



FOsteRing Efficient long term Supply parTnerships

Final Project Report



INTELLIGENT ENERGY
EUROPE



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1 Executive summary

The FOREST project has been supported by Intelligent Energy Europe (IEE), a European programme which aims to remove market barriers to the wider adoption of measures that will improve energy efficiency and increase the uptake of renewable energy technologies. Biomass technologies offer a sustainable, low carbon alternative to fossil fuels in a great many heating applications but in order to provide a viable alternative end users and specifying clients must have complete confidence in the total bio-heat system. The primary aim of the FOREST therefore, has been to promote and support the development of integrated supply chains in the biomass heating sector.

Biomass heating with wood chips and pellets is technologically mature, having been developed in countries like Austria and Sweden over more than three decades. However in regions where the biomass markets are less well developed, some of the early experiences with biomass have been mixed. Problems experienced by early adopters can often be attributed to supply chain difficulties rather than technological ones, so the FOREST project has targeted actors from across the supply chain, from the production and supply of the fuel to the installation and maintenance of the boiler systems, to help them consider how they can provide more integrated solutions. The project has also engaged with architects, engineers, educators and specifying clients, who are all seen as key target groups. The aim in each case is to help providers and consumers understand the interdependence of elements within biomass systems and between actors in the wider supply chain.

The project has been carried out by nine partners from seven regions in Austria, Ireland, Italy, Poland, Spain, Sweden and the United Kingdom. A key element of the project has been the exchange of technical knowledge and market experience from partners and businesses in more developed markets to those where biomass is less well developed. The focus has been on non-domestic applications from 100 kW to 1 MW as well as small to medium scale CHP and district heating up to 10MW as experience has shown that developments in this market can often provide the critical mass on which to build effective supply chains. Existing fossil fuel supply chains are well established and the technologies are more widely understood so providing a comparable service in an immature market can be difficult. Lessons learnt in Austria and Sweden indicate that increasing the level of cooperation and partnership working between supply chain actors can help to deliver a high level of service in developing biomass markets which builds confidence in the total bio-heat system and encourages investment from non-domestic and larger heat users.

Work to develop the supply chains has consisted of three main types of activities:

- The development of best practice guides and tools focused on supply chain business models, the importance of standards, and consideration of biomass as a whole system rather than as individual elements.
- Business to Business networking and direct learning from experienced practitioners to stimulate the development of new and more integrated ways of working coupled with a wider appreciation of supply chain issues.
- Building capacity in the supply chain through training seminars and advice to individual businesses, while encouraging new and existing trade organisations to adopt a whole supply chain approach.

This report describes the actions that have been carried out in the different regions over the course of the project and the rationale behind them. It should also act as a signpost to the materials produced, all of which can be accessed on the project website at www.forestprogramme.com. Although the project itself has finished, all of the partners are actively engaged in developing different aspects of the biomass supply chain, and can be contacted for local advice and information.

Key findings/summary of lessons

Successful biomass installations require input from actors with different areas of expertise, in forestry and agriculture, fuel production and logistics, system specification and design, installation, operation and maintenance. The extent to which supply chain operations overlap or depend on each other to work efficiently means that failures in individual parts of the system can be extremely detrimental to overall performance. Out

of specification or contaminated fuel, poor access for fuel deliveries, oversized boilers, undersized thermal stores and a lack of suitable training for operatives can all contribute to difficulties.

In developing markets coordinating biomass projects may fall to end users or specifying clients who can soon be overwhelmed with the relative complexity of installations. This acts as a disincentive to some but can also lead to poorly implemented systems. In advanced markets many businesses operate as Energy Supply Companies (ESCOs), providing all of the necessary biomass services on the basis of heat contracts, effectively shielding end users from all operational aspects of the system. With a single, experienced company taking responsibility for all aspects of the installation, the ESCO model has been shown to deliver reliable and customer orientated biomass solutions.

The ESCO model is hard to reproduce in its entirety in developing markets but a great many problems are easily avoided through better communication and closer integration of supply chain activities. In the interim, businesses that have developed of closer working relationships and partnerships have shown how they can provide successful installations and high quality services. The difficulty in these regions is that businesses are necessarily driven by competition and the benefits of cooperation are less apparent, particularly where markets are relatively small. The aim of FOREST and similar projects is to demonstrate elements of best practice in the biomass sector using case studies and successful examples of collaboration.

The relatively high capital costs of biomass systems are usually recovered in the longer term through lower fuel costs and provide additional stimulus to local economies. Despite economic and environmental advantages, supply side initiatives are not sufficient to drive the markets for biomass on their own. Government incentives and regulations play an important role in stimulating demand by rewarding desirable behaviour and taking into account the societal cost of polluting behaviour. To be effective these policies must be designed to work together and must be expected to operate in the longer term as inconsistency in policy making can have a detrimental effect on the confidence of businesses and end users.

The level of participation at FOREST events in all regions has demonstrated serious interest in biomass technologies and at the same time there are large amounts of resources which remain underutilised. Resource assessments in many regions indicate considerable reserves and through sustainable management even Sweden, where utilisation is much higher, can demonstrate that biomass policies have resulted in net increases in forest growth. Under managed woodland with poor access, or inaccessible terrain remain a challenge and significant investment may be needed before the material can be accessed economically. The expected contribution from energy crops has not yet materialised in many regions, partly as a result of the longer term investment that is required by farmers but also because of sensitivity to growing fuel over food. Fuel derived from energy crops such as miscanthus or agricultural residues also require more specialist equipment for smaller scale combustion, due to the larger amounts of ash produced and lower ash melting temperatures. There are concerns about sustainability and emissions, particularly where air quality is an issue, and the industry must be prepared to continue to respond positively to critics through continued research and the adoption of best practices.

2 The FOREST project and partners

The need for renewable sources of heat to replace fossil fuels has seen the development of increasingly sophisticated wood chip and wood pellet heating systems, as well as larger district heating and Combined Heat and Power (CHP) schemes. The widespread adoption of wood heating technology, particularly at the larger scale, in countries like Austria and Sweden has seen many benefits including reduced CO₂ emissions, less reliance on fossil fuels and boosts to local economies involved in the bio-heat supply chain. The level of maturity in non-domestic bio-heat markets varies considerably, outside of established markets in Austria and Sweden, where biomass is considered mainstream, the technology is often seen as novel and knowledge remains limited. The FOREST project aim has been to improve this situation by sharing knowledge of different supply models across its partner regions.

The FOREST partners come from regions in Austria, Sweden, Spain, Poland, Italy, Ireland and the UK (Figure 1, Table 1), there is a wide geographical spread and the main lessons from the project should be relevant to many other regions where biomass heating is being developed. Individual project partners are well connected and are all experienced in providing support for businesses as well as local and regional authorities. Most have previous experience working in the bio-heat sector and have been well placed to engage with the businesses to promote the knowledge sharing and networking activities. There are also well-regarded technical organisations that have provided sector specific expertise to help develop the best practice guides that form the basis for other activities.

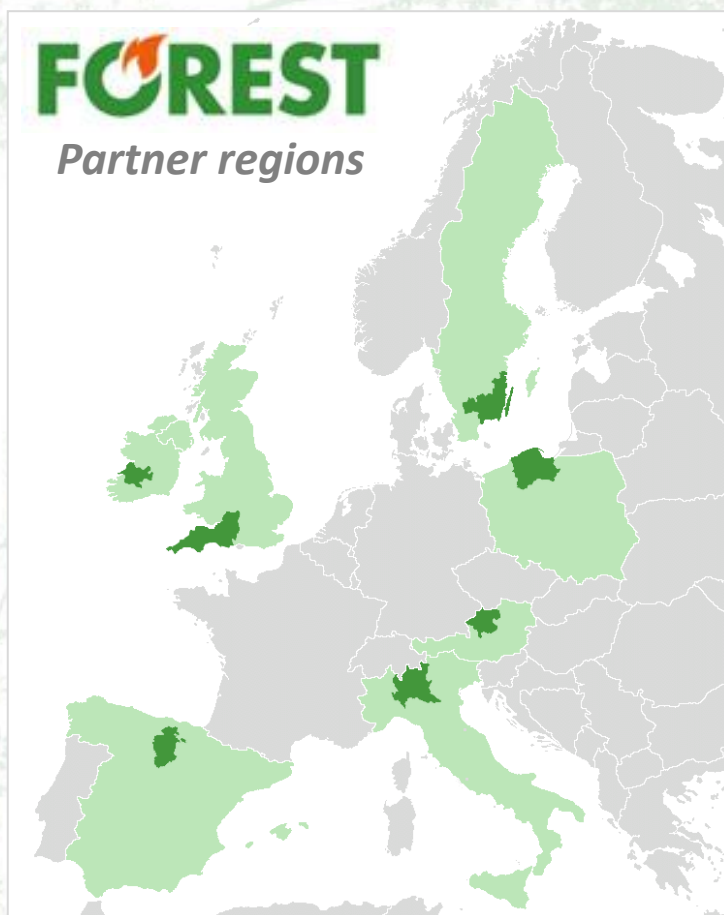


Figure 1 - FOREST partners and regions

For more details about the FOREST project partners and regions see:

www.forestprogramme.com/about/partners

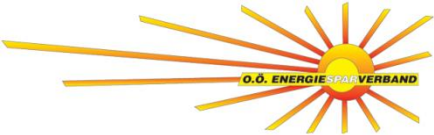
 Centre for Energy and the Environment	Centre for Energy and the Environment (CEE), University of Exeter FOREST project coordinator. Research and consultancy group specialising in energy and sustainability in the built environment. Provides technical and strategic support to local authorities. Supported in FOREST by the Centre for Rural Policy Research (CRPR).
	Regen SW Not-for-profit organisation helping businesses, local authorities, and communities to deliver sustainable energy projects. Ran the SW Bio-heat programme on behalf of the South West England Regional Development Agency (SWRDA) and Forestry Commission.
	Forestry Commission (South West Region) Supporting the SW Bio-heat Program and FOREST through Regen SW to support the growth of the wood fuel supply chain and the development of undermanaged woodland.
	Severn Wye Energy Agency (SWEA) Regional energy agency established as an independent not-for-profit company in 1999, promoting sustainable energy and affordable warmth in Gloucestershire, Wiltshire and Powys.
	Energikontor Sydost (ESS) Energy Agency for Southeast Sweden, a development and information centre promoting energy efficiency, renewable energy sources and support regional development.
	Bałtycka Agencja Poszanowania Energii SA (BAPE) Energy Agency for Pomeranian Poland, promotes energy efficiency, rational energy utilization and wider usage of renewable energy sources, including legal, financial and environmental challenges of sustainable energy development.
	O.Ö. Energiesparverband (ESV) Energy Agency for Upper Austria provides comprehensive information and awareness raising on sustainable energy production and use, organiser of the international conference, <i>World Sustainable Energy Days</i> (WSED), and manager of the Oekoenergie-Cluster (OEC).
	Comitato Termotecnico Italiano (CTI) Independent no-profit association affiliated to UNI (Italian Standardization Body) undertakes standardization work in thermal energy production, distribution and utilization in collaboration with private industries, public bodies, agencies and associations.
	Tipperary Energy Agency (TEA) Aims to lead and support Co. Tipperary to reduce its CO ₂ emissions by stimulating and contributing to the implementation of best practice in the field of sustainable energy. Undertakes energy auditing, integration of renewable energies and feasibility studies.
	Agencia de Provincial de la Energía de Burgos (AGENBUR) Energy agency for the Province Burgos in northern Spain. Develops and promotes the rational use of energy through policy and public awareness campaigns. Provides technical advice and project management through feasibility studies and energy audits.

Table 1 - Summary of FOREST partners

Experience from developed markets has shown that supply chain factors play an important role in the successful implementation of biomass systems, weak links in the supply chain can lead to poor quality fuel, incorrectly specified boilers and inadequate maintenance regimes, all of which undermine consumer confidence and can be damaging to the industry as a whole. There are a number of different actors that can make up a supply chain (Figure 2) and a successful market requires all of these actors to be in place at the same time. Failure at any part of the supply chain can seriously undermine the installation or performance of a biomass system. A successful and sustainable market is dependent on customer confidence in biomass technology, and each member of the supply chain must be clear on their role and responsibilities in the final delivery of heat to the customer. Without confidence in the whole supply chain, bio-heat will struggle to compete with fossil fuels where the supply chains are well established.

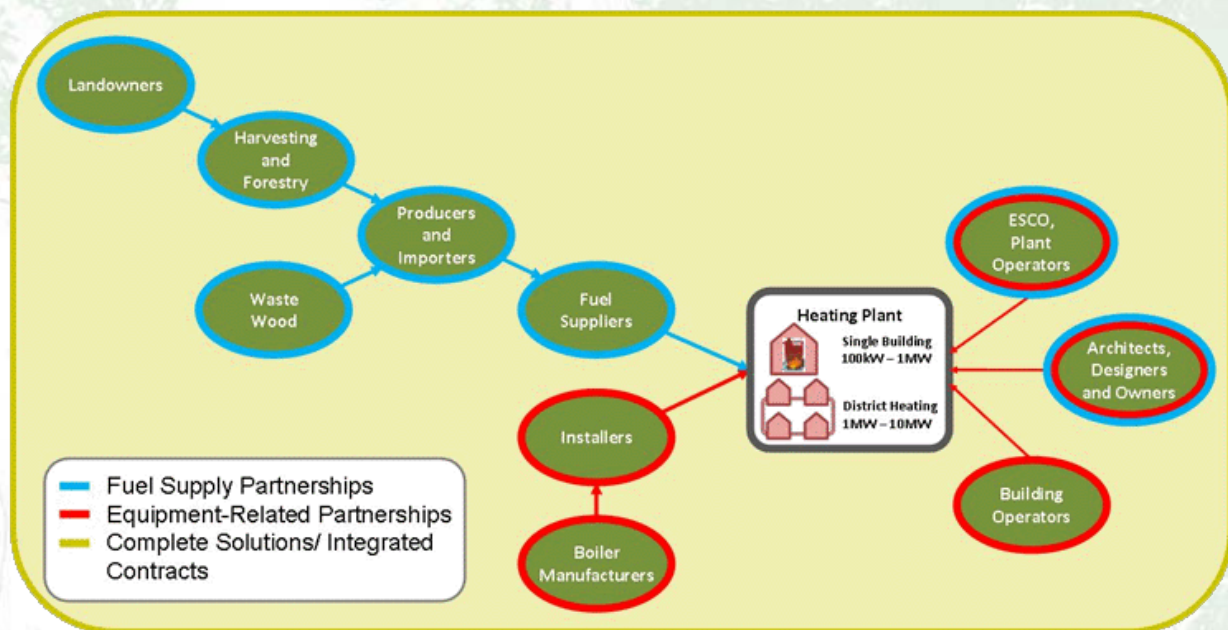


Figure 2 - Schematic of the biomass supply chain

The FOREST project has investigated the biomass supply chain, from the harvesting and production of fuel, to the installation and maintenance of the boiler systems, in order to find successful supply models which may be adapted to local conditions. Through the development of their own markets, providers in Austria and Sweden have learnt that where knowledge and experience of biomass are limited, partnering with other supply chain actors to deliver better services can increase rate of successful installations. The project has been focussed on solid biomass for non-domestic heating applications (100 kW to 1 MW) and small to medium scale CHP and district heating (up to 10MW) as these are the scales which can provide a 'critical mass' from which supply chains can develop. FOREST has worked directly with a number of bio-businesses in an attempt to develop and consolidate longer term supply chain partnerships that will give the end user confidence in the total bio-heat system and so encourage investment from larger non-domestic heat users. The work to develop the supply chains has consisted of three main types of activities:

- The development of a best practice guides focused on supply chain business models, standards, and the specification and design of bio-heat systems;
- Business to business (B2B) networking across a wide range of businesses to promote the exchange of knowledge between business in the supply chain and their clients, and to facilitate the development of new partnerships;
- Direct capacity building through individual businesses advice and support to develop new supply chain partnerships, consolidate existing ones and to improve the reliability of the supply chain.

These main tasks are supported by a project website (www.forestprogramme.com), which provides on-line access to all the guides and materials developed, as well as providing other services such as newsletters, details of events and a database of suppliers.



Figure 3 - FOREST partners at kick off meeting, June 2009, University of Exeter

3 Summary of biomass markets in partner regions

At the start of the project a data gathering exercise and survey of biomass activity was carried out in each of the partner regions. Apart from gaining insight into the level of activity, the subsequent review provided evidence of existing market structures, as well as features and similarities with more advanced markets. The subsequent review provides some insight into how the markets may develop and helps to highlight potential routes into market expansion. Information gained during this phase, including patterns of use and similarities between partners was used to inform other aspects of the project.

Up to 20 businesses in each region were interviewed about the nature of their activities and the extent to which biomass forms the major part of the business. In most cases the developing bio-businesses were specialists, with to 80% or more of their activity centred on biomass, however in Mid-West Ireland and the Province of Burgos in Spain, this figure was much lower. This may be an indication of the relative immaturity of biomass markets in these regions; providers who are active in other markets may be reluctant to pursue biomass more strongly if the market for biomass is perceived to be weak.

Obtaining accurate figures for biomass consumption was difficult as data is not collected uniformly and accounting practices can vary. In some regions records of pellet and wood chip are simply not available and figures were derived from data on the number and type of installations which were deemed to be more reliable. Where biomass quantities are known there is little consistency in units. Variation in the energy content of fuels like wood chip due to moisture content and bulk density is seldom accounted for, so even reporting by weight and volume can be unreliable. To understand the consumption and movement of material between EU states more clearly, greater consistency in recording and reporting will be required.

3.1 Regional variations

While the survey clearly highlighted the disparity between the mature biomass markets in Southeast Sweden and Upper Austria and those in other regions (in Southeast Sweden for example, biomass is estimated to provide more than 800 times the amount of primary energy to the South West region of England), it also revealed some interesting aspects about the way these markets can develop. In Southeast Sweden biomass heat is often supplied through large industrial installations and widespread use of district heating, while in Upper Austria the market is dominated by the domestic sector which accounts for 60% of the installation capacity. In the developing regions some early characteristics of the markets can begin to be seen; in Burgos for example the domestic sector appears to be dominant, while in South West England the non-domestic sector, often driven by public procurement, has grown more rapidly. Pomeranian Poland has a relatively high proportion of domestic installations but many of these rely on inefficient older technologies, often burning straw. The non-domestic sector in Poland is significant and includes district heating and Combined Heat and Power (CHP), often the

biomass is in pellet form and is used for co-firing with coal. Data for Lombardy is limited but from the regional energy planning policy it is expected that the residential sector will play the major role in the 2020 targets for reduction in fossil fuels, providing almost half of the required CO₂ savings. In the process renewable heat from biomass is expected to increase by 15%. The market in Mid-West Ireland is somewhat smaller, but is broadly balanced between domestic and non-domestic

3.2 Variation in advanced biomass markets

Among the more advanced markets, the survey revealed how structures can vary and how there can be different routes to maturity. The average size of companies supplying services in Southeast Sweden, for example, is somewhat larger than those in Upper Austria, which corresponds in part to the difference in the average size of installations in those regions. It should be a source of encouragement to those in developing markets that a successful biomass industry can develop in different ways and is not dependent trying to replicate market conditions from other, possibly dissimilar regions. In practice cultural, economic and political factors will all combine to determine the way that biomass develops in any given region. It could be argued that rural economies with a tradition of log or straw burning may be more accepting of modern biomass equipment, but equally industrial economies built on other solid fuels such as coal, or imported gas and oil might also be expected to be keen adopters, aiming to reduce their emissions and/or provide a more diverse mix of energy sources.

While the routes to increasing the biomass heating potential in an economy are varied, successful development does seem to be characterised by some common factors:

- Individual and collaborative entrepreneurs in the agricultural and forestry sectors
- Innovative products and services from equipment manufacturers and installers
- Long term, supportive government policies

In Sweden and Austria the presence of all the above at different stages has allowed comprehensive and robust supply chains to evolve which serve their consumers, and the wider economies, very well.

Building confidence in new or unfamiliar technologies is crucial because without adequate structures, end users can be left feeling isolated with poorly performing installations. In developing markets it is common to find entrepreneurial activity within the biomass supply chain but often it is only weakly connected to other elements. This can make it harder for consumers to get good quality advice or to procure all of the fuel, equipment and services that are required to run a biomass system efficiently.

Many early adopters and dedicated biomass consumers are able to overcome shortfalls in the market through their own endeavour and by research, often with the support of a good supplier. However, under these circumstances markets will struggle to grow and more mainstream consumers will continue to perceive biomass to be a 'difficult' technology. Supply chain actors have an important part to play in overcoming these perceptions and can respond by providing products and services that reduce uncertainty and build confidence. A feature of advanced markets is the range of 'turnkey' solutions that are available including Energy Supply Companies or ESCOs who provide a complete service, including heat on a metered basis, and a range of options around operation and ownership of plant. In smaller, developing markets there are few providers able to provide such a breadth of service, yet individual supply chain actors can provide similar levels of support for their customers by working closely with other providers in the supply chain. Early collaboration can take many forms including informal agreements, partnerships or cooperatives, but the strength and comprehensive nature of the services on offer will demonstrate that the biomass technology is mature and the sector and can be trusted to provide a long term, reliable source of heat.

For more information on the market surveys and methodology used please download the full report at www.forestprogramme.com/tools-resources/guides/

4 Development of advanced biomass markets

In regions where the deployment of biomass is relatively low there is a tendency to be overwhelmed when looking at the operation of an advanced market. The large numbers of business in these markets, the extent of the supply side innovation and even the number of biomass installations can make it easy to forget that at some point even the Austrian and Swedish energy needs were once dominated by gas and oil. It is important to remember that these markets have all had to evolve over time; there have been no 'quick fixes'. Indeed the development of biomass in Austria and Sweden has relied on technological development and innovation on the part of businesses, regulatory and financial support from government as well as awareness raising initiatives and research programs. From the point of view of the immature markets this means that there are great many lessons that have been learnt already by others, and businesses who can appreciate what has gone before can save themselves considerable amount of time, effort and expense.

An important lesson for FOREST partners is that it may not always be possible or desirable to replicate *all* the features of the advanced markets in the short term, the successes in these markets are due, at least in part, to the way that they are suited to the local conditions and have responded to serve local demand. It could be difficult for example to develop a biomass market in its early stages around large scale district heating in a region where the heating culture is dominated by individual boiler systems or where key elements of the supply chain such as timber harvesting or fuel processing had not developed sufficiently. Similarly the introduction of small scale systems could be hindered in a region where the local markets are dominated by wood chip, or where the availability of quality pellets is limited. The relative complexity of the supply chain means that there are a number of factors that contribute to the success of an installation or a business supply arrangement, this in turn means that most solutions cannot simply be transplanted from one situation to another; businesses need to be aware of the local constraints and opportunities and be prepared to adapt lessons from the more developed markets rather than simply transplant them.

A consequence of the supply chain complexity for biomass means that few providers have sufficient knowledge to be able to offer all the services necessary to provide the end user with a complete heating solution, particularly in early stage biomass markets. Complexity in the supply chain however should not be taken to mean 'difficult' or 'obscure', indeed many of the system components can be remarkably simple. Instead it is the diversity of the skills that need to be combined in a successful biomass system that is complex, an expert in sustainable land management or forestry for example would not be expected to understand the intricacies of sizing a boiler and thermal storage vessel (and vice versa). Early problems with biomass systems have arisen where system components are not necessarily suited or are incompatible with efficient operation. This could be the result of the inexperience of a single supplier or poor communication between different suppliers. Three way disputes, between boiler manufacturer, installer and fuel supplier can result, which disrupt the heat supply for the customer and undermine confidence in the technology.

From the point of view of an end user or specifying client, a biomass system can therefore appear complicated, and the perception of risk may be too great for proposals to be given adequate consideration. It falls to providers within the supply chain to take steps to simplify the procedure for end users by offering better or more complete solutions. Partnering with other supply chain companies and organisations has allowed forward thinking businesses in Austria and Sweden to offer a wider range of biomass heating solutions (as opposed to a selection of 'biomass components'), including innovative supply models with different degrees of ownership and responsibilities for plant and maintenance, as well as contracts to supply heat. These Energy Supply Companies or ESCOs are a key feature of advanced markets and remove almost all elements of risk from the end user; the ESCO may be a single large company but can equally be based around several smaller companies, who between them deliver an integrated solution to the client. In this way the 'risks' of the biomass project are devolved among those supply partners who are ultimately best placed to deal with them. The interests of all parties are protected by contracts or agreements which lend stability to the partnership and ensure a good experience for the end user.

FOREST partners have benefitted enormously from the flow of information from Austria and Sweden, and have seen a great many examples of successful partnering in the biomass supply chain. Few of the barriers to biomass are unique, and while it may not be advisable to attempt to replicate solutions directly, there is much scope for shared learning and the 'principles' of successful operation remain the same for everyone. It has been

particularly encouraging to see elements of good practice in every one of the FOREST partner regions and case studies of the most interesting examples have been developed for the FOREST website (www.forestprogramme.com/case-studies) and a selection are presented in the FOREST guide to partnering and contracts, *Partnerships for Success* (www.forestprogramme.com/tools-resources/guides).

While the success of biomass in Austria and Sweden can be attributed in part to the ability of businesses to meet the requirements of end users, the role of governments and agencies cannot be overlooked. At the national level the successful integration of policies and incentives, balanced by appropriate regulation has supported the development of the biomass industry over the long term. At the local level, public authorities can 'lead by example' by procuring biomass systems for their own estate. This can send out a strong signal to other potential buyers and larger buildings or sites can stimulate the local supply chain and trigger investment in key infrastructure elements such as depots for handling or sorting wood fuel. Exemplar projects, perhaps installed in high profile buildings, can be used to educate and demonstrate biomass technologies, providing information through published figures on financial or CO₂ savings which can also generate interest.

Political decisions are out of the hands of individual businesses but well organised associations such as the Oekoenergie-Cluster (OEC) in Upper Austria or the Bioenergy Group in Southeast Sweden (details in subsequent sections) can provide a coherent industry-led voice which decision makers can turn to for information on development, capacity and other issues affecting businesses. Both groups provide market intelligence, training and research and development for the benefit of members which can also inform important areas of public policy such as energy or environment.

4.1 Upper Austria

Upper Austria is one of the nine Austrian regions, located in the Northern part of the country with 1.4 million inhabitants. It is highly industrialised, with significant heavy industry. Currently renewable energy sources provide 34% of the primary energy (of which 15.5% is biomass) (Figure 4) and about 48% of all heating is produced from renewable energy. The regional government has adopted the target to cover 100% of all space heat and electricity from renewable energy by 2030.

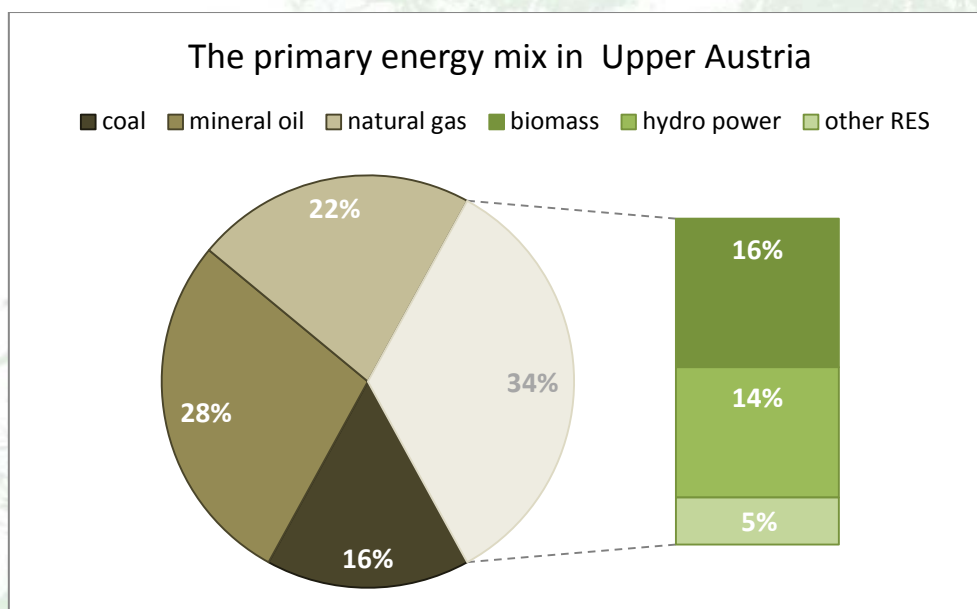


Figure 4 - Primary energy in Upper Austria¹

To achieve this ambitious goal, a comprehensive action plan is being implemented and the O.Ö.Energiesparverband, the energy agency of Upper Austria, is largely responsible for the implementation of the measures included.

¹www.esv.or.at/english/energy-in-upper-austria/

Already today, the use of wood in clean high-efficiency biomass boilers contributes significantly to the high share of renewable energy sources: currently 42,000 automatic biomass boilers are in operation in homes, public and commercial buildings (half are fuelled with pellets, half with wood chips) and more than 320 biomass district heating systems have been built.

‘Carrots, sticks, and tambourines’, a three pillar approach for biomass heating

Upper Austria has developed policy ‘packages’ for different target groups. These packages consist of financial incentives (mostly investment grants), legislation to mandate installation obligations, and promotional activities (energy advice, outreach campaigns, training). The different types of support mechanisms can be thought of, respectively, as ‘carrots, sticks, and tambourines’ (see Figure 5).

‘Carrots’	‘Sticks’	‘Tambourines’
Financial incentives	Legal measures	Information and training
• Investment grant program • Renewable heating as program requirement • Contracting program • Regional R&D program, pilot projects	• Emissions and efficiency standards • Fuel requirements • Renewable heating mandate • Minimum requirements for heating and cooling	• Energy advice • Training and education programs • Publications, campaigns and competitions • Local energy action plans • Sustainable energy business network
Policy Packages 		

Figure 5 - ‘Carrots, sticks and tambourines’ for biomass heating

Main policy instruments

Financial support:

One important incentive for biomass heating is a residential grant programme that has been in place since the mid-1980s. Upper Austria also provides incentives for a broad range of biomass heating installations beyond just those for residential systems, such as biomass district heating. The stable support offered by the regional government over more than two decades has not only contributed to a well-developed biomass heating market. It has also supported the growth of a vibrant renewables industry which now is the global technology leader in this field and strong in exporting their products in Europe and beyond.

Driving the market through standards:

Austrian biomass boiler technology is a textbook example of how technological advances can be driven by regulatory requirements and incentives. The government increasingly tightened efficiency and emissions standards over the years, which spurred innovation. Austrian boiler manufacturers responded favourably to these standards by developing equipment with high efficiency and ultra-low emissions. This, in turn, positioned Austria’s small scale biomass boiler industry in a prime position to capture a global leadership position and create more than 3,000 manufacturing jobs in the process.

Early standardization of fuels (especially pellets) was a key success factor: it allowed manufacturers to design ultra-low emissions heating systems that were convenient to use. The quality and convenience of these systems helped create consumer confidence. Fuel standards are a legal requirement, but are also reinforced through product warranties on biomass boilers.

Renewable heating obligations:

Since 1999, all new or renovated public buildings must use renewable thermal technology for heating and hot water. New homes that receive funding from the regional housing programme (i.e. 95% of all new single family homes) must also install a renewable heating system. The only fossil fuel-based heating systems that are allowed are gas condensing boilers, which must be combined with a solar thermal system of at least 4 m² in size.

Advice, information and awareness campaigns:

Awareness programmes that are independent of the sales of a product and service are crucial to market growth; this is especially true for an emerging industry that has limited resources for marketing. Successful promotion is characterised by a smart and effective mix of communication instruments. The O.Ö.Energiesparverband supports homeowners, public agencies, and businesses with energy advice when they are making building or energy-related investment decisions. Each year, the O.Ö.Energiesparverband provides 10,000 free face-to-face energy consultations to homeowners and public agencies. The O.Ö.Energiesparverband has also carried out a number of information campaigns to promote biomass heating utilizing the media, billboards and other advertising strategies. Competitions have also proven to be a powerful tool for drawing people's attention to heating with wood. For example, pellet competitions have invited schools to carry out pellet-related projects, with extraordinary responses. The Chamber of Agriculture operates a support service for farmers and forest owners that are interested in starting a biomass district heating project and advises them on economic and technical issues.

Education & training:

A vibrant biomass heating market requires a highly skilled workforce across the entire value chain – from fuel production, to equipment manufacturers, to contractors that design, install, service and operate heating systems. The Energy Academy, which is managed by the O.Ö.Energiesparverband, offers more than 30 technical training seminars on sustainable energy every year, many of which cover biomass heating.

One of the main challenges encountered in all emerging biomass heating markets is that heating contractors generally lack confidence in, and knowledge of, biomass systems. As a result, many contractors may not offer biomass heating systems, or may actively discourage potential clients from investing in them. To overcome this market barrier, a vocational training for "eco-installers" was developed in cooperation with the regional school for heating system installers that allows young professionals to specialize in renewable energy systems at the beginning of their training.

The state agricultural schools include biomass fuel production in their curricula and three of them have recently started a bioenergy training programme for farmers.

Supporting biomass heating manufacturers:

Several regional programmes support biomass heating manufacturers. The most important is the 'Ökoenergie-Cluster', a renewable energy and energy efficiency industry network in Upper Austria that supports business development, networking and cooperation, joint marketing, and export activities. Presently 160 partners are members of the network employing more than 8,880 people and achieving a turnover of about €1.9 billion. A regional R&D programme supports product development and ensures the competitiveness of the biomass heating industry in Upper Austria.

Success factors for biomass heating programmes and action plans

- 'Policy packages' (consisting of a mix of regulatory, financial and training/awareness programs) are likely to deliver the fastest market growth by stimulating demand for biomass heating systems, while simultaneously supporting the development of cost-effective and good-quality products
- Clearly defined quantitative targets, supported by well-developed action plans, give confidence to biomass heating businesses
- Regular market intelligence is necessary to understand progress, communicate success, and take corrective action when necessary
- High efficiency equipment that meets stringent emissions and quality standards is crucial for market transformation
- Fuel standardization will support consumer confidence
- Heating systems must offer user convenience levels similar to oil and gas
- Biomass heating will only gain public acceptance if the fuel is sourced from forests where sustainable forest management practices are in place

- Understanding and effectively communicating the benefits of biomass market growth beyond climate and environment protection is critical (e.g. energy independence through local fuels, income for the farming community, local employment in rural areas, innovation, etc.)
- Involving farmers and forest owners in the biomass business can help to develop biomass fuel supply chains and provide important support for policy development
- Typically, the most promising markets for biomass heating are in areas where oil heating dominates and there is no connection to the natural gas grid. Conversion from oil-based heating to biomass is technically easier (because both require fuel storage) and usually more financially viable. Hydronic heat distribution systems in a building also make conversion to biomass more economically attractive.
- For larger buildings, it might be easier for programs to initially target new construction, and then to move to renovation after an initial learning period. Biomass heating in new buildings is usually simpler to implement and often less expensive to install than it is in existing buildings.
- Demonstration programs (e.g. the first 10/100/1000 biomass heating systems in a specific market segment) are very useful, especially if the findings are used to design training and funding programs
- Training needs to be proactively offered to all actors along the value chain as a part of any policy package; it should target producers, installers and users of larger systems
- Local biomass information campaigns can be very helpful to kick-start markets, especially for private homes or public buildings
- A longer term perspective on market development, which takes into account the learning curves of different market actors and the expansion of production and installation capacities, is important for developing a healthy industry. In the long run, it is better to have only a few installations in the first years that work well than it is to risk having faulty installations during rapid market growth. This includes getting funding programs right by taking a longer term perspective and avoiding boom-and-bust markets

4.2 Southeast Sweden

The Southeast of Sweden consists of three counties; Kalmar, Kronoberg and Blekinge, which between them have a population of around 570,000 inhabitants. Energy from biomass is used in all sectors in Sweden; the size of plants ranges from small pellet boilers supplying single family homes up to city scale combined heat and power (CHP) plants supplying the majority of heat and electricity.

The biomass itself is sourced from agriculture as well as forestry, and accounts for about 45 % of the total energy used in the Southeast Sweden. Positive legal frameworks and policies regarding to the use of bioenergy, combined with good growing conditions and well developed infrastructure mean that the conditions for the bioenergy sector are very favourable. Supply chains for biomass from forest products and agriculture are well established across the whole of Sweden and the infrastructure is well organized, extending from the within the wood working industries through to highly organized forest owners and farmers.

The success of the biomass sector can be attributed to a number of factors, not least of which are geographical and cultural, almost 70% of the land area is forest (Figure 6) and there is a long standing Swedish tradition of using the natural resources that the forests provide, as a result large quantities of residues are available for energy production. However there has also been support for the development of bioenergy at all levels; national, regional, local and individual.



Figure 6 - Swedish pine forest

The Swedish government strives to create a sustainable energy system with a long term vision for Sweden to meet all of its energy requirements from renewable energy sources and aims to be independent of fossil fuels by 2020. All of the counties in Southeast Sweden have already achieved high shares of renewable energy production compared to other regions (55% compared to the EU target of 20%) and sustainability ambitions extend to the regional and local levels; the Kalmar Region and the City of Växjö, for example, have proclaimed themselves as Fossil Fuel Free regions (Figure 7). Local and regional energy and climate strategies have also been designed and implemented in close collaboration with Energikontor Sydost (the Energy Agency for Southeast Sweden, ESS).

Renewable energy has long been a significant part of the Swedish energy system (i.e. hydro power) along with the promotion of energy efficiency measures and behaviours. During the last few decades the use bioenergy has increased dramatically to become the largest energy source (137 TWh), mainly because of an exponential increase in the use of district heating.

The biomass market is strongly supported at the level of the municipalities; each of the 290 municipalities has a politically elected administration with responsibilities for levying taxes and implementing policies related to energy, environment and transport. Since 1977 the local authorities have been legally obliged to promote the efficient use of energy in their planning and the demand for locally and environmentally friendly produced heat and electricity is still very high among the inhabitants in the region. There are some 250 biomass district heating plants which range in capacity from a few hundred kW up to more than 100 MW. These district heating plants serve a variety of public buildings, industries, churches and domestic dwellings. There are currently four biomass CHP plants operating and at least one more is under construction.

While the larger plants are often run by international companies, there are many smaller heat networks, operated local companies, sometimes delivering heat to just a few households. In both cases good supply chain partnerships exist between the growers, producers, and operators. Transport and logistics are also an important consideration when moving relatively low value material around. Partnerships built around smaller installations tend to have fewer partners with each covering a wider range of supply chain activities, while larger district heating sites can involve a number of businesses, but partners often have a more specialised role, covering a single supply chain element e.g. delivery of wood chips. The successful expansion of the biofuel supply chain has been helped by the cooperation between businesses and the ability to integrate activities at different scales; this has built up the supply side infrastructure enabling the industry to meet the needs of a wide range of consumers.

Cooperation between bioenergy companies in the region is also helped with continued opportunities for training and education. The Bioenergy Group in Växjö provides a platform for discussion and learning between companies active in the forestry and energy sectors. Representatives from companies in the different markets and business areas are working together with Linnæus University where there are programmes and research in all aspects of bioenergy technology and forestry. With organisation from ESS the aim of the group is to promote the use of bioenergy and to further develop the technology for cleaner and better products. Meetings take place several times a year and can include workshops and seminars on current technological and economic developments; the pool of knowledge provides benefits for all of the organisations involved.

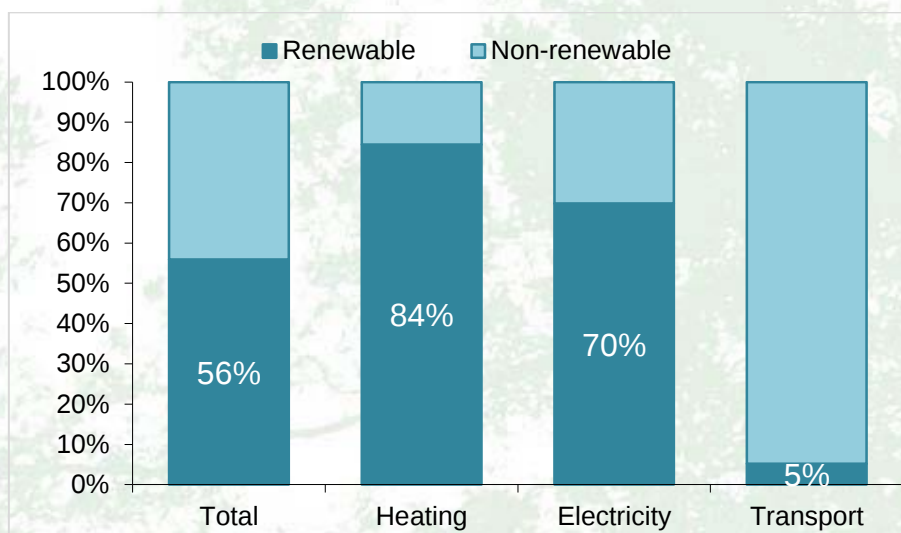


Figure 7 - Share of renewable energy in Växjö, 2009

Efforts on the supply side are underpinned by cross party support for policies which have incentivised the switch from fossil fuels among the industrial, service and domestic sectors. Since 2003 there has been stimulation for renewable electricity production via a green certificate system that has had a big influence on the production of electricity from renewable energy sources and development of biomass CHP plants. However it is the introduction of a Carbon tax in 1991 that has played a key role in the development of bioenergy. The Carbon tax is based on the *Polluter Pays Principle* (PPP), where those responsible for CO₂ emissions pay for the present (and future) costs associated with increases in atmospheric CO₂. Environmental costs which are often seen as external are in this way internalised, becoming part of the overall cost of the activity itself. This encourages efficiency and innovation on the supply side (to remain competitive) and incentivises desirable behaviour on the demand side as lower carbon goods and services become relatively cheaper than their polluting counterparts.

Soon after its introduction the initial flat rate of around €25 per tonne of CO₂ was lowered for industry who feared negative effects on competitiveness in international markets while, at the same time, it was increased for the domestic and service sectors. An important element of the introduction of the tax was not to increase the overall tax burden so other taxes were lowered to reduce the overall effect on individuals and businesses. In this way the economy is steered towards more efficient and greener solutions. Compared to other incentive/taxation schemes such as cap and trade, quotas or feed-in tariffs, the Carbon tax is seen as relatively easy to implement alongside existing energy taxation systems and efficient to administer. The Swedish Carbon tax has been raised several times since it was introduced (it is currently more than €100 per tonne) although the industry rate has remained considerably lower in order to reduce the risk of carbon leakage i.e. exporting emissions to China and the developing countries. Introducing the tax at a low level in this way and escalating it slowly, has allowed time for the general principle to become accepted and for consumers to adjust their behaviours accordingly.

The resulting switch to bioenergy, largely from imported oil, has seen greenhouse gas emissions fall by 9% between 1990 and 2010, while over the same period the country has experienced rapid economic growth. With limited access to natural gas, the growth in bioenergy has been particularly high and bioenergy passed oil as the largest energy source in 2009.

5 FOREST involvement in the regions

The experiences of advanced biomass markets have shown how increased integration in the supply chain is an important factor in the development of biomass. Consumers need to have confidence in the whole of the system and its ability to deliver heat reliably and efficiently before making long term investment decisions, and cooperation and coordination between supply chain actors is an important part of providing this reassurance. The framework for FOREST activities has been based around three areas:

- The development of best practice tools
- Providing opportunities for business-to-business exchange and networking
- Longer term capacity building in the supply chain

These are supported by management and coordination at local and European level, and by communication and dissemination activities. Many of the challenges for improving integration in the regions are similar but there are a number of differences between markets:

- *Physical*
On the fuel side there may be variation in the availability of raw materials, for example transport infrastructure (road, rail, water) can affect distances over which fuel travels, the availability of appropriate machinery for harvesting and processing can require economies of scale which may not be present in some regions. Local climate too has an effect on the extent to which heating or cooling is required.
- *Cultural*
Differences in attitudes to heating have been noted for instance in preferences for individual or community based heating schemes. Similarly in business there can be a reluctance to consider collaborative practice, particularly where biomass markets are in the early stages of development; often 'competition' rather than 'cooperation' is the motivating force.
- *Political*
The interaction between environmental taxes, support for research and incentives for low carbon technologies is complicated. Where political support for the green agenda is mixed or where policy is less than coherent, there will be doubts in the minds of investors on the supply and demand side. Investment decisions over business expansion or boiler replacement, are taken in the long term, maybe 20 years or more, and some form of security or reassurance is required from governments.
- *Economic*
The effects of the global financial crisis have been felt in all regions although for some the effects have been greater than in others. Many key investment decisions will have been postponed or shelved altogether as companies focus their efforts on survival rather than growth. Biomass projects in particular can be expected to have higher capital costs (but lower running costs) and decisions to replace existing boilers may be postponed or cheaper fossil based alternatives sought as a short term solution.

Differences such as these mean that a system which is successful in one situation may not translate readily to another, and partners have all been required to apply local knowledge to the FOREST framework. The flexibility to adapt the implementation of the project on the ground has enabled the partners to develop events and initiatives to suit local conditions. The core activities for the project are described in more detail below, while subsequent region specific activities can be found in Sections 5.2 - 5.6.

Best practice tools

At the outset a review of the level and types of activity in each region was carried out to identify interesting business models and elements of good practice. The findings of are summarised in the *Regional Bio-heat Market Structure Report* and its associated Annexe (www.forestprogramme.com/tools-resources/guides); copies of individual region reports are also available. This study has provided information for partners locally and informed subsequent guides and activities. An integral part of the research has been the development of case

studies from each region, illustrating how different elements in the supply chain have come together to provide a more reliable service to end users (www.forestprogramme.com/case-studies).

The best practice toolkit consists of a selection of downloadable guides and an online training tool developed by Linnæus University, these are business focussed and designed to highlight elements of best practice:

- *Partnerships for Success – a guide to partnership working in the biomass heating supply chain*
Provides an overview of the biomass heating supply chain with guidance on how supply chain actors can work together to provide effective biomass heating solutions. These are typically fuel related partnerships, equipment related partnerships or ‘complete solutions’ where all services are delivered, often by a group of providers working closely together. The guide advises on elements of successful agreements and contracts including price escalators and is illustrated throughout by successful case studies.
- *A Guide to biomass heating standards – ensuring quality and reliability in the biomass heating supply chain*
The role of standards is often misunderstood but their development and widespread adoption is critical to the biomass industry. Links in the supply chain are forged through agreements and contracts, but it is standards which underpin the agreements, providing robustness and repeatability. The guide explains how standards are developed through consultation and consensus between manufacturers, consumers and regulators, and summarises the standards in operation across the range of supply chain, particularly in the production of fuel.
- *A guide to specifying biomass heating systems*
This guide describes the project lifecycle and introduces biomass heating as a system of systems. For those specifying biomass systems it is important to understand how components are interconnected, and how decisions made about one part of an installation can have a large impact on another. Factors affecting choice of fuel are considered along with site based constraints which would favour one solution over another. An annexe provides region specific advice and links for further reading about regulation and incentives



Figure 8 - FOREST guides produced as part of the best practice toolkit

All of the guides produced are available at www.forestprogramme.com/tools-resources/guides.

The Online Training Tool provides much of this information along with a range of related topics including energy fundamentals and detailed properties of a range of sources of biomass (www.forestprogramme.com/training-tool). Chapters on common fuels and their suitability in applications at different scales are presented in an easily accessible matrix format, and a self-test facility is provided for those who wish to see how well they have understood the material. Questions are generated at random from a large selection so you may not get the same questions twice.

FOREST Biomass Training Tool

INTRODUCTORY CHAPTERS • Global resources • Energy fundamentals • Overall biomass properties • Fuel/Energy supply

FUEL	APPLICATION	Single-family houses	Larger buildings	District heating	Combined heat and power
FIREWOOD (LOGS)	- Introduction - Properties	Domestic firewood	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE
PELLETS and BRIQUETTES	- Introduction - Pellet properties - Briquette properties	Domestic pellets	Pellets for larger buildings	Pellets for district heating	NOT APPLICABLE
WOOD CHIPS	- Introduction - Properties	NOT APPLICABLE	Chips for larger buildings	Chips for district heating	Chips for CHP

03-00: Introduction to small-scale district heating

As a "small" district heating network, one would consider anything with a peak thermal power less than about 5-10 MW, but there is no strict limit.

The fundamental idea with district heating is simple enough, as shown by the schematic below:

Since combustion units will have limited turn-down ratios (we assume 1:3) a district heating system have to contain several boiler units to cover all different load cases.

If "100 %" denotes the typical maximum load, please then tick the system solution that will be the cheapest but still maintain a reasonable fuel flexibility. We assume peak load to occur up to 150 % for short times and minimum load to be about 10 %.

- ☐ 5 small parallel units, each with the capacity span 10-30 %, providing a supply range from 10 up to 150 %
- ☐ One low-load unit, capacity 10-30 %, a base-load unit, capacity 30-90 %, a peak-load unit with the capacity 10-30 % all providing a supply-range from 10 to 30+90+30 = 150 %
- ☐ One low-load unit, capacity 10-30 % and a base-load unit, capacity 30-90 %, together providing 10-120 %. Customers to provide individual solutions for the peak-load cases 120-150 %.
- ☒ One low load unit, capacity 10-30 %, and a base-load unit, capacity 40-120 % providing capacity 10 - 160 %. Low load supplied by the low-load unit running intermittently in combination with an accumulator tank.
- ☐ One base-load unit, capacity 50-150 %. Low load supplied by intermittent operation in combination with an accumulator tank.

(10 points)

Correct

next

Figure 9 - FOREST online training tool and self-test facility

Business- to-business (B2B) activities

These activities were designed to promote interaction between supply chain actors and to encourage the exchange of information. By providing venues and events promoting a 'whole supply chain approach' and attracting a wide range of supply chain actors, the aim was to encourage greater cooperation and present opportunities for creating partnerships. The tasks consisted of supporting/setting up/coordinating of:

- Trade fairs
- Business exchange training/study tours
- Local/regional business associations

Trade fairs were organised in Poland, Italy and the UK, while all partners were able to offer tailored study tours to selected groups of businesses to Austria and/or Sweden to learn directly from practitioners in these advanced markets. In each event seminars and talks were provided and delegates were given plenty of opportunities for networking and to share details of their own experiences.

Business associations have been seen to provide an important service in developed markets; they can act as a focal point for new and established businesses, promote the exchange of market intelligence including improvements in technologies or working practices, as well as providing updates on evolving legislation and regulation. Wherever possible the aim of FOREST has been to work with existing groups to give them publicity and to encourage wider supply chain involvement or a more diverse membership. Where there are no such groups, FOREST partners have tried to bring key supply chain actors together to discuss issues and consider more formal involvement.

Trade associations can also lend confidence to a market, providing reassurance on the state of development of the industry, particularly where membership requires some measure of competence and adherence to standards. More details of the events and activities which took place in individual regions are provided in the following sections.

Long term capacity building

FOREST has been essentially a supply side project, building capacity in the supply chain will be important if biomass is going to be able to convince consumers that it is a reliable, long term and cost effective alternative to fossil fuels. However, where markets are in the early stages of development businesses in the supply chain can be understandably reluctant to expand, particularly where evidence of growth in demand is limited, or while there is uncertainty about the direction of government policies. This leads to a potential stalemate between supply and demand which is made worse under the difficult economic conditions experienced across most of Europe. Stalled growth for whatever reason undermines confidence and individual actions from the supply or demand side are unlikely to be successful in driving the market alone.

Capacity building exercises in the FOREST project have attempted to engage with the supply and demand side by increasing the knowledge of best practice among suppliers and highlighting the possibilities to end users and specifying clients. Many clients are unaware of the full range of applications where biomass offers feasible solutions so events and meetings where customers and suppliers are brought together helps the suppliers to understand misconceptions and misgivings of the customer, while the customer can make an informed judgement about the services being offered. Within the project capacity building activities have consisted of:

- Technical seminars
- An online database of bio-heat businesses in the regions
- Support for new and existing partnerships

Technical seminars were designed to improve understanding of biomass heating in general and of supply chain considerations in particular, and have attracted a wide range of industry professionals and end users. Seminars have made use of the tools developed as part of the project but have also included input from external experts from established business and organisations. These events have also provided additional opportunities for networking between businesses, and allowed potential biomass customers to meet face-to-face with a range of providers from across the supply chain.

The online database (www.forestprogramme.com/supplier-search) contains business offering services at the local and European level and is drawn from companies known to the project partners. Other companies wishing to feature on the database will have been involved with at least two successful installations and will have provided information on these to their local FOREST partner. The database is there to inform potential end users of supply chain actors in their regions but also as a tool for businesses to identify related services in their regions of interest, for some this could be local, while for other actors there may be interest in the wider European market.

FOREST Newsletter Signup

About FOREST Case Studies Supplier Tools Community FOREST Events

SUPPLIER SEARCH

Looking to form partnerships with other European biomass companies? Region +

This European wide supplier search will help you find companies that are looking to develop and grow into new European wide markets. This directory allows you to search for wood fuel suppliers, boiler manufactures, installers, consultancies, systems engineers, services, and other forms of support across Europe.

Want to Become a Supplier?

The supplier database is managed by Regen SW with input from each of the partners and is updated regularly. If you want to be added as a supplier, please send us your details and examples of your work or case studies of the last two systems you fitted. To do this, contact your regional agency.

COMMUNITY

By visiting the community you can build your own community groups to develop, promote and support your biomass programmes.

Visit the FOREST Community

Service +

Business Type +

Search for Suppliers

Figure 10 - FOREST website, supplier search

Supporting the development and growth of partnerships can take many forms and the assistance offered has varied between regions depending on the characteristics of individual markets. In some cases FOREST partners have provided a ‘brokering’ service by acting as an intermediary in discussions between parties or providing venues and chairing meetings. In other cases the support has been more on the technical side, providing information or advice to procurement groups or committees, and bringing relevant supply chain actors into discussions. In each of the following sections details of activities and interventions in each partner region are given.

5.1 A shared learning experience

One of the strengths of FOREST has been the ability of partners to adapt the best practice learning to local conditions and a lot of work has been focussed on engaging with supply chain actors. The direct involvement of key bio-heat businesses through Local Management Groups (LMGs) has informed the project and provided forums for members to discuss local supply chain issues. Many members have benefitted directly from involvement in FOREST activities such as the trade fairs and study tours and others have given their time and expertise as speakers at FOREST events or have allowed their businesses to be used as case studies.

Partners have learnt valuable lessons from the advanced markets but the exchange of experience between developing markets has also been extremely useful. Project consortium meetings have provided additional opportunities for partners to learn about the markets in each other’s regions, in each case short study trips have been organised to see local businesses and partnerships and see interesting examples and applications of biomass technologies. These have been informative and inspiring, many of the sites visited could be classified as ‘early adopters’ of biomass technology and have had to overcome considerable hurdles in very immature markets to implement their projects.

At the Kick-Off Meeting in the UK, partners were taken to Castle Drogo, a large country house with very specific heating requirements relating to the conservation of the building and the artefacts within it (Figure 11). The estate has its own woodlands and has an agreement with a nearby agricultural and engineering business to process and deliver wood chip for the building. This has included the design and manufacture of a custom built delivery trailer.



Figure 11 – Castle Dogo and the Teign Valley

In Sweden partners were able to visit a small scale district heating plant at Rottne (Figure 13), the plant is operated by VEAB, a municipally owned energy company based in Växjö. The main boilers have capacities of 1.5MW and 1.2MW and run on low cost, high moisture wood chips (up to 50%), having two boilers allows the system to accommodate periods of low load (e.g. during the summer) while still operating at high efficiency. The plant generates 11.5 GWh a year, consuming 16,000 m³ of woodfuel in the process, at maximum load consumption is around 90 m³/day. The plant can be operated unmanned for the majority of the year through remote monitoring and control systems. The network is approximately 10km long and services 166 customers, the largest of which is Vidingehem, a municipality company which manages property including kindergartens, schools and care homes. Moving large quantities of low value material requires efficient logistics and partners also visited a nearby woodfuel depot which acts as a transfer station where chipped material is stored prior to delivery.



Figure 12 - District heating plant in Rottne



Figure 13 – FOREST partners visiting woodchip transfer station near Växjö

In Ireland partners visited Tipp Wood Chip, a fuel supply company who have partnered with Environmental Heating Technologies Limited to provide ESCO services under the name of Ecocell Energy Ltd (see www.forestprogramme.com/files/2011/11/Case_study_Ecocell-Energy.pdf). Between them they have developed a containerised heating plant system and a novel wood chip delivery lorry featuring sloping sides and a conveyor delivery system (Figure 14). The lorry can cover further distances than a tractor and trailer and can deliver to sites with above ground storage without resorting to a blower (which is noisy and time consuming). To ensure high quality wood chip, Tipp employ the services of Ballynoe Agri Services, a specialist wood chipping contractor who use an Austrian Mus Max chipper, believed to be the first of its kind in Ireland. This machine can process large volumes of material in a short space of time (up to 130 m³ of chip an hour), while maintaining a high degree of consistency in the finished chip (Figure 15). Partners also visited Rockwell College where an energy cabin, based on two 240kW biomass boilers, is installed into shipping containers, by partners Environmental Heating Systems Ltd. (Figure 16). The cabins are easily transported which means that the majority of the installation can be carried out in a workshop environment and just connected to the existing heat distribution system at the site.



Figure 14 – Tipp Wood Chip/Ecocell delivery lorry



Figure 15 - Wood chip processing at Tipp Wood Chip



Figure 16 - Energy cabin at Rockwell College

The Spanish consortium meeting included a visit to Expobioenergía, a very large international bioenergy fair. Despite the relative immaturity of the market in Spain, the scale of this exhibition and diversity of exhibitors, demonstrated the seriousness and intent of the biomass industry in Spain. The trip was made in conjunction with members of the project Polibiomass, an INTERREG IVC project which is investigating local policies for stimulating demand for biomass heating. Project partners were also received by the President of Burgos and took part in a televised press conference on the importance of developing biomass in the region.



Figure 17 - FOREST and POLIBIOMASS at Expobioenergía 2011



Figure 18 - FOREST partners meet with César Rico Ruiz, the President of the Province of Burgos at a press conference

In Poland partners were taken to see the School complex in Owidz, which featured as a FOREST case study (Figure 19). The 300kW plant is owned and run by Vapo, a large company operating in both the heat and power, and pellet markets. The plant is housed in a container with neighbouring pellet silos allowing storage of up to 30 tonnes of pellets. The school buildings are serviced through a small heat network (about 100m long), and a renewable heating contract with the company has provided finance for the scheme and is responsible for the maintenance and operation of the plant (see www.forestprogramme.com/files/2011/11/Case_study_Heat-contracting-for-school-complex-in-Owidz.pdf).



Figure 19 - Heating a school complex with wood pellets

For the Italian consortium meeting partners went to see a brand new biomass CHP plant on the outskirts of Milan. The Prometheus project (Figure 20) consists of two biomass boilers (7MW_{th} and 5MW_{th}) and a 1MW_{e} Turboden CHP unit. The project will provide heat and power to around 1800 residents in 16 buildings. The plant is within 1km of the development and fuel will be sourced from locally grown short rotation poplar and salix from woodchip depot near to the plant. Getting all of the required consent from residents and authorities took a long time and strict air quality standards will have to be maintained. A large multicyclone and filtering units, representing around 10% of the total costs, will clean up the particulates and emissions which is essential in Lombardy due to particular concerns over air quality (Figure 21). The fly ash from the flue has different chemical properties from the bottom ash and must be handled separately.



Figure 20 - Prometheus project, alongside the 1MW_{e} Turboden CHP unit



Figure 21 - Prometheus project, between the air filtration units

5.2 South West Region, UK

The South West region is the largest in England in terms of area (2.4m ha) and has a population of around 5.3 million people. The region is largely rural with one in five people living in villages, hamlets or other isolated dwellings. Total woodland area is around 250,000 ha of which 17% is either owned or managed by the government through the Forestry Commission. About half of public forests are conifer while in the privately owned sector about 60% is broadleaved. While this represents a considerable resource much of the woodland, as elsewhere in the UK, is undermanaged. Allowing for difficulties with access and extraction, it has been estimated that an additional 2 million (green) tonnes of material could be made available from better management alone.

Agricultural land in the region is dominated by grassland and rough grazing (75%), which supports approximately one third of the UK cattle and a fifth of the sheep (cereal crops cover about 12% of the available area). Despite suggestions that up to 6% of agricultural land could be turned to energy crops without effecting food security², and the availability of subsidies, farmers generally have been reluctant to switch from more conventional crops on a large scale. Economic viability and general uncertainty about the long term security of biomass market are the most likely reasons for this. The ability to switch between alternative crops to capitalise on fluctuations in the market is also lost with the longer term cycle for energy crop plantations.

The market for renewable heat is growing in the region, with a 30% increase (to 18.6 MW) in installed capacity over the last year^{3,4}, biomass comprises more than 60% of this capacity and is seen in as a key enabling technology in a rural region where almost 30% of all households cannot access the gas grid. Where electric and oil, which are the dominant form of heating in these areas, are displaced, there is considerable scope for carbon saving. Despite encouraging signs for renewable heat, the region, and the UK as a whole, is starting from a very low base, and a sustained period of exponential growth will be necessary to meet the 12% renewable heat target for 2020. Regen SW estimates that this could require something like 1,000 industrial installations, 8,800 commercial and public sector installations and 136,000 domestic installations; the current total number of installations is estimated at under 700. Fuel production in the region is largely wood chip with some small scale pellet production. Just over the border, a much larger pellet plant with an annual capacity of 55,000 tonnes, is

² Defra, *UK Biomass Strategy*, 2007

³ Regen SW, *Renewably Energy Progress Report: South West Annual Survey*, 2012.

⁴ Figure includes a 10MW pellet installation, providing steam for pasteurisation and drying.

operated by Verdo. It began production in May 2011 and is now producing pellets to the ENPlus-A1 premium standard.

Improved support for biomass and other renewable technologies is anticipated through a new policy based on providing tariffs for each unit of heat (kWh) produced. The Renewable Heat Incentive (RHI) has been eagerly anticipated since 2009 and was finally launched for non-domestic systems in November 2011, with domestic systems expected to be included in 2014. The use of tariffs as opposed to grants is designed to provide support over the longer term, avoiding the peaks and troughs in activity often associated with announcements of grant based funding. This is the first system of its kind for incentivising heat and the results are being monitored closely. The scheme has got off to a slower start than had been anticipated by many, partially as a result of the complexity of application process and metering requirements. A renewed Government focus on cost control mechanisms rather than uptake for the RHI, which includes potentially suspending of the scheme have also had an undermining effect on consumer confidence. Almost 18 months after its introduction biomass boilers represent 99% of the installed capacity (171 MW) and approximately 750 have been registered on the scheme nationally.

Local management of FOREST

The South West is a region with a strong reputation for the development of renewable energy technologies, the excellent woodland resource and large areas without access to mains gas make biomass an economic and environmentally important sector. The development of biomass has been driven by a small number of dedicated firms who have built up considerable experience of biomass applications, and by support from schemes such as South West Bioheat Programme, launched in 2007 with funding from the South West of England Regional Development Agency (SWRDA) and the Forestry Commission. FOREST has been seen in many ways as a successor to the South West Bioheat Program, and has benefited from the input and experiences of many of those directly involved. Some of the key supply chain actors who have offered their support and advice over the course of the project include

- Forest Fuels - well established woodchip producer and supplier offering a wide range of consultancy services, including forest management, biomass system and fuel store design. and pellet supplier.
- Forever Fuels - large pellet supplier/importer with network of depots providing extensive cover in the region and beyond.
- Woodsure - not-for-profit organisation providing quality accreditation for wood fuel producers & suppliers.
- Dartmoor Woodfuel Cooperative – cooperative which has invested in its own fuel handling and processing machinery, supplies wood chip to members and other local boilers.
- Hoval - boiler manufacturer with UK based manufacturing facilities and regional sales network.
- Forestry Commission - government department responsible management of publicly owned woodlands. Operates and funds various schemes for developing woodland and promoting woodfuel.
- ConFor - national trade organisation with regional coverage, representing interests of the private forestry sector. Organisers of the South West Woodland Show, and Woodfuel Suppliers Group.
- Torbay Coast and Countryside Trust - independent charity managing 1750 acres of woodland, farmland and coastline in Torbay. Manage their own boiler and have set up a local wood fuel supply depot.
- Devon County Council - local authority, actively promoting biomass and forestry through a number schemes, own and operate a large (860kW) biomass boiler.
- Bristol City Council, local authority with experience of procuring, installing and running biomass boilers across a range of sites, including nurseries, schools and leisure centres. The council have set up a wood processing station and have invested in their own machinery and equipment. Innovative options for supply are also being pursued e.g. internal ESCO, and partnerships with local businesses.

All of the above have offered intelligence on the current state of the market from their own perspectives, and have given guidance on FOREST documents and events. Many have contributed as speakers or supporters and have provided biomass related venues for events, where delegates have been able experience fuel processing

and delivery, and to learn about issues related to the procurement, running and maintenance of biomass systems.

Development and implementation best practice tools

The market survey provided a good starting point for subsequent activities; it helped to assess the state of development of the market, identify particular areas of concern and enabled the project to make initial contact with a number of businesses who have subsequently helped or been helped by the project. Formal partnerships were found to be rare with the majority of collaborative practice relying on trust and/or mutual respect. While these are good qualities, the relationships are often temporary or are formed to meet the requirements of individual projects.

The survey revealed a range of observations and concerns, many of which can be found in other regions where biomass is still developing:

- Resource availability – concerns do exist about sustainability and availability of fuel. At the current low levels of deployment fuel suppliers are confident that there is plenty of material; concerns may be based on future demand projections based on energy targets which do not necessarily take into account the ability of the supply side to adapt to market conditions. There is plenty of scope for the development of undermanaged woodland and good links with fuel producers will bring additional material to market. In the waste wood sector competing demand, particularly from the panel board industry, is seen as a barrier. Some projections⁵ anticipate shortages of waste wood by 2015, meanwhile recession in the construction sector has seen a fall in demand for panel board products and a ‘glut’ of waste wood has been described, with much of the excess finding its way into exports. A clear way to demonstrate sustainability will improve confidence among end users.
- Fuel quality – the majority of problems with boilers were ascribed to fuel quality although fuel suppliers were quick to point out that they are often used as a scapegoat for poorly designed systems. There was some confusion around different standard systems with reference to ÖNORM and DIN standards and the importance of fuel specification on the efficient operation of some boilers was not always fully appreciated. The introduction of new European standards (e.g. EN 14961 Solid biofuels - fuel specifications and classes) will hopefully remove some elements of confusion.
- Technology – some early installations have suffered problems either in the original specification or from poor support e.g. difficulty procuring fuel, advice/training in operation and maintenance, availability of spare parts. This has had a lingering effect on confidence among key consumers and enabling groups such as architects and designers. Typical problems have included oversized boilers and undersized fuel stores and/or thermal stores. Spatial constraints were not always well understood in terms of plant that became difficult to operate or maintain, or awkward access for delivery vehicles.
- Economics – the high capital costs associated with biomass systems is a major barrier for many end users. Most boilers can be expected to have a lifespan in excess of 20 years and consideration of the full lifecycle costs is not always given consideration. It can be difficult to make a purely economic case for biomass in some instances, for example where the heat load is low or where natural gas is available. The relatively low levels of deployment affect the investment decisions of businesses, while lending institutions have yet to come to terms with the opportunities for renewable heat in the same way that they have with renewable electricity (in particular PV), which is perceived as lower risk.
- Information – frequent frustration at the lack of good quality independent information was noted. While generic, low level information was commonplace it was often incomplete (e.g. internet) and the lack of biomass expertise among building services professionals was disappointing. Detail on integrating systems (e.g. in conjunction with solar thermal) was also lacking.

⁵ Defra, *Wood waste: A short review of recent research*, July 2012

Attempts have been made to address these concerns through the subsequent guides and online material as well as through the events and seminars.

The guide to partnerships is a combination of generic advice based on lessons from Austria and Sweden with specific examples of how firms in other markets have come together to provide an improved service to customers. Partnerships are commonly based around woodfuel, equipment, or as 'complete' solutions where the customer purchases heat. Case studies for the UK version were also selected to reflect the interests of firms in the South West. These included models for sharing forestry and fuel producing machinery from Austria, small woodland owners and growers coming together to manage their forestry more efficiently, an installer who is acting as an agent for Swedish boiler manufacturer and a Polish school complex that has installed a small heat network and has a heat supply agreement with an ESCO. The project has been asked on more than one occasion for sample supply contracts and although these can be useful, existing firms can be reluctant to share commercially sensitive details. There is an added danger that contacts will be taken out of context and copied over to another partnership in an unsuitable manner so the guide makes it clear in all cases that partnerships and agreements must be tailored to suit the individuals involved if they are to succeed in the long term.

The FOREST standards guide gives some interesting detail on how standards are made and goes some way to addressing some of the confusion, particularly around fuel standards. In the South West they are expected to be especially useful to smaller suppliers or those looking to develop their own resource; the potential for self-supply is a strong driver in a rural area with a high proportion of off gas areas. Widening the availability of standardised fuel can also be expected to send out a positive message to architects and designers, many of whom remain to be convinced about biomass. The fact that standards are developed by consensus with industrial partners and other experts ensures that they are appropriate and widely accepted and can act as the cement in agreements, providing clarity for each partner over expectations and boundaries.

The final FOREST guide aims to address a shortfall in knowledge about specifying biomass systems among architects and building services professionals. This is a common concern among specialist bioheat businesses who feel that opportunities for installing biomass can be missed, especially in new buildings and large refurbishments. The guide provides an overview of the project life cycle and important system components. Well informed clients are more likely to recognise characteristics which make a site particularly suitable for biomass (large base load, good access, space for plant) and, in addition, they become better customers. Encouraging deeper engagement with the project often turns clients into biomass 'champions'. Champions can often play a crucial role, proving an additional communication channel between members of the design team and the building occupants.

Business to business (B2B) activities

These activities have all been designed to bring a variety supply chain actors together, to promote the exchange of ideas and experiences and to share information. Opportunities have been provided for networking between businesses on the supply side and, where examples of good practice have been found, many have been given a platform to promote the products and services they offer. Current and potential end users have also been included, as delegates, and as speakers, to provide businesses with feedback on experiences of the biomass supply chain from the consumer perspective.

Trade fairs

The South West Woodland Show is a biennial event organised by Confor in the South West and for a number of years has been regarded as 'the' specialist forestry show in England. In 2009 the show moved to the Longleat Estate, famous for its Elizabethan mansion, safari park and the current the seat of the Marquesses of Bath. The 3600 hectare site includes 1600 hectares of sustainably managed woodland and 400 hectares of parkland, about half of which is broadleaved while the remainder is coniferous.

The show itself has developed strong support with foresters, land owners, farmers and members of the timber industry all attending in good numbers. Woodfuel represents an increasingly important option as an income stream and interest in growing, processing and even fuel supply is high. With the involvement of FOREST as event sponsors in the 2011 event, the programme saw an increased number of exhibitors from the wood energy sector, including boiler manufacturers and installers as well as a series of seminars and discussions promoting successful examples of collaboration and best practice. Around 1,300 visitors and 80 exhibitors attended the

event, a 10% increase on the previous year according to the organisers. A distinctive FOREST marquee provided information on the project and officers were on hand to give additional advice, and engaged directly with more than 250 visitors. A seminar program included speakers from:

- Forestry Commission – status update on the spread of the Phytophthora ramorum pathogen
- Forest Fuels, Hoval boilers – an industry perspective on wood fuel heating
- Confor – welcome, overview of forest industries
- Tipperary Energy Agency – on ESCO delivery in Ireland, in an otherwise immature market
- Woodheat Solutions – IEE project led by the Forestry Commission raising awareness of biomass
- Regen SW, Severn Wye Energy Agency (SWEA) –the FOREST project
- Devon County Council - Ward Forester project, bringing smaller woodlands back into management.



Figure 22 –FOREST marquee at the South West Woodland Show

Feedback has been very good, with biomass businesses reporting important leads and some having booked their places for the 2013 show already. There was also praise from the chairman of the South West Woodland Show saying “With the involvement of FOREST the wood energy sector really came together as a sector”. By popular demand the event is being extended to two days in 2013, and is being renamed the Confor Woodland Show to reflect the fact that many visitors come from across the UK to attend.

On the day before the show FOREST sponsored a meeting of the Confor Woodfuel Suppliers Group (WSG)⁶, a newly formed subgroup, now affiliated to the Renewable Energy Association (REA). The aim of the group is to act as a forum for supply side businesses, promoting networking and exchange of information. Key items on the agenda included quality control, membership options, sustainability criteria and the new Renewable Heat Incentive (RHI). The meeting was hosted at HMP Guys Marsh who provided an extensive tour of the prison’s 1.2 MW biomass energy centre, which was scheduled to coincide with a woodchip delivery (Figure 23). In the evening a dinner was provided for members of the WSG and exhibitors at the show, encouraging further opportunities for networking. Speakers at the event included Merlin Hyman, Chief Executive of Regen SW, Martin Biggs, Professor in Environmental Technologies at the University of the West of England (UWE) and Director of the Environmental iNets programme, and Kim Slowe, Managing Director of ZeroC, a low carbon developer with a special interest in biomass and district heating.

⁶ For more information on WSG see: www.confor.org.uk/AboutUs/Default.aspx?pid=332



Figure 23 - Wood chip delivery at HMP Guys Marsh

Attendance at trade fairs has been found to be a good way to engage with larger numbers of businesses and individuals and FOREST played an important role in a second trade event in March 2012. Renewable Energy Marketplace (REM), organised by Regen SW, is a showcase for renewable energy technologies, providing a full conference program, individual seminars and surgeries alongside a wide range of renewable energy exhibitors, including installers, associations and other professional services. FOREST supported the involvement of a number of Swedish firms through Symbiocity, a Swedish government initiative consisting of a network of companies involved in sustainability, looking to export equipment and expertise. A dedicated FOREST stand demonstrated the guides and tools developed through the project, while officers were available to answer questions relating to practical issues regarding supply chain involvement. Interest in renewable heat, awakened by Government announcements about the UK's Renewable Heat Incentive, was high and FOREST speakers presented on the biomass supply chain and on lessons for system procurement at the main conference hall. In a series of smaller, technical seminars FOREST presented on the role of standards, improving woodlands and financing wood fuel installations. FOREST officers were supported with presentations from important members of the local supply chain including Forest Fuels, Forestry Commission, Devon County Council, and Dartmoor Woodfuel Cooperative. Reports on the trade fairs can be found at: www.forestprogramme.com/tools-resources/guides.

Study tour/exchange visits to Austria and Sweden

There are a wide range of supply chain actors who are active in the region, and some of the businesses are more developed than others, so the aim of the study tours was to provide something of interest for different groups. The Austrian and Swedish FOREST partners are well connected in their respective regions and were able to provide a bespoke agenda for the visitors. As well as delivering sector specific content, additional benefit was perceived to be gained by introducing members of the forestry and fuel side of the supply chain to the equipment and heating side (and vice versa).

The resulting tour programs also included delegates from Ireland and Poland; the organisers felt that this would provide good opportunities for exchanging experiences and ideas between the under developed biomass regions as well. In Ireland for example management of woodland is being helped with the introduction of growers groups which is of interest in the UK. In Poland, as in Ireland, the state controls the majority of forests, and biomass heating has to work hard compete with cheap coal while at the same time there is great pressure nationally to reduce CO₂ emissions.

The first study tour to Austria took place in October 2011 and was attended by 11 individuals from 8 different businesses including consultants, a boiler manufacturer, a community energy group, a local college offering training in renewable energy technologies and a woodfuel cooperative.

The Austrian program was organised over two days by O.Ö.Energiesparverband and included introductory seminars on:

- Market development in Upper Austria;
- Technical elements of biomass boilers;
- Biomass district heating systems.

These were supplemented with other talks and site visits:

- Production facilities at boiler manufacturer, ETA, with examples of different system designs;
- Woodchip production and logistics at Bioenergie Preuner;
- District heating at Pettenbach;
- Biomass heating facilities and the heat contracting model at inverter manufacturer Fronius with Ing. Aigner;
- Passivhaus school in Altmünster with biomass heating.

Feedback from the delegates was excellent; many were amazed and inspired at the level of integration and sophistication of the market in Upper Austria. The supporting seminars underlined the importance of the 'Three Pillar Approach' adopted in the region, a coordinated mixture of incentives, regulations and information activities, delivered consistently over a long period of time. Some delegates questioned whether this level of integration would be possible in their own regions, but the point was made that support from decision makers did not happen by itself, the supply chain had to take steps to organise itself, ensuring the quality of the services offered in order to gain political and public support.



Figure 24 – 1.2 MW biomass boiler sited in a bunker at the Fröhling factory



Figure 25 - Chipping round wood at Bioenergie Preuner

The second study tour was developed by Swedish partners Energikontor Sydost and was focussed on biomass heating at a larger scale and included delegates from Poland and Ireland. The UK contingent consisted of 15 delegates from three local authorities, fuel producers, consultants, the Forestry Commission, Confor, an agricultural college, an estate manager, a renewable energy/sustainability training provider, and the University of Exeter.

The two day study tour included site visits to:

- Small-scale heat plant at Braås near to Växjö;
- Wood fuel storage facilities;
- The Sandvik II biomass CHP plant in Växjö;
- Lantmännen Agroenergi pellet, briquette and wood powder production facilities in Malmbäck.

The visit culminated with a visit to the World Bioenergy Fair at Jönköping. The fair included leading manufacturers and suppliers and featured many practical demonstrations of chipping and timber handling equipment. A full list of the exhibitors and a short film about the event can be seen at:

www.elmia.se/en/worldbioenergy/For-Visitors/Fair-Catalogue-2012/
<http://youtu.be/2MwqWvSw9V4>

Delegates were impressed with the sheer scale of operations that have been achieved in Sweden. The smaller district heating plant at Braås for example has a network length of about 9,900 m and provides 20 GWh of heat a year for 118 customers, the largest of which is a Volvo factory. At peak production the plant, consisting of a 3.5 MW woodchip boiler and 1.5 MW pellet boiler consume around 120 m³ of fuel a day (approximately 22,000 m³ over a whole year). The site includes 2 oil boilers to provide peak/reserve power but 98.4% of the demand is met with biomass.



Figure 26 - Walking floor at Braås district heating plant; in cold weather chip are frozen solid and need to be broken up

Meanwhile in Växjö, the Sandvik II CHP plant (Figure 27) has a capacity of 65 MW_{th} and 35 MWe, its heat network is 400km long and provides 97% of the cities heat requirement (approximately 600 GWh a year). It is fuelled entirely with woody biomass with a small amount of peat which contains some sulphur and improves the quality of the combustion. The boiler itself is based on a fluidised bed where the fuel is combined with limestone and sand to help control SO_x and NO_x. Emissions from flue gases are very low and are cleaned up by multicyclone and electrostatic precipitator. The accumulator tank is some 60m high, and can store 2,500 MWh of thermal energy. Despite the scale of the operation all of the woody material comes from within a 16 Km radius and the costs of transport and woodland management amount to around 3% of the total energy output. A 14km cooling network is also included through an absorption chiller to supply the hospital.



Figure 27 - Sandvik CHP plant, Växjö



Figure 28 - Delegates on a guided tour of the Sandvik II biomass CHP plant, Våxjö

Pellet and briquette production figures are similarly impressive, with the Malmbäck plant operating 24 hours a day, it produces around 100,000 tonnes of biofuel a year, including around 25,000 tonnes of wood powder where chips are dried down to around 5% moisture content and finely milled for combustion in adapted oil boilers.



Figure 29 – Malmbäck, large piles of chip must be carefully managed to prevent self-ignition

More details on the study tours can be found at www.forestprogramme.com/events/past-events

Capacity building activities

Technical seminars

Seminars and dissemination events have been held at various locations in the region, the first event in March 2011 was held at the University of Exeter and was attended by 10 local authority officers and Councillors with renewable/sustainability portfolios who are seen as key to the delivery of larger biomass installations in the region. Most are members of the South West Energy and Environment Group (SWEEG) which is coordinated by the Centre for Energy and the Environment at the University of Exeter. The seminar coincided with a visit to the University of Björn Zethræus, Professor of Bioenergy Technology at Linnæus University and included details of

work being carried out by FOREST and results of monitoring work carried out by the University. Professor Zethræus gave a talk on district heating which is extremely under developed in the region.

A second seminar was held in June 2012 at Bicton Earth, a training and conference centre for renewable technologies and sustainable buildings. More than 40 delegates attended from a variety of backgrounds and FOREST was pleased to welcome supply chain experts from outside the project to add to the FOREST material. Additional speakers included:

- Graham Waddell, Head of Earth Programme at Bicton College
- Andy Bradford, Dartmoor Woodfuel Cooperative. Innovative woodfuel supply cooperative based around a Dartmoor farm, providing a hub for biomass related activities.
- Sam Whatmore, Forest Fuels. Founder and director of Forest Fuels, the largest woodfuel supplier in the region.
- Helen Bently-Fox, Woodsure. Not-for-profit organisation providing accreditation for woodfuel producers
- Graham Smith, Independent consulting engineer. Collaborating on a CIBSE guide to biomass which is expected to become the definitive guide for engineers installing biomass in the UK.
- Mick Bracken, Ward Forester Project. Bringing smaller woodlands into management through collaborative practice.
- Jez Ralph, Silvanus Trust. Working with businesses and communities to develop woodland potential economically, socially and environmentally.



Figure 30 - Introducing FOREST at Bicton Earth

Presentations can be downloaded from www.forestprogramme.com/events/past-events/.

More information about Bicton Earth and biomass can be found at www.bictonearth.co.uk/about-us

Bristol lies to the North of the region and has the City has consistently been at the forefront of installing biomass in its building in the region so Bristol City Hall was seen as a fitting venue for the final FOREST seminar, held in September 2012 (Figure 31). Despite atrocious weather and widespread flooding almost 60 delegates made it to the seminars which again featured guest speakers whose presentations complemented the FOREST materials. Speakers included:

- Steven Irving, Commerce Director, Bio Nordic. Innovative consultancy/designers/installers delivering Scandinavian expertise to the UK renewable energy and sustainability sectors
- Bengt-Erik Löfgren – Technical Advisor/Trainer, Bio Nordic.
- Paul Barker, Energy Management Officer, Bristol City Council. Active in biomass procurement, exploring multiple options for public/private partnerships for the operation and supply of biomass on behalf of the Council.

- Stuart Mclean, Boomeco. Leading resource recovery company, specialists in the recovery of wood based products.
- Finian Patrick, Fair Energy Ltd. Experienced designers and installers of biomass boilers and district heating, offering a full range of technologies and integrated heating solutions.
- Dr Jutta Chisnell, Vollmer Engineering. Experts in low-carbon solutions for buildings and systems engineering approaches to the design and management of biomass and district heating systems in the UK and Germany.



Figure 31 - Bristol, City Hall

At the end of the seminars delegates were given the opportunity to visit the biomass boiler at the nearby 'M Shed', a museum on the historic dockside, where forever Fuels, a leading supplier of wood pellets, arranged to demonstrate the practicalities of delivering wood pellets in an urban environment (Figure 32).



Figure 32 - Forever Fuels demonstrate a pellet delivery at the M Shed in Bristol

Developing supply chain partnerships

Businesses in the region have been encouraged to develop closer working relationships or partnerships through exposure to more advanced methods of delivering biomass heating, and in particular those that can simplify or otherwise de-risk the process for end users. Each of the trade fairs, study tours and seminars have served a dual purpose, in the first place to educate and illustrate the biomass supply chain and the success factors associated with best practice and closer integration. The second and equally important aim has been to allow businesses the opportunities for networking. The early opportunities were generally seized upon with enthusiasm, and in all subsequent events every effort was made to provide ample time to allow for exchanges to take place. Potential end users were also present at many events, taking good advantage of the accumulated expertise within the room, but their presence also gave added interest for businesses interested in developing sales. Questions and concerns from consumers help to demonstrate the extent of the (mis)understanding in the wider market and give the bioheat businesses an indication of the barriers experienced by some. Ultimately it is hoped that the interactions will help the businesses to develop their products and services, and that consumers will get a better sense of the possibilities that biomass presents.

Many of the individual bioheat businesses in the South West are technically very proficient and FOREST has not always been in a position to add to this. There is however considerable lack of understanding among important building and forestry related trades such as architecture, engineering and agriculture, and these groups have benefitted directly from the FOREST guides. Bioheat businesses however have still found the market growth rate frustratingly slow. Considerable investment is required for any business entering the market, whether that involves buildings, machinery or forward buying timber and market uncertainty will make these investments harder to maintain. The economic situation has had a widespread effect on consumer confidence and large capital projects, in particular, have suffered. Cuts in government budgets have had a corresponding effect on public procurement at the local level and even the latest government funding scheme, the Renewable Heat Incentive, which has got off to a slower start than expected, is not yet to delivering necessary growth, despite some assurances that (eligible) installations as far back as 2009 will be accepted on to the scheme.

It has been difficult to 'sell' supply side solutions to otherwise organised businesses in this climate, so the emphasis has been on bringing buyers and suppliers together at every opportunity. Both sides stand to benefit from thinking about the biomass 'system' rather than a series of components. To this end FOREST has been involved with a number of additional events aimed at promoting the biomass agenda between businesses and communities.

- Cockington Court, Wood fuel Supply Chain Day.
With members of the Ward Forester project having recently returned from Germany and FOREST having returned from Austria, an opportunity was taken to bring the two groups together to discuss their experiences. The day included a tour of the biomass facilities, including chipping and a woodfuel delivery.
- Boiler manufacturers Woodpecker held a one day CPD event in Somerset, including talks and boiler demonstrations as well as a visit to a small district heating system driven by a 200 kW pellet boiler. FOREST supported the event with a speaker and materials.
- After the success of the first visit, HMP Guys Marsh offered to host another event incorporating the whole of the supply chain. 'Designing, building and operating a biomass energy centre' was organised with FOREST and included consultants, WSP, construction company Kier, boiler installers Wood Energy and wood fuel suppliers New Forest Energy. The 80 invited delegates were given detailed presentations on the procurement and construction of the energy centre and a tour which followed the timber, from the depot where it was chipped, and loaded, through to the fuel store and boiler.
see www.forestprogramme.com/files/2012/04/FOREST-event-summary_HMP_Guys_Marsh.pdf

In addition to these events FOREST has engaged directly with local authorities to improve and develop their experience of biomass. A series of three one day workshops were held by Devon County Council involving fuel providers, these interactive sessions were aimed at understanding the requirements of the local fuel supply chain and simplifying fuel procurement process for local authorities, a 'modular' contract was been proposed to

enable smaller suppliers the opportunity to tender for local authority contracts. Meetings have also been held with engineers in Cornwall Council to assess their biomass procurement procedure. A site based checklist and some high level calculation tools were developed to assist in the decision making process. A number of boilers in Devon and Cornwall have also been monitored through the Centre for Energy and the Environment to help the authorities understand their fuel consumption and efficiency and to help with fault finding.

Devon County Council have made an additional commitment to fund a Devon based 'Biomass Supply Chain Group' for at least another year carry on the work started by FOREST. The group will be run jointly by Regen SW and Forest Fuels with member likely to include other partners from the FOREST local management group. FOREST guides will also continue to be used in training sessions at Bicton Earth where materials have been well received.

The market in the South West is showing signs of picking up speed, and the attendance at the Regen SW Renewable Energy Marketplace (REM) for 2013 has confirmed this. Previous events have been dominated to some degree by PV firms (a direct result of the Feed-In Tariff Scheme) and while the PV bubble has not exactly burst, it has become deflated somewhat by large cuts in tariffs (reflecting the falling cost of installing PV). The number of biomass orientated businesses at REM has certainly increased and it is very interesting to see a number of businesses offering interesting ESCO type services. A great many of the businesses have been involved in FOREST activities but to claim this development as a FOREST effect would be overly simplistic. The Renewable Heat Incentive has clearly been important but it is interesting that so many of the firms are using the RHI payments as a means of financing the ESCO services they are offering, rather than waiting for end users to apply for the Incentive themselves. Exposure to the operation of advanced markets through FOREST has hopefully been persuasive, and the need to simplify the procurement and operation for end users understood.

5.3 Pomeranian Poland

The Province of Pomerania has a significant potential biomass resource and is one of the most forested regions in the country (average forestation is 36% compared to a national average of around 30%). However woody biomass in the form of woodchip, briquettes and pellets are all more expensive than the coal offered at local markets, even the high quality pea and nut coal used in modern automatic stoker boilers is cheaper than biomass. Firewood in the form of logs is used in rural areas in stoves and small boilers but in general biomass is more likely to be competing with the more expensive fuel oil and LPG installations. This is a relatively small market and as a result there have been no medium size biomass-fired boiler plant installed in the region. According to the information from businesses about 30-50 small pellet boilers are installed in the region annually.

During the course of the FOREST project, the legal framework at the regional level has remained largely unchanged and while a National RES Action Plan has been adopted which anticipates the doubling of the use of biomass between 2008 and 2020, there are no obligations imposed at regional or local levels. After a long delay the new RES law is planned to be adopted in 2013. Incentives will be offered to increase the number of smaller, distributed energy generation projects, including biomass CHP plants. The law will also gradually reduce support for co-firing of biomass with coal in older power plants. These plants currently provide the biggest share of 'green' energy in Poland and the amount of biomass used for co-firing continues to grow, it is hoped this change of emphasis will make more biomass available at the local level and provide additional stimulus to the market. Over the next year a system of allowances based on CO₂ emissions will be brought in for bigger boilers and plant which will affect coal combustion in particular.

The Pomeranian administration is also considering a plan which aims to stimulate the development of small-scale renewable heat and energy sources in the region. The experiences gained through FOREST and the materials developed will be helpful in supporting those trying to build up the market for biomass and to promote the whole supply chain way of thinking.

Local management of FOREST

The Local Management Group (LMG) in Pomerania was set up to guide actions of the project and ensure the relevance of actions within the region. Together with BAPE representation, the members of the LMG for Pomerania were drawn from a range of government departments and private businesses and included:

- Pomeranian Province Administration (Energy Department), Gdansk
- Regional Agriculture Advisory Centre, Luban
- Regional Forestry Administration, Gdansk
- Association of Forest Engineers and Technicians, Gdansk
- Centre for Renewable Energy Ltd., Kwidzyn (wood-chip producer, biomass HOB operator)
- VAPO Heat & Power Polska, Gdansk (pellet producer, boiler operator, ESCO)
- Regional Environmental Fund, Gdansk

Between them, these institutions cover much of the supply chain and support from the government is particularly important as most forestry in Poland is state owned. Each of the members signed formal supporting letters and delegated their representatives to act. All documents developed within FOREST were distributed to the members of LMG and they were invited to participate in all FOREST events. Formal meetings were organised with the next contacts ensured by circulation of emails and phone conversations.

Development and implementation best practice tools

The structure of the market in Pomerania

During the market survey 39 companies were contacted and 13 interviews completed, although over the duration of the project many more companies have been contacted and involved in other activities of the project.

The use of biomass in the Pomerania Region has increased steadily over last few years and the main biomass fuels in the region are:

- Wood chips; the majority of wood chip production from wood-processing industry (totally over 500 000 m³) is used by plants themselves (for technology and drying of wood) or collected by board producers.
- Wood pellets; the biggest consumers of pellets are two big CHP plants in Gdansk and Gdynia, using pellets and other biomass, including imported biomass, in co-firing with coal.
- Fuel wood (chopped); domestic use of wood is mostly in farmhouses and houses in the countryside, it is typically burned in low-efficiency furnaces, stoves and boilers.
- Straw in bales; straw bales are often combusted using older Danish technologies; these can be automatic or batch boilers.
- Straw briquettes; the use of straw briquettes is a relatively new development use and offers a cheaper biomass fuel that can compete with coal.

In general, all biomass fuels have to compete with cheap coal, so the conversion of plant from fossil fuels to biomass typically occurs when additional support is available from special environmental funds. An additional concern, expressed by many actors, is not just the cheapness of coal; it is the variability of biomass prices. The cost of raw materials varies significantly throughout the year, these effects which are often seasonal, are a considerable source of uncertainty for both suppliers and consumers and can undermine the 'trust' in biomass technology. Fluctuations in raw material prices have also undermined the willingness and ability of companies to form of stable partnerships. The lessons from Austria and Sweden indicate that working in partnership can have real benefits in a developing market yet many actors perceive longer term partnerships as a barrier to making the best profits, as they impinge on the ability of the business to adapt freely to the latest market situation.

Other weaknesses in the market which were mentioned and have limited the growth of biomass affect both the fuel side of the supply chain and the equipment. A key concern is the availability of raw materials at the right quality, quantity and price. This gives rise to anxiety over the security of fuel deliveries and whether they can be

relied on in the future. This is compounded by the lack of good quality heating appliances and the architects, system designers and installers with the right qualifications, knowledge and experience to implement the systems well.

Poor quality fuel and badly designed heating systems will conspire to undermine confidence in the technical potential of biomass technologies, particularly when there is a relatively higher price to be paid. In addition, when a poorly performing system offers scope for fuel providers to blame the equipment and for equipment providers to blame fuel, the situation appears to be a 'problem without solution', the end result of which is to discourage potential investors from considering biomass altogether. This is a problem that, perhaps unsurprisingly, is mentioned by both fuel producers and boilers manufacturers in interviews.

Many of these challenges, according to the businesses who were surveyed, are a result of the immaturity of the market in Poland. Failing to learn lessons from advanced markets, and the slow rate of adoption of best practice examples, means that development can be erratic and the uncertainty puts an upward pressure on prices. In a similar fashion, the short history of the market means that key decision makers in government departments are perceived to lack competence, and underestimate the value of biomass and the role the sector could play in the wider economy. Finally the economic barriers cannot be underestimated, high levels of upfront investment can be offset in some areas by lower variable costs, but in the face of competition from cheap coal, such investment decisions can be much harder to justify. Many suspect that special incentives are the only way that this barrier can be overcome.

For more details on the structure of the biomass markets in the partner regions please see www.forestprogramme.com/tools-resources/guides/

Model supply agreements and contracts guide

The guide to contracts and partnerships arrangements developed within FOREST is particularly helpful under the current market conditions in Poland. Supply agreements and complex contracts are very rare in the Polish bio-heat market. Typically biomass heating is introduced to public sector facilities (local or regional administration schools, kindergartens, other public buildings), the investment is performed within public procurement, and key decisions concerning fuel supply, boiler design, supply and installation and operation of the plant are undertaken centrally or with limited consultation of potential supply chain partners.

Lessons from advanced markets indicate that Energy Services Contractors (ESCOs) can be very successful at overcoming issues around uncertainty, variability and quality in biomass markets. There are still few of ESCOs operating in Poland, but some successful installations have been identified and publicised as examples of good practice locally:

- **Renewable heating contract at school in Owidz.**
A renewable heating contract between VAPO Heat & Power and a school complex in Owidz provides the school with the benefit of a convenient, cost effective and environmentally friendly heating system. VAPO Heat & Power has implemented numerous large biomass heating projects and is therefore able to offer a reliable service agreement which covers the operation, maintenance and servicing of the plant. Although the service is provided by VAPO Heat & Power, it cooperates with local companies for delivery on the ground. Pellets for the biomass boiler are delivered by VAPO Pellets which ensures consistent quality and the certainty of longer term supply contracts helps to maintain the fuel production business. The partnership between the larger company and local providers has benefits for both, and the level of service and commitment provides a good experience for the school.
- **Heat contracting for nursing home in Ryjewo**
The biomass heating system in Ryjewo is operated under a heat contract by the Renewable Energy Centre (CEO Kwidzyn). One of the CEO owners has a short rotation willow plantation, which provides fuel for the boiler. Operation and maintenance is provided also by CEO. The heat supply contract covers pricing, payments, heat demanded, maintenance, maximum reaction time and responsibility for failures

The heat tariff itself includes two elements:

- A price for certain heat power demand ordered by a customer,
- A price for heat consumed (metered).

For more details see the full list of FOREST case studies at www.forestprogramme.com/case-studies/

Guide to biomass heating standards

In advanced markets effective standards have been long recognised as crucial to the development of the industry as a whole. Standards provide assurance about quality, compatibility and repeatability and provide a badge of recognition to help consumers make informed choices. Like many other countries Poland has never had its own set of biomass orientated standards and is an issue that has been raised regularly by those companies who were interviewed. Previously the only segments of the market that were actively pursuing standardisation were exporters, and in particular those exporting pellets where adherence to recognised national standards (DIN, ÖNORM, SS) was required to gain access to the markets. It is hoped that the new EN standards will provide a basis from which Polish producers can demonstrate quality. The FOREST guide to standards has provided a useful overview of current standards and a good deal of background of the process of making standards.

Materials from three guides on biomass market, partnerships and standards formed the base for presentations used for training and education during local FOREST meetings.



Figure 33 - Containerised pellet-fired boiler house in Owidz

Bio-heat specification guide

The FOREST guide to specifying biomass systems is seen as the final step in supporting the fuel and equipment supply chains and is considered as very important and helpful in the current Polish market conditions. Generic information designed to demonstrate the importance of supply chain considerations and the effect on optimal system design is supplemented with region specific information on the legal framework for biomass plants (decisions, permissions, basic design requirements, local planning, building law rules, air quality standards), as well as quality and standards requirements and the availability of financial incentives.

The guide has been translated and adapted to Polish conditions, including relevant local data for district heating. The regional annex includes basic information on legal framework for biomass plants (decision processes, permissions, basic design requirements, local planning, building regulations, air quality standards), as well as quality and standards requirements and the availability of financial incentives. The guide has been published as the next volume and in the same format as the previous FOREST publications.



Figure 34 - FOREST guides in Polish

On-line training tool

Elements of on-line training tool have been incorporated in the training materials. The on-line tool in English has been practiced by BAPE staff and was used as part of training of students (course in English).

Business to business (B2B) activities

Trade fairs and FOREST seminar in Poland

Various possibilities for setting up trade fairs was analysed and discussed within the Local Management Group. Experience has shown that new trade fairs in this area can struggle to attract an audience so the return on effort can be disappointing. FOREST aims to work within existing structures where they exist so order the decision was made to partner with existing fairs in the region to present the FOREST message and tools. The International Fair of Equipment and Technologies for the Pellet and Briquette Industry, 'PELLETS-EXPO & BRIQUETTES-EXPO', in Bydgoszcz is one of the biggest annual events of its type in Poland. Joining this fair exposed the project to the widest possible group of businesses and helped to widen the agenda for a fair that has been traditionally had a more narrow focus.

The FOREST seminar at the fair was organized by BAPE and entitled 'Pellet and briquette market - possibilities of development', was presented on 2nd June, 2011 (Figure 35). FOREST officers delivered four presentations:

- Bettina Auinger, O.Ö. Energiesparverband - 'Biomass heating in Upper Austria; Green energy – Green jobs';
- Kierson Wise, Seven Wye Energy Agency - 'Wood fuel supply co-operatives in the Forest of Dean – lessons learnt in the UK';
- Erik Blomgren, Energikontor Sydost - 'Biomass use in the Southeast of Sweden – working towards a fossil free region'
- Andrzej Szajner, BAPE - 'FOREST tools supporting biomass supply chains'.

Presentations by BAPE and other experts dealt with development of biomass fuels market. The seminar attracted audience of over 150 specialists from wood fuel businesses and biomass users. Participants were provided with FOREST documents and copies of the presentations, which were also published in 'Czysta Energia' ('Clean Energy'), a national monthly magazine with a circulation of 6700, targeted at biomass sector actors, public authorities and businesses.

The fairs themselves gathered over 65 exhibitors from Poland and abroad, including major equipment providers from across the biomass supply chain. Visitor numbers were estimate at a few thousand, including Polish and foreign specialists, including Eastern Europeans. Other FOREST delegates from Spain and the UK visited the fairs.

Contact with the Fairs organisers has been sustained and the importance of including the wider supply chain issues within the content has been understood. It is anticipated that future seminars in subsequent fairs will continue to deliver this message.



Figure 35 - Andrzej Szajner from FOREST demonstrating the supply chain principle

Study tour/exchange visit to Sweden

The two day study tour to Växjö in Southeast Sweden took place on 29-30 May, 2012 and was focussed on the use of biomass at the larger scale. Local and city wide district heating schemes were visited as well as large scale pellet production facilities. The tour ended with the World Bioenergy Fair in Jönköping. To encourage the exchange of ideas delegates from the UK and Ireland were also present. The interaction between the various groups was good and it is hoped that scope for further cooperation exists.

The Polish delegation included active partners from the Local management Group and other businesses from the biomass sector. End users and those with an interest in biomass procurement were also present. Participants were given FOREST materials and guides before the visit. The tour was very well received and considered helpful from professional point of view, the quality of the organisation was also praised. Points of special value for Polish participants included:

- Technical presentation of the biomass supply system and operation of the biomass CHP/district heating plant in Växjö, with detailed discussion on economics and everyday problems.
- Visit to a large pellet production plant, with details on production and product handling.
- The world Bioenergy Fair in Jönköping, showing the full range biomass products, services, equipment and systems.

Overall the example of the Swedish approach to biomass for heat and power revealed how much improvement can be made under Polish conditions. By adopting a more integrated approach, including the handling, processing and transportation as well as the final use of biomass, the Swedish experience showed, in practical terms, how effective the biomass market can be. There is some optimism that many of the lessons can be developed in Poland. It was also clear that the public sector has a leading role to play in 'kick starting' biomass projects; this creates the initial demand around which the supply chains can grow. As the markets develop, the scope for entrepreneurial activity increases and more private companies and schemes can become involved.

Capacity building activities

Establishing of 'Biomass for Pomerania' Initiative

Over the period of the project about 80 businesses and other actors of the biomass market have been contacted. Some are members of trade chambers and associations with interest in individual segments of the market (e.g. forestry, energy); however there is no regional body with a wide enough scope to cover all of the biomass supply chain. Some businesses are understandably reluctant to join formal associations, even when the longer term benefits are recognised, particularly when membership documentation, time commitment and fees may be required.



Figure 36 - Polish delegation at the pellet production plant

Finally, however a decision on announcing the new Initiative 'Biomass for Pomerania' has been undertaken. The Initiative will promote the lessons from FOREST and the 'whole supply chain approach' to the regional administration and lobby for increased support to the bio-heat in the region. The early goals of the Initiative are summarised below:

- To provide support to the regional authorities in implementation of the regional energy strategy, including RES;
- To stimulate activities in energy efficiency and renewable energy areas and contacts between businesses in biomass market;
- To lobby for increased financing of biomass supply chain investments from regional funds.



Figure 37 - logo 'Biomass for Pomerania'

An invitation to join the Initiative was issued to all businesses and participants that have been in contact with the project through training seminars and other FOREST events. At the end of November 2012, 17 businesses have formally offered their support to the Initiative. A website, hosted by BAPE, has been opened for new supporters: <http://bape.com.pl/forest/BiomasadlaPomorza.aspx>

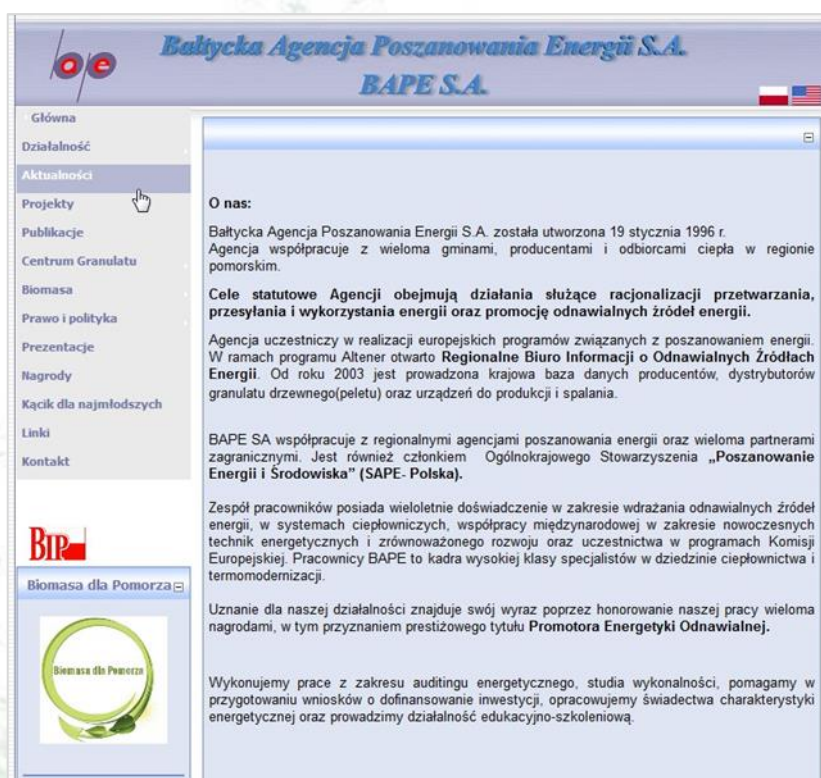


Figure 38 - Initiative 'Biomass for Pomerania' at BAPE front page

Technical seminars on the best practice tools and models developed

The format and content of the seminars was made with the support of local business and in consultation with the LMG to present the most relevant and useful aspects of the project to the intended audiences. As well as the materials and guides developed within the project photos and short films from technical visits have also been presented.

Eventually three seminars were delivered:

Lebork – Municipal Administration (October, 2012) <i>Partnerships and quality in biomass supply chain</i>	Suppliers of biomass and equipment providers for planned biomass CHP plant were invited. Out of 35 invited companies, 22 representatives from different companies took part with a good cross section of supply chain actors. The discussion concentrated on organisational and quality aspects of the biomass supply.
GKB (Gdansk Building Cluster) (November, 2012) <i>Quality and business opportunities in biomass-for-energy supply chains</i>	The Gdansk Building Cluster consists of more than 55 businesses from the building sector in the Pomeranian Province. Its aim is to increase investment opportunities and competitiveness through cooperation and knowledge sharing, particularly in relation to 'novel' technologies. 19 representatives took part in the training. The biggest interest was in the investment possibilities and guarantees on incentives in the biomass sector.
Gdansk University of Technology, Chemical Faculty (November, 2012) <i>Organisational and quality aspects in biomass-for-energy supply chains</i>	Training was organised for 3rd year students of the 4-year study on Environmental Protection and Management. The lecture and training was delivered within the course 'Alternative Energy Sources'. One group of students has studies in English on Technologies of Environmental Protection, allowing for use of on-line training tool. In total 71 students took active part in the training.



Figure 39 - Training in Lebork, October, 2012

Developing supply chain partnerships

Partnerships in the region are often formed around individual projects; case studies of two of these have been presented on the project website. Many businesses are wary of collaboration and would only consider building a partnership in order to improve chances of being considered for 'concrete' projects.

The possibility of one such project occurred when plans for installing a biomass CHP plant in the town of Lebork got promise of financing. While the technology has been decided by the municipality, potential for raw material, biomass processing, storage and transportation was to yet be described. The demand for biomass has been estimated at 28,000m³ annually and there is a compelling case to be made for close cooperation between actors as to provide the quality and quantity required.

Businesses within distance of 100 km from the site were identified and 35 biomass businesses have been contacted by mail, phone and fax. Some of these are relatively small businesses from the forest service sector and saw mills, and do not have a large internet presence or web pages and could otherwise have been overlooked, despite have good local knowledge and capabilities. Traditional methods of contact, either by phone or by personal visits were required.

All of the businesses were informed about the potential for biomass collection, storage and transport to the CHP plant. Preliminary questionnaires were delivered to the businesses with questions on types of biomass, historical, present and projected volumes, transport possibilities, willingness to cooperate with the Lebork plant and expected prices. Materials and guides developed within the FOREST project have also been sent to the businesses, and invitations to join the training seminar in Lebork as well as the 'Biomass for Pomerania' Initiative.

Eventually 11 of the businesses were able to offering suitable services, including raw materials and processing. All of the businesses have been offered support and been given information relevant to the project. The list of companies has been presented to the Lebork Municipality who expect to make contact will be contacted as the project progresses.

On-line supplier database from Pomerania

Contacts with 35 businesses have been provided for the FOREST supplier database. The companies included have answered to questions at different stages of the project development (market survey, development of supplier chain) and are known to BAPE as businesses providing deliveries and services in Pomeranian region. All types of potential partners from the biomass supply chain are present in the list.



Figure 40 - FOREST sub-page at BAPE website

In the Pomeranian Province of Poland FOREST has been the forum where regional administration officers responsible for energy planning have discussed biomass issues with representatives of the Regional Administration of the State Forest, Agriculture Advisory Centre and businesses from the bio-heat market. FOREST has helped to bring the first estimation of biomass market in the region, including businesses, sources of biomass fuel, problems encountered and the expectations of the market actors. Longer term biomass contracts and service provision are still not popular because of problems with setting the heat price which is decided centrally. There is still a lack of mutual trust and good example installations remain relatively rare, although larger companies entering the market are expected to initiate more biomass heat contracting.

5.4 Lombardy, Italy

The sustainable production of energy represents one of the major challenges for economic growth, both regionally and nationally. Increasingly decentralised energy solutions, based on the availability of local resources are being sought to provide additional sustainable capacity. Political and legislative conditions for the bioenergy sector are improving through European and National initiatives, and the bioenergy proportion of renewable energy generation is increasing although it is still at a very low level with solid biomass accounting for approximately 2-3% of the national energy requirement. This however is still in line with European averages, although rather lower than in advanced markets like Austria where the figure is 12%.

In the Lombardy Region particular emphasis has been placed on the biomass sector, it is seen as having key strategic benefits in its ability to 'kick start' the local economy by improving business opportunities within the biomass and associated sectors. Wider benefits such as improvements in social cohesion are also expected as a result. Heat supply is a crucial element of the regional energy plan⁷ and the contribution of renewable heat is expected to double between 2008 and 2020 is expected. Overall, the residential sector is expected to provide about 50% of the total reduction in CO₂ by 2020, the most efficient way to provide the quantity of heat required will be through biomass district heating and CHP.

However, a high proportion of biomass is consumed in small appliances in the Lombardy region, much of this is in the form of wood logs, although self supply and the ad-hoc nature of the market make it very difficult to gather reliable consumption data. Combustion efficiency and management of emissions is often poor with small appliances and there are concerns over the effects on air quality. Lombardy lies within the Po Valley, an area which frequently experiences critical levels of air pollution due to the highly industrialised nature of the region and the poor ventilation characteristics which result from the meteorological and geographical conditions.

⁷ Piano per una Lombardia Sostenibile, 2009

While industrial emissions and those from transport are often responsible for the majority of emissions, those from biomass burning are still significant.

Local and regional air quality plans are in place to manage emissions but in order to maintain and increase the contribution from biomass there will need to be more emphasis on high quality fuels and a shift towards larger plant. Medium and large scale boilers can provide higher combustion efficiencies and superior control of emissions. Larger plant can often be implemented as part of a district heating network, or with CHP capabilities however the legal and financial frameworks can be complex and can vary between municipalities so that problems associated with gaining approval for such schemes can be a disincentive to investors. There is also work to be done in convincing the public of the benefits of community based heating schemes.

FOREST activities in the Lombardy region have aimed to strengthen the exchanges between business by providing opportunities for high quality interaction and by learning from the best practice examples offered by others.

Local management of FOREST

A key feature of the FOREST project has been the interaction with businesses, both as a management tool, providing feedback on the project aims and output locally, and as a means of providing support to local initiatives. CTI has been grateful to those who have given their time to the project and have acted as speakers and given presentations at events organised through the project. The difficult financial situation has put large pressures on many of businesses, and at a time where possibilities for cooperation or exchange of ideas might otherwise have been limited, FOREST has allowed CTI to act as a conduit, helping to establish or maintain the channels of communication.

Key contacts for the project have been members of the Distretto Agroenergetico Lombardo (DAEL – Lombardy Agroenergy District, www.agroenergetico.com), a consortium of small and medium sized businesses with an established constitution and who have formulated a regional energy plan with input from CTI. Developed in a spirit of collaboration, the group aims to promote agro-energy and biomass as a priority for the Lombardy Region as an important element of energy policy, climate change mitigation, and the promotion of agricultural diversification.

Development and implementation best practice tools

The market survey carried out at the beginning of the project identified a lack of knowledge and misunderstandings about biomass heating among key actors in the region. Public authorities with responsibilities for commissioning larger construction and refurbishment projects were not necessarily well informed about biomass and susceptible to common misinterpretations about the ‘difficulties’ with the technology while at the same time lacking positive examples of successful installations and innovative supply models such as heat contracting and ESCOs. This situation was thought to be compounded to some extent by a corresponding lack of knowledge among system designers and other professionals from whom the authorities might be expected to turn to for advice. Equally important in difficult financial times, are the means to develop the financial models necessary to overcome the high upfront capital costs of larger biomass developments.

In each of the FOREST guides CTI has provided Italian translations and tailored the information to be relevant to local conditions. CTI has a recognised role as a standardisation body in Italy and has managed the production of the FOREST publication, ‘A Guide to Standards in Biomass Heating’. This document has had a particular strategic importance to the project as it brings together all of the relevant standards from the production, transport and storage of fuels to the installation of boilers. Standards are widely seen as crucial to the development of the sector and provide the basis upon which collaboration and partnerships can be built.

For more details and to download FOREST guides please see:

www.forestprogramme.com/tools-resources/guides/ or alternatively:

www.cti2000.it/index.php?controller=pubblicazioni&action=gruppo&gid=299&idn=569

Business to business (B2B) activities

The mcTER-FOREST trade fairs

In the Lombardy region B2B activity has centred on exhibitions and fairs to support the local biomass market. Strengthening the networks and developing individual contact between key actors in the biomass supply chain was seen as a priority by members of the Local Management Group and by CTI. The aim of FOREST has always been to work with existing organisations and events wherever possible, and while there was no pre-existing biomass specific event, partnering with an existing fair on cogeneration (mc-TER) provided a good opportunity to bring these key sectors together.

The first mcTER-FOREST event, 'Biomasse - Soluzioni, Tecnologie, Componenti', was held over one day in June 2011 and was structured into two sessions; a plenary conference in the morning dealing "Bioheat from woody biomass: case study and new prospects" dealt with current topics and provided an overview of the European and domestic market as well as introducing the FOREST project and tools. Case studies from the Austrian, Swedish and Italian markets were presented by CTI and other FOREST partners and representatives from key local organisations AIEL (Italian Agriforestry Energy Association), FIPER (Italian Federation of Producers of Renewable Energy) and DAEL (Lombardy Agroenergy District). In the afternoon more than 30 individual workshops were provided by private organisations covering market news, technologies and solutions. More than 2000 people pre-registered for the event online which attracted more than 50 exhibitors and 800 visitors to the trade fair.

The success of the first event revealed the extent of the appetite for knowledge and information, and the continued demand for information and opportunities for networking, lead to a second event being organised in June 2012. The number of pre-registrations increased by more than 500, and the number of exhibitors and participants also increased. The format was largely similar with a morning conference supplemented with the trade fair and workshops in the afternoon. Workshops were provided by key technology and service providers including Ingeco, Turboden, Viessmann (ORC based biomass CHP modules), Hascon (emissions treatment), Cofely (district heating), Alfa Laval (heat exchangers), NME (steam turbines), Prüftechnik (predictive management control systems), Uniconfort and Kohlbach (biomass boilers and CHP). Individual workshops and the exhibition area, used for coffee and lunch breaks, provided good opportunities for exchanges between businesses.

The mcTER-FOREST bioheat fair looks set to become an annual self-supporting annual event, with many businesses at a regional and national level, looking to make it a 'yearly appointment' in their diaries. The fair has also had a positive effect on contacts to CTI, with a 17% increase in visitors to the website. The result is particularly pleasing given the current economic downturn but it highlights the importance to businesses of keeping up to date with technological advances and changes in the legislative framework. This is especially true in a developing market where the change can happen quickly, for example CTI has learnt from the feedback that the sustainability of woody biomass is one of the main concerns in Italy and many citizens and consumers remain sceptical about the potential benefits.

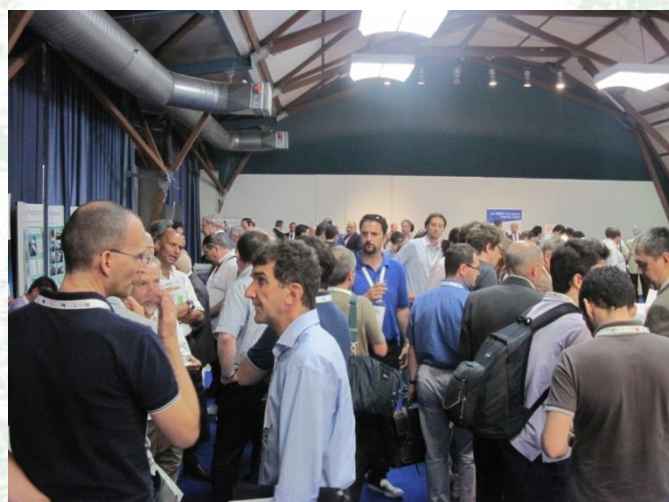
For more details of this and other FOREST trade fairs please see:

www.forestprogramme.com/tools-resources/guides/

First trade fair, 30th June 2011



Second trade fair, 28th June 2012



Business exchange/study tour to Austria

Highlighting examples of best practice and illustrating solutions with case studies has proved to be a successful strategy because it gives concrete evidence of technologies and supply models that have been shown to work. Taking this further, FOREST has given a few businesses the opportunity to visit businesses operating in advanced biomass markets first hand and to speak directly to those involved. The Italian exchange visit was provided in conjunction with FOREST partner O.Ö. Energiesparverband, the energy agency for Upper Austria. The Italian businesses represented on the trip were:

- CET – Consorzio Energia Toscana
- DAeL – Distretto Agroenergetico Lombardo
- Comunità Forestale - Unione dei Comuni di Valdarno e Valdisieve
- Consorzio Rurale val di Fiemme
- Termas – Cooperativa forestale ambientale
- FIPER – Federazione Italiana di Produttori di Energia da Fonti Rinnovabili
- CTI – Comitato Termotecnico Italiano



Figure 41 - Technical training sessions at ESV offices in Linz

The O.Ö. Energiesparverband (ESV), through its connections with the renewable energy network, the Oekoenergie-Cluster (OEC), was able to provide an agenda, arranged over two days and suited to the needs of those attending, based on classroom seminars and site visits to manufacturing and fuel production facilities, as well to district heating plants. Seminars were delivered by ESV experts on elements of biomass policy and market development, technical aspects of biomass heating and contracting and on biomass district heating systems (Figure 41). Site visits included the Guntamatic biomass boiler production facilities at Peuerbach () where additional technical training in system design was given. This was followed by a visit to Bioenergie Preuner, wood chip production & logistics specialists in Frankenburg. Max and Thomas Preuner (father and son) are farmers who have diversified into a successful wood chipping business. Investment in high quality machinery was an important requirement to be able to provide fuel of the right quantity and quality for the local market; the two mobile chipping machines can chip wood logs with a diameter of up to 80 cm, producing between 80m³ and 150m³ of wood chips an hour.

On the second day the group visited a cinema, *Star Movie*, in Dietach, where the 200kW biomass plant provides 210 MWh/yr for space and water heating (Figure 43). The plant is run on a contract by a *MR-Service*, part of the Upper Austrian 'Maschinenring'⁸, a farming cooperative which has evolved from sharing agricultural machinery to providing a whole range of biomass related services, including ESCOs. The final site visited was the 530kW district heating plant in Wartberg managed by Füsslberger GmbH. The system includes a 12,000 litre thermal

⁸ www.forestprogramme.com/files/2011/11/Case_study_Fuel-supply-by-the-members-of-the-machinery-ring-Upper-Austria.pdf

store to smooth out peaks in demand and provides 1,425 MWh/yr heat to a school building and 8 family homes. The annual fuel requirement is 2,500 m³, most of which is provided by forest owners in the region.

Participants in the study tour were particularly interested in the variety of business models for the supply of heat and in the economic and logistical elements of woodchip supply. Some would have like to have stayed longer and learned more, for example, about harvesting machinery and sustainable forest management. Networking opportunities were judged to be very good with some real potential for collaboration in the future.



Figure 42 - Automated production facilities at Guntamatic



Figure 43 - Farmers from the Maschinenring operator group at Star Movie Dietach

Developing local bio-heat associations

During the lifetime of the project much of the effort from CTI has involved providing networking opportunities and market intelligence to business in the bio-heat sector in Lombardy. The success of the trade fairs and the enthusiasm with which businesses have seized networking opportunities has shown that there is a need for the continuation of this kind of 'brokering service' in the region. CTI has worked closely with DAEL (Distretto AgroEnergetico Lombardo) through the local management of the project and DAEL representatives have provided content in FOREST seminars and events; as a result the organisation understands the aims of FOREST

and the importance of improving integration in the supply chain. DAEL, in return has been helped by CTI to prepare its own energy plan which has identified improvement in the bio-heat supply chain as one of the main issues to pursue. Businesses in the region looking for a supportive association to promote and develop biomass projects can look to contact DAEL at www.agroenergetico.com.

Capacity building activities

Technical seminars

Capacity building activities in Lombardy have consisted initially of seminars aimed at publicising the FOREST guides and associated materials but also addressing particular needs of industry in the region. One of the key concerns regarding increased use of biomass in the region is sustainability, uncertainty about which raises questions about acceptability of biomass as a viable solution to heating requirements. Details of sustainability criteria for energy production from biomass and the calculation of related GHG emissions have been explained including relevant Italian standards. More than 40 delegates attended the seminars, the first of which was delivered within the framework of the first trade fair, while the second was delivered as a standalone event in November 2012 (Figure 44). As well as Antonio Panvini (CTI Technical Director), who has introduced the topics, technical contents have been explained by Dr. Daniele Duca from the University Polytechnic of Marche.



Figure 44 - Forest training seminars in Lombardy

On-line supplier database

Approximately 250 businesses from the region have been included in the FOREST online supplier's database; contact with many of the business has been gained through the trade fairs and through the extended networks of the groups who have been involved with the local management of the project. The supply chain is well represented which is encouraging in a developing market. In a parallel initiative, a large number of forest management bodies, both public and private, have been selected in order to foster the concept of a 'Zero km' supply chain. Other producers, manufacturers and installers have expressed interest in the idea. CTI will remain active in the biomass sector beyond the FOREST project and will continue to collect information on businesses to add to the database, it is expected that DAEL, with whom CTI have worked closely, will provide management of the list.

Developing supply chain partnerships

Through FOREST activities CTI has maintained connection with the local supply chain and management group, and has encountered range of interesting businesses and projects. The levels of activity have been encouraging despite the wider economic and financial crisis. Two projects of note include a project aiming to install a biomass tri-generation plant to serve a hospital and school in the municipality of Sospiro to the south east of Lombardy and the Prometo project to the east of Milan, which has installed a biomass district heating system and cogeneration unit to supply about 1,700 flats (see table xxx below for more details) CTI has provided support in the form of dissemination, publicity and the promotion of good practices to the widest audience possible.

Sospiro	Prometo
• Biomass Boiler: 6.29 MWth • Turbine with an Organic Rankine Cycle: 0,999 MWe • District Heating grid: 1500 m • Total heat demand: 4,5 MWth • Total cooling demand: 1,5 MWth • Thermal Efficiency: 86,6% • Water temperature: 90/60 °C • Biomass NCV: 2.10 kWh/kg – 3.30 kWh/kg • Biomass consumption: 19,000 t/year	• 2 Biomass Boilers: 7 MWt + 5 MWt • Turbine with an Organic Rankine Cycle: 0.999 MWe • Biomass consumption: 28,000 t/year produced in the local region mainly from SRF

Table 2 - Sospiro and Prometo projects

Both of these projects can be described as ‘full supply chain’ partnerships and although there is a single private organisation behind both, each individual project includes several partners including:

- Farmers and biomass suppliers;
- Consultants, designers and engineers;
- Boiler manufacturers;
- Financial institutions;
- Building owners.

Members of the FOREST project team visited the Prometo site (Figure 45) while in Milan for a project meeting and were given a detailed tour of the site and shown how the fuel supply operation will work. CTI has also been asked to provide some technical input into the final testing before the project enters the handover phase.

In both cases CTI has given support to the coordinating organisation, whose involvement with FOREST and the Local Management Group was found to add ‘weight’ to the position of the coordinator by demonstrating commitment to good practice and an integrated approach. CTI in its role as a standardisation body has been able to contribute actively to the overall ‘quality’ of the projects, which has provided a degree of reassurance about the viability and sustainability of the project to the partners involved and to the end users.



Figure 45 - Prometeo biomass CHP plant on the outskirts of Milan

5.5 Mid-West Ireland

The market for biomass heating is very much in its infancy in Mid-West Ireland, the few early adopters who have sought to embrace the technology has struggled to find good quality independent advice and have been unsure about the availability of fuel in the longer term. The climate in the region however is ideally suited to forestry and willow coppice, and growers are confident that the capacity can continue to grow to match demand.

Approximately half of the forests in Ireland are state controlled by Coillte, although a commercial company, all of the Coillte shares are owned by the Minister for Agriculture, Fisheries and Food and the Minister for Finance on behalf of the Irish State. The company is active in forestry, land based businesses, renewable energy and panel products. The remaining private forestry is largely owned by farmers, with the average plantation size being around 8 ha. Much of this resource was planted in the 1990s as a response to government afforestation policy and the availability of grants and is now ready for thinning, but the small size of many plantations coupled with under management and poor access means that harvesting operations are difficult or expensive. One of the keys to developing the Irish resource will be to bring these woodlands back into management.

The dominance of the state forestry sector is seen by some as a deterrent to the longer term investment in larger biomass plant, uncertainty over the direction of policy can cause large fluctuations in timber prices which has a destabilising effect on the market. Added to this the buying and selling of timber is not traceable or well regulated which has left some inexperienced owners exposed to unscrupulous practices. This is likely to increase concerns over the sustainability of fuel supplies.

On the equipment side there are a few experienced installers and companies acting as ESCOs but many more that lack experience or training, but would like to be involved in the biomass sector. As a result there have been some poor quality installations which are causing harm to the market for wood energy in Ireland. The lack of specific knowledge about biomass systems and the subsequent shortage of impartial advice have undermined confidence in the technology among key members of the supply chain such as engineers, consultants and architects who consumers will naturally turn to for information.

There remains considerable scope for optimism in the Irish market, the maturing forests and growing interest in utilising the biomass resource have seen an increase in the activities of 'growers groups' and the number of installers with experience of biomass is increasing also. Interestingly a fibreboard plant, close to the region which might normally be expected to compete for the available material, is providing a useful base demand for growers while the market for wood fuel develops. Experience from advanced markets such as Sweden has shown that growth in the overall market for wood products can be beneficial to all parties.

Local management of FOREST

The local management group (LMG) established by the Tipperary Energy Agency (TEA) consisted of the relevant actors from industry, academia, government bodies, forestry (state & private), and wood chip suppliers. The LMG gave good market insight into the particular difficulties they experienced in the market and provided feedback to TEA on the content and direction of FOREST output and activities. Organisations represented included:

- Tipp Wood Chip (local producer and supplier of wood chip)
- Gurteen Agricultural College
- Clare Wood Chip (local wood fuel producers group)
- Teagasc (The Irish Agriculture and Food Development Authority)
- Michael Fahey Tree Care Services (forestry harvesting contractor)
- Limerick Institute of Technology (Higher Education Institution)
- Ecocell (Biomass system designers and installers)
- DPellet (large scale pellet producer)
- Tipperary and Limerick Forestry Growers Group

Organising of physical meetings with this large, high level group of individuals proved to be difficult at times and attendance at meetings was particularly difficult for some. Travelling times and business commitments were a

particular barrier so much of the exchange was managed by TEA through telephone and email, although conferences and events made occasional face to face meetings possible.

Development and implementation best practice tools

Contact with local suppliers through the market survey enabled TEA to provide feedback on the information that would be most useful in the subsequent guides. In many cases the problems in Ireland are echoed in other developing markets; things like a lack of understanding of boiler types, fuel quality and handling, the importance of correct sizing, the use of thermal storage.

A lot of these questions are 'technical' in nature and can be answered relatively unambiguously. In many cases users must become accustomed to the concept of the heating 'system' where the choice of one component has important consequences for other parts of the installation. For instance a simple choice between fuels, e.g. wood chips or pellets, will effect options for storage, transport, delivery, plant size, thermal storage not to mention changing the options for procurement and management of the installation. It is harder to provide generic advice on 'systems' and it becomes more important to provide information which helps users to understand the relationships between the different components. The same can be said of the various options and contracts for the supply of goods and services between supply chain actors and end users, while the concept of a 'standard contract' is appealing in its simplicity, in practice a contract needs to be able to protect the interests of all parties otherwise the agreement is likely to fail, so for longer term security some contractual elements will always be bespoke. In the FOREST guide '*Partnerships for Success*', the use of case studies was one way of balancing the need for practical information with the uniqueness of many biomass installations.

Business to business (B2B) activities

Trade Fairs

The TEA attended the UK trade fair, which was based around the *South West Wood Show*, a pre-existing forestry event which, through FOREST sponsorship, was able to attract a large contingent of biomass boiler installers and fuel suppliers. Michael Bell presented for TEA on the Irish experience of ESCOs and heat supply contracts in an emerging market (Figure 46). By collaborating and presenting the end user with a more complete solution, businesses in Ireland have shown how they can provide a better guarantee of quality and reliability. Benefits to the customers include a simplified way to procure a properly integrated system and the reassurance of fuel security, both of which can be valuable in a developing market. The talk was well received TEA made valuable contact with actors in the UK supply chain in the South West of England which have been shared when appropriate with businesses in Ireland.



Figure 46 - Michael Bell from TEA presenting at the UK trade fair

Developing local bio-heat associations

The FOREST project is committed to working with existing associations where they exist and initially TEA made contact with the Tipperary & Limerick Forestry Growers groups. A number of committee meetings were assisted with input from TEA members and the TEA remains in regular contact with the board of this group.

Through FOREST TEA has brought together all the significant wood fuel producers in the region and a number of ESCOs to form a 'Mid-West and South East Region Wood Fuel Producers Group', the first of its kind in the area. The size of these regions and relatively small numbers of producers meant that it made sense to bring the two neighbouring regions together. The group have met twice under the guidance of the TEA and FOREST and a chairman, secretary and treasurer have been appointed. Organising and running such a group takes time and resources and the immediate benefits in terms of market intelligence and commercial advantage are not immediately apparent to some members, particularly while the market remains small and more immediate commercial pressures from the recession are being felt. As a result the group has not come together since the project ended although the TEA will continue to monitor their development and assist as resources allow. It is hoped that improvements in the economic situation will provide renewed interest in the commercial advantages of collaboration between members.

Capacity building activities

Exchange visit/ study tours to Austria and Sweden

The TEA held a public invitation and competition inviting businesses to apply for funded places to join the FOREST exchange visits. The competition was used to generate some more publicity about FOREST and applicants were scored on relevance of their activities to the trip. Eventually 12 attendees were chosen to go to Austria in October 2011 with a further 10 selected to join the visit to Sweden in May 2012.

The first study tour was coordinated with the UK partners and the FOREST partner in Upper Austria, O.Ö. Energiesparverband (ESV), to provide a range of relevant experiences including technical seminars on aspects on biomass and district heating and on the development of the biomass market. Site visits included small community sized district schemes, boiler manufacturers ETA as well as Preuner Bioenergie, a father and son team who have set up a successful fuel supply and logistics business (Figure 47). The site visits promoted discussion and the exchange of ideas and experiences.



Figure 47 - Chipping and delivery vehicles at Bioenergie Preuner

On the second study tour, organised in conjunction with the Swedish partners at Energikontor Sydost (ESS), as well as a UK delegation, a contingent from Poland was also present which added another dimension to the trip. In Poland the majority of the forest is under state control so there were some similarities with the situation in Ireland. This time the emphasis was on larger systems, including the city scale biomass CHP plant in Växjö,

district heating at Rottne (Figure 48) and large scale pellet production. The visit was timed to coincide with the culminated with the World Bioenergy Fair in Jönköping.



Figure 48 - Fuel storage at the district heating plant in Rottne

While on the tour, the Irish and UK business we able to discuss their businesses in a way which is not always possible without an introduction and valuable contacts were made between boiler manufactures in Ireland, UK and Austria as a result of the exchange visit. All of the businesses were impressed by quality of the organisation and impressed by the way that the markets for biomass have grown to become mainstream. The openness and honesty of the companies they met was welcomed as was the willingness to share commercial information which at home might be considered too sensitive to be discussed.

A good cross section of the local supply chain was represented on these visits trip which was designed to provide good networking and opportunities between the local businesses and those overseas. The Irish businesses that have benefitted have included:

- Michael Fahey Tree Care Services (regional and national contract harvesting and fuel supply)
- Tipp Wood Chip (Wood chip producer, developing innovative delivery and supply solutions)
- Eco Cell Energy (ESCO and heat contracting)
- Limerick Regeneration Agency (Planning and urban design, looking at biomass district heating)
- Ballynoe Agri Services (mobile chipping services)
- Overy and Associates (Mechanical and Electrical consultants, specialising in low energy projects)
- Gurteen Agricultural College (Agricultural college with biomass district heating system, growing SRC willow)
- Tipperary and Limerick Growers Group (looking at collaborative practice and wood fuel production)
- Teach Bhride (Cooperative developing district heating)
- Kenmare Ireland Group (private consortium looking to develop community heating projects)
- Thermoguard (company looking to provide ESCO to commercial market)
- LTH Templemore (consulting engineers with experience of renewable energy projects)
- Kilshane House (private developer with interest in biomass)
- Carlow Institute of Technology (higher education institution)
- NTLP (local development group from North Tipperary)
- Retired facilities manager with interest in RES
- Tipperary Energy Agency (TEA)

Capacity building activities

Training seminars

The first training seminar was held in February 2012 to coincide with the SERVE Project (Sustainable Energy for the Rural Village Environment). This was a CONCERTO project aimed at developing integrated community energy strategies, involving renewable energy and efficiency improvements, so there was a natural synergy with the FOREST project.

The venue in North Tipperary was Gurteen Agricultural College which has installed two 300kW biomass boilers to an upgraded district heating system (Figure 49) and is also developing its own willow crop and drying facilities, with the aim of becoming self-sufficient in wood fuel within three years. At the same time students will be able to learn about short rotation coppicing and wood fuel production and how it can be integrated into a working farm environment.



Figure 49 - Gurteen Agricultural College, biomass boilers and thermal accumulator tank

Delegates, including developers, specifying clients, fuel supplies and educators/training providers, were given details of the FOREST guides and the online training tool which features a self-test facility which was used to 'test' the audience, bringing an element of competition to the event. There was also a full tour of the heating system at the college and the willow plantation (Figure 50).



Figure 50 - Fuel store and agitator at Gurteen Agricultural College

The second training seminar was held at the Waterford Institute of Technology Green (WIT) in conjunction with the Interreg projects GIFT (Green Innovation Future Technologies Project) which aims to up-skill SME businesses within the Ireland and Wales and help to grow the green economy, and BIO-EN-AREA which is working to improve regional policies for bioenergy and help partners to develop Regional Biomass Action Plans. The involvement of other projects allowed a wider range of speakers and access to a wider audience. WIT is a key

player in R&D of forestry and associated products and has state of the art wood fuel testing laboratories which members of the LMG were keen to explore (Figure 51).



Figure 51 - Seminar at the Waterford Institute of Technology

Presenters on the day included TEA, REHEAT Ltd, and speakers from WIT. Feedback from the attendees was positive and FOREST training tools were well received. After the technical seminars a tour of the laboratory facilities was provided (Figure 52). This was an important lesson to many of the producers and demonstrated the science involved in the testing and how wood fuel must be prepared to be able to meet the right standards. Quality assurance remains paramount if customers are going to be convinced about the reliability of biomass systems.

Online supplier database

TEA contacted over 250 businesses with information about the development of the FOREST online database. In Mid-West Ireland it seems that with relatively few actors currently active in the biomass market, most of the business is carried out locally and through word of mouth. Some businesses do not have an online profile as such and as a result only a few requested to be included in the database. TEA anticipates that as the sector develops the importance of online marketing will grow, the ability to publicise good quality and high profile biomass installations and case studies over the internet can be both informative and persuasive to potential end users.



Figure 52 - Fuel testing at the Waterford Institute of Technology

Developing partnerships

The FOREST project has enabled TEA to work closely with a number of businesses to try to identify potential opportunities for collaboration among supply chain actors in order to offer improved services to customers. A few of these businesses are reasonably well established in the local biomass sector while others are still exploring the possibilities of diversifying into biomass. The current level of market development coupled with the economic difficulties in Ireland makes it difficult to see which of these businesses will develop the biomass side of their activities and to what extent lasting partnerships will be formed. The investment required to enter the market can be considerable for growers, fuel producers and manufacturers/ installers alike and while

diversification can give the business a broader base from which to operate, the perceived risks in an immature market will be too much for some. For others, having made the investment, entering into some form of shared practice is considered equally risky, with the prospect 'losing ground to competitors' and diminishing market share looming large in their minds.

Despite remaining uncertainty, FOREST has shared the lessons from advanced markets and demonstrated to the businesses how provision of more integrated services from actors on the supply side of the chain can improve the quality of installations and develop confidence on the demand side. Some of the groups who have benefited from interaction with FOREST are given below:

- **North Tipperary County Council (NTCC)**
The Council operates a number of large energy using sites and have been assisted and encouraged by TEA and FOREST to consider options for biomass. There have been meetings and information on technical aspects of biomass heating has been provided as well as market intelligence gathered throughout the project. Members have also been brought together with various companies offering relevant bio heat services. Currently NTCC is engaged in a number of heat supply agreements.
- **South East Regional Authority (SERA)**
SERA has been updating its Bio Energy Implementation Plan⁹ this is an influential document and through FOREST, TEA have provided lessons from the project and contact with large energy users, energy agencies, businesses and consultants for inclusion in the report.
- **Leisure Centre in Roscrea**
A biomass boiler at a Leisure Centre in Roscrea had suffered technical problems over a number of years. The boiler had not been successfully integrated with the fossil fuel heating system, but by bringing together relevant supply chain actors including an installer and fuel supplier, TEA was able to assist in resolving the issues at the Leisure Centre. Individual partners were made to understand the heat requirements at the leisure centre and how a structured partnership would protect the interests of all parties. Earlier system integration issues have been resolved, and there is a longer term plan in place, involving boiler conversion and a larger fuel store, to move the system from pellets over to wood chip through a heat supply contract.
- **North Tipperary County Council (NTCC) ESCO**
NTCC together have been supported by TEA to develop a heat supply contract with a local boiler installation company. NTCC were looking for lower cost heating alternatives with the potential to reduce CO2 emissions at two sites. Lessons from FOREST have shown the benefits of heat contracting to both parties, the Council pays for heat at an agreed rate without having to worry about fuel procurement, while the ESCO operator secures a longer term contract which gives additional security to the business. Using local suppliers means that a portion of the Council spending can be retained in the local economy. Ultimately one of the sites was found to be unsuited to the biomass solution (the potential availability of natural gas at the site in the future was one factor which influenced the decision), although the remaining project proceeded.
- **Forestry growers association/ forestry contractor/ chipping contractor**
Between them the Tipperary Forestry Growers control a large amount of forestry but the size of individual plantations is not large enough to justify ownership of expensive forestry equipment and can often be too small to be able to provide meaningful work for specialist contractors. Through the FOREST local management group and other events, including visits to Austria and Sweden, good relationships have been established between the growers group, a forestry contractor and a wood chipping contractor and the potential for developing a wood chip supply business in the local area is being explored. This partnership is in its early stages but the long term potential is good.

⁹ www.sera.ie/media/Regional%20BioEnergy%20Plan.pdf

- **ESCO/ boiler supplier**
Through the market survey, TEA had identified a forward thinking local business that was already acting as an ESCO and was interested to find out about their experiences. While the idea behind the business model was popular with the consumer, difficulties with the boilers required a large number of unplanned call outs. Although the issues were generally minor the cumulative effect was detrimental to the business in terms of its time and in the potential to undermine customer confidence. Contact through the FOREST project, and guidance on the assurances that ought to be expected between an installer and a boiler supplier, has brought the ESCO together with a boiler importer in the region. It is hoped that a new agreement between the two parties will provide a reliable product, backed up with more supportive service arrangements.
- **Tuam Leisure centre district heating scheme**
TEA have carried out discussions with Galway County Council over a potential biomass district heating scheme. Supported with FOREST guides and tools, TEA has helped with initial feasibility studies to demonstrate the technical and economic potential of such a project, and contact with key providers in the supply chain has been made. It is hoped that an ESCO or heat supply model will be adopted and that local businesses that have benefitted from contact with FOREST will be in a strong position to tender.
- **Community groups**
TEA has assisted community groups in Broadford and Cashel with early stage enquiries into the possibilities for biomass heating and for a district heating network. Initial calculations and guidance on systems and potential supply chain issues were provided by TEA.

5.6 Province of Burgos, Spain

The Province of Burgos is in the north eastern part of the region of Castille y León. The province has an area of 14,300 km² and a population of 375,000. The province contains some 369 municipalities, although the majority of the population (approximately 70%) is concentrated in the three main cities, Burgos, Aranda de Duero and Miranda de Ebro. Although the current biomass market is relatively small, there are a few experienced companies who know the sector well. There is much less experience in the non-domestic market where installed capacity usually exceeds 100kW.

Burgos is the province with the highest energy consumption in the region and while the potential biomass resource is large, the adoption of biomass technologies is slow but is expected to grow. Consumer confidence in the technologies remains relatively low while and while the economic conditions remain difficult the incentives to switch to biomass heating are limited. For many businesses biomass services are offered alongside fossil based heating solutions so biomass activities may only form a part of the business income. Uncertainty in the economy means that most businesses are focussed maintaining core services and on survival, the incentive to provide increased specialisation in biomass or to divert resources to growing the biomass elements of the business is diminished.

Research carried out by Agencia Provincial de la Energía de Burgos (Agenbur) indicates that the forestry resource is around 955 GWh (82 ktoe) per annum, while agricultural residues from woody and herbaceous crops could provide 2,500 GWh (216 ktoe) (

Figure 53). This can offer some reassurance about fuel availability to the market in the short term but on its own is not sufficient to drive the sector.

Local management of FOREST

Many key stakeholders in the biomass sector and local businesses have been involved in consulting and participating in the activities of FOREST. They come from a range of trade organisations, government departments as well as businesses providing fuel supply and equipment. The main organisations represented include:

- Avebiom (Spanish Association of Biomass Energy Recovery);
- EREN (Regional Energy Agency of Castilla y León);
- Cesefor (Forestry Services and Promotion Centre of Castilla y León);
- Cámara Oficial De Comercio E Industria De Burgos (Burgos Chamber of Commerce);
- Cooperativa Serpaa (pellet production cooperative);
- Satis Energías Renovables (engineering company with specialism in biomass boilers and equipment);
- Eco-systems Instalaciones Eficientes (specialist renewable energy installers);
- BioSAR (engineering and project management in renewable energy);
- Burpellet (timber processing, pellet production and distribution).

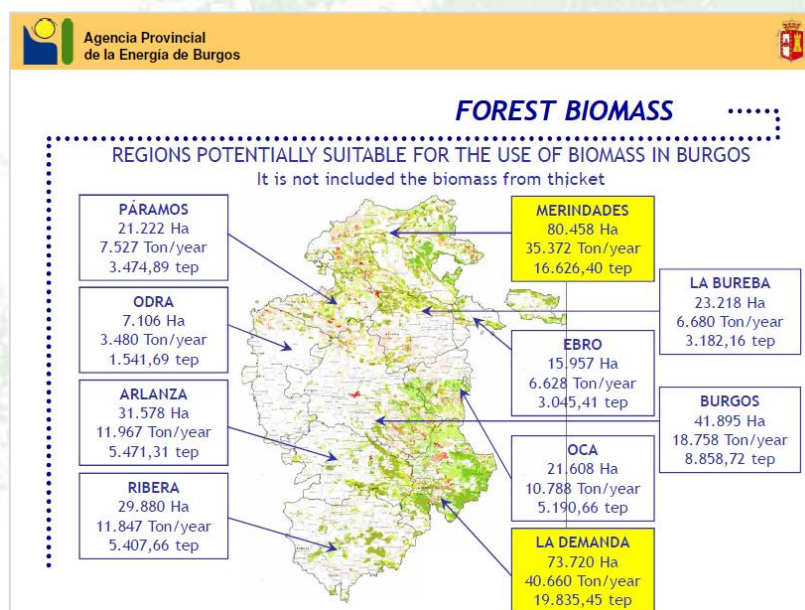


Figure 53 - Forest resource in Burgos

Development and implementation best practice tools

The level of knowledge about biomass was considered to be generally low in the region so work in preparing the main FOREST guides for the Spanish market was particularly important. The interviews carried out during the market survey revealed considerable agreement among different business types about the difficulties experienced in the region. Certainly improving the knowledge of key consumers is widely seen as crucial to accelerating demand while business looking to enter the market must be made aware of the detrimental effect that poor quality installations and service can have on the development of the market as a whole.

In a developing market where the supply chain is incomplete or has weaknesses, it is even more important that businesses understand the situation from the consumer's point of view; for example, even if a boiler installer is not directly responsible for fuel quality, the successful operation of the appliance is dependent on the quality and availability of suitable fuel. Not all businesses will be capable of providing all services but by communicating or cooperating with others in the supply chain, or by creating more formal partnerships, the customer experience can be improved.

The FOREST guide to partnerships provides a lot of information on the ways in which partnerships can be developed, and key criteria to consider such as what happens when things don't work as expected. Used in conjunction with the guide to standards relating to biomass heating, potential collaborators are building their partnerships on firm foundations.

Good quality case studies providing detail on the technical and contractual considerations on how different supply models work in practice have proved particularly popular among business and potential clients. The range of applications for biomass and the number of different solutions means that consumers are not always aware of the possibilities at a given site.

Business to business (B2B) activities

Attendance at biomass trade fairs

AGENBUR has supported the attendance of local businesses to the international trade fairs organized in Poland, Italy and the UK, providing a fairly wide geographical coverage across Europe. Burpellet and Biomad, two businesses involved in wood pellet production, visited the 9th International Fair of Devices and Technologies for Pellet and Briquette Industry "PELLETS-EXPO & BRIQUETTES-EXPO" in Bydgoszcz, Poland and Ecosystem Instalaciones Eficientes and Cooperativa Serpaa attended the June 2011, mcTER FOREST event in Milan. The pellet market is a global one and while many producers are keen to meet domestic demand, in areas where demand limits the ability of the business to grow, looking towards the export market is one way that a business can generate orders to build capacity. Eventually, as local markets improve, consumption of home produced pellets can be expected to increase.

In May 2011, AGENBUR provided support to develop a local trade fair "BIOMER" in Villarcayo, a municipality located in one of the most important forest areas of Burgos Province. This event shared the same objectives of other larger FOREST trade fairs: to allow the exchange of knowledge between businesses in the supply chain and their clients, and to facilitate the development of new more integrated supply chain partnerships. Ten businesses, representing different elements of the biomass supply chain exhibited (Satis Energías Renovables, Foresa, EIC Estudio de Ingeniería, Burpellet, Rehau, Maderas García Varona, Biosar, Cidaut, Creo and HC Ingeniería) and more than 300 visitors attended. Two technical sessions carried out with 50 participants and the FOREST project and its aims were presented in the technical sessions. A technical visit to a district heating plant was also provided which brought together 70 people.



Figure 54 - Technical session in BIOMER



Figure 55 - Local biomass trade fair



Figure 56 - Site visit to district heating plant

Business exchange/study tour to Austria

A two day study tour organised with the help of O.Ö.Energiesparverband (ESV), the Upper Austrian Energy Agency, gave interested business and individuals from the Province Burgos to experience the the workings of an advanced biomass market at first hand. Attendees from different parts of the supply chain Burgos included forest owners from two different municipalities, an architect with a particular interest in biomass, and representatives from Cesefor (not for profit organisation representing the interests of the forestry sector), EIC

Burgos, S.L. (a civil engineering and project management company), Ferroli (boiler manufacturers), a member of a large apartment building looking to replace aging fossil boilers a biomass solution, and AGENBUR.

The tour provided by ESV provided an excellent balance between classroom based learning and discussion along with practical experience from the site visits. The introductory seminar showed how Upper Austria has developed its biomass market, through a combination of incentives, regulations and awareness raising campaigns. This was supplemented with technical sessions on biomass boiler and on district heating.

The site visits included a visit to the Hargassner, biomass boiler production facilities in Weng, followed by a 700MW district heating system in St. Ägidi. The heat network is 1.5 km long and serves a combination of 20 homes and public buildings, producing 1500kWh of heat a year. The system is operated by a cooperative of 19 farmers who also supply most of the wood chips for the installation.

On day two the visitors were taken to the Fronius Factory in Sattledt, which produces inverters for solar PV systems. The heating needs for the site are provided by two biomass boilers which are operated as an ESCO, provided by Aigner Engineering who designed, installed, own and operate the heating plant. The trip continued with a trip to Sturmberger (wood chip storage & logistics) in Wartberg. The business, run by a husband and wife team, runs its own fleet of vehicles and delivers around 28,000 tonnes of pellets and up to 60,000 tonnes of wood chip over an area that includes Salzburg, Munich and Vienna. The final visit was to a state of the art agricultural and home economics college. The building is constructed to Passivhaus standards, using local timber and sustainable materials such as sheep's wool for insulation. The school's heat is met by a 400kW biomass boiler and 90m² of solar thermal panels (Figure 61).



Figure 57 - Spanish delegates on the study tour to Upper Austria

Members of the group learned from each other as well as from their hosts, particular highlights included the heat contracting arrangements at Fronius and the background on the evolution of the biomass market provided by ESV.

Capacity building activities

Training seminars

In June 2012 a half-day technical seminar was developed in the Official College of Industrial Engineers. The 20 participants were given an overview of the FOREST project and the materials that are available through the

website. A series of FOREST case studies were also presented highlighting the development of projects through partnerships. As a result of the seminar contact was made with three new businesses who have agreed to cooperate and collaborate in the project. At the seminar they gave explanations about technical elements of biomass systems and key factors that should be taken into account at different stages.



Figure 58 - Technical seminar at the Official College of Industrial Engineers

The second technical seminar took place in October 2012 in Valladolid, making the most of the opportunity to partner with the international bioenergy trade fair 'Expobioenergía'. The FOREST seminar was included in the technical sessions developed simultaneously with the trade fair. Expobioenergía is a major annual event with more than 400 exhibitors and is attended by more than 10,000 professionals involved in the biomass industry. The audience is very wide including forest owners and businesses, members of the timber and agricultural industries, solid biofuel distributors, energy suppliers, boiler installers, architects, property developers, training providers, consultancies and national, regional and local administrations and is therefore ideally suited to the FOREST target groups. The FOREST seminar itself was presented in conjunction with a local partnership who had installed a biomass heating system for a church and a school where two large, inefficient fossil fuel boilers were removed and replaced with a 168 kW pellet boiler and small heat network. In order to make it more convenient for local businesses to attend the trade fair and technical seminar, free transport was made available from Burgos to Valladolid.



Figure 59 – iSeminar at the international bioenergy trade fair "Expobioenergía"

Developing bioheat associations

In Spain, *Avebiom*, the Spanish Association of Biomass Energy Recovery, is a national association promoting the development of the bioenergy sector, and is involved with bio-businesses across the biomass energy chain. At the same time there is *Apropellets*, the Spanish Association of Wood Pellet Producers, another national association with which most of the wood pellet producers are associated. In Burgos at the moment there are no specific biomass related associations, who might be able to develop trade locally so AGENBUR has arranged meetings with different businesses in the region to propose the establishment of a local group (Figure 60).

At first seven companies showed interest in the concept and were keen to learn more about the opportunities and obligations. On their behalf AGENBUR carried out research for information about other associations and/or clusters that are working in the biomass field. An extended list of 50 businesses who might be interested was

then developed and was presented with an online survey to better understand their role in the supply chain, and to gauge their involvement and interest in trade associations. From the 21 businesses who answered the survey a number of difficulties were identified, in particular:



Figure 60 - Meeting to discuss options for a local biomass group

- The biomass heating market in Burgos province is still very immature and most of the businesses have not had a broad experience in biomass heating systems.
- The respondents were already members of various national and local associations including for example, associations for businesses in plumbing, heating, maintenance, gas and electric installations. Membership of additional associations was seen as a potential problem in terms of time commitment and financial obligations.
- The slow development of the market and the lack of economic resources have left many businesses struggling to remain active in the market, and involvement in external groups is considered a low priority.

In general, the potential advantages of working collaboratively or in partnerships were not well understood and AGENBUR will continue to develop the current limited network of qualified businesses. The aim will be for businesses with broad experience in biomass heating systems, and who have developed and undertaken successful installations to be able to register their details and the quality criteria and standards to which they adhere. Eventually the aim will be to create a network of experienced and reliable installers (a group which others will perhaps aspire to be part of), which will give end users the confidence to invest in biomass heating.

Developing partnerships

As the FOREST project has developed AGENBUR has been contacted by a variety of businesses looking for assistance. The nature of business is such that it is not always possible to share full details of the collaboration but a summary of some of the activities is provided below.

Fuel related:

- A local manufacturer of domestic electric heating devices was looking for a suitable pellet producer to set up a distribution business, with the aim of exporting, primarily to the UK market. A UK partner was found and a shipment sent to the UK for quality testing. Although the tests on the pellet quality were passed, the quantities available at the time were not sufficient to cover the logistics of transport. When the volume constraint can be overcome, the partners have agreed to re-visit the proposal.
- As a result of the local trade fair organised by AGENBUR, good contact was made between various businesses, in one case a partnership has been developed between a biomass system designer/installer, a local pellet producer and a wood chip producer. Since the event, the first systems developed by the installer are being supplied with wood fuels produced by these two businesses.
- In the summer of 2011, a wood pellet producer started its production and managed to achieve the ENplus A1 quality certification in less than one year. AGENBUR have promoted the success of this business through its dissemination channels and resources, and have communicated the benefits of

working with high quality fuels to local installers and managers of heating systems. One of the local installers, with experience of operating ESCOs, has agreed to supply these local pellets to all of their biomass installations.

Equipment related:

- AGENBUR has helped to establish a new supply chain partnership between the municipality of Espinosa de los Monteros and a biomass installer. The municipality wanted to reduce the heating costs of the primary school, which currently consumes more than 140,000 kWh a year of propane. AGENBUR has helped to provide an independent, first valuation of the reduction in fuel costs and how the installation will be depreciated. A list of qualified businesses which could carry out the biomass installation, take responsibility for the maintenance and manage the fuel supply was provided. The municipality will need some additional funding to realise the project and AGENBUR has given advice on local and regional grants. While the project has a promise of €9,000 in aid from the Burgos Provincial Government, the economic situation in the municipalities in Burgos is not yet good enough to be able to complete the project, but additional funding is being sought.
- AGENBUR has linked the municipality of Covarrubias with a boiler installer for carrying out the replacement of the fossil fuel boiler with biomass in the town hall. AGENBUR has also supported the municipality in the search of public grants. The total investment has been €20,000 and awards of more than €10,000 have been made from the Regional and Provincial Governments. The new heating system is estimated to be able to save the municipality €2,300 per year in fuel costs.
- A bakery factory which makes cookies contacted AGENBUR for information about biomass heating systems in relation to its production process. The current system uses a burner fuelled with diesel oil. The factory's objectives were to reduce the fuel costs and energy consumption, so it was looking for a more efficient burner and cheaper fuels. For overcoming of biomass systems, AGENBUR found information about some industrial bakeries that are working with wood pellets to help answer questions about the feasibility of biomass in this situation and provided the contract details for suitably qualified businesses that might provide site visits and economic appraisals.
- Canicosa de la Sierra, a municipality located in a forested area of Burgos, has promoted the building of a social housing development with 16 dwellings. Initially oil fired heating was proposed but over the course of several meetings between AGENBUR and the municipality, the socio-economic and environmental advantages of pellet based systems were discussed, as well as the availability of government support. The biomass solution was accepted and a series of pellet boiler have recently been installed by a local business, the handover is not yet complete but supply arrangements are in place which should allow the delivery of pellets from a production plant less than 50 km away.

Complete solutions:

- Villarcayo is a municipality with 4,900-inhabitants in the north of the province, is looking to replace a series of fossil fuel boilers with a small biomass district heating system. The complex includes a municipal school, a regionally owned health centre and a privately managed nursing home and should provide a good heat load for the system. The municipality has relied on AGENBUR to provide advice on the proposal, options for funding and contact with businesses and organisations that might be able to fulfil the brief, either individually or as a partnership. Discussions about the final model of supply are ongoing but hopes are high that the project will be fulfilled.
- An apartment building which house 50 families is looking to replace a 25 year old oil fossil boiler due its high maintenance and running costs. The housing owners organised three technical committees to study the different boiler options available to them: natural gas, oil and biomass. AGENBUR supported the biomass committee to compile information on potential biomass solutions and suppliers. A general assembly of all of the owners was held to hear the findings of the technical committees. Heating with

biomass was unfamiliar among the owners so AGENBUR staff attended the meeting in order to provide technical support. Approval for the biomass heating system was passed by a majority and requests put forward for more detailed proposals from several businesses offering ESCOs. The representative of the biomass committee was also invited by the FOREST project to attend the study tour to Austria, to see how these systems operate in a developed biomass market. Replacing the central heating system in a multiple occupancy building is complicated as decisions must be taken unanimously and unfortunately disagreements surfaced just prior to the final replacement of the boiler, causing the whole boiler replacement project to be halted.

- Among the delegates of the study tour to Austria was an architect who is interested in and member of a municipal authority in the province. On his return he started to develop a municipal biomass plan covering all aspects of the supply chain and including training for unemployed people, a not-for-profit workers' cooperative for the forest management activities, the building of a local biomass distribution centre, and the installation biomass heating systems in public and private buildings. This plan is ambitious and is still under development, but the first steps have been taken. For example, in a month, a wood chip boiler will be installed in a municipal building and a 200 hour training session, covering theory and practice of biomass systems, is scheduled to take place in April 2013. Contact has also been made with a business, new to the region, but with a range of specialisations which could see it managing the biomass logistic centre, the biomass heating systems, and even develop the forest training.



Figure 61 - Passivhaus School of Agriculture, Altmünster

6 Conclusions: lessons for developing biomass markets

FOREST hosted the conference 'Biomass Partnerships' as part of the World Sustainable Energy Days (WSED) 2012 which is held annually in the City of Wels in Upper Austria (www.wsed.at/en/reviews/wsed-2012/programme/biomass-partnerships). At the conference FOREST presented key findings on the importance of the supply chain in successful biomass installations and was joined by a range of guest speakers, many of whom have engaged with the project. All of the speakers were experts in their own field and were able to illustrate the practical ways in which supply chain cooperation can work.

The speakers and topics are summarised in Table 3 (presentations can be downloaded in full from www.wsed.at/en/reviews/wsed-2012/review-2012/presentations).



Figure 62 - Stadthalle, Wels. Venue for WSED 2012

The conferences are accompanied by a large exhibition and trade fair, the 'Energiesparmesse,' with 1,600 exhibitors which attracts 100,000 visitors a year. Attendees at the conferences were also able to attend technical site visits on the theme of heating with pellets and woodchips including:

- Manufacturer of biomass boilers Frohling, Grieskirchen
- Company specialising in pellet lorries, Redlham
- Pellet production plant, Oberweis
- New passive-school in timber construction with wood chip heating system, Altmünster
- Biomass combined heat and power plant (8.9 MWe and 21 MWth) supplying district heating and innovative hot water storage, Linz.

A short review of the conference is available at:

www.wsed.at/fileadmin/redakteure/WSED/2012/WSED_Gesamtprogramm.pdf

The full program for WSED 2012 found at:

www.wsed.at/fileadmin/redakteure/WSED/2012/R%C3%BCckblick_12/WSED_Rueckblick_2012_en.pdf

Chairman	Mark Prior, <i>Forestry Commission</i> , United Kingdom
Speaker	Presentation
Andrew Rowson <i>University of Exeter</i> United Kingdom	The Intelligent Energy Europe project 'FOREST' Summarising the structure and rationale behind the project and highlighting key success factors
Christine Öhlinger <i>O.Ö. Energiesparverband</i> Austria	Biomass partnerships – quality and success criteria Highlights the role of biomass in the energy mix in Upper Austria and the role of the Energy Agency and the Oeokenergie-Cluster in delivering a sustainable energy strategy for biomass. Provides overview of the supply chain and options for partnering between supply chain actors at different scales as well as success factors for long term contracts.
Asko Puhakka <i>North Karelia University of Applied Sciences</i> Finland	Business models for biomass heat Provides an overview of the biomass heating industry in Finland, and explores the range of business models for supplying heat including ownership and responsibility, risks and challenges for entrepreneurs as well as indicative returns at different scales.
Diana Hehenberger-Risse <i>BioRegioEnergie</i> Germany	One-stop for biomass heating Describes how the company optimises the use of biomass resources in the Tirschenreuth Region (Upper Palatinate, Bavaria) and develops, manages and supports the complete biomass supply chain. This enables the provision of low carbon, sustainable heat, while generating revenues for local business and communities.
Francisco Puente-Salve ESCAN Spain	Biomass heat contracting initiatives in Spain Gives an overview of the Spanish Biomcasa program, which is incentivising biomass for heating and cooling through ESCOs by offering subsidies of 400 to 800 €/kW capacity. Customers agree to contracts of up to 10 years and in return the ESCO develops all the technical elements of the project, including the application for funding, and provides a guarantee of savings. IDEA (Instituto para la Diversificación y Ahorro de la Energía) provides approval of ESCOs and ensures that installations meet quality and efficiency standards.
Siegfried Aigner <i>Ing. Aigner Wasser-Wärme-Umwelt</i> Austria	Biomass contracting for commerce and industry Heat contracting provides an attractive means for companies to develop clean, efficient energy options for sites without large amounts of capital investment and at low risk. Guarantees are provided for operational reliability, security of supply along with a transparent pricing structure and escalation mechanism in exchange for longer term contracts. A selection of projects are presented including details of the system design.
Andrzej Szajner <i>BAPE</i> Poland	Pellet contracting for schools Presents the situation for biomass in Poland along with some initiatives which are being implemented in schools. In Poland the dominant fuel for heating is still coal and while some subsidies are available through a system of 'green certificates', these are aimed mainly at co-firing and power production rather than heating. Although public procurement procedures can be complicated and communal resources are limited, suppliers have been exploring different pricing and ownership models to stimulate demand.
Vanessa Gallo <i>FIPER (Federazione Italiana Produttori di Energia da Fonti Rinnovabili)</i> Italy	Biomass district heating – successful heat supply in Valtellina Explains the process of setting up town sized district heating networks including the creation of a public/private consortium, feasibility evaluation and agreements. The three heating districts of Tirano, Sondalo, and Santa Caterina Valfurva are close to arterial roads and biomass is supplied from a variety of local sources including forest residues, sawmills and short/medium rotation forestry. More than 100MW of thermal capacity and 1MW of electrical capacity have been installed and around 1500 users are connected to the schemes.
Áine O' Callaghan <i>Teagasc Advisory Office</i> Ireland	Clare Wood Chip – a successful supply chain project Teagasc is the Irish Agriculture and Food Development Authority, and have helped to establish the County Clare Wood Energy Project (CCWEP), a scheme aimed at creating better supply chains for biomass fuel while at the same time stimulating demand for boilers. The scheme has more than 400 members and accounts for 5500 hectares of forestry. It offers help through the formation of clusters and training and demonstrations.
Andy Bradford <i>Director, Dartmoor Woodfuel Cooperative</i> UK	The Dartmoor Woodfuel Cooperative Describes how a small group of biomass boiler owners set up their own woodfuel supply business to secure a stable and sustainably sourced fuel supply. Early grant assistance help procure handling and chipping equipment, and any profits from the business are reinvested into the coop. The business has expanded and now acts a hub providing advice to other businesses and individuals who are interested in biomass.
All presentations are available to download at: www.wsed.at/en/reviews/wsed-2012/review-2012/presentations	

Table 3 - FOREST conference, Biomass Partnerships, WSED 2012



Figure 63 – WSED 2012, site visit to boiler manufacturers, Fröhling

At the end of the conference an open discussion session was held, chaired by Michael Bell from the Tipperary Energy Agency (TEA), it gave delegates the opportunity to comment and share their own experiences. Key issues raised included:

- Issues surrounding fuel quality and security
- Equipment and maintenance
- Sustaining longer term partnerships
- Continued support for biomass

Fuel quality, security and sustainability

Difficulties with fuel have been cited by many as the source of the majority of problems with biomass installations, but it is easy to see how fuel suppliers can become the scapegoats for a range of other system deficiencies. Fuel has to be delivered, stored and fed into the boiler, usually mechanically or pneumatically, before it gets to be combusted; this involves a lot of processes and potentially a number of different companies. Difficulties at any of these stages could lead to reduced performance, and all could be loosely attributed to ‘fuel’.

Out of specification woodchip generally comes down to moisture content which in the majority of cases is too high for the boiler, but incorrect particle sizes (long slivers, high proportion of fines) also affect combustion efficiency and can cause blockages in feed systems. Wood pellets by their nature are more consistent but deviation in properties such as mechanical durability or pellet size can undoubtedly contribute to inefficient operation or boiler downtime. It would be wrong however to attribute all problems to fuel producers when the transport and handling of woodfuel can contribute significantly to its final delivered quality, and may well be carried out by a third party.

Other fuel related concerns include anxiety over security of supply, sustainability and emissions. The market for biomass is increasingly global and even in the most heavily forested areas questions are asked about availability. While the motivation behind such concern may be selfish (‘is there going to be enough for me’) it does lead into the wider debate on biomass sustainability which is a crucial one; after all, if the industry is not sustainable it can scarcely be described as renewable. Arguments around sustainability can be complex, relating to supply chain emissions, the market for clean waste wood or detailed analyses of the carbon balances under different forestry management regimes. There are also arguments surrounding growing food versus fuel and the carbon impacts of changes in land use, both of which may be particularly pertinent for the energy crops sector.

Unfortunately newspaper headlines and media reports cannot always be relied upon to convey the full details of the debate, and even some high profile reports from environmental groups have been questioned over their accuracy and interpretation of facts regarding biomass. A recent piece commissioned by Friends of the Earth, Greenpeace and the RSPB¹⁰ is entitled ‘*Dirtier than Coal? Why Government plans to subsidise burning trees are*

¹⁰ Royal Society for the Protection of Birds

*bad news for the planet*¹¹ and has been strongly criticised along with the paper on which it is based¹². Criticism of this particular work has come from a variety of sources including the UK Biomass Energy Centre¹³, who claim that the original peer reviewed work from the Forestry Commission and North Energy Associates Ltd.¹⁴ (on which both studies were based) has been taken substantially out of context to provide source material for both reports;

“The Searchinger paper bases its main contention on the (rejected) worst case scenario, and the “Dirtier than Coal” report appears to base its fundamental arguments on this misleading and uninformed contribution.”

An extended discussion and/or rebuttal of all the claims made against the expansion of biomass is beyond the scope of this report, but supply chain actors should be aware of the arguments that are being put forward and be prepared to have to re-state the case for biomass for the reassurance and satisfaction of clients. Decision makers can also be reassured by exposure to the facts about local biomass production and can learn about the wider benefits of sustainable working practices, including those to local economies.

Equipment and maintenance

Within the supply chain poorly maintained or incorrectly specified equipment can have implications further down the line, and ultimately affect the success of installations.

Experienced wood chip manufacturers understand the importance of high quality chipping machinery and experienced operatives, who can tell very quickly when knives need sharpening or replacing. Similarly pellet producers have to manage supervise production lines closely to maintain the levels of consistency and quality demanded by the ENplus standard for pellets. Fuel brokers and suppliers will also have invested heavily in storage and handling facilities will also affect the quality of the fuel, water ingress obviously affects moisture content, but screening for particle size or metallic objects (nails etc.) is often required (depending on feedstock). Considerable investment is made in specialist delivery vehicles, which have to be able to access a wide variety of sites to be able to recoup the initial outlay, so sites where access is constrained or where bespoke delivery solutions required will have fewer suppliers to choose from which be reflected in the price and availability of fuel.

End users are often motivated by the prospect of self-supply, particularly if they have access to woodland or waste material, and while this is possible and even to be commended in some circumstances, fuel of variable quality will cause problems. Through commissioning and in the early stages of operation, it is recommended that fuel of known quality from experienced suppliers is used. A biomass boiler can be expected to last for 20 years or more so there is plenty of time for the ‘self-supplying’ client to familiarise themselves with the requirements of the system.

In terms of the combustion plant and associated equipment, design decisions should always be made in conjunction with potential fuel suppliers, who in many cases provide advice, consultancy or services to help establish sensible options for supply and delivery. Potential issues such as availability of fuel (quality and quantity), vehicular access (frequency and mode of delivery) as well as storage requirements can often be eliminated by early consultation with fuel suppliers.

Biomass systems have particular maintenance and cleaning schedules which must be adhered to, and site staff need to be trained to carry out necessary tasks. Like many other mechanical devices the way that the system is used will affect the way that it behaves and if driven hard (i.e. poorly maintained, incorrectly fuelled, operated at very low capacity etc.) then problems can be expected.

¹¹ www.foeeurope.org/biomass-dirtier-than-coal-121112

¹² Searchinger, T., *Sound principles and an important inconsistency in the 2012 UK Bioenergy Strategy*, 2012

¹³ Parent page: www.biomassenergycentre.org.uk/portal/page?_pageid=74,535254&_dad=portal&_schema=PORTAL
Direct link: <http://tinyurl.com/ay3329y>

¹⁴ Forest Research, North Energy Associates Ltd., *Carbon impacts of using biomass in bioenergy and other sectors: forests*, April 2012 (Direct link: <http://tinyurl.com/c3d74cs>)

The scope for equipment related errors becomes complicated where otherwise reasonable practices are undermined by inconsistent fuel quality so that apportioning responsibility for 'failures' in any of the various subsystems may prove difficult. Under these circumstances dispute resolution can take longer and, in the worst cases, risks leaving customers without heat. Although instances of such behaviour may be rare, all practitioners must be aware of the potential damage to the whole supply chain; bad news tends to travel further and faster than good news, and considerable effort can be required to rebuild damaged reputations, whether they were earned or not.

Sustaining longer term partnerships

Successful installations will generally be characterised by early consideration of the supply chain, consultation with relevant actors and analysis of the supply options. Subsequent agreements and contracts will define the roles and responsibilities of each party and incorporate processes that will minimise disputes or avoid them altogether, leaving the end user to enjoy an uninterrupted heat supply.

Even the most successful biomass installations will admit to 'teething troubles' at the beginning. Adapting to new fuels and the delivery and maintenance schedules required with biomass can be expected to require a short period of adjustment. It should be pointed out that this is not dissimilar to any other construction or engineering project. The learning curve for the end user can be shortened if supply chain actors collaborate to provide the best solution at a given site, and then cooperate to deal with any unforeseen issues. Almost all of the concerns listed above can be addressed by closer integration of supply chain activities.

Contracts and agreements help to forge the links in the supply chain at every stage, and when underpinned by reference to appropriate standards, they can provide protection for all involved parties and ensure that relationships are equitable, profitable and long lived. The profit motive in business is strong but seeking to increase profits at the expense of other supply chain actors (e.g. driving the price of raw materials too low) is likely to pressurise some businesses unfairly, perhaps even contributing to failure. Ultimately this serves to destabilise the supply chain. In advanced markets like Sweden and Austria, the successful installation of every new biomass system, regardless of which companies are involved, is seen as a success for all as it contributes to the growth and development of the market.

Integration of the supply chain is at its most complete in the ESCO (Energy Service Company) model of supply. Where all services are supplied by a single provider the scope for blaming others for system defects is effectively eliminated, and the motivation to 'get everything right' is clear. The existence of ESCOs, usually a feature of more advanced markets, provides end users with a 'one stop shop' for biomass; plant is supplied, owned and operated by the ESCO who charge the customer, on the basis of metering, for the heat that they use. Longer contracts give the ESCOs a chance to recoup their investment in plant, and customers benefit from an agreed price and escalation mechanism. The escalator is an important part of longer term agreements and is designed to provide protection for both parties, insuring companies against rising costs while allowing customers to anticipate future budgets with a greater degree of certainty. The mechanism will be transparent and usually based on a basket of indices which reflect the relative costs of supply; these will tend to be dominated by timber based indices, but will also feature some link to fossil and energy prices, reflecting the reliance on fossil fuels for the harvesting, processing and delivery of biofuels. The tariff paid by the customer will usually have three parts; a fixed fee or standing charge which is independent of consumption, a metering fee and a price per kilowatt hour.

Other integrated solutions include ESCO type models with a variety of options for ownership and operation of plant, designed to suit the experience and preferences of the customer. An ESCO may have specific expertise in a particular part of the supply chain and carry these operations out itself (for instance system design and installation), and while it retains ultimate responsibility for the delivery of heat, it may rely on contractors to provide other services (fuel or maintenance for example). The 'risks' at each stage of the supply chain are devolved to those who are in the best position to deal with them. A company with specific expertise in engineering, for example, may be confident in its ability to design and install plant but would be less sure about sourcing or processing fuel, and would therefore represent an additional element of risk. Specific agreements, in this case between an engineering partner and a fuel partner can therefore include guarantees to buy and supply fuel at an agreed price per kWh, perhaps subject to plant maintenance schedules according to manufacturer's recommendations. For the engineering partner risks associated with fuel are passed on to the

fuel partner who may agree to take on the risk for an additional premium. The heat paying customer, is not necessarily party to any of these behind-the-scenes agreements, and sees only the final per kilowatt hour cost of delivered heat, yet the arrangements behind the heat contract provide longer term stability for the companies involved and provide a secure supply for the customer.

This type of long term thinking can be absent in developing markets where competition for relatively limited amounts of business is the driving force, rather than cooperation to develop the security and stability of the wider supply chain. The situation varies across regions and is exaggerated by the difficult economic conditions but there are of course notable exceptions, for example many established businesses have provided individual biomass champions or act as ambassadors willing to share their knowledge. It can be easy to overestimate the extent of the knowledge of customers in an industry which is still in its infancy in some regions; even building services professionals may have limited practical experience of actual biomass systems. Experienced practitioners provide an invaluable service when participating in awareness raising activities and sharing the knowledge they have gained despite the potential conflict with their own economic interests. The value and circular nature of involvement in such awareness raising programs is underlined by the fact that many biomass entrepreneurs had their interest triggered by similar exposure to successful installations.

In many European countries consumers like the idea that they can switch suppliers at will, and in traditional network based energy/service suppliers such as gas, electricity, water and telecommunications, this can often be encouraged to allow market forces to express themselves. Where customer loyalty is limited however, competition will often be on the basis of price alone, and in this 'race to the bottom' service and support are often the first casualties. This is not a good model for the biomass sector, where the emphasis needs to be on sustainability in longer term. In a longer term contract there is a commitment on both parties (a commitment to buy, and commitment to supply) and while the arrangement is fair to both parties, it will remain sustainable.

Continued support for biomass

The biomass industry can and should continue to improve the services that it offers but while the aim of increasing the renewable heating capacity of biomass remains a goal, supply side initiatives can only provide part of the solution. Unlike the market for mobile devices, the technology 'push' of technological innovation and market 'pull' of demand for green/efficient products are insufficient to drive the biomass market alone; additional drivers in the form of regulation are required (

Figure 64).

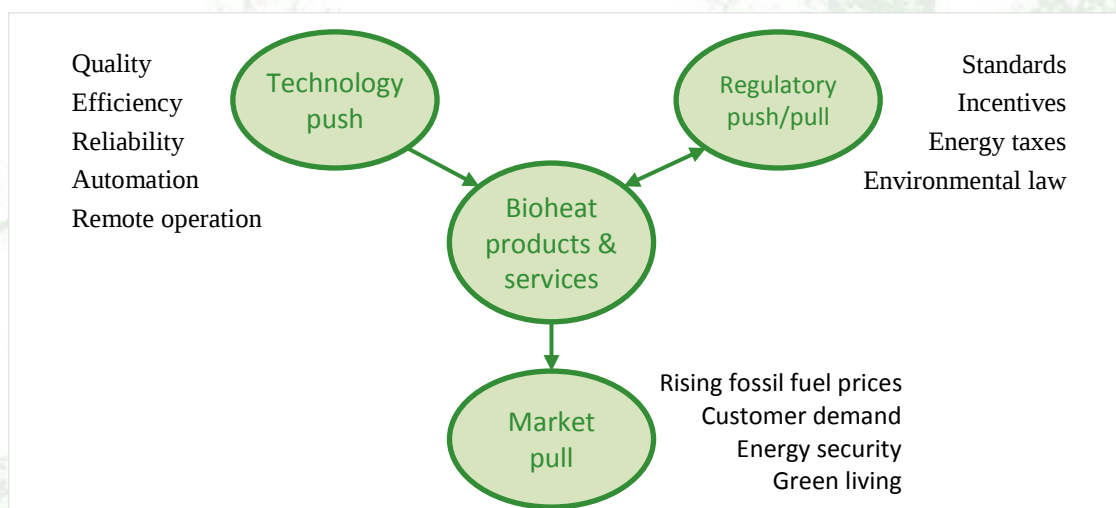


Figure 64 - Determinants in the market for bioheat (after Rennings, 2000)

Regulation can take a number of different forms, the introduction of carbon taxes, tightening of environmental laws and the adoption of standards, all of which increase the magnitude of the regulatory push by inflating the prices of competing products and services which are environmentally undesirable. The effect can be seen in a supply and demand diagram (Figure 65), where it is manifested by two demand curves, a lower one representing cost of polluting behaviours to individuals, and a higher one which takes account of the higher

societal costs. The vertical distance between these two marginal cost curves represents an *externality* or a cost which is not fully realised by businesses producing the pollutants or emissions. Targeted carbon/pollution taxes seek to internalise these costs so that individual and societal costs are more closely related – this is the ‘polluter pays principle’ and is designed to shift the equilibrium point between unsustainable consumption patterns to those which can be maintained.

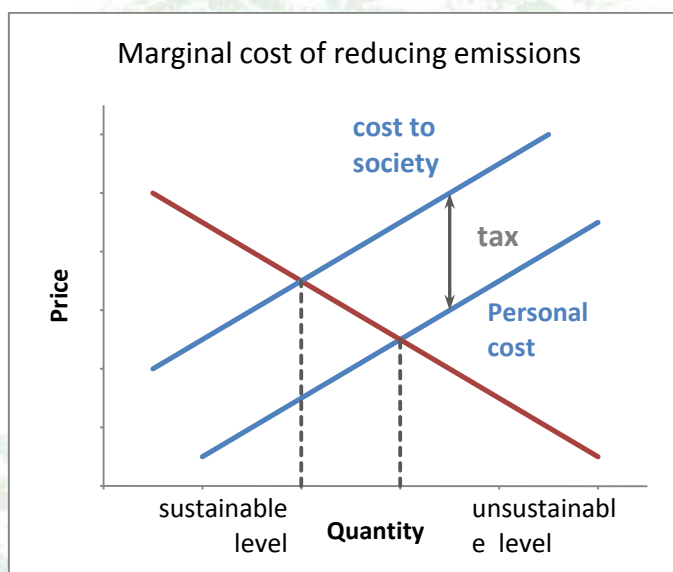


Figure 65 - Marginal costs of polluting for individuals and society¹⁵

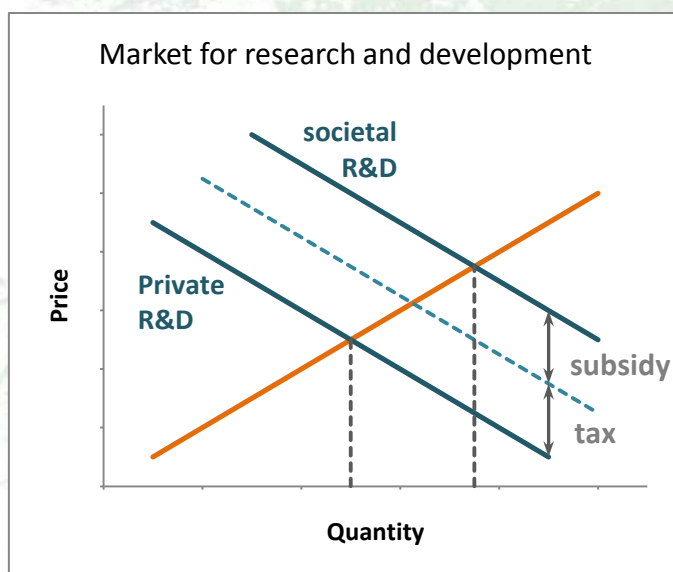


Figure 66 - The double externality in renewable energy technologies/R&D

There is however an additional externality where positive spill over effects are felt by competitors and by society as a result of the development of renewable energy projects by individual firms (Figure 66). In this case the innovator does not realise the full benefit of their investment in terms of increased profits, similarly early adopters of new technologies pay higher in markets that are in the early stages of development. The incentive to develop innovative energy technologies is cost will be suboptimal. The difference between the private benefit to investors and the wider benefit to society can be seen on supply and demand curves for renewable energy/R&D (Figure 66). This so called *double externality* problem requires policies which address each externality individually.

Taxes on polluting activities reduce part of the gap by making polluting technologies less competitive but do not address the positive spill over effect, a shortfall which can be corrected by providing tariffs, subsidies or grants

¹⁵ Derived from Copenhagen Economics, *Innovation of energy technologies: the role of taxes*, 2010

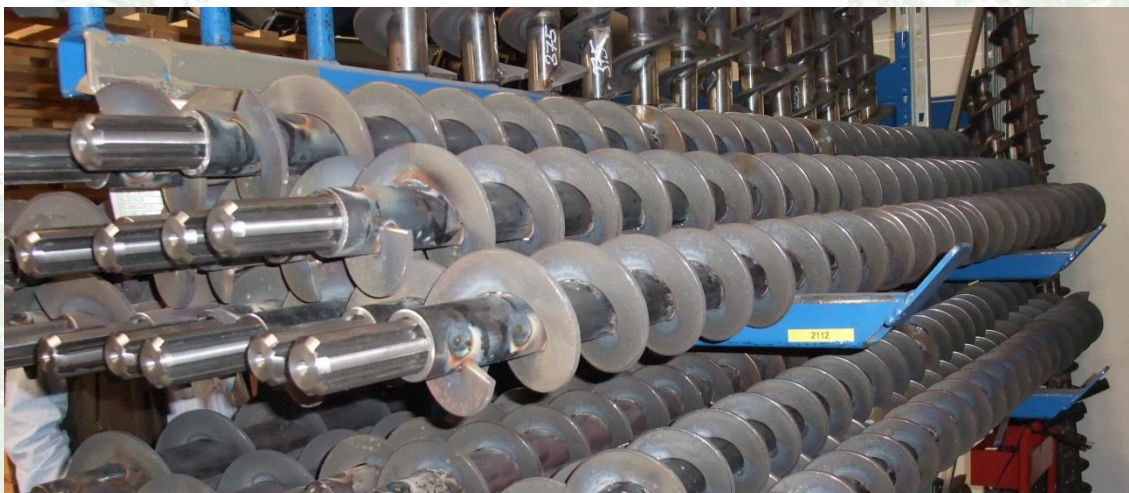
for example, or by funding demonstration and research projects. One might think that higher environmental taxes alone would have a similar effect but this tends to over internalise the costs and can have a distorting effect on the market, perhaps depressing levels of overall demand. The case for separate policies to deal with the two spill over effects is also apparent in the way that businesses tend to react to different stimuli, a key factor is the element of risk that renewable energy innovators and entrepreneurs must contend with.

Once implemented, taxes tend to remain relatively stable and (or at least tend not to be revised down) and send out clear signals regarding the direction of policy and the extent of government intent. Conversely schemes offering incentives and grants will expire when the budgets are exhausted and are generally more easily manipulated and prone to political tinkering. This can have a destabilising effect on longer term investments which are required to bring innovative products into the mainstream.

Local governments have another important role in supporting the development of biomass schemes. Many public buildings have a high profile and a large heat load which can make them good candidates for biomass heating. Larger installations help the industry financially, but also demonstrate credibility and confidence in the technology which can boost the confidence of other consumers. The largest sites can also trigger for investment in infrastructure or logistics, for example the creation of woodfuel depots and recycling centres, or networks of installers.

Evidence of the effects of these policies has been seen in the Swedish and Austrian markets (Chapter 0) with the carbon tax in Sweden and the three pillar approach in Austria (referred to as carrots, sticks and tambourines) and it is worth reiterating that the success of these biomass markets is neither accidental or incidental, but is a result of strong political will and a sustained and deliberate campaign to reduce dependence on fossil fuels. Within the remaining FOREST regions we can find many individual biomass success stories but considerable barriers remain.

Wider economic concerns and policy uncertainty have affected all regions, the UK market appears to be at a tipping point as interest in biomass is developing, aided by the introduction of the Renewable Heat Incentive (RHI), the first tariff based system to reward renewable heat generators on a per kilowatt hour basis. The majority of additional capacity through RHI is expected to come from biomass yet a degree of uncertainty remains, changes to feed-in tariff rates for electricity (in particular larger scale PV) and delays in the final implementation of the scheme have had an undermining effect, as have some government announcements which appear to favour an energy future based around nuclear and gas. In Spain, Italy and Ireland the effects of the economic downturn have arguably been felt harder than other FOREST regions, and there is a real danger in spite of reliance on imported energy, that policies aimed at incentivising green energy and penalising increases in emissions are being neglected in favour of short term policies to save struggling economies. Poland has weathered the crisis rather better than many EU countries but will not be immune to contagion as its trading partners continue to struggle, however the Polish economy is heavily reliant on coal and under current energy policy will remain the key element for energy security until at least 2030. Even at the European level, the appetite for green policies is stumbling as the price of carbon credits in the EU Emissions Trading Scheme (ETS) falls to new lows.



Conclusion

Lessons from the FOREST project have shown how bioheat businesses can develop the quality and reliability of the services they offer to provide credible alternatives to heating with fossil fuels. In well developed markets consumers have a variety of supply options to choose from including heat contracting and ESCOs. These 'complete' biomass solutions, this can limit the perceived risks for end users and builds confidence in the market. Where the markets are less well developed the supply chain is often incomplete and it can be difficult for individual businesses to provide these levels of assurance. Building a successful market requires the development of all the different elements at the same time and working in partnership with other supply chain providers can help to build the confidence and capacity necessary to do this. Better organisation and integration with the supply chain is however only one part of the equation and the importance of regulation has been demonstrated in the form of carbon/pollution based taxes and incentives for developing innovative products and services. Finally there is a need to continue to publicise the benefits of biomass heating and to demonstrate elements of best practice, many of which remain poorly understood. The FOREST project has worked to introduce these concepts to key supply chain actors and through the printed guides and website it is hoped that these concepts will be introduced to a wider audience.

7 Other FOREST documents

Reports

- Regional Bioheat Market Structure Report
- Partnerships for Success, a guide to partnership working in the biomass heating supply chain
- A Guide to Biomass Heating Standards in biomass
- A guide to specifying biomass heating systems

FOREST website

- FOREST Guides and documents
- Online training tool
- Case studies of successful partnerships
- Supplier search
- Past events
- Newsletters



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