilafranca (EMAVSA), which acts as an energy service company organising, together with NOU VERD, the whole value chain and managing the operation of the combustion facility in the district heating.

[1] The calculation of CO_2 emissions saved was done by the Vineyards4heat project in 2016.

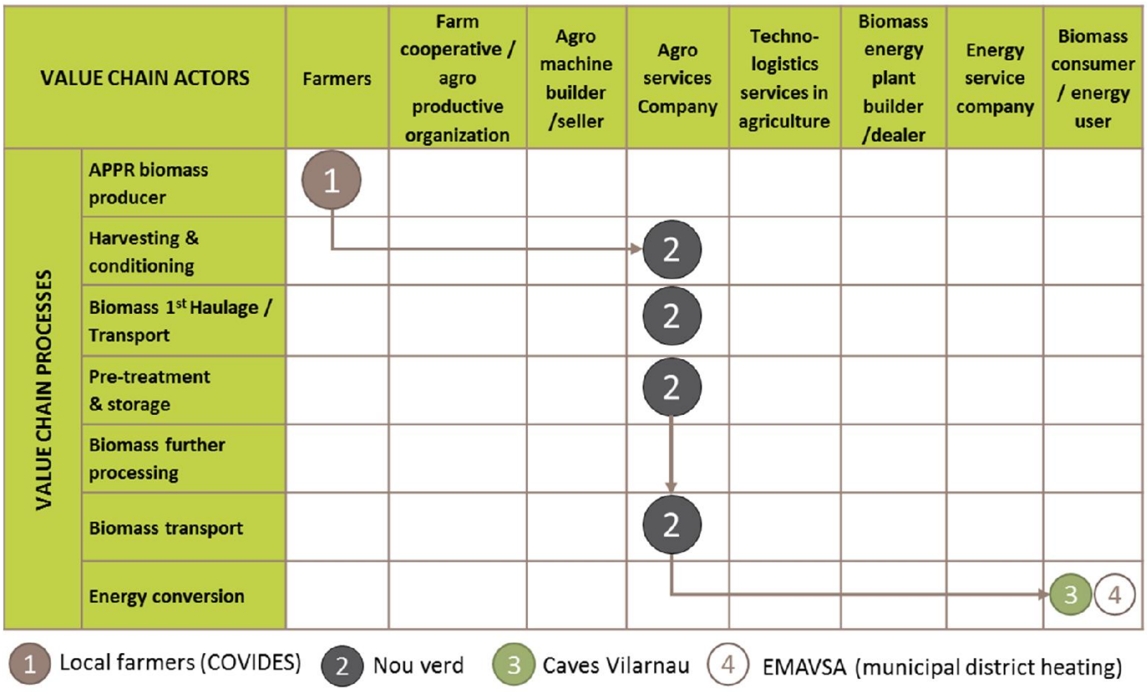

Figure 3. Role of actors involved in the Vineryard4heat case.

Table 2. Benefits for the actors participating in the Vineyards4heat case.

Value Chain Actor	Tangible benefits	Intangible benefits
Farmers	Save time and money in pruning management	Avoid risks of fires and diseases Avoid pollution due to open-field burning of prunings
Social Cooperative (NOU VERD)	Get economic margin Diversify activities	
End user (Cavas Vilarnau)	Lower energy cost	"Greener" image of business
End users (local authorities)	Lower energy cost Reduced municipal taxes	Improved air quality Promote successful utilization case of prunings Job creation

A total of 4 new permanent jobs have been created linked to the logistics operations for the resource.

History / Reasons for initiating

Part of the motivation came from the subscription of the Municipality to the Covenant of Mayors for Climate & Energy (EC initiative) in which several Sustainable Energy Action Plans were promoted.

The rest of the motivation was triggered: (1) by the reality of the pruning residues management, which needed to be improved; (2) by the willingness to increase the competitiveness of the county economy; and (3) following the wine tourism local initiatives in the area, promoting sustainability and a zero km economy as a flag.

Availability, harvesting and logistics of APPR biomass

From the 90's until the present day, the cultivated lands in the Penedés area have undergone improvements and the plantation systems have been adapted in order to allow mechanised harvesting.

Currently the vineyards have been adapted to allow performing the pruning operations with an initial mechanical pre-pruning, followed by a manual pruning to remove the remaining shoots from its base. At the moment the initiative focuses on pruning residues from manual prunings.

The project has also evaluated the idea to use the material from the pre-pruning labours to increase the potential of resources to be collected, a prototype has been developed for this purpose and further improvements are needed to reach commercial state and acceptable economic feasibility. The most important concept of this prototype has been the building of a machinery that once pruned, cuts the branch and push the biomass to the container without touching the soil.

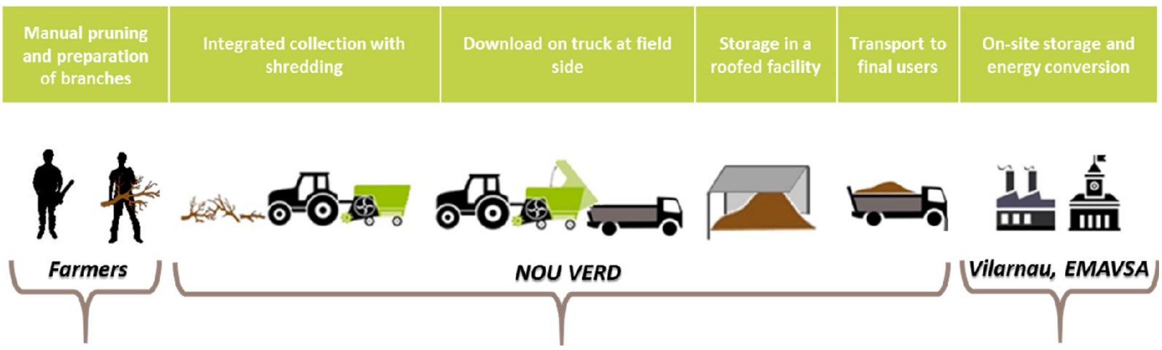

Figure 4: Logistics arrangements for the Vineyards4heat case.

Usually, the prunings are left for a period of around 30 days on the field before harvesting, in order to reduce their moisture content till 30 % (wet basis). The productivity measured during the project development is around 0.5 - 0.7 t/ha although it should be highlighted that the years of the project have been really dry and therefore it is expected that during regular conditions, the potential could rise up to 1 t/ha.

The harvesting is then organized by the gardening service company NOU VERD. The machinery, a Cobra Collina B1400 from the company PERUZZO, consists of a shredder able to perform the pick-up and shredding of the branches. The material is conveyed into an integrated tilting bin. Once the bin is filled, it is able to discharge the material collected directly on agricultural trailers or small open-box trucks (see Figure 5). The prunings from 44-46 farmers, in a radius of less than 15 km, is gathered. The selection of farmers includes not only the distance to the storage point, but also the vineyard species since some of them are more productive and the surface easily available.

Once the bin is full, the hog fuel (not wood chips, but inhomogeneous shredded pieces of wood) is unloaded on a trailer (Figure 6) parked at the field side. Around 0.5 ha are harvested per hour with an approximate consumption of 7 l/h. With this chain, it is estimated that around 1 % of the potential material remains on the field.

The small trucks bring the material to the storage point, which gathers yearly around 1,000 m^3 from November to June, in a roofed and paved area with piles of 100 m^3 (see Figure 7). The distance between the storage point and the current consumers is less than 15 km. The storage, managed by the harvesting company, allows to decrease the moisture content to less than 20 % in around 1.5 months.

The costs per tonne of vineyard pruning wood (accumulated along the whole chain till the consumer) are around 70 €/t at 20 % moisture content (4.72 €/GJ), which enables a selling price competitive with the fossil fuels and other biomasses from forest sources supplied in the area.

Figure 5: Harvesting + pre-treatment process using the Cobra Collina B1400 (Source: Vineyards4heat).

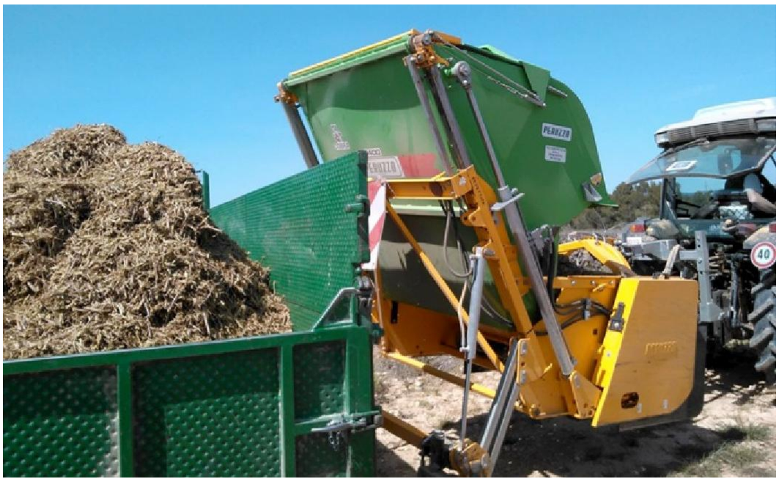

Figure 6: The Cobra Colina (PERUZZO) unloads vineyards pruning chips to a trailer (Source: CIRCE).

Figure 7: The roofed storage facility (Source: Vineyards4heat).

Soil management and agronomic practices

The perception from farmers is that soil sustainability issues are not influenced in a significant way by the use of this resource. A survey made by the cooperative of farmers involved in the project resulted in the fact that 97 % of the farmers involved would like to continue providing their prunings since they save time and money in managing this resource.

End use of APPR biomass

The pruning hog fuel is consumed at an average moisture content of 20 % on wet basis, an ash content of 6 % on dry basis, a low heating value of 14.8 MJ/kg and a particle size distribution classified as G50 (see Figure 8). The low density and irregular shape make the hog fuel required an adaptation of the boilers feeding system: the silo is designed to avoid bridges and the feeding screw is prepared for particles with longer size. Regarding the combustion system, the higher ash content and lower density compared to regular forest wood fuels, was taken into account in the selection of the system and in the operational parameters.

Figure 8: The inhomogeneous biomass (hog fuel) from vineyard prunings consumed at Vilafranca district heating (Source: CIRCE).

The boiler at Cavas Vilarnau (winery sited in Espiells, about 15 km distance from Vilafranca del Penedés) has an output power of 130 kW, consuming 75 t/year at 20% moisture on wet basis. The boiler is a Herz Firematic, which required a fine tuning and adapting the feeding system, ash discharge and air flows. This boiler has been prepared to be able to burn both, dry forestry woodchips and vineyards pruning, though switching from one to other fuels require the maintenance service to modify the boilers parameters. The boiler, together with the auxiliaries, was installed in a container besides the winery (see Figure 9). The winery has substituted totally the consumption of fossil fuels by APPR biomass. The heat is utilised for sterilising the bottles along the bottling line.

The district heating sited in Vilafranca del Penedes was built to supply the necessities of 4 public buildings (heating and hot water) placed in the quartier of La Girada. A Heizomat RHK-AK-500 boiler of 500 kW was installed. It is fully runs on vineyards pruning wood hog fuel. The saving in natural gas and electricity are up to 153 and 13 MWh, respectively, thanks to the use of APPR biomass.

Figure 9: Container placed at Cavas Vilarnau to supply heat to the winery (source Vineyards4Heat).

Figure 10: Sketch of the district heating fed with vineyard prunings (source Vineyards4Heat)

Success factors and obstacles

The main barriers that, according to the Vineyards4heat project experience, can stop or slow similar initiatives are:

- The low biomass potential of vineyard prunings (≤ 1 t/ha) can make difficult the economic feasibility of the chain.
- Farmers are not aware that APPR for energy is possible.

- Initial reluctance of the technical staff that operates the boiler: hard work to find the optimal operation.

In that sense, the project provides the following keys to bear in mind:

- The area has an important concentration of vineyards (30,000 ha in a small radius).
- INNOVI cluster of Catalonian wine industry made research and market analysis, to be sure that there exists a real interest and demand for biomass vineyard pruning.
- The biomass demand was ensured by means of the new District heating unit in Vilafranca del Penedés.
- The city council and the wine makers performed an intense information campaign to promote social acceptance.
- In the area there were already service companies / persons with capacities to start new biomass chains on prunings (e.g. service company providing APPR wood to Bodegas Torres).
- Farmers were aware of the costs for management of the pruning (further work performed by COVIDES cooperative to their members).
- The twinning with the German town of Buhl, from where they got to know their initiatives in pruning harvest.
- Policy makers had in mind clear objectives on the utilisation of pruning or agrarian residues (Vilafranca del Penedés city councils was the catalyser and leader to promote the association and the new initiatives).
- The dialogue, understanding and alliance among diverse local key actors boosted the starting of pruning utilisation (private/public consortium to use pruning for heating in public schools).
- The modification of the statutes of the local water management public company, to be able to take care of providing not only pipe water service, but also energy services.
- An optimal planning of the logistic to satisfy the farmers demands, since their priority is to get rid of the pruning residues as soon as possible.
- The selection of the harvesting machinery is essential to ensure product quality and economic feasibility.
- An optimal placing of the storage point to be able to make the value chain feasible.
- The optimisation of the boiler operation and maintenance to be able to work satisfactorily with a fuel of lower density and higher ash content as compared to regular forest woodchips.

Lessons learnt

In some cases, the public institutions should be the ones triggering “non-conventional” initiatives, to assume the initial technical and economic risks associated. Once performed, this type of projects become the seed that triggers new ones in the area, promoting private entrepreneurship.

In the case of Vilafranca del Penedés, the implementation of a public entity in charge of managing the logistics and the consumption was the best solution to increase the participation of the population (farmers and consumers), providing both the continuation of the project and assuring the biomass supply.

Future prospective

With the material currently mobilised (around 50 farmers involved), the initiative has the capacity to supply the whole consumption for the two APPR biomass consumers (the winery and the district heating). Interest has grown from private companies in the area and new public buildings are planned to join the district heating.

The service company performing the pruning wood harvesting (NOU VERD) will continue optimising the prototype developed by the project to gather the pre-pruning material and testing the economic feasibility in the local conditions.

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D6.3: Flagship success cases update v1
Annex III: ITC Shabo flagship report

uP_running

Take-off for sustainable supply of woody biomass from agrarian pruning and plantation removal

Grant agreement: 691748
From April 2016 to June 2019

Prepared by: SECB & CERTH

Date: 20.10.2017

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Introduction

Industrial-trading company Shabo LTD (ITC Shabo) produces industrial heat from vineyard prunings with a steam boiler of 1.6 t/hour capacity). It is the first example of successful heat production from such biomass on an industrial scale in Ukraine, and for this reason, it is considered an uP_running project flagship.

Production facilities of the ITC Shabo are located in the village Shabo of Bilhorod-Dnistrovskyi district of the Odessa oblast (Ukranian administrative division equivalent to States or Provinces). This area is located in the Black Sea region, where winemaking traditions trace back to ancient times.

SINCE 1822
SHABO

Figure 1: The ITC Shabo logo and company building. Source: ITC Shabo.

Figure 2: Location of Shabo.

Table 1. The ITC Shabo flagship case at a glance.

ITC Shabo at a glance	
Location	Odessa region, Ukraine
Type of APPR involved	Prunings
Crop species used	Vineyards
Year of initiation	2015
Volume of APPR mobilized	1,000 – 1,500 t/y
Surface area with permanent crops mobilized	1,000 ha
Maximum radius of operation	10 km
Main product	Heat production from APPR
CO_2 emissions avoided[1]	1,535 tCO_{2eq} per year
Number of jobs created	6.7 (equivalent full-time jobs)
Total level of investment	Not disclosed for commercial reasons

Business model

Two main types of actors are involved in the value chain of ITC Shabo. The local agricultural enterprise (Shabo Agrofirm), which provides the prunings from its vineyards and performs all the logistics operations. And ITC Shabo, which is involved directly only in the final energy conversion step. It is a simple organizational model, in which the final consumer of the APPR biomass avoids involvement in field and logistics operations, although it can provide feedback on the quality of the fuel received.

The whole operation have the approval of the local municipal authorities, which are against the open-field burning of prunings; however, they are not directly involved in the value chain.

[1] For the estimation of the CO_2 emissions avoided in the ITC Shabo case, the following assumptions are made:

- The vineyard pruning consumption is 1,500 t/y. The average moisture content during combustion is 20%, with a typical LHV of 14.7 MJ/kg.
- No GHG emissions for the operation of the logistics chain are considered.
- The boiler efficiency is equal to 87% (heat production).
- The CO_2 savings are calculated using the Fossil Fuel Comparator for heat production found in Staff Working Document SWD(2014) 259, which is equal to 80 gCO_{2eq}/MJ.

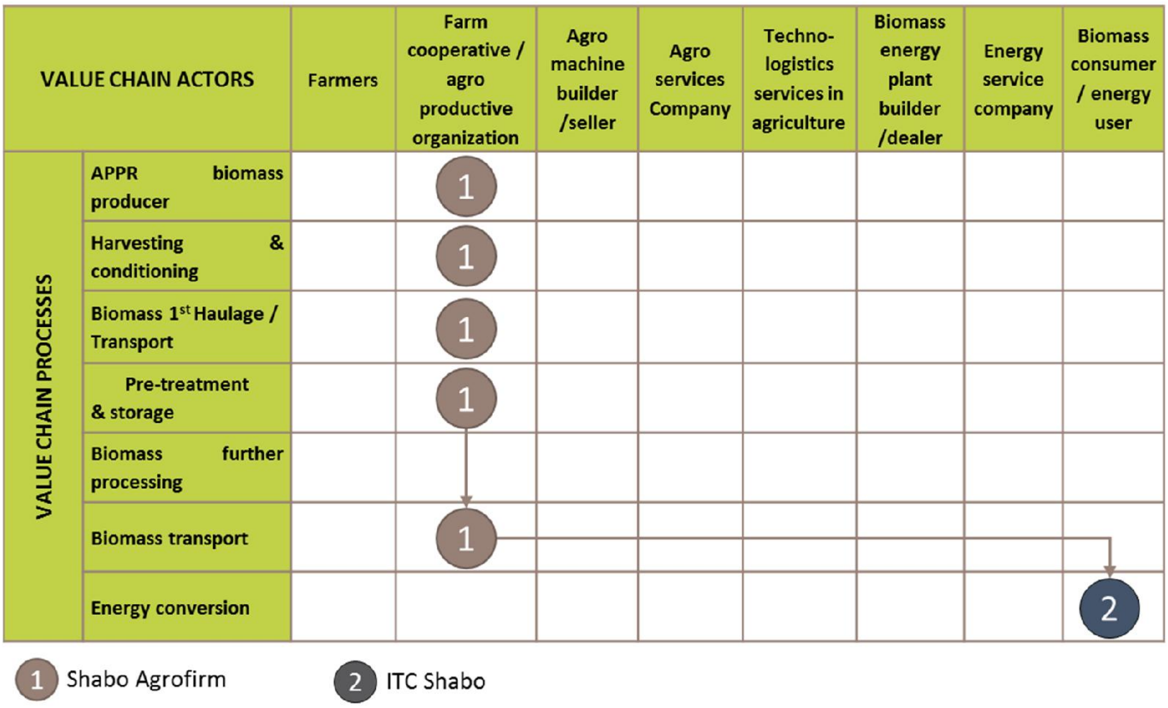

Figure 3: Role of actors involved in the ITC Shabo case.

Table 2. Benefits for the actors participating in the ITC Shabo case.

Value Chain Actor	Tangible benefits	Intangible benefits
Farm Cooperative (Agrofirm Shabo)	Save time and money in pruning residues management Small revenue from selling prunings to end-users	Avoid risks of fires Avoid production of smoke and emissions in the area. Good image for local authorities and population.
Biomass consumer (ITC Shabo)	Low cost of biomass Savings in respect to wood or other fossil fuels heating	Diversification of energy sources Increased competitiveness Branding: “sustainability” and ”good practices”

14 new jobs have been created through the operation of Shabo. Of these, **5 are permanent, full-time jobs** for the boiler house operation with ITC Shabo. 7 part-time workers are involved in operations related to harvesting and biomass transport, while another 2 part-time jobs are created at the storage facilities. It is estimated that the total equivalent to full-time jobs is 6.7.

History / Reasons for initiating

Shabo is one of the oldest grape growing settlements in Europe. Ancient Greeks are considered the forefathers of winemaking in this region. In the 6th century BC, Greek colonists founded the settlement of Tyras on this terroir at the Black Sea shore (later known as Akkerman) and planted the first vineyards there. The beginning of cultural winemaking in this region is attributed to Swiss immigrants who founded here the winemaking settlement Shabo in 1822. Shabo's centuries-old winemaking traditions were the basis of foundation in 2003 of Shabo Wine Company – ITC Shabo, a Ukrainian winemaking complex with full production cycle.

Since its foundation, the company faced the need to find a cheap local energy source as an alternative to heating oil for the production process in view of the lack of natural gas networks nearby. The solution was found in the energy usage of vineyard prunings. Before this, the pruning residues were usually accumulated in huge piles each year and then they were burned on the open air.

Figure 4: Pile of prunings near vineyard (Source: SECB).

For the practical implementation of this concept in accordance with specific local conditions and technologies of viticulture, Shabo Agrofirm has developed an efficient pruning biomass value chain which covers the full cycle from the collection of local pruning shoots to its use (in form of shredded wood, also called hog fuel) in a special biofuel boiler adapted to burn the vineyard prunings. The necessary buildings were built and the suitable technological equipment was purchased, including a shredder. The boiler house was commissioned in 2015.

The Wine Cultural Centre Shabo was created in 2009 on the facilities of ITC Shabo. In September 2011, by the recommendation of the Council of Europe, it has been named «Cultural heritage of Europe» and included in the European map of the museums of wine. The wine centre aims to introduce to visitors the theme of the winemaking culture. A visit to the modern boiler house, which uses vineyard pruning as fuel, is included in the tour of the wine centre and familiarizes numerous visitors with the concept of using prunings as an energy resource.

Availability, harvesting and logistics of APPR biomass

Collection of the vineyard prunings is carried out within a radius of 10 km from the boiler house. The main viticulture enterprise in this region is Agrofirm Shabo, whose vineyards take up an area of 1,100 hectares. Annual pruning of vineyards is carried out in February-March.

The freshly vineyard pruning residues have a moisture content of about 45 %, which makes it difficult to store them. Therefore, after the pruning is performed, tractors with forks get out APPR from the vineyard rows and collected them on piles. The pruning shoots gathered are accumulated in piles and left on open-air storage (at field side) for several months, in order to reduce the moisture content below 25 %. Then the vineyard prunings are shredded by means of a drum shredder Green Bull, produced by Zerma-Ukraine Ltd. The shredder is towed and powered by a tractor. The shredded biomass is picked up and transported by a tractor with a trailer to the central storage facility.

Figure 5: Shredder Green Bull in Agrofirm Shabo (Source: Zerma-Ukraine).

According to the biofuel need, the shredded prunings are supplied by a tractor from the central storage facility to the storage facility of the boiler house.

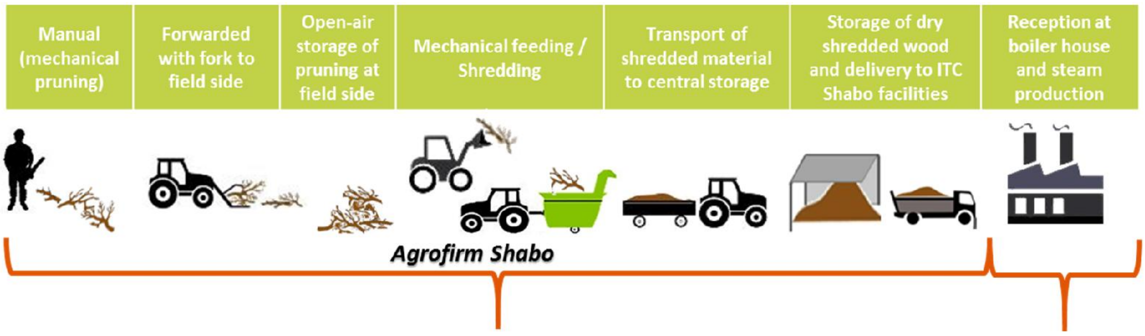

Figure 6: Logistics arrangements for the ITC Shabo case.

Figure 7: Biomass storage facility of boiler house (Source: SECB).

Figure 8: Shredded prunings (Source: SECB).

From one hectare of vineyards, between 1 to 1.5 tons of shredded and dried APPR biofuel are received. Thus, the annual stock of vineyard prunings is up to 1,500 tons, which are delivered to the biomass boiler of ITC Shabo.

End use of APPR biomass

From the boiler storage area, the biofuel is picked up with live-bottom of automatic fuel supply system, adapted to shredded vineyard prunings, and fed into a steam boiler KPM-1,6-1,4-P (heat capacity of 1.16 MW_{th}), produced by Ukrainian company Kriger. The steam boiler capacity is 1.6 t/h. The steam is used to provide in different technological processes employed for wine and alcoholic beverages production, such as distillation. During the cold season, the energy produced by the boiler is also used for space heating. Overall, the pattern of heat production is not constant throughout the year and depends on the weather as well as the requirements of the production.

Figure. 9: Steam boiler KPM-1,6-1,4-P (Source: SECB).

The boiler uses daily from 3.0 to 9.0 tons of shredded vineyard prunings with ash content 3 – 4 % on dry basis. The boiler is equipped with a system for cleaning internal surfaces of the boiler from ash and a multi-cyclone, which ensures that flue gases comply with current air emissions environmental standards.

Success factors and obstacles

The key factors of success should be considered the coordinated and purposeful work of the companies' teams in implementing the concept of energy use of the vineyard prunings.

Important effort was in determining the feasibility and planning prior starting the business. The price on fossil fuels rose and made prunings of economic interest due to the limited forest resources in Bilhorod-Dnistrovskyi district.

On the way from idea to the operating value chain, many practical tasks were solved, which were connected with the choice of necessary equipment suppliers, elaboration of skills of effective operation and obtaining biofuels with stable quality characteristics.

The ccompanies managers attended international exhibitions and learned the experience of overseas wineries for finding effective solutions.

The project was implemented on the own funds of ITC Shabo. No public funds were used to finance the investment.

Lessons learnt

The harvesting and shredding of the vineyard prunings are the most important stages in the value chain and have a big effect on the biomass characteristics of the final product (the shredded biomass, also called hog fuel). It is necessary to avoid the excess contact of biomass with wet soil, which causes an increase in ash content.

The inefficient and uncoordinated performance of shredding and transport operations can lead to excess consumption of diesel fuel and working time, which results in an excessively high price of biomass produced.

Logistics infrastructure, especially storage facilities, should be protected from precipitation.

When planning the work, it is necessary to monitor the weather forecasts and control the moisture content in the prunings. It is necessary to withstand prunings in piles before shredding until the end of April.

Future prospective

In the nearest future in ITC Shabo, it is planned to purchase modern equipment for picking and shredding the prunings directly in the vineyard rows. The extension of the APPR biomass harvesting area is considered also.

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D6.3: Flagship success cases update v1 Annex IV: Pelets de la Mancha (Athisa Group) flagship report

uP_running

Take-off for sustainable supply of woody biomass from agrarian pruning and plantation removal

Grant agreement: 691748

Prepared by: CIRCE & CERTH

Date: 20.10.2017

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 691748.

Introduction

The company "Pelets Combustible de la Mancha S.L." (Athisa Group) is dedicated to the manufacture of solid bio-fuels in pellet and chip exclusively form from vineyard prunings. This vineyard pruning wood pelleting plant is the largest of its kind in the world, with a production capacity of 20,000 tons per year. Due to this fact, and because of the company capacity to proceed with their business (even if the market and frame conditions brought constant difficulties) this initiative is considered an uP_running success flagship case.

Pelets de la Mancha (Athisa Group) is located near the town of Socuéllamos, in Spain.

Figure 1. The Pelets de la Mancha, Athisa Group, and Athisa biogeneración logos (left) and company building (right). Source: Pelets de la Mancha (Athisa Group).

Figure 2. Location of Pelets de la Mancha (Athisa Group).

Table 1. The Pelets de la Mancha flagship case at a glance.

Pelets de la Mancha (Athisa Group) at a glance	
Location	Socuéllamos, Spain
Type of APPR involved	Prunings
Crop species used	Vineyards
Year of initiation	2011
Volume of APPR mobilized	Up to 20,000 t/y (fresh matter of raw material)
Surface area with permanent crops mobilized (ha)	30,000 ha (total potential in the area, not all being collected)
Maximum radius of operation	30 km (sourcing)
Main product	Wood chip and pellet production from APPR
CO_2 emissions avoided[1]	22,272 tCO_{2eq} per year

[1] For the estimation of the CO_2 emissions avoided in the Pelets de la Mancha case, the following assumptions are made:

- The production of vineyard pruning pellets is equal to consumption is 20,000 t/y. The typical LHV of the pellets is 17.4 MJ/kg (according to the company website).
- No GHG emissions for the operation of the logistics chain or the pelletization process are considered.
- The pellets are combusted in heating devices / plants with a typical efficiency of 80%.
- The CO_2 savings are calculated using the Fossil Fuel Comparator for heat production found in Staff Working Document SWD(2014) 259, which is equal to 80 gCO_{2eq}/MJ.

Pelets de la Mancha (Athisa Group) at a glance	
Number of jobs created	15
Total level of investment	5.8 M€ (initial investment; does not include additional costs invested afterwards)

Business model

The supply of the large amounts of biomass consumed by Pelets de la Mancha (Athisa Group) requires the sourcing from hundreds of farmers and several wineries. The actors being involved in the supply are farmers and wineries (owners of vineyards), intermediate service companies and Pelets de la Mancha (Athisa Group) as processing company. It is evident that each case is different and farmers have their own preferences and means. Therefore, no single type of value chain can cover the needs of all cases and all diverse actors participating. However, some roles are common in all cases.

In all cases, farmers take the role of withdrawing the loose pruning vine shoots out of their fields and depositing them either at the field side or at intermediate collection points. From then on, two different approaches can be followed:

- Value chain type 1 (Figure 4): supply of loose branches to the pellet plant organized by the farmers (1.a), intermediate service companies (1.b) or Pelets de la Mancha (Athisa Group) itself (1.c). This approach is currently a minor part of the whole pruning volume mobilised.
- Value chain type 2 (Figure 5): treatment of the large pruning piles. In this case the piles are principally prepared by intermediate service companies, which gather the prunings from each farmer and bring them to collection points. The biomass is treated in semi-mobile shredders, either by service companies (2.a) or by Pelets de la Mancha (Athisa Group) (2.b, 2.c). Transport of the shredded material to the pellet plant is carried out either by the service companies (2.a, 2.b) or by Pelets de la Mancha (Athisa Group) (2.c). In case 2.d, Pelets de la Mancha (Athisa Group) performs all the actions from field side to plant.

The models described above illustrate the variety of schemes needed to procure such large amounts of biomass from hundreds of farmers, towards the pelleting plant. And also provide an indication of the complexity of logistics, communication, and the close collaboration needed between the multiple actors.

In terms of the strategy to obtain the biomass from the fields, the case of Pelets de la Mancha (Athisa Group) has followed the simplest approach: allowing each farmer to perform the withdrawal with their own means and with practically no investment. This strategy allows a good alignment of farmers, who find the practice easy, and that save time in the management of their residues. The disadvantage is the quality of the material: pruning are being collected from the field with rakes or forks mounted on tractors. The material at field side contains important amounts of soil and stones and thus makes the subsequent handling and processing required in order to produce woodchips or pellets of acceptable quality more complex.

Figure 3: Left: manual pruning of vineyards. Right: withdrawal of pruning residues with a rake mounted at the back of a tractor. Source: Pelets de la Mancha (Athisa Group) commercial video on YouTube.

It is worth mentioning that there is currently no biomass supply based on the mechanized collection of prunings with integrated harvesters and shredders. These devices consist on an integrated machine able to pick-up the pruning from soil plantation, shred it and convey the material to a bin or on a towed trailer. This practice requires that either the farmers or a third company face a new investment, sometimes requiring organization among farmers and intermediaries for sharing, or for coordinating the timing of the pruning harvest.

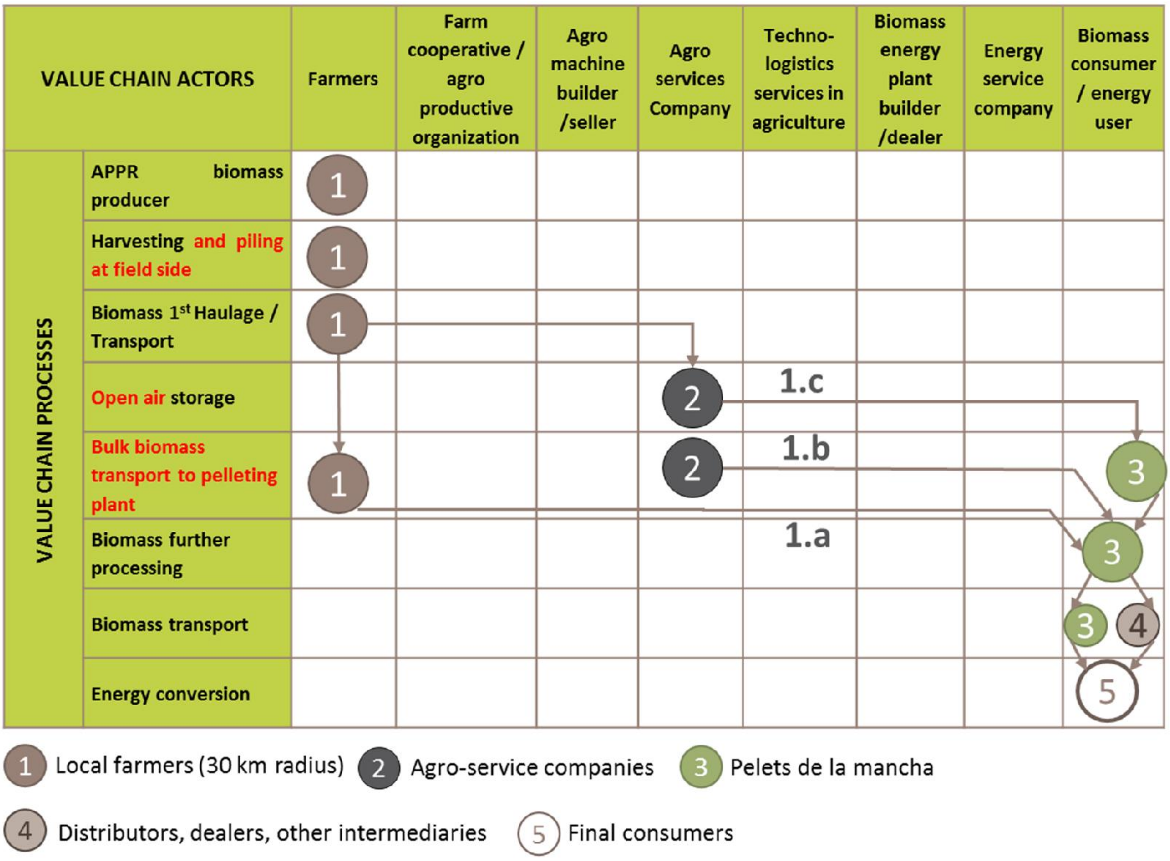

Figure 4. Role of actors involved in the Pelets de la Mancha (Athisa Group) case. Value chain 1: direct mobilisation of loose branches to the facilities.

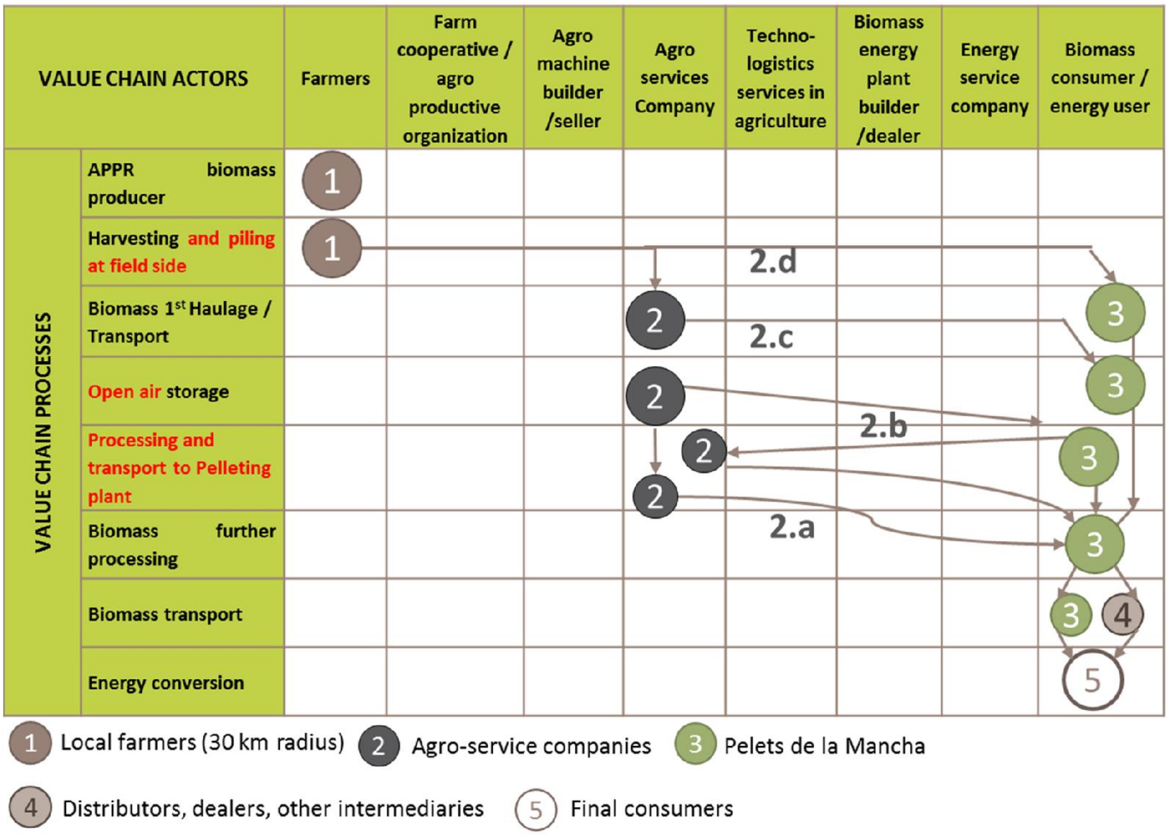

Figure 5. Role of actors involved in the Pelets de la Mancha (Athisa Group) case. Value chain 2: shredding of the piles at the collection point with large shredders and transport of the shredded wood to the facilities. .

Table 2. Benefits for the actors participating in the Pelets de la Mancha (Athisa Group) case.

Value Chain Actor	Tangible benefits	Intangible benefits
Farmers	Save time and money in pruning management Small income from pruning sales (in business model 1.a only)	Avoid risks of fires and diseases Avoid air pollution from open-field burning of prunings Avoid troublesome task of burning the pruning (obtaining permits, keeping eye on the open-fire)
Intermediate companies	Gain profit margin	Diversify their activity
Pelets de la Mancha (Athisa Group)	Gain profit margin	Relevant role in the area Prestige as unique case in world Differentiation: 100% vineyard pellets (not mixed)

History / Reasons for initiating

The company Pelets Combustible de la Mancha S.L. is a modern company created in 2007, though the factory started its activity only after 2011. The biomass that is used in this company are prunings that are collected from vineyards in a 30 km radius around the town of Socuéllamos.

Before Pelets de la Mancha (Athisa Group) started its activity, farmers used to burn the pruning residues at the field side. This practice entails fire hazards and is, indeed, a waste of thermal energy and a source of air pollution. Since the implementation of this factory, farmers have the opportunity for a new source of revenues whilst the existing management problem is solved.

The project was initially benefitting from public support, through the participation of public institutions in the company with an initial share of up to 45 %. As the initiative matured, the share of public ownership has decreased and, currently, private companies have the largest share of the company.

It is worth mentioning the use of public funds for industrial innovation: (1) direct funding for covering research activities or knowledge required to implement the investment (market research); (2) favourable credit conditions for the investment.

A key success factor has been the tough work carried out to align the farmers' vision and interests to that of the company. In the very beginning, most of the farmers did not agree in supplying their prunings to be utilized for the profit of the pellet company. Without a perseverant work to approach farmers, they would have probably continued using the traditional disposal method (burning at the field side). The situation changed as soon as they realized that it was more advantageous for them.

Availability, harvesting and logistics of APPR biomass

Pelets de la Mancha (Athisa Group) is a factory located in the northeast of the province of Ciudad Real, an ideal logistical situation for delivering to any point in the Iberian Peninsula. The plant is based completely in the processing of pruning residues from vineyard. The vineyards pellets made up from the branches generated in Socuéllamos and the surrounding areas (e.g. Villarrobledo, Tomelloso, Las Mesas, Pedro Muñoz). No other wood types are added in their processing (not even vine stocks).

The pruning is performed yearly, and manually in this area. The mechanical pre-pruning is not a usual practice. Therefore, the collection of the loose branches is simpler compared to the case when the pruning operations combine a first mechanical pre-pruning with a subsequent manual pruning. Usually, prunings are left on the field or at collection points (without shredding) for a period of 60 – 90 days. This is a sufficient time for the raw material to get a moisture around 30 %, which is appropriate to feed the production process. In the case of Pelets de la Mancha (Athisa Group), farmers carry out a haulage to the side of the field where the branches are piled. Afterwards, either a third company or Pelets de la Mancha (Athisa Group) moves the biomass to the collection points.

Figure 6. The on-farm storage of piled branches (left) and the roofed storage area at Pelets de la Mancha (Athisa Group) factory (right).

Two main types of logistics arrangements are applied by Pelets de la Mancha (Athisa Group):

- Value chain type 1 - Supply of bulk branches to the factory (**Error! Reference source not found.**): the main feature is that pruning wood is collected and transported in the form of loose branches, without any specific treatment. Farmers have the role of removing the branches from their fields. Once there, some farmers perform the transport by themselves to Pelets de la Mancha (Athisa Group) facilities (1.a). Most of cases farmers call a local service company to let them know that their biomass is available; then the company picks up their biomass from field side and the transports the branches bulk to the pellet plant (2.b). An alternative is that some farmers call directly Pelets de la Mancha (Athisa Group) , and then the company personnel takes care of the gathering of the biomass.

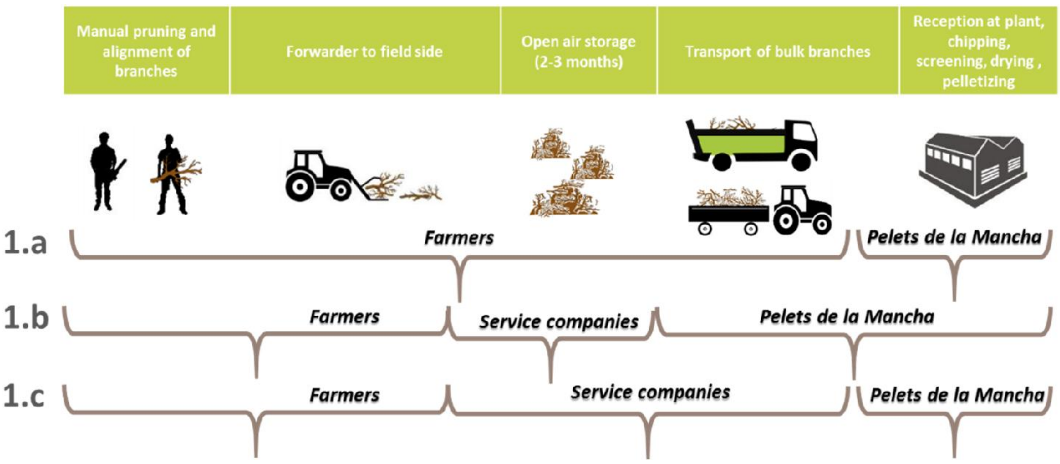

Figure 7. Logistics arrangements for Pelets de la Mancha (Athisa Group) based on bulk branches (value chains type 1).

Figure 8: Value chain type 1: handling of bulk branches from field to intermediate collection point. Above: preparing pile at field side. Below, left: loading agricultural trailers with telehandler. Below right: alternative of transporting bulk pruning on open box truck. Source: Pelets de la Mancha (Athisa Group) commercial video on YouTube.

- Value chain type 2 - Supply of shredded biomass (hog fuel) to the factory (*Figure 9*): in this case, the start is same as for value chain 1, and farmers take care of preparing piles of pruning wood next to their fields. The pruning wood (still in form of vine shoots) is mobilized from these piles to intermediate collection points, principally by intermediary companies (cases 2.a, 2.b, and 2.c). The biomass stays there for few months, and afterwards either the service company (2.a), or Pelets de la Mancha (Athisa Group) (2.c) bring large semi-mobile shredders (mounted on truck) to transform the large piles at the collection points into shredded wood pieces (hog fuel). A hybrid practice may occur when Pelets de la Mancha (Athisa Group) takes care of the shredding, and the transport of biomass is in charge of the service company (2.b). A possible alternative is Pelets de la Mancha (Athisa Group) performing all operations: biomass collection in form of large piles, shredding and transport of the shredded material to its facilities.

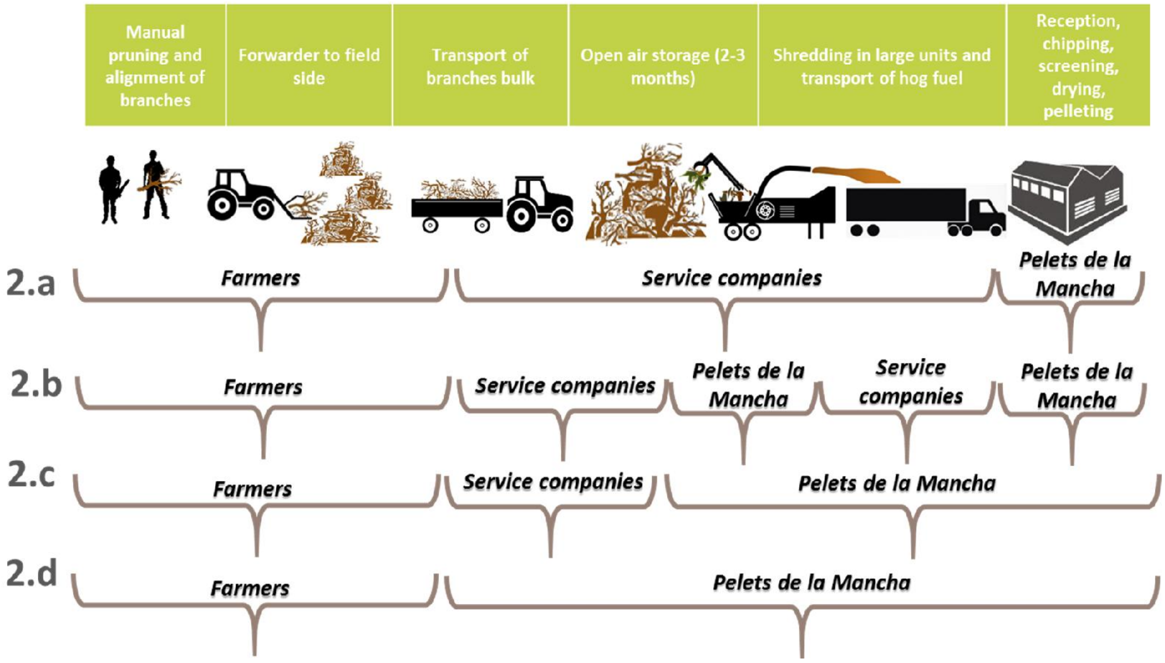

Figure 9. Logistics arrangements for Pelets de la Mancha (Athisa Group) based on hog fuel (value chains type 2).

Figure 10: Value chain type 2: shredding the large intermediate piles of bulk branches. Above, left: Wilibald MZA 4600 shredder. Above, right: hog fuel obtained with the shredder. Below, left: Walking floor truck downloading shredded material at Pelets de la Mancha (Athisa Group) reception park. Below, right: telehandler utilised to feed the plant. Source: official Pelets de la Mancha (Athisa Group) commercial video on YouTube.

Pelets de la Mancha (Athisa Group) processes only the annual vineyard prunings, since the vineyard vine stocks (uprooted at the end of a plantation life) have a much harder wood and include significant amounts of soil and stones with the roots. Therefore, the processing of this resource into pellets is not feasible at the moment. Processing vineyards pruning wood into pellets and finding a market for it has been a huge challenge for Pelets de la Mancha (Athisa Group). In the course of time, they have adapted continuously. Concerning the factory, a continuous improvement in the processing of the pruning wood, with special dedication in lowering its content in fine and inorganic materials (stones, soil particles, sand). Right now, their facilities include the most appropriate technology for the processing of the vine pruning wood. Some elements are trommels, sieves, milling (2 stages), fines separation, drying and pelleting. In terms of market, the company is on a continuous search for the best clients. Pellets are sold both wholesale and retail. The market price of biomass has sunk during recent years, and thus they have invested much effort in finding new clients and more added value market niches.

Figure 11: Pelets de la Mancha (Athisa Group) facilities: Above, left: trammel to separate large fractions and part of fines. Above, right: rotary dryer. Below, left: detail of pelleting units. Below, right: aspect of the processing facilities. Source: official Pelets de la Mancha (Athisa Group) commercial video on YouTube

Soil management and agronomic practices

The vineyard prunings used by Pelets de la Mancha (Athisa Group) are located inside of Protected Designation of Origin (PDO) La Mancha (30.000 km^2 dedicated to vineyard). The weather of the area is typical Mediterranean inland climate, also known as Continental Mediterranean Climate (typical in Spanish central inlands with heights above 600 m over sea level). The climate, the uniform ground and the limestone soil of the area make it a perfect place to grow vines. The rainfall is low, averaging 450 mm/y, a crucial fact to understand the current soil cover management.

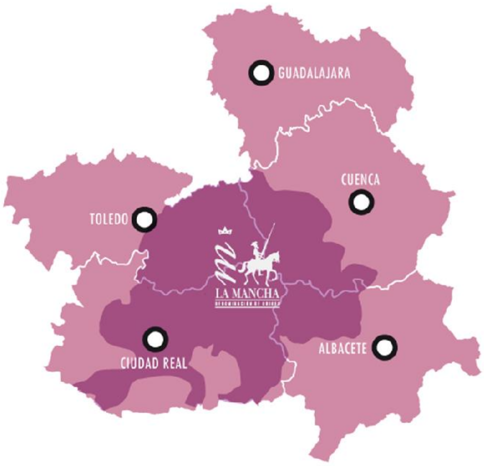

Figure 12. The Protected Designation of Origin (PDO) La Mancha.

With respect to soil cover, the main agronomic practices in Castilla la Mancha are the minimum tillage (about 80% of the vineyards) and the traditional tillage (about 15% of the vineyards). The minimum tillage is performed with superficial cultivators that remove the unwanted vegetation and leave it on the soil; by contrast, the traditional tillage use moldward-like ploughing systems to remove the spontaneous vegetation growing in the inter-rows, affecting a larger depth of the topsoil (more than 20 cm). In general, these practices are performed in Castilla la Mancha and as well in the target area of Pelets de la Mancha (Athisa Group) factory as a mean to increase the water availability and the nutrients uptake by the vines (competition is reduced). In areas with low precipitation (such as the vineyards around Socuéllamos), the spontaneous grass coverage growing in the inter-rows enters in direct competition with vineyards, which are very sensitive to drought stress during the growth of grapes. Therefore, the general practice in the area is the removal of the grass cover, and thus the landscape in the area is of vineyards with bare soils.

Figure 13: Vineyards in the area of Socuéllamos. Detail of soil cover. Source: Pelets de la Mancha (Athisa Group) commercial video on YouTube.

It is worth mentioning that drip irrigation is expanding much in recent years in Castilla la Mancha (reaching a share from 30 to 40% according different information sources). This fact presents an opportunity for soil cover management, as the spontaneous vegetation would not enter to such tough competition with vines, and the current practices of tillage could be reduced, or avoided.

End use of APPR biomass

Pelets de la Mancha (Athisa Group) mainly produces 2 different kinds of products: wood chips and pellets both of them 100 % from vineyard prunings.

Pellets

The pellets produced by Pelets de la Mancha (Athisa Group) are cylindrical granules of compacted wood whose size is 6-8 mm in diameter and 3-5 cm in length and less than 8 % of moisture. This form allows fluency to the product so that it can be transported by mechanical means and automatically fed into boilers.

This final product, pellets, is marketed by Pelets de la Mancha (Athisa Group) or through a distributing company and sent to multiple users. The main consumers are public or private companies which use pellet for heating purposes as well as industrials units. Moreover, these pellets can be used in buildings with a high heating demand (where medium sized boilers above 200 kW can be installed). The market is regional and - partly – national, and has a share of the market displacing some other fuels like DINplus / ENplus pellets, olive oil dry pomace, olive pits or almond shells. In comparison to DINplus or ENplus certified pellets, the Pelets de la Mancha (Athisa Group) product has the advantage of price, which can be a very attractive feature for some consumers.

Figure 14: Vineyard pruning pellet produced at Pelets de la Mancha (Athisa Group) . Left: aspect of the pruning pellets. Right: bagging unit. Source: Pelets de la Mancha (Athisa Group) commercial video on YouTube.

A key point for the success of Pelets de la Mancha (Athisa Group) is the constant search for market and new clients. The target consumers were initially both the small consumers of pellets and the medium-size consumers of industrial pellets. The experience revealed that the boilers utilized in households and other small units are usually not ready to work with industrial pellets, especially due to its high ash content (ash disposal systems of the boiler undersized, and tendency to agglomerate around the burner and terminate the combustion). On the contrary the vineyards pellets are an alternative for medium sized facilities consuming industrial pellets, olive oil dried pomace or other biomass fuels. These boilers usually can adapt their combustion parameters to use this new pellet type. Compared to the industrial pellet price of 180 €/t (served bulk at plant gate), the pellets from Pelets de la Mancha (Athisa Group) attain a relevant reduction in price of about 30 %.

As an example of the continuous adaptation and search for new market niches, Pelets de la Mancha (Athisa Group) recently started producing pellets for horse bedding. This product absorbs water up to 4 times more than wood shavings or straw. It also has a very low humidity level between 6 – 10%, which translates in longer shelf life, under perfect conditions before it is time to be removed.

Pelets de la Mancha (Athisa Group) also includes as a sale strategy the pellets gourmet, which are orientated to be utilised in barbecues. The product is object of different packaging, more orientated to the recreational and domestic market segments. The product is branded as being 100% natural-made product from vineyards.

Pelets de la Mancha (Athisa Group) carries out the supply in **three formats** depending on the needs of each consumer and according to the characteristics of the boiler:

- **15 kg bags**. For small consumers with small boilers and stoves. These bags are supplied individually or in pallets.
- **1 m^3 Big Bags.** For medium sized consumers who have automatic feeding system.
- **Bulk by full truckload.** This system is ideal for large consumers that have reception silo and automatic boiler.

Wood chips

The wood chips produced from Pelets de la Mancha (Athisa Group) factory are cleaned of inorganic materials (stones, sand, soil particles) and subject to sieving. They commercialize wood chips with different particle sizes (similar to P20, P40 and larger particle size classes) and different moisture (less than 20 % or more than 20 %) based on the client´s needs. Even though the material is sieved, the final particle distribution differs from forestry woodchips of same classes, due to the shape of the original material: thick vineyards shoots and thin tree stems (as is the case of forestry wood).

This final product is marketed by Pelets de la Mancha (Athisa Group) mainly to large companies that produce power from biomass. Moreover these wood chips can be used for heating use and industrial use in small/medium/large enterprise.

Same as pellets, the pruning chips can be used as bed for animals and in barbecues.

Pelets de la Mancha (Athisa Group) carries out the supply in different formats depending on the needs of each consumer:

- **1 m^3 Big Bags.** For medium sized consumers who have automatic feeding system.
- **Bulk by full truckload.** This system is ideal for medium and large consumers.

Success factors and obstacles

The Pelets de la Mancha (Athisa Group) case was investigated extensively through a survey of the EuroPruning project. The following **key factors** were considered critical for its success:

- **Project:** there was an important effort in feasibility and planning prior to starting the business.
- **Market:** there was a continuous search for clients and new added value markets.
- **Pruning management:** the high density of permanent crops plantations in the area (almost 300,000 ha around 100 km).
- **Support:** at the beginning there was a public participation in the initial company, lowering the risk for private capital.

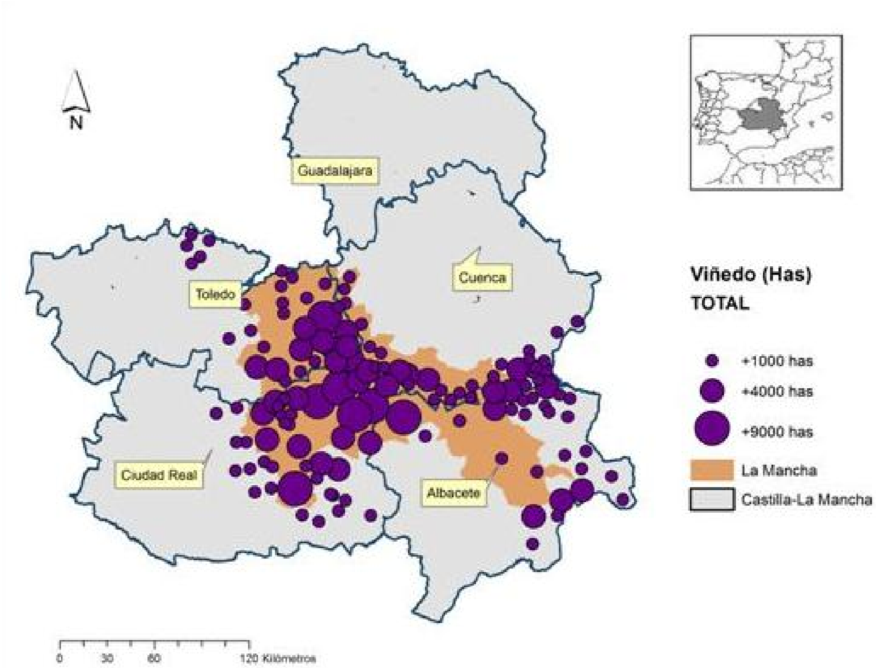

Figure 15: Vineyard area in Castilla La Mancha (2010).

However, throughout its lifetime, the project also faced several **obstacles** that needed to be overcome:

- The project was created from the beginning and there was no similar model to follow / imitate.
- Developing a new logistic/collection system of vineyard prunings together with farmers and local service companies in order to get a feasible business and a biomass free of foreign materials.
- Developing a new pre-treatment process in order to eliminate the huge amount of inorganic materials that are collected during harvesting of this biomass.
- The actors behind the entrepreneurial initiative had to convince others before initiating (value chain actors).
- Even though the entrepreneurs tried to get some external support, no company/agrarian association/agrarian consultant was able to guide them.
- No fuel certification / quality scheme for pellets produced by APPR biomass is available (such as ENplus for high quality wood pellets).

Lessons learnt

The high biomass production in the nearby area is helping reduce the cost of logistics and has increased the profitability of the operation. The mobilisation of large amounts of biomass from hundreds of farmers require an important effort in logistics, and a degree of flexibility. As reported, multiple alternative value chains are in operation to feed the material to the plant.

The dialogue with farmers is necessary. Without a mutual understanding it is not possible to promote new APPR value chains.

Even though many efforts were invested in aligning farmers to be ready to supply the biomass, it has been difficult to make them invest in pruning harvesters. For a pruning harvester to be economic, it must be utilized in a few hundred hectares. The initial costs are an obstacle. Sharing the machinery is another obstacle. Being the pelleting plant the convinced actor, the prime mover of the initiative, farmers tend to participate more passively and only when their risk is low, and when they find the new management of the pruning residue is easy. The introduction of other collection systems needs more maturing and more involvement of the vineyards owners.

The method for collecting the biomass by pushing it with rakes or forks mounted on forwarders has resulted effective. Its simplicity allowed that many farmers started making available their prunings.

The practice of transporting branches bulk entails important costs, because of the very low bulk density of the branches when transported in trucks.

Another lesson relates to quality. Getting woodchips or pellets under 4 % ash is difficult when the branches are being raked or pushed out of the field, since they incorporate many inorganic elements. The treatment in later production stages requires robust technologies, and a specific cleaning process.

Pelleting material with high amounts of inorganics increased deterioration of the machinery at the facilities (chippers, mills, and pelletiser).

It is worth noting that a successful operation may face some initial difficulties, but it can generate a positive snowball effect after some time. The increasing volume of local farmers as fuel suppliers of Pelets de la Mancha (Athisa Group) is a proof of that.

Finally, it is important to say that the pellets made by APPR biomass unfortunately cannot be used in this moment for the household market due to the fact that the boiler made for this market are usually designed for biomass fuels with less than 2-3 % of ash content.

A final lesson learnt is that producing pellets out of materials with important amount of foreign materials is very difficult. And that marketing those pellets is not as simple as other wood industrial pellets. Pelleting solves some issues like storage, homogenization, and compatibility with feeding systems ready for pellets, among others. But also involve important capital and operational costs, penetrating the market is not easy.

Future prospective

During the past 4 years the company has been innovating a process for the cleaning of inorganics (extraneous elements like soil particles, stones) from prunings. The application of the patented process on the raw material reduces weight by 30 %, liberating extraneous material and resulting in a wood chip that is completely free of extraneous materials and safe to burn in all types of thermoelectric plants as **low cost, sustainable biomass**. This process could make available a total **of over 800,000 annual tons of raw biomass** previously inaccessible to the biomass market.

Athisa Group is directing its efforts to commercializing this biomass potential locally, nationally and internationally.

First, applying a circular economy model, through Athisa Biogeneracion, **the Group is seeking partners to promote the construction of a thermoelectric plant** in the vicinity of the valorisation plant to produce renewable energy exclusively using valorised grape vine pruning biomass where using another source of biomass would be neither competitive nor profitable in the current biomass energy production market.

The group is also working to **commercialize this sustainable biomass to renewable energy markets in Spain and Europe**, offering large shipments of valorised grape vine prunings in the format and humidity that the end client requires at a highly competitive price.

In summary, the valorisation of the 800,000 annual tons of grape vine pruning wood chips would generate a **social value**, due the important number of rural jobs to be created, it **does not compromise the future** because it avoids the felling of over 7 million trees a year somewhere on the planet, and is a **profitable** business model.

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D6.3: Flagship success cases update v1
Annex: The Fiusis flagship case

uP_running

Take-off for sustainable supply of woody biomass from agrarian pruning and plantation removal

Grant agreement: 691748
From April 2016 to June 2019

Prepared by: CERTH & UFG

Date: 20.10.2017

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 691748.

Introduction

Fiusis is a **small-scale power plant (1 MWe)** producing electricity exclusively from olive tree prunings (Figure 1). It is the first plant of its kind in the world using this feedstock, and for this reason it is considered an *uP_running* project flagship.

Fiusis is located near the city of **Calimera, in Puglia**, a southern Italian region that is already a forerunner in the utilization of wind and solar energy (Figure 2). Summary information about the Fiusis are reported in Table 1.

Figure 1. The Fiusis logo and company building (Source: Fiusis).

Figure 2. Location of Fiusis.

Fiusis at a glance	
Location	Calimera, Italy
Type of APPR involved	Prunings
Crop species used	Olives
Year of initiation	2010
Volume of APPR mobilized	8,000 t/y
Surface area with permanent crops mobilized	2,400 – 2,700 ha in total (800 - 900 ha per year due to every three-year pruning frequency)
Maximum radius of operation	10 km
Main product	Electricity production from APPR
CO_2 emissions avoided[1]	5,359 tCO_{2eq} per year
Number of jobs created	6 permanent employers operating in the energy plant + 10 permanent and 5 seasonal employers in pruning harvesting and transporting
Total level of investment	8 M€

Business model

Two main types of actors are involved in the value chain of the Fiusis plant: **local farmers**, who are providing the prunings from their fields and are responsible for the arrangement in suitable form before the harvesting (e.g. windrows, piles, etc.) and the **Fiusis plant** itself – through its subsidiary **Ligna** - which is organizing all other steps of the value. This organizational model allows Fiusis a complete control over all the production steps and guarantees good fuel quality. The company also claims that by taking over the logistics operations, significant cost savings have been achieved as compared to the use of independent contractors. The role of actors and the particular logistics steps performed differ a bit depending on the size of the fields (Figure 3 / Figure 6 and Figure 4 / Figure 7). Apart from supplying biomass, sometimes farmers have to keep shredded biomass piles on their fields for a while.

It should be noted that farmers receive no payment for the pruning delivered to the Fiusis plant. The prunings are offered free of charge, since farmers no longer have to incur direct costs related to disposing prunings from their fields. Farmers seem to accept this kind of arrangement. The local authorities of Calimera and neighbouring municipalities (Figure 5) supported Fiusis since the beginning and encouraged farmers to supply their pruning to the energy company in order to avoid residues disposal through open field burning (Table 2).

[1] For the estimation of the CO_2 emissions avoided in the Fiusis power plant case, the following assumptions are made:

- The olive tree pruning consumption is 8,000 t/y. The average moisture content during combustion is 20%, with a typical LHV of 14.7 MJ/kg.
- No GHG emissions for the operation of the logistics chain are considered.
- The plant electrical efficiency is equal to 24.5%.
- The CO_2 savings are calculated using the Fossil Fuel Comparator for electricity production found in Staff Working Document SWD(2014) 259, which is equal to 186 gCO_{2eq}/MJ.

VALUE CHAIN ACTORS		Farmers	Farm cooperative / agro productive organization	Agro machine builder /seller	Agro services Company	Techno-logistics services in agriculture	Biomass energy plant builder /dealer	Energy service company	Biomass consumer / energy user
VALUE CHAIN PROCESSES	APPR biomass producer	1							
	Open field storage in windrows	1							
	Harvesting & conditioning				2				
	Biomass haulage				2				
	Biomass further processing								
	Biomass storage								3
	Energy conversion								3

1 Farmers 2 Ligna (Fiusis subsidiary) 3 Fiusis power plant

Figure 3. Role of actors involved in the Fiusis power plant case. Value chain 1.

VALUE CHAIN ACTORS		Farmers	Farm cooperative / agro productive organization	Agro machine builder /seller	Agro services Company	Techno-logistics services in agriculture	Biomass energy plant builder /dealer	Energy service company	Biomass consumer / energy user
VALUE CHAIN PROCESSES	APPR biomass producers	1							
	Temporary storage in field	1							
	Pruning gathering in piles at field side				2				
	Biomass processing (static chipper)				2				
	Biomass transport				2				
	Biomass storage								3
	Energy conversion								3

1 Farmers 2 Ligna (Fiusis subsidiary) 3 Fiusis power plant

Figure 4. Role of actors involved in the Fiusis power plant case. Value chain 2.

Fiusis employs 6 workers on a permanent basis for the plant operation. 15 more workers are employed for the biomass collection and feedstock delivery activities; of these, 10 work on a permanent basis, while the remaining 5 are seasonally employed. Teams of two-three workers per field are formed in order to manage the biomass harvesting and haulage operations.

Table 1. Benefits for the actors participating in the Fiusis power plant case.

Value Chain Actor	Tangible benefits	Intangible benefits
Farmers	Save time and money in pruning management	Avoid risks of fires Avoid air pollution from uncontrolled burning of prunings
Fiusis power plant & Ligna subsidiary	Higher feed-in tariff for electricity production by using local biomass Cheaper sourcing of biomass	"Greener" image of company Closer ties with local community / fewer objections to operation

History / Reasons for initiating

Fiusis started back in 2010 as an initiative of a single man, Mr. Marcello Piccinni, current owner and plant director. His vision was to take advantage of an abundant local resource, olive tree prunings, which were disposed in open-fires and not generating any value to the community.

The project was made possible through the supporting policies that the Italian State adopted for the producers of renewable energy from biomass; a subsidized feed-in tariff of 28 c€/kWhe (gross) was secured by the Fiusis through a 15-year contract with the grid operator. This high value is paid only if the biomass is sourced locally (i.e. within a 70 km of radius from the power plant the so called "short" supply chain is recognized).

As with most biomass power plants, once favourable economic conditions for initiation are established, the major issue to be resolved was the sourcing of the fuels. Although the resource is abundant in the area, local farmers were sceptical at first and hesitant to allow third parties to go in their fields and collect their prunings. Conditions have changed as more and more farmers realized that cost savings can be achieved by letting people with access to mechanized equipment performing the management of the pruning. **At the first year of operation, only 12 farmers have collaborated with Fiusis; in 2016, the number has increased a hundredfold, to 1,200**. This large number of farmers is justified considering both the very limited average surface of olive groves in the area (the so called "Grecia salentina" sub-region) and the multiyear frequency of pruning operation in each field. It is estimated that 60 % of the local farmers currently collaborate with Fiusis. In return for the collection of the prunings, farmers have their fields cleaned and no longer need to resort to field burning, which is harmful for the environment and costly also. At present, thanks to the development of this new energy value chain, it is estimated that the open field burning practice of residues has decreased significantly inside the supply basin (by approximately

70%). This should be considered a very useful result in terms of reduced environmental pollution and better agronomic soil conditions.

The harvesting and logistics operations themselves have also been subject to change within Fiusis. Initially, the company was relying on external agricultural contractors for the pruning collection and harvesting steps. This initial decision was abandoned after the first three-year plant-operating period because it proved economically unsustainable. However, from 2014 onwards, a new company inside Fiusis ("**Ligna**") was set up, dedicated exclusively to the field feedstock-collecting phase, equipped with machinery for chipping, harvesting and delivering residual wood feedstock to the energy plant (Figure 3). The company reports that this change has led to an increase of the profitability of the whole scheme. The biomass supply plan of the company is organized so that farmers interested in pruning supplying can submit a request directly to the company administration, which involves filling in a form in which they indicate cadastral identification, the number of pruned trees and the date of pruning. This collected information is then archived in a database in order to ensure the biomass traceability and facilitate the logistic organization of biomass harvesting and delivery.

Availability, harvesting and logistics of APPR biomass

Fiusis is sourcing olive tree prunings in a **10 km radius** around the power plant *(Figure 5)*. Nine municipalities are located in that area (Calimera, Melendugno, Carpignano Salentino, Sternatia, Vernole, Melpignano, Castri di Lecce, Caprarica di Lecce and Martano) where it is estimated that approximately 7,000 hectares of olive groves are present, occupying around 75 % of the total utilized agricultural area. The total annual amount of prunings available to energy conversion is approximately equal to 25-26,000 t, compared to 8,000 t of biomass annually supplied to the Fiusis plant *(Table 2)*. This means that the biomass potential availability is approximately three times the biomass that is actually collected.

The typical pruning frequency in the region is once every three years. Pruning is usually done from January to June; less severe pruning operations also occur from September to December. Due to the long time between cuttings, the biomass accumulation in the olive trees is high; **the typical biomass productivity is around 10 t/ha**. Usually, **the prunings are left for a period of 25 – 30 days on the field**; this is a sufficient time for the material to dry out and let the leaves fall off.

Winter-spring harvest yields an overall production of 110 t a day with humidity at 37 – 38 %, while autumn harvest yields 35 – 40 t a day with humidity at 15 – 16 %. Particularly, the former operation is mainly dedicated to branch pruning, and the latter is specifically focused on picking up the suckers at the base of each olive tree. This explains the limited amount of biomass collected in autumn. The overall quantity is sufficient to continually power the plant that requires 24 – 28 tons of prunings a day, depending on the humidity of the product.

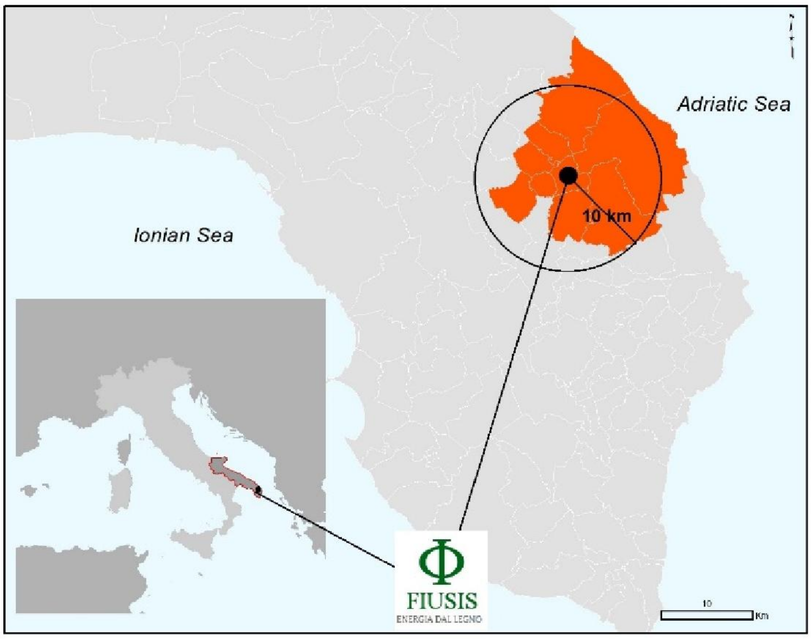

Figure 5. Supply basin of olive pruning within a radius of 10 km (Source: Fiusis).

Table 2. Agricultural surface devoted to olive groves and net olive pruning availability in the area near Fiusis (biomass moisture at field conditions).

Municipalities	C1: Utilized Agricultural Area *ha*	C2: Olive groves Area *ha*	C3: Surface density (=100*C2÷C1) *%*	C4: Net Available Pruning *t/y*	C5: Pruning surface density (=C4÷C2) *t/ha/y*
Calimera	281.03	261.05	92.89	1,138.5	4.36
Caprarica	394.4	294.91	74.77	1,141.0	3.87
Carpignano	1,281.33	943.22	73.61	5,334.9	5.66
Castri	353.43	299.02	84.61	1,534.3	5.13
Martano	539.74	256.17	47.46	888.9	3.47
Melendugno	3,549.21	2,903.23	81.80	9,787.0	3.37
Melpignano	161.58	116.37	72.02	405.0	3.48
Sternatia	512.46	218.07	42.55	751.0	3.44
Vernole	1,898.09	1,396.47	73.57	4,875.7	3.49
Total	**8,971.27**	**6,688.51**	**74.55**	**25,856.3**	**3.87**

Sources: C1 and C2 from the Italian institute of Statistics (ISTAT); C4 from the bulletin of the Apulia Region - no. 170 of 27-11-2012, Annex A

Fiusis employ two different harvesting methods depending on the size of the fields.

- **Value chain type 1**: for smaller fields, containing up to 400 trees (Figure 3.a and Figure 6). Farmers are responsible for aligning the prunings in windrows, while *Ligna* is performing the harvesting and chipping operation. For this, they use **three harvesters** (*FACMA*, *models TR200*), purchased in 2015, 2016 and 2017 (Figure 8 and Figure 11). Each machine can typically process 20 – 25 tons of pruning per each working day; the quantity can be somewhat lower (around 18 tons per day) when considering the time required for moving a machine from field to field.
- **Value chain type 2**: for larger fields, with more than 400 trees (Figure 3b and Figure 7). *Ligna* itself collects the branches with a front loader mounted on a tractor and make large piles at the field margins. A work platform with hydraulic arm and a spider grabber (Figure 9) is used to catch the piled material and feed it to a **static chipper** operating at the field margin. The machine used is a *Caravaggi* shredder (Figure 10) with a production capacity of 10 t/h.

Both operations result in the production of heterogeneous material. *FACMA TR200* produces a shredded material usually called *hog fuel* (Figure 12). The chipping operation of *Caravaggi* includes an initial shredding (hammer rotor) followed by a disc chipper. The material is more homogeneous, but still not as uniform to be considered woodchips. The particle size is appropriate for the requirements of the boiler.

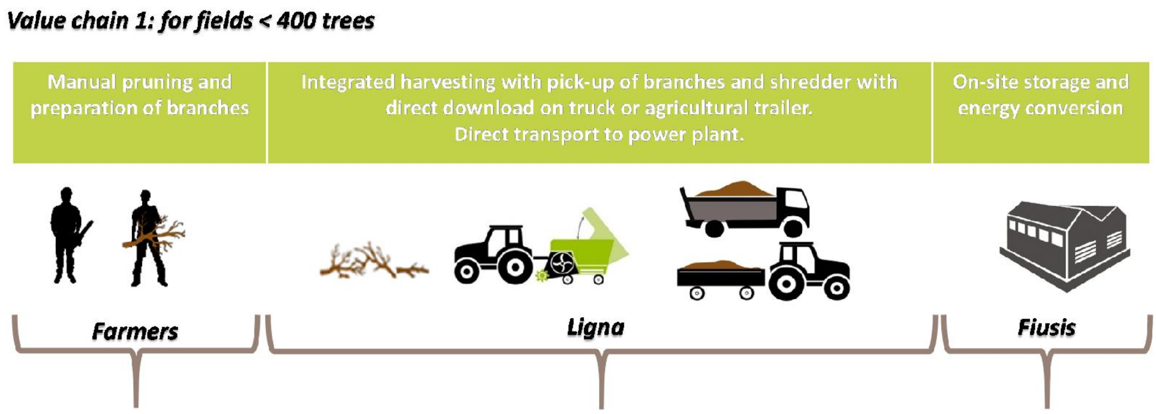

Figure 6. Logistics arrangements for smaller fields (less than 400 trees). Value chain type 1.

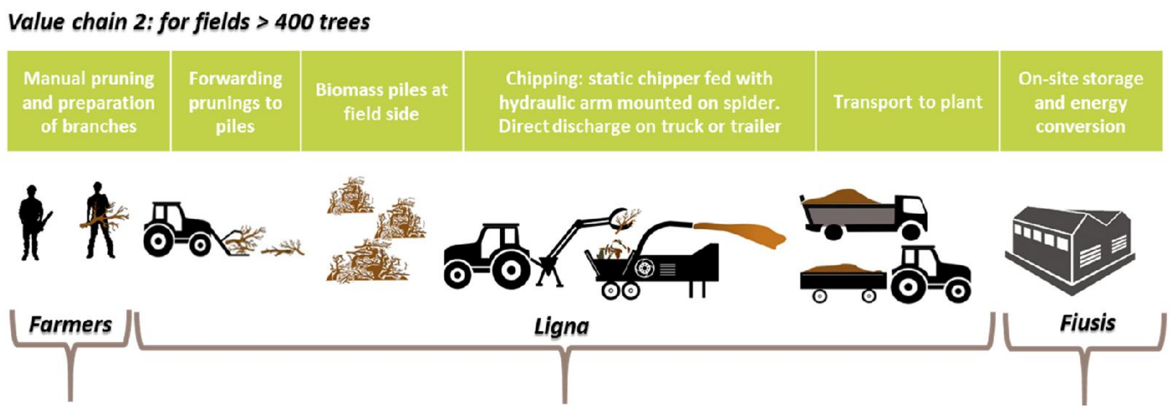

Figure 7. Logistics arrangements for larger fields (more than 400 trees). Value chain type 2.

Figure 8. A FACMA harvester (model TR200) adopted for smaller fields with less than 400 trees (Source: Fiusis).

Prunings in windrows or piles are left temporarily on the field (Figure 6 and Figure 7). The plant itself is equipped with a sheltered area for the storage of the biomass (Figure 13). The roofed storage capacity in the plant is around 400 tons, with plans for further expansion. From here, the hog fuel is transferred to the loading pit and supplied to the boiler through a system of rakes and conveyor belts. This supply system allows to use fuel with irregular particle size that favours air permeability, speeding up natural drying in heaps, while optimizing primary combustion in the fire-bed.

Plant operation requires a constant flow of biomass, but the volume of the logistics operations varies seasonally. During spring, where most of the prunings take place, the machines used by Fiusis to collect biomass treat around 110 – 120 tons of biomass per day. In autumn, this drops down to 35 – 40 tons per day.

Figure 9. A hydraulic arm and a spider grabber used to catch the piled pruning at the field margins when fields of more than 400 trees are considered (Source: Fiusis).

Figure 10. The static chipper Caravaggi operating in larger fields of more than 400 trees (Source: Fiusis).

Soil management and agronomic practices

Olive groves are predominantly traditional plantations, generally with plants over 50-year old and single specimens also frequently exceeding 100 years of age. Olive plants are largely spaced apart (usually 10 x 10 meters or even larger) and can reach remarkable heights and volumes. This traditional plant setting implies very high cultivation costs.

As a result, farmers try to reduce to a minimum the cropping operations and save money, in the first place by reducing the pruning frequency (once every three years or even more) and additionally by minimizing the soil mechanical operations. Some of these olives groves are characterized therefore by a state of partial abandonment. On the other side, some are considered “historical” monuments and protected by a specific regional regulation.

Irrigation is not the rule, but fixed irrigation systems are arranged sometimes through aerial irrigation pipes, from one tree branch to the other, along the plant rows; with drippers at the side of each tree canopy. A light harrowing is practiced in springtime to contain weeds in row spacing. Grass covering of the soil is not generally applied, considered too much competitive in water availability with respect to the tree crop. Olive harvesting is carried out by suspended nets between one plant and the other. These nets are no longer placed on the ground to avoid mould attack and the consequent olive oil quality shortage.

Tillage practices together with soil flatness and compaction at the end of the growing season and at the time of drupe ripening prevent pruning contamination with soil particles or little stones during pruning harvesting. One problem could be the high incidence of leaves in the harvested biomass. If the pruning is allowed to dry completely in the inter-rows, the leaf incidence may be significantly reduced.

Figure 11. A FACMA TR200 and a pile of collected olive pruning chips (Source: CERTH).

Figure 12. Indicative particle size of chips collected by the FACMA harvesters (Source: CERTH).

Figure 13. The roofed storage area at Fiusis (Source: Fiusis).

End use of APPR biomass

Fiusis electricity production facility bases on the Organic Rankine Cycle (ORC) technology, one of the few available options to convert boiler heat into electricity in small or medium sized units. *Unicomfort* and *Turboden* provided the two main components of the plant, the boiler (with moving grate and secondary combustion chamber) and the turbine, respectively. The power capacity of the turbine unit is 1 MWe, which provides production of 8,000 MWh annually (considering 8,000 operating hours per year). The plant owner takes pride in the fact that all major equipment used in the plant is 100% made in Italy.

The plant typically consumes **24 – 28 tons of prunings per day**, depending on their actual moisture content. **The electric efficiency is in the range of 24 – 25 %**.

The pruning chips consumed by Fiusis have **an ash content of 3 – 5 % on dry basis**. Due to the plant's proximity with the village of Calimera, special care has been taken to ensure that it meets all air emissions limits of the European and Italian legislation by installing all appropriate monitoring and control systems (e.g. filters). Thanks to the innovative filtering system, also Italian, fine particle emissions is only 1 mg/Nm^3, well under the legal limit set at 30 mg/Nm^3. It is also important to know that flue gasses are channelled into a filtration system consisting of 30 multicyclone filters and 702 stainless steel mesh filters. The emissions of the fumes through the chimney are drastically reduced, and the Regional Environmental Agency (ARPA) monitors the emissions.

The produced electricity is delivered to the national grid; the amount is equivalent 35% of Calimera's daily and 100% of its night-time needs.

Success factors and obstacles

The main success factors that made possible this initiative are summarised as follows:

- An important sensitization campaign was launched ensuring social acceptance by local population about the biomass plant.
- Renewable electricity was largely supported by a subsidized feed-in tariff of 28 c€/kWh for 15 years.
- The pruning surface amounts (t/ha) are significantly high considering that pruning is performed every 3 years (yields of about 10 t fresh matter per hectare).
- Pruning harvesting by the *Ligna* Company greatly simplifies the current management of pruning performed by farmers avoiding costly operations.
- The high density of olive groves in the area reduces the transport distances and the total area of the supply basin.
- A high joining rate of farmers in supplying prunings due to a good dissemination by Fiusis and the relevant advantages of the new kind of pruning management as solid biofuel.
- A good logistic performance of the harvesting process according to two different collection methods and able to coordinate approximately 1,200 farmers.

It is worth to mention that Fiusis developed social acceptability and consensus at local scale (within public opinion in the municipalities surrounding the energy plant facility). This effort was decisive especially in the first phase of the investment, i.e. in the time of the energy plant designing, authorization and construction as well as soon after that.

Local population commonly considers biomass burning in combustion plants a dangerous practice for public health; therefore, large opposition was detected during the biomass plant authorization process in less informed population. As a general reason of conflict, there was the fear that other types of fuels could be supplied to the energy plant and, in particular, industrial and/or municipal waste.

Therefore, an intense information campaign to promote social acceptance was displayed and agrarian residues utilisation for energy was subject of debate by local policy makers and social groups in the year before the investment was done.

Figure 14. Burning of olive pruning in the open fields is source of pollution (Source: UFG).

The main factor in convincing public opinion was the trade-off between uncontrolled and free open field burning of pruning in comparison to, alternatively, the controlled and safe conditions of burning inside the energy plant (Figure 13). The latter was much more acceptable than the former.

Another relevant reason that made easier to public opinion the idea to have a biomass energy plant in the area was the prevailing rural economy of the region and the large cultivation of olive groves as the dominant tree crop. Olive tree pruning, indeed, represents a great economic cost for farmers and the collection of pruning free of charge by the Fiusis personnel was considered a very interesting solution to the problem of pruning disposal. The use of agrarian residues for biomass was finally regarded by community as beneficial.

Disseminating a full understanding of the technical aspects connected to the energy production process starting from pruning (as a virgin wooden biomass) allowed to convince all those persons that were initially against the initiative.

On this respect, a very open behaviour and a strong attitude to establish a dialog was applied in regard to public opinion, environmental associations, policy makers, etc. Some relevant initiatives applied were the following:

- Devoting one day a week to the visit of the energy system by groups of citizens;
- Establishing agreement with the neighbouring municipalities in order to involve farmers in stopping pruning burning and adhere to the collecting procedures put in place by Fiusis.
- Participating to national and European events dedicated to renewable energy technologies and several dissemination initiatives; as a result of this policy, some awards and large public recognition derived to Fiusis;
- Starting information activities with students of the area, encouraging plant visits and producing didactic and informative material.

- Fiusis is supporting the municipality of Calimera through the free maintenance of urban green and financing social and cultural activities in collaboration with private associations and public institutions.

As a choice of maximum transparency, even the walls enclosing the energy plant do not hinder the view inside, so all people passing by can clearly observe the activity that takes place in the implant itself.

The plant authorization process was quite complex and very time-consuming. Moreover, Fiusis installed a network of sensors for monitoring the air quality, both inside and outside the biomass plant, giving the highest assurance about atmospheric emissions.

It deserves to be remarked that, according to the public statements of the owner, no public funds were used to finance the investment.

Lessons learnt

The Fiusis power plant took advantage of a good support scheme for renewable energy from biomass, but that was not the only factor behind its success. Indeed, without carefully planning and constantly adjusting the operations, it would not have been made possible.

The high biomass productivity in the area is another factor that helped reduce the cost of logistics and increased the profitability of the operation.

Finally, it is worth noting that a successful operation may face some initial difficulty, but it can generate a positive snowball effect after some time. The exponential increase of local farmers as fuel supplies of Fiusis is a proof of that. Mr. Piccinni remarks upon a memorable moment, when an 80-year-old local farmer approached his company to offer his fields for pruning collection. Thus, even farmers that many people would consider as “conservative”, set in their ways and impossible to change, may be persuaded by an arrangement that has proven as profitable for all stakeholders involved.

Future prospective

The Fiusis power plant has a contract with the state grid for a duration of 15 years. As a result, the continuation of the **current business is ensured for at least 10 more years**.

Further to this, the plant owner and manager, Mr. Piccinni, is interested in expanding the business activities in two new areas. The first is the **production of olive tree prunings pellets for the domestic / industrial sector**. This would require the installation of a biomass pelletization production line; no changes in the pruning supply scheme would be required, other than an expansion of the capacity.

The second business area is the use of the **biomass ash as a fertilizer**. Returning the ashes from pruning combustion to the field is a historic practice in the area that has fallen out of favor due to the application of artificial fertilizers. Currently, Fiusis is collaborating with the University of Foggia in order to characterize the ashes and check if there is a possibility for their application on the fields in line with the Italian legislation.

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