From forest to furnace: optimising the wood-for-energy sector around the Mediterranean Rim

by Nicolas JOLY

Today, the development of renewable energy has become a major issue in which biomass occupies a special place. How can we increase the recourse to forest biomass usable for energy production around the Mediterranean Rim in a way that is sustainable economically, environmentally and socially? This was the question asked by the partners in the Proforbiomed project. This article presents a summary of the main work undertaken during the project. Over and above the technical results, the development of biomass is even more an opportunity to « reconcile forests and woodlands and their stakeholders with the expectations of the wider public ».

The Proforbiomed project

The objective driving PROFORBIOMED is the development and promotion of biomass coming from forests and woodlands to establish a truly sustainable wood-for-energy sector around the Mediterranean Rim with the emergence, over the middle term, of a market for biomass for energy.

At both European and local levels, the development of renewable sources of energy has become, for a number of reasons, a major issue:

– in the struggle against climate change;

– in the independence of countries producing fossil fuels;

– in safety (low risk of accidents, low impact of any actual accident…).

In energy science, the term "biomass" encompasses all organic matter that can generate energy directly through combustion or after a transformation stage. Thus, biomass includes not only wood coming directly from forests but, also, the biodegradable fraction of industrial or agricultural waste.

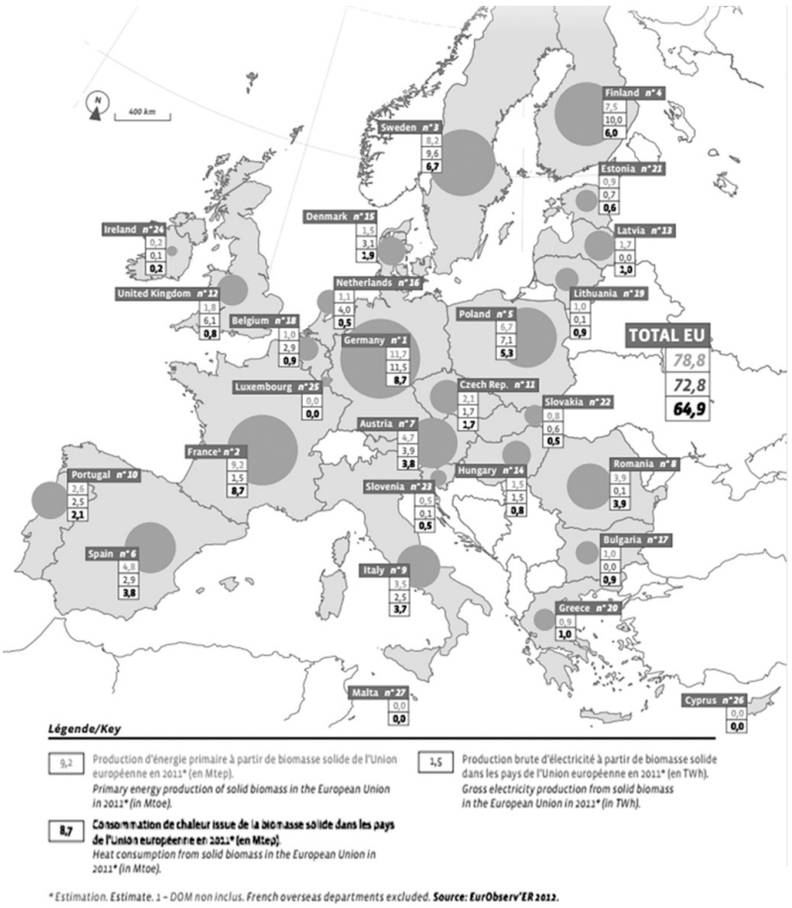


Fig. 1: Primary energy production, gross electricity consumption and heat consumption from solid biomass in the European Union in 2011.

In the mix of renewable energy in France, biomass occupies a special place. First of all, biomass is France's leading source of renewable energy with 10.8 Mtep consumed, all types included (source: ADEME, the French organization supervising renewable energy), see Fig. 1.

This form of energy is expected to undergo major development in the light of the French objective of "three times twenty" (17% reduction in greenhouse gases (GHG), 20% reduction in energy consumption by 2020, 23% of renewable energy in total energy consumption by 2020).

However, is this ambition compatible with truly sustainable development? In the economic context, tension in the supply line is likely, especially with the pulp sector. An increase in the use of this resource may also entail risks for the environment due to local over-use, methods of exploitation whose impact is less well understood than that of traditional technology, and the development of technically unsatisfactory wood-fired stoves for heating that will produce concomitant air pollution.

Also, public sentiment about cutting and felling is crucial. Rural and peri-urban populations are not enthusiastic about the arrival of noisy large-sized forestry vehicles and equipment in the forests and woodlands where they go for family walks on the weekend. Forest landowners, sensitive to the price of their own "peace and quiet", are most often reticent about exploiting their forests.

With these facts in mind, the PROFORBIOMED project was committed to an audit of the hindrances to the development of the use of biomass in the different partner countries involved in the project and to seeking ways, both technical and political, to overcome such obstacles.

To limit scattered holdings, regrouping in private forest landowners' associations

The scattered pattern of landholdings is one of the most frequently-cited explanations for the absence of management.

1/3 of privately-owned forested land can be managed independently

There are a certain number of forest properties that are sufficiently large to permit their independent management, with felling thus decided by their individual owners. Such owners, if they overcome the reticence referred to above, can each adopt a *Plan simple de gestion*, or simplified management plan, which aims to provide a framework for a felling programme nowadays likely to incorporate improvement of stands and the production of a better quality of timber.

But for the remaining 2/3 of this area, sustainable management implies collective action

On the other hand, there are a large number of forest landowners whose properties are too small to permit rational forestry management on them. Any such owner, if s/he decides to adopt such a type of manage-

ment, must first overcome the same reticence mentioned above, then group together with neighbouring owners who have also overcome such reticence and are also convinced of the worth of the method: it hardly needs to be said that such spontaneous initiatives are extremely rare. When they do occur, it is usually the result of an outside dynamic or "recruitment" effort generated by a forestry advisor, a felling or timber company, a forestry consultant or, occasionally, a convinced forest owner on a "mission" who is attempting to spread the word.

One must be aware that such regrouping operations represent a fastidious effort: on account of the very large number of owners involved, a great deal of time must be spent for success. Furthermore, a great deal of persuasion is required to avoid having to bring in a surveyor in the middle of a forest to determine the exact limits of enclaves belonging to owners refusing to participate; such surveys are very difficult due to the absence of reference points and the little knowledge owners have about the contours of their plots.

Within the framework of the PROFORBIOMED project, we considered that it was important to work on these aspects in order to ensure the future reliability of the wood-for-energy sector. If the supply is going to be increased, it will be indispensable to work closely with forest landowners in order to win them over to active participation. Such an approach implies new ways of working in order to overcome the obstacles described above.

Why work with elected representatives?

The dynamic generated by the development of wood for energy seemed to us an opportunity to go beyond the obstacles referred to above and work with local elected representatives, thus benefiting from the image they have of being close to their electors. Because municipal councils are involved to very different degrees in this issue, we decided to seek the involvement of those representatives who were already interested in or aware of wood as a source of energy in order to develop effective synergy with them in the work of the project.

The second idea was to restrict work to limited areas in order to test, in partnership with local and regional authorities, new methodologies for contact with the landowners. Analysis of the strengths and weaknesses highlighted by the tests involved should facilitate action in larger areas.

The approach via the wood-for-energy sector at the local level and work with local elected representatives seemed to us an excellent strategy for getting across to the private forest landowners the message from the CRP concerning the sustainable management of their holdings which are extremely numerous and scattered in the Provence-Alpes-Côte d'Azur Region (PACA) -220,000 hectares out of 1 million.

First methodology tested

After establishing contact with the Aix District Government Council (CPA), we began work with two municipalities: Saint Cannat and Lambesc. The aim was to test the different methodologies for each stage of the pilot action:

– contact forest owners with the back-up of the local elected representives;

– presentation of PROFORBIOMED and the action it envisaged in the area involved;

– an attempt at regrouping.

In fact, the most laborious aspect in mobilising the wood-for-energy resource in private hands is to obtain the authorisation from a forest owner to fell trees on his or her plot. Because the economic interest is very low in our regions (wood coming from stands that have never benefited from silvicultural management and scattered plots), raising the awareness of the owners is better done by other means. Wildfire prevention and protection has often been a way in; at present we are seeking to test whether the development of wood for energy could be another.

As stated in introducing the project, we have worked in close collaboration with local elected representatives as a way of obtaining local backing for our undertaking. The objective was obviously to first involve the landowners and enhance their awareness, to ensure they would commit to our project, by explaining in as much detail as possible the nature of the work of each body involved (CRPF, municipal councils, service providers…).

The village of Lambesc showed the most immediate interest; hence, we set up our first trial within its confines.

1 - http://www.ofme.org/crpf/projets-europeens.php?NoIDP=2

Before lauching any action directed at privately-owned forests, we wanted to « check the pulse » of the owners via a questionnaire designed in collaboration with the municipal council, the CPA and the *Syndicat des propriétaires forestiers sylviculteurs*, the owners' professional association. This questionnaire was sent by post so as to contact as quickly as possible a large number of people. Its purpose was to learn about their expectations concerning their forests and woodlands, the obstacles they met with as well as their projects and, lastly, their views on wood for energy. The survey also enabled us to see whether collaboration between publicly- and privately-held forests was a relevant option in this locality. The replies were kept anonymous in order to ensure the sincerity of the replies and increase the overall number of returned questionnaires. Given the highly-fragmented pattern of private forest landholdings in this municipality, it was decided in cooperation with the municipal council to contact all owners with more than 0.4 ha (around 300 people).

The questionnaire was accompanied by a letter co-signed by the CRPF, the mayor of Lambusc as well as the president of the Syndicat des propriétaires forestiers silviculteurs of the Bouches-du-Rhône *département*, along with an invitation to a presentation meeting at the town hall. The deadline for reply was fifteen days, either by returning the reply to the headquarters of the CRPF or by depositing it at the town hall. Rapid treating the questionnaires was facilitated by Excel software for logging and analysing data.

The analysis of the results was the object of a public meeting held in the town hall offices to which all owners involved were invited. A presentation sheet was given to everyone who attended and was sent to all absent owners. A PDF version is available of the CRPF web site [1].

For the operation at Lambesc, the rate of reply was 13%, representing 20% of the overall area. This is a very honourable level for this type of survey.

This first trial run at Lambesc enabled us ot identify several aspects of our methodology that needed improvement. The first was the threshold used in contacting the owners: the cut-off at 0.4ha was felt to be too low by some people while others found it too high and, above all, it engendered much discontinuity between the plots. Consequently, for our action at Saint Cannat we decided to choose a wooded area on which to focus our efforts. We thus contacteed all the owners with holdings in the area of the La Trévaresse massif without applying a threshold. The fact that the salient aspects of this area had been previously identified was indicated in a letter accompanying the questionnaire so that the owners could realise that preparatory work had been carried out. Also, the questionnaire was slightly modified to better reflect the local topics of concern.

It is worth noting that the rate of response for this second questionnnaire attained 29% in number and 33% in area represented.

At the public meeting, an information sheet was distributed detailing the main results of the survey. It can be consulted on the project's web site.

In parallel to this operation, a call for tender was put out to select a contractor who would carry out operations on the land of the two municipalities in accordance with the provisions of the specifications document. The contractor chosen was required to follow the protocols supplied by the CRPF.

The reports for the two work sites run by the Alcina company are available on the project's web site. The work took place at:

– Lambesc: 12.2 ha, 5 owners,
– Rognes: 22.4 ha - 4 owners
– Eguilles: 13.6 ha - 2 owners.

This made for a total area of 48.2 ha of thinned pine forest in zones that had never been worked, for a volume of recovered wood in the order of 2,000 m^3 at a cost of €14,000 exclusive of VAT (and not including the writing of reports of meetings etc.). This represents a cost of about €7/m^3.

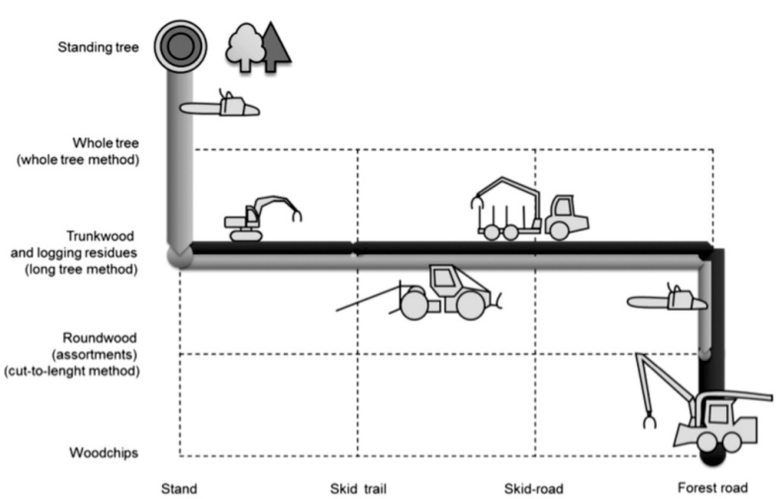


Fig. 2:
Flow chart of roundwood production, including skidding to forestry track, in Slovenia. The trees, felled by hand and debranched, are skidded to the trail edge where the crown branches are chipped and the logs exported.
Source Proforbiomed Report

Methodologies tested to favour optimal mobilisation of wood for energy

In parallel to the work of the CRPF , the other partners in the project studied the more technical aspects of the mobilisation of biomass.

The cost of each stage of production was monitored for each working site in order to offer wood chips at a sales price taking into account the production costs.

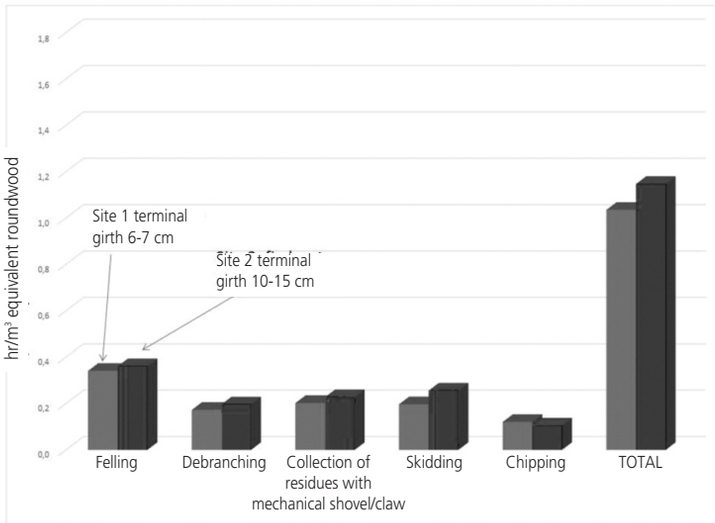
To facilitate the clear and accurate understanding of the actions undertaken, a series of charts shows the stages of the work in the forests (see Fig. 2).

The Slovenian partner tested two methods of manual felling: on the first site, the lumberjacks debranched to obtain a terminal girth of 10-15 cm. On the second site, the terminal diametre was 6-7 cm. On both sites, the residues were ground on site to produce wood chips. Thus, site 1 favoured wood for energy at the expense of roundwood whereas site 2 favoured roundwood.

The production of wood chips thus costs €17.68/m³ equivalent roundwood (er) for site 1 and €20.41 for site 2, making a difference of 15%. This difference is attributable in the main to the skidding operations (See Fig. 3).

Making wood chips out of broadleaved species: a strange idea?

The Slovenian partners also tested the idea of the profitable use of a broadleaved species (*Ostrya carpinifolia*) for wood chips. Two sites were involved:



	Felling	Skidding (avg. distance=500m)
Site 1 (entire tree)	6.42 m³ er/hr/man	3.31 m³ er/hr/man
Site 2 (roundwood)	3.19 m³ er/hr/man	1.85 m³ er/hr/man

Er = equivalent roundwood

– on the first site, the operation was based on the entire tree: the tree was felled by hand then skidded whole to the edge of the road using an agricultural tractor fitted with chains, then chipped.

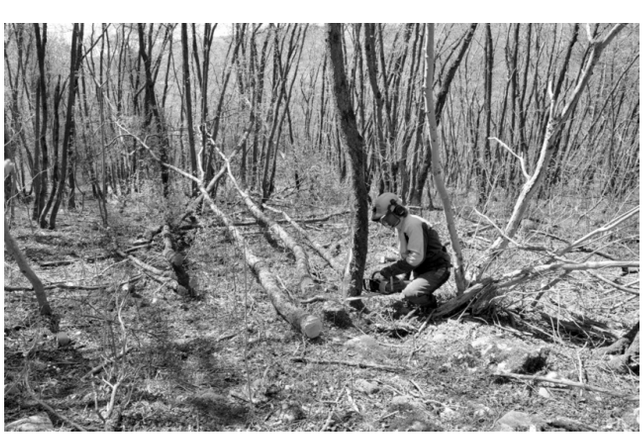
– on the second, the trees were felled and debranched in the forest prior to their transfer to a storage facility. The residues, after reduction to lengths of less than a metre, were left *in situ* in accordance with the stipulations of the forestry regulations in effect on the site.

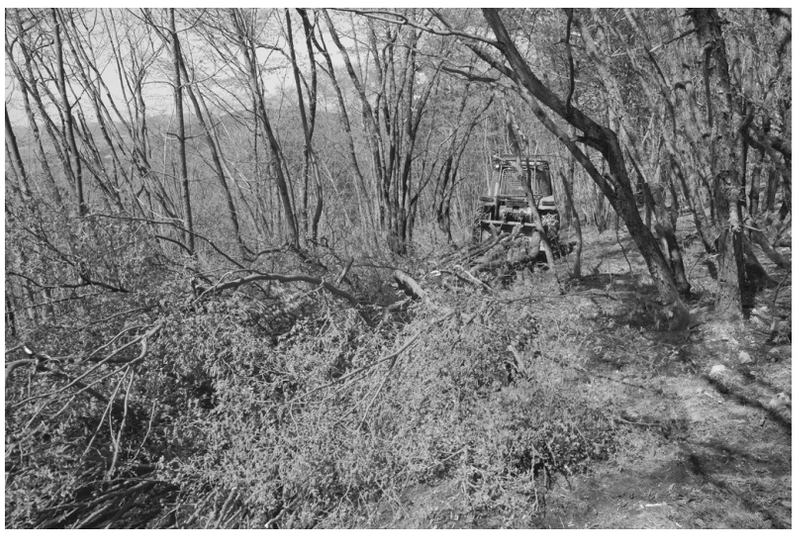
The yields are shown in table 1.

Fig. 3 (above):
Breakdown of time taken for each stage of wood harvesting for each site. Because roundwood and wood chips were produced on the same sites, the units of volume have been converted into «equivalent roundwood».
Source Proforbiomed Report

Table 1 (above):
Yields obtained by the Slovenian partner.

Pictures 1 & 2 (below):
Showing lodgging operations in a coppice of *Ostrya carpinifolia*.
Author Matevž Triplat





Picture 3: Skidding residues of *Ostrya carpinifolia* with a tractor. *Author Matevž Triplat*

As to the sale of wood, it was the owner who chose the logging contractor. The feling was done on both sites at a cost of €16/tonne of wood at the road edge. The owner sold the logs for €36/tonne and the wood chips for €44/tonne. Grinding/chipping cost €11/tonne.

Whole-tree logging in Catalonia

The Catalonian partners of the CTFC tested and compared several methods of felling. Of the methods for making profitable use of the entire tree, two were tested :

In a first section of the stand, the whole tree was harvested using a felling head of the type used at our on-site demonstrations.

In a second section, felling was by hand, the felling head being used only to pile up the trees to facilitate the skidding operation.

The yields were as follows:

– Felling head (felling+stacking): 2.2 tonnes/man/day

– Felling by hand: 4.3 tonnes/man/day

– Felling head (stacking only):1.3 tonnes/man/day

And the costs :

– Felling by hand+stacking+skidding = €68.7/tonne

– Mechanised felling+ mechanised stacking+skidding = €46.3/tonne

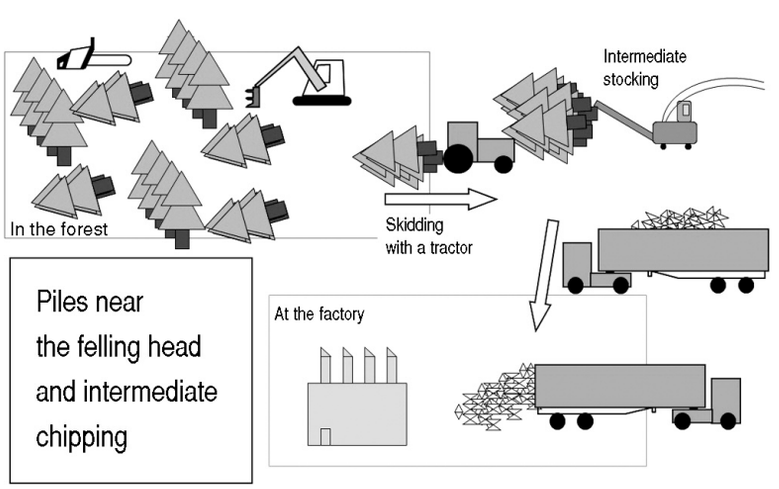
The trees were skidded using an agricultural tractor pulling with chains (See Pictures 4 et 5).

In these conditions, the yield for skidding was 1.97 tonnes/man/day.

This operation was cost-free for the owners: they received no payment but now have managed stands in better condition. In future, the wood will be of better quality with profits to match.

The average price paid by the Borges Blanches factory is €35/tonne.

Fig. 4 : Logging flow chart with intermediate stocking. The trees are skidded with an agricultural tractor using a chain then taken to an intermediate stocking area for grinding/chipping.



Finding other sources of wood

Some partners attempted to find other technical or socio-economic methods to mobilise additional wood; others focused on new sources of biomass to meet the demand for wood-for-energy : pruned branches from fruit orchards, growing other fast-growing tree species and tests on pellets made from as-yet-unused species.

Dedicated plantations

Another source of biomass consists in planting very fast-growing species which will be cut down for the rapid production of large quantities of biomass after only a few years of growing. Such intensive methods of production have been tested in Spain with Pawlonia. The trees, planted in 2012 at a density of 1,600 trees per hectare (4m x 2m), will be harvested in 2015. The trees are irrigated with a drip system and benefit from a nitrogen input in the form of ammonium nitrate at 350 kg/ha/yr.

The method is the object of much criticism and does not seem of likely use on a large scale in our region. Nevertheless, the work done on harvesting techniques and yields can be applied to invasive species such as mimosa and tree of heaven (*Ailanthus*)... for which as yet there is no market.

Efficient collection of fruit orchard prunings

The Agency for Energy Management of the Murcia Regional Government Council has studied ways of gathering the residues from fruit tree pruning. In this region, where fruit production is highly developed, such residues may well supply significant quantities of biomass. By optimising the collection process, the cost of collecting the residues were reduced from €50/tonne to €27.

Pellets from mimosa

Forest biomass can also take the form of pellets, a form which is currently expanding at a boom rate worldwide (global production 19 million tonnes in 2012). At present, even very powerful central heating plants in the United States and Canada are running on pellets.

Work by the CICAE, a Portuguese technical institute, on pellets obtained from typically Mediterranean vegetation has proved particularly interesting. They made pellets from tree species such as maritime pine, eucalyptus and mimosa but, also, from bush plants such as lavender and cists. They also made pellets with half mimosa and half shrubs and carried out comparative tests with 100% pine pellets, measuring their calorific value and technical characteristics (moisture level, ash, density, mechanical resistance and amount of small particles).

The highest calorific value was obtained with a mixture of half pine wood and half mimosa branches. The results were within the acceptable range, thus offering new perspectives. However, studies need to be carried out on the operational and economic feasibility of the products.

These results are available on the PROFORBIOMED project's web site.

Picture 4:
Agricultural tractor with load. On average, each rotation ensured the skidding of 12 trees.

Picture 5:
The chains referred to.

Author Ignacio Lopez

Conclusion

The work carried out by the different partners enabled them to be both particularly creative in the methods they designed and tested and inventive in the emergence of new partnerships. One can synthesise the impact of the development of the wood resource by stating that it can trigger off a number of developments.

It can trigger off the implementation of silviculture in stands that, as of today, have no commercial outlet likely to cover the operating costs involved. Thousands upon thousands of hectares of forest can now be incorporated into the positive world of silviculture with its promise of future products with high added value and the maintaining and improvement of the services forests and woodlands provide (quality of the air, quality of water, carbon sink, landscape, leisure activities...).

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It can trigger partnerships between forestry professionals and local and regional stakeholders who are seeking to promote renewable energy based on local resources and partnerships with operators in the energy sector who want to diversify their fuels and save money.

On the other hand, there will be the triggering of effects that will require attention if the consequences of the development of wood-for-energy are to remain beneficial. In the first place, the environmental impact on biodiversity and the non-commercial services provided by forests must be born in mind and, when necessary, contributions made to offset the costs of such impact. Furthermore, triggering of silviculture is only reasonable if at the same time there is effective backing for the development of the primary transformation sector.

In concluding the final seminar organised in Marseille on June 20, 2014, the participants agreed that the development of biomass represented an opportunity to « reconcile forests and woodlands and their stakeholders with the expectations of the wider public ». In addition to everything that forests provide in the way of services and material goods, they must also be seen as the source of local renewable energy. For society as a whole, this will mean a guarantee of independence for a strategically vital possession, the sustainable use of the planet's resources and a tool for local development.

The details of the pilot projects are available on the website http://proforbiomed.eu

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Summary

How can we increase the recourse to forest biomass usable for energy production around the Mediterranean Rim in a way that is sustainable economically, environmentally and socially?
This was the many-facetted issue tackled by the eighteen partners involved in the PROFORBIOMED project. Superimposed on the European and global context of converting to new sources of energy and their sustainable development are more local issues: sustainable local use, pressures on the resource, the introduction of the products onto pre-existing markets... In order to respond in the most exhaustive manner possible, various slutions were tested and improved: reducing production costs through improvements to existing operational logging techniques, trials of new equipment, enhanced contacts with forest landowners, stugies for new installations of heating furnaces... This article presents a summary of the partners' main activities.

Résumé

Comment augmenter la mobilisation de biomasse forestière à vocation énergétique dans le bassin méditerranéen, de manière durable sur les aspects économiques, environnementaux et sociaux ? Telle a été l'équation aux nombreux paramètres qu'ont cherché à solutionner les dix-huit partenaires du projet PROFORBIOMED. Aux contextes européen et mondial de transition énergétique et de développement des énergies renouvelables, se superposent des problématiques plus locales : mobilisation durable, pression sur la ressource, de ventilation des produits sur les marchés existants... Pour répondre de la manière la plus exhaustive possible, différentes solutions ont été testées et améliorées : diminution des coûts de production grâce à l'amélioration des techniques d'exploitation existantes, test de nouveaux matériels, amélioration du contact des propriétaires de la ressource, étude de nouvelles implantations de chaudières… Cet article présente un résumé des principaux travaux menés par les partenaires du projet.