Good practice cases in practical applications of agro and forestry side-streams processing

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Bringing added value to agriculture and forest sectors by closing the research and innovation divide

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1. Learn about AGRIFORVALOR

Valorisation of biomass sidestreams from agriculture and forestry

AGRIFORVALOR is an EU funded H2020 project with duration from 01.03.2016-31.08.2018. It comprises 16 partners from 6 European countries.

AGRIFORVALOR aims to close the **research and innovation divide on agriculture and forestry biomass sidestreams** by connecting practitioners from agriculture and forestry to research and academia as well as with associations and clusters, bio-industry, policy makers, business support organisations, etc. in multi-actor innovation partnership networks.

The focus of the project is on the *transfer of know-how and information to enable and support farmers and foresters to exploit existing research results on biomass sidestream technics and facilitate the capture of grass root ideas for bio-industry application and development*.

Definition of sidestreams: High value by-products, wastes, residues from agriculture and forestry which are non-food-competitive.

AGRIFORVALOR unites especially practitioners in the field of biomass side-streams in three Biomass Innovation Design Hubs (Hubs), piloted in **Spain** (Andalusia), **Hungary** and **Ireland**. The Hubs and respectively their Hub managers will bring together several different actors mainly on regional/ national level but as well as on EU-level from business sector, research or academia, forest and agricultural sector (so called multi-actors) offering together with Hub steering committees a manifold variety of services such as workshops on exploitation of research results and on developing new business models for the forestry and agricultural sector based on biomass sidestreams.

The three different Hubs were officially set-up and their Hub manager elected in March 2016.

Hub visions

Each Hub elaborated its own vision having in mind the different conditions of the forest and agricultural sector in each region.

Hub Hungary

“Support to the further establishment of the bioeconomy sector from biomass sidestreams in the innovation landscape of Hungary (including policy support)”

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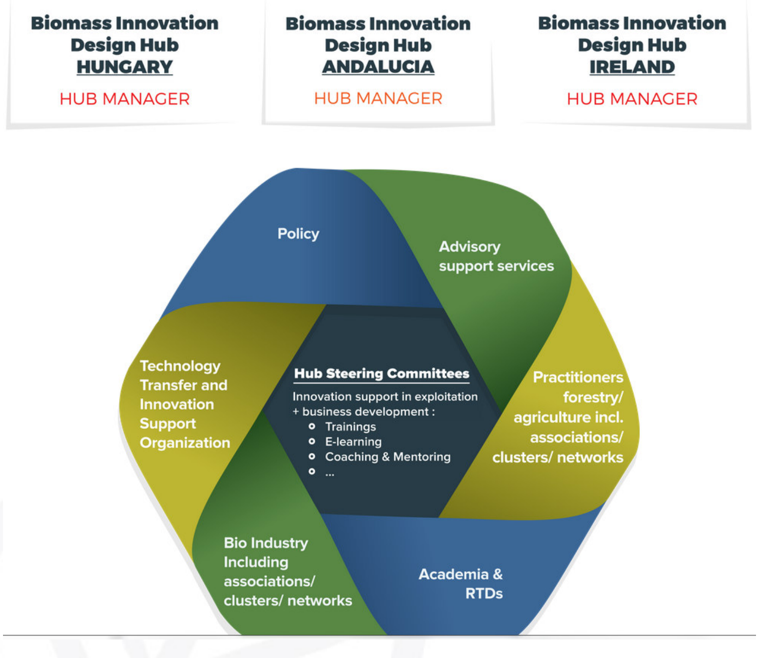
Hub Ireland:

"Increase the value proposition of the agro and forest sectors in IRL by moving from energy to higher value products offering new business opportunities"

Hub Spain (Andalusia):

"Strengthening the agro and forest sectors by generating new business opportunities supported by a favourable public regulatory framework"

The AGRIFORVALOR project:



AGRIFORVALOR vision

"Connecting multi-actors in order to:

- ***achieve new value chains***
- **stimulate biomass sidestream market uptakes into value-added products"**

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Project team

Project Coordinator

Project Partners

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2. Summary of Findings

This report summarizes the characterisation of current Good Practices (GP) that valorise agricultural and forestry biomass sidestreams in the three project hubs (Andalusía - Spain, Nagyalföld - Hungary and Ireland) and for the wider EU.

The findings are based on **29 GP identified until October 2016** hat valorise biomass sidestreams.
From 29 GP 6 have food applications, 2 have feed applications, 9 have applications for functional materials/fine chemicals, 4 GP have applications for fertilizers and 17 have fuel applications.[1]
The identification of good practices was not the result of a systematic review, so it cannot be considered as representative for the number of good practices in the hub regions or the EU. However, the outcomes may indicate some directions of development.

What is a good practice?

Based on definitions from literature[2,3,4] and on FAO criteria[1] for good practices we used as criteria for good practices:

- Technique more effective than other techniques
- Successful experience, which has been tested and validated in practice
- Replicable and adaptable (to specific context/circumstances)
- Environmentally and economically sustainable
- Reduce waste, improve quality
- Reduce risks, if applicable

What are success stories in view of AGRIFORVALOR?

In order to describe success stories and find out whether groups of comparable projects or projects with comparable drivers can be distinguished, the good practices were classified following the categories:

- ***Economic viability of technics***

[1] Comprising multi-application outputs
[2] FAO, 2014. 9-8-2016 Good practice template http://www.fao.org/3/a-as547e.pdf
[3] BPIR.com 9-8-2016 http://www.bpir.com/benchmarking-what-is-best-practice-bpir.com.html
[4] Technopedia 9-8-2016 https://www.techopedia.com/definition/14269/best-practice

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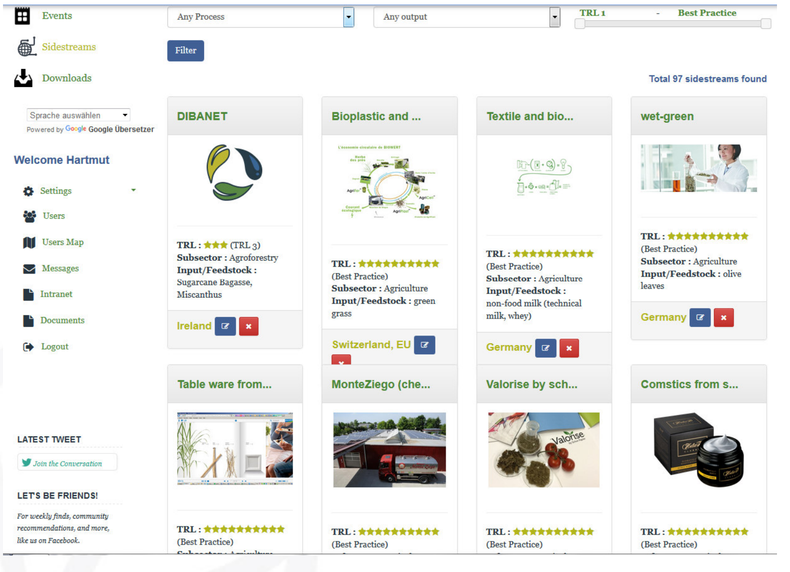
- ***Multi-actor projects***

- ***Access to innovative funding***

⇨ All results identified during and after the project's end will be made visual under the "**Sidestream Value tool"**

⇨ **Sidestream value tool: www.agriforvalor.eu**

⇨ For accessing all information on Good practices (GP) and research examples please **register on our website**.



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3. Hub Specifics

3.1 Spain (Andalucia)

Andalusia is an exceptional region from the point of view of territorial and population within the EU, with 87.597,7 km2, Andalusia surface is similar to that of states like Austria, Portugal, Czech Republic and Hungary and its population amount is very close to that of countries like Austria and Sweden.

The Andalusian Agency of Knowledge (AAC) is the hub manager and a Public Agency that depends on the Ministry of Economy and Knowledge of the Regional Government in Andalusia. Its mission is to foster innovation among Andalusian entities and to help them internationalize their innovations.

Agricultural sector is a key pillar of the Andalusian economy, the forest is the second largest in terms of size in Spain. Andalusia produces approximately 4.2 mio. tonnes per year of vegetable wastes and by-products, equivalent to 56% of the Spanish volume. Agricultural waste is mainly used for animal feed, incorporated into the soil or burned.

Sidestreams used are mainly based on olive biomass and on forest biomass sidestreams (wood chips) with focus on energy production.

But opportunities can be found as well in the area of valorising sidestreams aiming at achieving a higher value other than energy production.

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Table 1: Overview of identified good practices on the market in Spain, valorising biomass side-streams

Good practices Hub Spain (Andalusia)				
	Biomass side-stream	**Technique**	**Output**	**5Fs**
1	Pig slurry, poultry and turkey manure, olive oil mill wastes, sewage sludge, slaughterhouse wastes and other agricultural wastes	Anaerobic digestion	Biogas	Fuel
2a	Olive wastes	Extraction, Purification, Combustion	Pharmaceuticals*, Nutrition, Electricity	Food Fuel
2b	Grape and vine wastes	Extraction Purification Combustion	Pharmaceuticals* Nutrition Electricity	Food Feed Fuel
3	Forest harvest residues (wood chips)	Combustion	Heat	Fuel
4	Forest harvest residues (wood chips)	Combustion	Heat, Electricity	Fuel
5	Forest harvest residues (wood chips)	Combustion	Heat, Steam	Fuel
6	Forest harvesting residues	Composting	Soil conditioner	Fertilizer

* Pharmaceuticals and health products are classified as Food in the classification of the 5Fs (Food, Feed, Functional material/Fine chemical and Fertiliser)[5]

[5] Cat-Agrofood, 2012. Chances for biomass. Integrated valorisation of biomass resources. Wageningen, Wageningen-UR.

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3.2 Hungary

Hungary has a significant potential in the field of agricultural and forest waste and side-streams production. 1-1.2 million m3 forest felling waste and 13.7-18.9 million tonnes of agricultural waste are produced in Hungary annually. Based on these quantities, Hungary can play a major role in valorisation of agro and forest biomass sidestreams for bio-energy production. As the level of bio-energy is still low, additional support including knowledge transfer and innovation support for new sustainable biomass material is needed to achieve 11 % renewable energy production by 2020. In addition know-how for valorizing biomass sidestreams for bio industrial usage (e.g. chemistry) is needed.

The HUB manager will coordinate regional or national innovation partnership networks (e.g. inter cluster-missions, coordinating input for regional research agenda).

The biomass potential of the hub is proportionate to the potential of the general agricultural and forestry sectors in Hungary as the members of the hub cover a fair proportion of the biomass producing sectors. Sidestream is already used, mainly for energy production. Other uses of sidestreams are also possible and some examples exist for other applications. The activities within the AGRIFROVALOR project will contribute to raising this proportion and introducing new technologies in the market.

Table 2: Overview of identified good practices on the market in Hungary, valorising biomass side-streams

Good practices Hub Hungary (Nagyalföld)				
	Biomass side-stream	**Technique**	**Output**	**5Fs**
1	Mushroom substrate	Anaerobic digestion, filtering	Biogas, Heat, Fertilizer	Fuel, Fertilizer
2	Sunflower stem	Extraction	Skin Cream*	Food
3	Tree bark chips	Chipping, Fractionation, Composting	Clean air Compost	Functional material Fertilizer
4	Sawdust	Drying Mixing	Adobe bricks	Functional material
5	Wood chips,	Combustion	Heat, electricity	Fuel

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	sawdust, sawmill wastes			
6	Wood chips, woody crop residuals (grape pruning, lavender wastes)	Combustion	Heat, electricity	Fuel

*) Pharmaceuticals and health products are classified as Food in the classification of the 5Fs (Food, Feed, Functional material/Fine chemical and Fertiliser)[6]

[6] Cat-Agrofood, 2012. Chances for biomass. Integrated valorisation of biomass resources. Wageningen, Wageningen-UR.

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3.3 Ireland

The Irish Hub is a collaboration of multidisciplinary experts in Agriculture, Forestry, side-stream valorization, innovation management, technology commercialization and enterprise development. Institute of Technology Tralee is providing expertise in side-stream valorization, enterprise development and commercialization. Teagasc is the National center for Agricultural and Forestry research and provides Agricultural and Forestry Advisory services. The Irish Farmers Association (IFA) and the Irish Forestry and Forest Products Association (IFPPA) play a key industry support role for the agriculture and forestry sectors, and collectively these organizations have an extensive national network of over 20,000 stakeholders and practitioners in the Forestry and Agriculture sectors. The Hub Team works in close collaboration with a steering committee which includes Maeve Henchion (Teagasc), Kevin O'Connor (UCD) and Tony Quinn (DAFM).

An estimated 1.3 million tonnes per annum straw is produced from the cereal sector mainly used in animal bedding and composting. Animal by-products amounting to 550,000 tonnes per annum (150,000 Meat and bone meal) is exported, disposed of or used in pet food and leather production. Manure and poultry litters, mainly land spread, represent another significant resource which has potential for generating greater value. Large amounts of residues are also produced from the dairy industry. Over 1 million tonnes of sawmill residues are produced in Ireland annually

Sidestreams are mainly used for energy production. Other uses of sidestreams are also possible and the activities within the AGRIFORVALOR project will contribute to raising this proportion and introducing new technologies in the market.

Table 3: Overview of identified good practices on the market in Ireland, valorising biomass side-streams

Good practices Hub Ireland				
	Biomass side-stream	**Technique**	**Output**	**5Fs**
1	Whey	Fermentation	Ethanol	Fuel, Food
2	Poultry manure	Fluidised bed combustion	Thermal energy	Fuel
3	Sawdust, sawmill wastes	Pelletising	Wood pellets	Fuel

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4	Forest residuals sawmill wastes	Torrefaction	Biochar	Fuel
5	Woodchips	Combustion	Heat, electricity	Fuel
6	Lignocellulosic biomass	Near Infrared analyses	Best valorisation applications	-

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4. Overview of Good practice cases in practical applications

In this chapter, good practices for the three hubs (Spain, Hungary and Ireland) and the wider EU are described. Both good practices valorising agriculture and forestry biomass sidestreams are handled.

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Good practices in Spain (Andalusia)

4.1 Forest Biomass and energy production

The Campillos Biogas plant is the first agro-industrial anaerobic digestion plant in Andalusia (Southern Spain) and is designed and promoted by GIESA Agroenergia, S.L., who also operates the plant. The plant is in service since June 2016 and is established to produce biogas from waste as pig slurry, poultry and turkey manure, olive oil mill wastes, sewage sludge, slaughterhouse wastes and other agricultural wastes.

Figure 1: Campillos Biogas Plant

The surplus of the biogas is combusted in a cogeneration motor, which produces electricity, both for self-consumption of the company and for supply to the grid. Furthermore, the plant treats the solid digestate, obtained from the anaerobic digestion process, to produce 10.000 metric tons of compost per year. In addition, 49.000 metric tons of liquid digestate (fertilizer) are obtained per year. The plant treats the waste generated in a number of farms and food industries in its immediate surroundings, generating biogas that is directly supplied to different turkey farms and a feed factory. All the suppliers of the waste and the consumers of the biogas are located within a radius of 4 km from the plant.

What makes it a good practice?

The processing of a broad spectrum of low value biomass wastes to high value fuels is one of the strong sides of the project. Selling the biogas for private heating purposes is one of the success factors contributing to the business model.

A second good point is the establishment of long-term commercial agreements with private actors, buying the biogas from the plant.

Find more information on this Good practice on www.agriforvalor.eu

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4.2 Olive and grape based food, feed, pharmaceuticals and cosmetics

Figure 2: The plant of Oleicola El Tejar

From olive biomass sidestreams (e.g. olive pomace, olive stones), polyphenols and other bioactive compounds are extracted and commercialized in international markets. Through extraction, purification and drying, bio-active compounds and neutraceuticals for cardiovascular health are produced. After extraction of the high value compounds, the secondary biomass is combusted for the generation of electricity.

Besides olive waste, also grape waste (skin, leaves, seeds) are used for pharmaceutical, food and feed applications. Through research it is has become able to pinpoint the health properties of grapes and locate the bioactive compounds responsible for them in the different parts of the grapevine.

Through extraction and purification grape pomace, skin, seed and lees as well as vine stems and leaves extracts are obtained. Depending on the part of the plant used, the type of grape (white or red) and the extraction and purification processes, different compounds are obtained.

What makes it a good practice?

The strength of the project is the strategic alliance between the world leader in olive tree production Oleícola El Tejar and the biotechnology company Natac, which, through its technology, know-how, and biomass resources, made it possible to commercialize innovative and value-added olive tree-derived ingredients at really competitive prices on international markets.

Find more information on this Good practice on www.agriforvalor.eu

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4.3 Biomass Centre Lozoyuela

The Lozoyuela biomass centre is raised to promote the use of forest biomass as a source of renewable energy, and creating an example to other rural communities. In 2013 the Centre was transferred to private companies associated to ASEMFO, an association of private companies working in the field of management and conservation of the natural environment.

Figure 3: Woodchips om the Lozoyuele biomass centre

The wood chips are used for heating of 1600 households, swimming pools, schools, sports halls, a heating network at a campsite. Wood chips are also sold for energy purposes to service companies who install boilers for households and for companies. In total, about 1MW installations have been installed and supplied with wood chips.

Energy for heating purposes and hot water provision, is produced with fully automated high-tech boilers, having automatic feedstock input and ash removal.

What makes it a good practice?

This project has created the technical and human infrastructure that provides a system of self-management of local quality forest biomass in the area. Many forest related companies are associated, all contributing to the valorisation of the wood chain.

By use of wood chips as renewable energy source CO_2 emissions are reduced and energy cost for heating and hot water are reduced. The centre produces wood chip at half the price of diesel.

Find more information on this Good practice on www.agriforvalor.eu

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4.4 Eco Heat Target Biomass plant

Background information

Figure 4: Harvesting of forest residues end processing to wood chips

Wood chip and pellet production increased from about 26,000 tons in 2015, to about 40.000 tons in 2016. The wood chips and pellets are used for combustion in high-tech boilers, in total 18,000 MWh is generated for heat and thermal use and about 40,800 MWh for electricity. It generates 10 jobs and 12 other temporary jobs.

The project is funded both private and public. Public financing was received from the National Energy agency and a regional agency stimulating innovation and economy.

What makes it a good practice?

The collaboration of biomass producers, distributers, and processors (energy) makes the value chain functioning well. Because of that, an attractive product can be offered to the customers. The energy service company takes care of placing the technical installation, maintenance and long term guaranteed supply of biomass. The customer does not have to do any investments, but only has to pay for the fuel.

Further advantages are lowering the fire risk in the Andalusian forests and risks of pest and diseases by the removal of forest harvest residues. The biomass processing, distribution and the installation and maintenance of the high-tech boilers create several jobs, which is of great importance for the region.

The use of biomass has also a positive environmental effect. The amount of biofuel used contributes to a reduction of 23,657 ton CO_2 emission.

Find more information on this Good practice on www.agriforvalor.eu

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4.5 Móstoles District heating

The Móstoles Ecoenergía district heating project has been developed by Móstoles District Heating, a company whose stakeholders include Veolia, SCEEF Fund managed by SUMA Capital and Tribiom FactorVerde. It was set up with the aim of implementing district heating in Móstoles, a town to the south-west of Madrid with a population of over 200,000 inhabitants. Móstoles District Heating is Spain's largest and most ambitious biomass-based district heating project. Its first phase has supplied 3,000 homes, with plans to increase this to 7,000. The households are supplied with heat and hot water.

Figure 5: Pipes and distribution unit of the heat distribution network of Mostoles District Heating[7]

To produce thermal energy, three boilers are used feeded by wood chips made of logs from nearby forest energy plantations (eucalyptus) and forest wood residues.

What makes it a good practice?

By use of renewable energy through wood chips from energy plantations and wood waste, CO_2 emissions are reduced by 9,000 tons annually. The households connected to the district heating network benefit from the fixed energy prices for the heating and domestic hot water supply, resulting in some 15% lower energy costs.

Using advanced filtering techniques, emissions from the installations are reduced to levels meeting present and future EU emission regulations.

Find more information on this Good practice on www.agriforvalor.eu

[7] Source: http://www.energetica21.com

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4.6 Improved soil conditioner

The TerraCottem Company was established in 1993 to bring this scientific know-how of the University on the market together with the resources necessary to produce and commercialise the TerraCottem soil conditioning technology on a global scale. Today the TerraCottem technology is distributed in more than 40 countries worldwide. In 1983, the University of Ghent (Belgium) started a research program to grow plants in the Sahel region in Africa using less water. It was found that by mixing certain hydroabsorbent, nutritive and root growth stimulating components together, that a superior soil conditioning compound was attained which produced dramatic and swift results. It was demonstrated that certain materials complement each other in a synergetic manner and provide soil conditioning benefits whose collective effect is better than the effect of their individual parts. The research resulted in the TerraCottem soil conditioner, a mixture of more than twenty components that work in synergy to improve growing conditions and plant growth. In the EU-FP7 project SUSTAFOR the TerraCottem soil conditioner was improved by mixing the soil conditioner with composted forest residues.

Figure 6 TerraCottem Universal PLUS, a novel soil conditioner[8]

The soil conditioner is applied only once in the tree's lifespan. It takes just few seconds to mix the product with the soil of the planting pit during planting. The prescribed dose is 40 g/tree for young seedlings up to 60 cm high and 100-200 g/tree for larger seedlings (1-2 m high).

What makes it a good practice?

The soil conditioner can be applied to any type of tree planting in sites where the investment in maintenance (especially, irrigation) is intended to be minimized - Drought-prone areas

[8] Source: http://www.sustaffor.eu

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where water deficit can be lethal for young seedlings - Soils with low water and nutrient retention capacity: light texture, high stoniness, low organic matter content.

Find more information on this Good practice on www.agriforvalor.eu

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Good practices in Hungary

4.7 Mushroom-biogas complex

Pilze Nagy is a company with its main activity mushroom growing. The objective of the biogas project was to eliminate the waste materials of mushroom production in the most economic and environment-friendly way. The organic waste from the production of mushrooms (spent mushroom substrate) are processed to biogas. From the biogas 1.800.000 kWh electricity is generated and supplied to the national grid. The side-product of the anaerobic fermentation, the digestate is separated into solid and liquid part given back to the fields (200 ha) as a plant fertilizer. The heat, which is the side-product of the energy conversion, is used in the mushroom drying plant to produce dried mushroom products.

Figure 7: Pilze-Nagy; Spent mushroom substrate

Figure 8: Pilze-Nagy: biogas plant running on spent mushroom substrate

What makes it a good practice?

It is a good example of circular economy. The application of thermal energy arising during generating electric power greatly improves the economic efficiency of mushroom production. The applied environment-friendly technology is a guarantee for the sustainable development.

Find more information on this Good practice on www.agriforvalor.eu

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4.8 Cosmetics from sunflower stems

The cosmetic company, Helia-D is a producer of different types of creams for skin care that are known for their plant-based active ingredients content. Among their nine patents, the first one has an exceptional significance, as it is the patent specification on which the first Helia-D product was based ("cosmetic product with skin and muscle regenerating effects and its manufacturing procedure").

The creams of Helia-D are based on sunflower stem extract. Usually, the stems are ploughed in or used as a fuel, as they are only poor feed[9].

Figure 9: Helia D - moisturising cream

After the discovery and successful testing in the early 1980s, the company began to develop a cosmetic product line. By the mid-1980s the product line had expanded to more than thirty products and several million boxes of cream were being sold each year. A couple of years later, the cream even became a sought-after product on the American market. The substance that makes the sunflower stem flexible is called auxin. Elasticity and firmness are two essential features of young skin, and auxin can provide the same benefit for human skin as it can for the sunflower stem through its ability to regulate protein synthesis. In practical terms, products with sunflower stem extract can be regarded as promoting collagen and elastin fibre production (by means of the auxin stimulating protein production). These fibres support the skin elasticity, enhance facial muscle function, and reduce wrinkling and looseness. Extraction and purification of these compounds result hence in a high added value. The product is patented, so not much information is available.

What makes it a good practice?

[9] Suttie, 2000, Plant Production and Protection Series No. 29

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A high added value is produced out of a huge amount of biomass that would otherwise be ploughed in or used as a fuel.

Find more information on this Good practice on www.agriforvalor.eu

4.9 Biofilter from tree bark chips

FOBA Kft. is a company in industrial engineering activities and related technical consultancy, located in Budapest, Hungary.

Figure 10: Filter units, installation and filter material[10]

FOBA developed a wood chip-based biofilter which can be used for odour decontamination of wastewater treatment plants and meat or vegetable processing factories. The input of the process consists of wood chips, a primary biomass derived from forestry. In a first step, the wood chips and other components are fractionated, followed by a mixing step. Next, the biofilter is filled and closed, resulting in a woodchip-based filter as output of the process. The biofilters are built in during the establishment of wastewater treatment plants and meat or vegetable processing factories. Although the raw material acquisition is continuous, the bark of conifer trees, one of the most important components, is imported from Austria and Romania.

What makes this a good practice?

The technique used is simple and robust. Taking care that the filters do not freeze, they are easy to operate and maintain. The biofilters produced by the company work with high

[10] Source: www.fobakft.hu

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efficiency (more than 90 %). Used filter material can be recycled or composted. The applied technique reduces CO_2 emission and environmental pollution.

Find more information on this Good practice on www.agriforvalor.eu

4.10 Adobe bricks from clay and sawdust

The brickwork factory Forrás Tégla, formerly Tapolcafői Téglaipari Kft., was founded in 1994. It uses environmental production techniques to reduce environmental impact, improve usage of natural materials, and reduce wastes.


Figure 11: Adobe bricks as building material[11]

An adobe brick is a composite material made of earth mixed with water and an organic material such as straw or dung. The soil composition typically contains sand, silt and clay. Straw is useful in binding the brick together and allowing the brick to dry evenly, thereby preventing cracking due to uneven shrinkage rates through the brick. Dung offers the same advantage. The most desirable soil texture for producing the mud of adobe is 15-25% clay, 10-30% silt and 55-75% fine sand. In dry climates, adobe structures are extremely durable, and account for some of the oldest existing buildings in the world. Adobe buildings offer significant advantages due to their greater thermal mass.

In the brickworks Forás Tégla, ancient knowledge is incorporated in modern commercial production techniques. Instead of straw, the sawmill by-product sawdust is used as admixture to the clay. Bricks are still dried in air temperature.

What makes it a good practice?

[11] Source: www.forrastegla.hu

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The adobe bricks are environmental friendly building materials, and do not produce any dangerous secretions such as gases or nuclear radiation, what can be the case when using gypsum-based materials. The bricks also are sound adsorbing and thermal insulating.

Once at the end of the life cycle, adobe bricks can be recycled into new brick or walls.

Find more information on this Good practice on www.agriforvalor.eu

4.11 Szakoly biomass energy plant

The Szakoly project concerns a wood fuel based power plant, operational since 2009. It is the first fully biomass fuelled power plant in Hungary. It is run by DMB Zrt, a subsidiary of Veolia. It first was built as a condensing plant, but possibility for supplying waste heat to a nearby greenhouse has been created.

The Szakoly power plant has a capacity of 19.8 MW, and has been producing 130 GWh of electricity per year from the combustion of wood chips and sawmill by-products, equivalent to the consumption of 50,000 households.

The traditional steam cycle with less than 20MWe generating capacity is applied to produce electricity from biomass fuel. The installed boiler plant is a suspension fired unit with water-cooled vibrating grate. The wood chips are dosed by screw conveyors into the air spouts which evenly distribute the fuel across the combustion chamber. As the fresh fuel is fed on top of the burning fuel it dries and ignites fast. As a large fraction of the energy is released in suspension, the boiler reacts quickly to load changes.

Figure 12: Szakoly power plant Hungary[12]

While fuel from the traditional forests could be obtained without problem, the Project Company encouraged the establishment of a cooperative for developing energy plantations. It will help, on the long run, the stabilization of fuel prices. The power plant is fed with 140,000-150,000 tons wood chips and waste wood annually, from nearby sawmills.

[12] Source: www.heatingblanket.hulladekho.hu/

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What makes this a good practice?

- Through the biomass plant, annual CO_2 emission is reduced by about 100,000 tons.
- 55 jobs have been created in a region with a high unemployment rate.
- A reliable technique is used, adapted to local fuel supply and regionally available knowledge.
- Partial financing through payments of the CO_2 credits trading system.

Find more information on this Good practice on www.agriforvalor.eu

4.12 Biomass fired CHP plant- Pannonhalma Archabbey

The Abbey of Pannonhalma is one of the oldest historical monuments in Hungary, founded in 996. To reduce its environmental impact and to be more sustainable, a wood chips boiler and a CHP (Combined Heat and Power) unit were installed in 2009, replacing the old boilers running on natural gas. The new biomass boiler with 700kW thermal capacity runs on wastes of the botanical garden and viticulture of the abbey itself (grape-stems, rests of lavender and the leafage and timber from the surrounding forests owned by the congregation), and furthermore woodchips from the forestry of the region secured by long term contracts to ensure continuous and low cost fuel supply.

Besides the biomass boiler, also natural gas based CHP unit was installed to provide heat and electricity for local use. This CHP unit can cover about 10% of the peak heat demand (including both heating and DHW demand) and 40% of the peak electric demand of the Abbey.

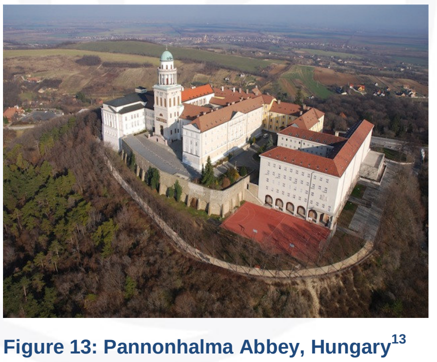


Figure 13: Pannonhalma Abbey, Hungary[13]

[13] Source: www.uniquetravels.eu and www.4biomass.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

By spreading the idea that using renewable energy resources can be profitable for the owners, the region and for the community at the same time, this project is a genuine best practice. The project finds solution to the practical usage of the large amount of horticultural waste produced on the fields of the abbey.

The project improves the security of energy services, the comfort of the monastery residents, and helps the Benedictine Congregation saves money which thus can be invested in other socially and economically important projects. The project also allows the abbey to consider further developments regarding the operation and the exploitation of renewable energies.

What makes this a good practice?

The idea of a low-carbon energy production system that was developed can be easily adopted by everybody. It can serve as good practice on how to reduce our energy bills and also our energy dependency.

Find more information on this Good practice on www.agriforvalor.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

Good practices in Ireland

4.13 Biofuel from whey

Carbery Milk Products (currently designated Carbery Group) from Cork, Ireland, started the operation of an industrial-scale whey-to ethanol plant in 1978. The operation was intended for the production of potable ethanol, but since 2005, the company has also been supplying fuel ethanol to a petrol company in Ireland. Currently, the Carbery plant operates with eleven cylindroconical fermentation vessels, using compressed air for agitation and aeration. A lactose stream produced during whey ultrafiltration is pumped into one of the fermentation vessels in the fermentation room. Yeast is added to each fermentation vessel at the beginning of vessel filling. Conditions in each fermentation vessel are set to enable the fast and efficient conversion of lactose to ethanol. The fermentation process is complete in each vessel within 24 hours. The yeast used for fermentation is recovered and reused a number of times before it is discarded. The yeast is recovered at the end of the fermentation by settling and mechanical clarification known from the beer filtration. The produced ethanol has food-grade quality and its distillate is further processed to spirits. It is noteworthy that potable ethanol and fuel ethanol have different quality requirements and therefore there may be some differences in the production process. Carbery produces about 11 thousand tonnes of ethanol per year. Up to 2005, the main markets were beverages, pharmaceutical and industrial (printing inks, etc.).

Figure 14: The Carbery plant, Ireland

Ireland is the only ethanol-consuming country in Europe not using sugar cane based ethanol imported from Brazil. Carbery sells 660,000 gallons of ethanol each year to the oil company Maxol. When you fuel up with bioethanol in Ireland it is coming from this one plant.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

What makes this a good practice?

Carbery is characterized as a good practice as it has an integrated energy use, the recovery of Phosphorus and the potential for water reuse. Ireland is the only ethanol-consuming country in Europe not using sugar cane based ethanol imported from Brazil.

Find more information on this Good practice on www.agriforvalor.eu

4.14 Biogas and fertilizers from chicken manure

Poultry litter from one batch is combusted on the farm to provide clean, dry renewable heat to sustain the next batch. Surplus heat is available to produce renewable power for use on the farm or export to the grid. Major savings are made in the consumption of propane for heating. The next batch of chickens thrive in the warm, dry, optimally ventilated, low ammonia conditions of the poultry house, putting on more weight for each kilogramme of grain fed to them. The litter they produce is drier and less odorous. Rather than being transported elsewhere for disposal, with ever-growing environmental consequences, the litter is securely stored on the farm and then combusted on the farm to produce the heat and power for the next batch.

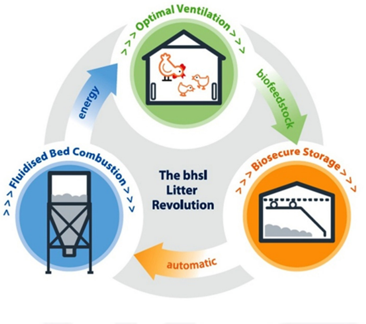


Figure 15: Schematic reproduction of the BHSL chicken manure to energy concept[14]

What makes this a good practice?

The several advantages related to environmental sustainability, bird welfare and economic viability make this a good practice. Besides, the support of the government in terms of developing new rules was crucial.

Find more information on this Good practice on www.agriforvalor.eu

[14] Source www.bhsl.com

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

4.15 Wood pellets from sawdust - Laois sawmill

Laois Sawmills limited was formed in 1987 and is a privately owned company establishes in Portlaois, Ireland. Since its foundation, the company invested to increase the efficiency of the sawmill.

Figure 16: Wood pellets from Laois sawmill[15]

The main driver of the business plan is to reduce mill wastes by reuse of sawdust and other waste residues. Costs are saved for transportation of the wastes off plant sites and former wastes can be sold as fuels. Use of wood pellets contribute to lowering CO_2 emissions. Energy needed for drying the feedstock and for the pelletizing process is generated by combustion of wood wastes which are less suited for pelletizing. Investment in a new hammer mill to break down wood bark from the sawmill allows it to be processed into wood pellets. Using waste bark has increased the pellet production by 15%. No information is available on the return of investment of the installation.

What makes this a good practice?

By products from the primary production in the sawmill are used for a second production line of wood pellets and wood chips, giving added value to the wood chain. Sawdust is the base for the wood pellets, where side streams/waste as bark and woodchips are being used for energy needed for the process of pelletizing.

The ENplus quality certification is a major step towards establishing pellets as a widely used energy commodity. The certificate ENplus not only fulfills the EN 14961-2 provisions for wood pellets, but requires even stricter quality criteria. This quality seal stands for low emissions and trouble-free heating with high energy value.

[15] Source: www.laoissawmill.com

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

Find more information on this Good practice on www.agriforvalor.eu

4.16 Low smoke fuels

Low smoke coal is produced through torrefaction of the biomass into charcoal and compression into torrefied pellets, briquettes or ovoid shape that can then be used domestically. Brash, bark, woodchip, sawdust, any other sawmill residues and woody biomass sidestreams such as olive stones are suitable as feedstock. Biomass to process must be low in contamination, low in leaf material, and as dry as possible. Torrefaction is a thermochemical treatment of biomass at 200 - 320 °C (392 - 608ºF) under atmospheric pressure and in the absence of oxygen, i.e. no air.

The pellets, briquettes or ovoids can be made of 100% char. They also can be made of a mix of char and fossil coal. The CPL smokeless coal is a mixture of fossil coal and a minimum of 50% torrefied wood.

Figure 17: Low smoke fuel[16]

Biomass sidestreams from forest harvesting and sawmills can be used as slowly burning material with high energetic value, producing up to 80% less smoke and lower CO_2 emissions than traditional house fuels.

What makes this a good practice?

Emissions of CO_2 from domestic heating is reduced through replacement of fossil fuel (coal) by biochar, with additional advantage of reducing air emissions of other pollutants such as particulate matter, NO_X, and VOC's. The latter having advantages for health. This will also provide a ready market for brash.

[16] Source: www.cplfuels.ie

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

Find more information on this Good practice on www.agriforvalor.eu

4.17 Wood chips to Climate Control - Astellas Ireland Co. Limited

Astellas Ireland Co. Limited is part of the Japanese pharmaceutical company Astellas Pharma Inc, which was established in 2005 after the merge of two Japanese Pharmaceutical companies. Astellas Pharma has two manufacturing plants in Ireland. The project 'Wood Chips to Climate Control' is part of Astellas corporate environmental initiative program of utilising renewable energy and to implement measures designed to protect the environment.

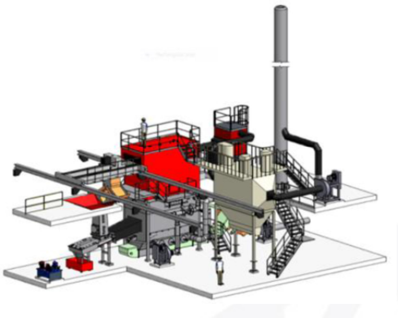



Figure 18: Impressions of the Astellas biomass installation[17]

The flue gas is cleaned by means of the latest techniques used in filter systems, by which national and local emission requirements are fulfilled. Renewable carbon-neutral fuel has replaced a gas fired boiler. The combined construction of an 800 kW wind turbine and wood fuelled boiler system has reduced the plants carbon footprint by 3,000 tons CO_2 per year.

Coillte was selected as the preferred biomass fuel supplier for the project. The company is committed to a biomass strategy that matches renewable energy requirements with local biomass supply and local private forest growers. Biomass feedstocks are sourced from Coillte's own forest resources and private sources in the Kerry region. Coillte's approach to managing all their businesses from forestry to renewable energy, panel product manufacture and telecommunications masts, is built on solid sustainable values which deliver a range of benefits for all stakeholders.

[17] Source: www.coilte.ie

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

What makes this a good practice?

The system has delivered an up to 45% reduction in fuel costs of Astellas energy supply. 800,000 liters of HFO are replaced by the renewable feedstock of 6,400 ton of woodchips from reginal origin. Combined with the additional benefits of a reduced carbon footprint, reduction of 3,000 tons CO_2 , the project will have a positive impact on the local community and the South Kerry economy.

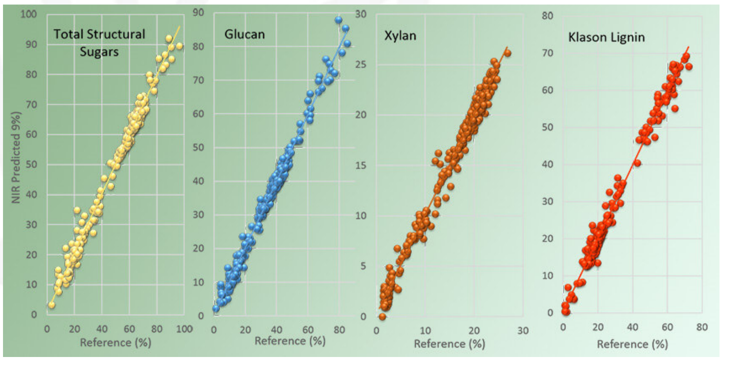
Find more information on this Good practice on www.agriforvalor.eu

4.18 Near infrared biomass analysis

Celignis Analytical is a division of Celignis Limited, located at the campus of the University of Limerick, Ireland. It provides services for the analyses and characterisation of biomass samples.

Celignis undertakes laboratory analysis of biomass samples to determine properties relevant for the production of biofuels and bioenergy. The main focus is on the analysis of lignocellulosic biomass, which is mostly composed of cellulose, hemicellulose, and lignin. Lignocellulosic biomass, depending on its composition, can be used for the production of second generation biofuels and platform chemicals (in biorefineries) and for the production of heat and power.

It takes approximately 2 weeks to examine the biomass via the standard (chemical) methods of analysis. However, it takes only approximately 2 minutes using NIR models. By that, time and cost are significantly reduced and therefore the NIR method allows clients to analyse many more samples than would be possible with standard methods.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

Figure 19: Near infrared models are used for biomass analysis[18]

What makes this a good practice?

All sidestreams and waste of all types of lignocellulosic biomass, including pre-treated biomass and the residues of conversion, can be analysed to determine the best use. The method generates data on the biomass composition that will enable the biomass supplier to characterise biomass in terms of bio-refinery potential or bioenergy applications.

The NIR method applied, substantially reduces time and cost of analysing biomass samples, enabling more samples to be analysed by which more accurate results are obtained and faster processing opportunities of biomass streams.

Find more information on this Good practice on www.agriforvalor.eu

[18] Source: www.celignis.com

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

Good practices in Europe

In table 4, an overview is given of the good practices identified in Europe in general. On EU-level, it can be identified that the focus is less on energy applications then in the 3 hubs. This can possibly be explained by the larger area considered, by which there is a higher chance to identify practices with a higher valorisation potential, such as the use of sidestreams for food/pharmaceutical and cosmetic applications, and functional materials/fine chemicals. Both sidestreams from the production of plants and animals are present, processed through a variety of techniques: fermentation, extraction, separation, chemical and physical modifications. This results in paper, food packaging, leather tanning agents, textile fibres, high quality biopolymers, fertilizer, household and office items. However, there are also some good practices focusing on fuel, especially in the valorisation of forestry sidestreams. Different techniques are used: fermentation, torrefaction, pyrolysis, gasification.

Table 4: Overview of identified good practices on the market in the European Union, valorising biomass side-streams

Good practices European Union				
	Biomass side-stream	**Technique**	**Output**	**5Fs**
1	Tomato and pepper fibres	Paper producing process, but with other fibres	Paper	Functional Material
2	Whey	Fermentation Extraction and ground into paste	Biogas,	Fuel, Functional material
3	Olive leaves	Hot water treatment (similar to brewing tea)	Leather tanning agent	Functional material
4	Milk (proteins)	Extrusion	Textile fibre, High quality biopolymers	Functional material
5	Grass (meadows)	Separation, fermentation, chemical and physical	Plastic raw materials, Basis for flavours and cosmetic	Food/Pharma Functional materials/fine chemicals,

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		modifications	products*, Fertilizer	Fertilizer
6	Sugar cane stalks	Extraction, grounding, moulding	Table ware	Functional material
7	Forest harvest residues, sawmill waste / Wood chips	Torrefaction, pyrolysis, gasification	Bio-oil, Biochar, Biogas	Fuel
8	Forest harvest residues, sawmill waste / Wood pellets	Gasification	Heat, Electricity	Fuel
9	Lignin fibres	Moulding, 3D printing	Household and office items	Functional materials
10	Black liquor	Purification, Filtering, dehydrogenation	Sweetener (xylitol)	Food

*) Pharmaceuticals and health products are classified as Food in the classification of the 5Fs (Food, Feed, Functional material/Fine chemical and Fertiliser)[19]

[19] Cat-Agrofood, 2012. Chances for biomass. Integrated valorisation of biomass resources. Wageningen, Wageningen-UR.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

4.19 Paper from tomato and pepper fibres

Headquartered in Heelsum, the Netherlands, Schut Papier is a leading manufacturer of high-quality uncoated paper. With four centuries of experience in manufacturing quality uncoated paper, Schut Papier has unrivalled expertise in paper, colours and fibre technology. The company disposes of modern research facilities and a laboratory. After two years of development, Schut Paper launches: Valorise by Schut Paper. This paper is the result of the collaboration with growers, knowledge centres and universities for the circular value from fibre from agricultural residues such as tomato plants. The optimal scenario is that agricultural residue (e.g. tomato and pepper crops) is not composted, but 100% is used as raw material for the paper sector and as ingredient for other industries.

Figure 20: Schut Papier - valorisation of tomato and pepper fibres

The processing of these agricultural fibres and the unique formula of Schut Papier has led to a particularly appealing paper with high tactile and visual value, wherein the fibres are very subtle present. In 2015, this paper was elected as one of the twenty most innovative products within the pulp- and paper industry. Instead of working with the classical wood fibres (cellulose), fibres of non-wood origin, such as from pepper and tomatoes are used in the production process of Valorise by Schut Papier.

Thanks to the centuries of experience, modern research facilities, a laboratory and close collaboration with growers, knowledge centres and universities for the circular value from agricultural residues such as tomato plants, this product is a real innovative application of valorisation of agricultural residues.

What makes it a good practice?

The use of non-wood fibres is unique for the production of paper. It reduces transport needs of raw material, and it reduces waste of agricultural crop residues.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

Find more information on this Good practice on www.agriforvalor.eu

4.20 Energy from milk

Monte Ziego is a cheese factory established in 2000 in Teningen Germany, producing a broad range of dairy products. They are located in the Black Forest area, and collaborating with farmers to meet the increasing demand for goat and cow products. In a cheese factory, large quantities of whey are produced, which is of limited use as food and feed, and is often expensive to dispose. During a research project in 2003, whey showed to be an energetically valuable biomass. In a pilot plant the whey was converted into biogas with an above average methane content of 65 percent. Based on these results, Monte Ziego now plans to establish the first zero-energy dairy in Germany. This is quite ambitious as dairies need a lot of energy for cooling milk and finished products, and heat to produce cheese. In the biogas plant established, only whey is used. The whey is fermented in the biogas plant. Afterwards, a cogeneration plant burns the biogas and generates electricity and heat to operate the CHP-unit. The annual yield of energy amounts 131,000 kWh of heat and 58,0000 kWh of electricity. Furthermore, the residues from the biogas plant are used as fertilizer.

Figure 21: Monte Ziego - zero energy dairy

There is also collaboration with other regional dairies for the delivery of biomethane or whey from cow milk, as the goat milk production and thus the supply of whey varies depending on the season. The biogas plant is part of the overall approach 'zero energy dairy', which designed the entire production chain from the milk suppliers to a sustainable region.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

What makes it a good practice?

A zero energy dairy is quite unique, and only whey is used as input, producing an above average methane content.

Find more information on this Good practice on www.agriforvalor.eu

4.21 Table ware from sugar cane

Pacovis AG is a progressive manufacturing and trading group employing over 300 employees across seven sites in Europe. Founded in Switzerland in 1935, branches have sprung up in Germany, Austria, Romania and Turkey, along with sales partners throughout the whole of Europe. The have an eye to the future and solid experience from years of pioneering work and pursue the goal of offering the market an extensive range of products made from sustainable raw materials and waste products from agriculture becoming increasingly important. Under the brand 'Naturesse', Pacovis AG offers solutions for sustainable food packaging and disposable tableware.

The residual material of sugar cane arises in large quantities from sugar extraction in the production of cane sugar. The particularly tough fibres, which have normally been burned up to now, can be used as a valuable biomass. Up to 50 disposable plates can be produced from the residue of a single sugar-cane stalk. Tableware made from sugar cane is stylish, light and nevertheless very stable. It is also water resistant, and is suitable for use in the microwave, and thereby also for cold and hot areas.

The sugarcane stems are rolled and pressed in order to obtain the syrup. After extraction, plant fibres are ground in to a fine paste with the addition of water and natural binders and processed and pressed into moulds.

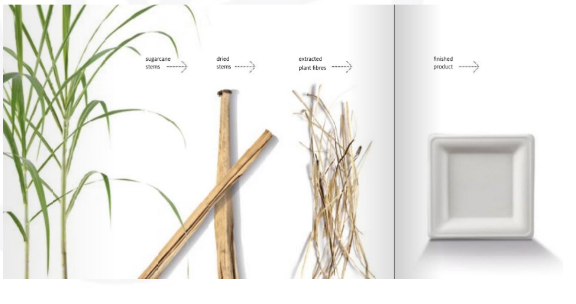

Figure 22: Table ware made of sugar cane stalks

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

What makes it a good practice?

The close collaboration with customers, sales partners and suppliers helps Pacovis to work market oriented, and to align their products with customer needs.

Find more information on this Good practice on www.agriforvalor.eu

4.22 Olive based leather tanning

Wet-green GmbH Innovationszentrum Leder & Kollagen is a team of the Leather Innovation Centre in Reutlingen, Germany, working to extend the application spectrum surrounding sustainable leather manufacture. The aspiration is to avoid the use of tanning chemicals which can harm our health and our environment. They found a tanning process for the production of ultra-fine leather, making use of an active ingredient of olive leaves. The olive leaves used for **wet-green®** are a by-product for olive growers and in many locations are actually burned.

The active ingredient used for the production of ultra-fine leather **wet-green®** OBE is recovered from the leaves of the olive tree using a method similar to brewing tea, and manufactured in plants complying to the stringent demands of the food industry.

This has led to a purely ecological leather tanning agent and an associated tanning process. The **wet-green®** tanning process permits the manufacture of biologically degradable premium leather with optimum skin compatibility – on an industrial scale.

Figure 23: Leather tanning from olive leaves[20]

The insight the company has into the formulations used for leather manufacture and the influence they can bring to bear towards providing greener alternatives offer the customers an additional sense of security unlike anything they have experienced before.

Benefits offered are:

[20] Source: www.wet-green.com

Feldfunktion geändert

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

- It is neither corrosive nor a hazardous substance (no REACH registration required) – which in turn makes for simplified logistics.
- Free of metals and any chemically synthetic reactive tanning agents.
- In terms of environmental and health considerations, the product is physiologically completely harmless across the entire value chain.

What makes it a good practice?

Their experience and insights make customers feel secure. Furthermore, the process guarantees maximum sustainability and helps to protect the environment.

Find more information on this Good practice on www.agriforvalor.eu

4.23 Textile and biopolymers from milk

Qmilch GmbH has developed an innovative process to produce a textile fibre (functional materials) from milk, which cannot be used for consumption. This project is a collaboration between different companies: Qmilch IP GmbH, Qmilch Holding GmbH and Qmilch Deutschland GmbH.

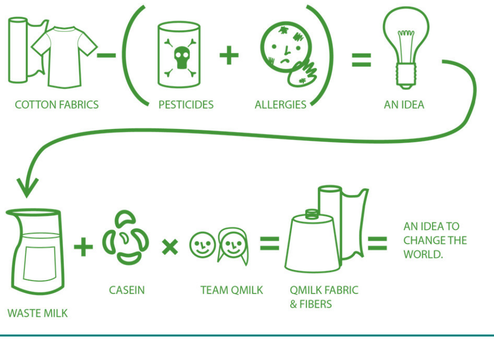

Figure 24: Q-milch - fibres made with waste milk

The casein, which is the main resource of the products, is made from raw milk, that is no longer tradable and regarding legislation cannot be used as food. This milk still contains valuable ingredients and offers great potential for technical purposes. A raw material, which is inevitably accrued and thus only extend its product life cycle is used.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

Qmilk fiber is made from 100% renewable resources. Because of the eco-efficient production technology and special recipe, new standards in fibre production were set.

- For the production of 1 kg of fibre only 5 minutes and max. 2 liters of water are needed. This implies a particular level of cost efficiency and ensures a minimum of CO_2 emissions
- Qmilch fibre is biodegradable and leaves no traces
- It is naturally antibacterial and ideal for people that suffer from textile allergies
- Fabrics made from Qmilch fibre provide high wearing comfort and a silky feel
- The organic fibre is tested for harmful substances and dermatologically tested for skin and body compatibility
- 0% chemical additives

What makes it a good practice?

Because of the eco-efficient production technology and special recipe, new standards in fibre production were set, implying cost-reduction and a minimum of CO_2 emissions.

Find more information on this Good practice on www.agriforvalor.eu

4.24 Bioplastics from grass

At Biowert, their goal is to use raw materials as efficiently as possible in a closed-loop recycling process, so that no wastewater or waste products are generated and only minimum resources utilised.

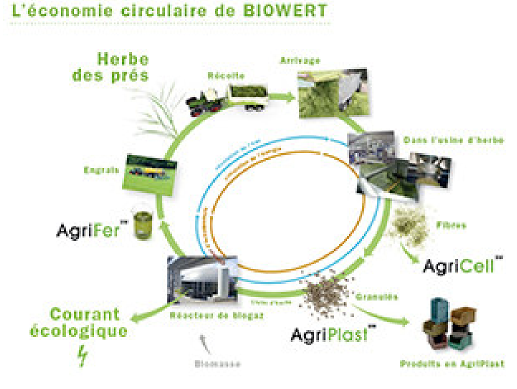

Figure 25: The BIOWERT circular concept

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

All materials are sourced either from recycling (plastics, biomass) or are renewable raw materials from the region (meadow grass). All the water comes from meadow grass and biomass and is constantly reconditioned so that no water must be pumped in from the public water supply. Biogas and waste heat from the production process are used for heating water, for drying processes and for generating green electricity. No waste products or wastewater are generated – neither in the production of the products nor at the end of their useful life.

The techniques used are the separation of solid and green juice by using pressure, followed by fermentation of the sugar content of juice and chemical and physical modifications of the press cake of grass.

What makes it a good practice?

It is unique in the world that meadow grass is processed into innovative materials, such as biobased plastic raw materials, base materials for the production of flavours and cosmetic products and a natural fertilizer, reducing the reliance on petroleum.

Find more information on this Good practice on www.agriforvalor.eu

4.25 Bio-oil, biogas and biochar from wood

Biogreen is part of ETIA Group. Founded in 1989. ETIA is a French engineering company specializing in innovation, equipment and processes for continuous thermal treatment of bulk products.

Biogreen is an innovative and patented process for thermochemical conversion of biomass, plastic and waste. It includes an exclusive and patented pyrolysis system that extracts useful substances to be used as a source of energy or a renewable product for green chemical applications. The Biogreen process is used in combination with the Spirajoule technology. It is designed with a low voltage electrically heated worm screw conveyor. The screw heats the product as a result of the joule effect. The product temperature is precisely controlled based on the heating screw temperature setting; the dwell time is regulated by screw rotation speed setting.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

Figure 26: The pyrolyzer Spirajoule[21]

The thermochemical conversion changes the biomass waste structure when applying heat in the oxygen free environment. Depending on the operating parameters, thermochemical processes applied to the biomass and waste produce recoverable materials as a solid, liquid and gas in varying proportions. As feedstock, wood, straw, cereal waste, plastic waste or tires, sewage sludge or digestate can be used. Maximum particle size of the feedstock is 20mm.

The wood waste is processed through torrefaction, pyrolysis or gasification. Before to be treated, the biomass is dried to reduce wet and to heat it more easily. The thermochemical transformation changes the product's structure by applying heat in a controlled atmosphere. Depending on the operating parameters, the thermochemical treatment of the ligneous cellulosic biomass will produce bio-char, bio-oil, chemical ingredients, soil fertilizer, and etc.

What makes this a good practice?

It is a continuous, fully automatic turnkey installation, that requires no labour and can be applied at own site.

It changes wood waste into valuable products, is a cost effective low risk investment with low running costs and more than 95% of energy efficiency.

Find more information on this Good practice on www.agriforvalor.eu

4.26 Micro CHP units for heat and electricity from wood

Auxentios Energy has been established in 2015 to promote a range of small-scale torrefaction reactors, improved thermal storage technology and unique domestic and commercial-scale micro-chp units to markets across Europe.

[21] www.biogreen-energy.com

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

The Home Micro Generating Unit (HMGU) makes use of the Greenturbine which is a small light weight turbo generator, that delivers heat and electricity with a relatively high efficiency. The turbine runs on some 20 to 40 C superheated and very dry (99.5%) steam and works in a condensing mode with a vacuum in a closed loop system together with a steam generator.

Figure 27: The Green turbine[22]

The micro-generating unit is fed with torrefied wood pellets, those being the only biomass fuel product containing enough energy to operate the system at maximum efficiency. The HMGU's will initially be available in two options. The 1.5 kWe, approx. 24kWth model will be suitable for individual properties, village halls, offices and many other situations where there is a small requirement for both heat and electrical power. The larger gasifier model (25 kWe, approx. 200kwth) will produce enough thermal and electrical energy to supply small district heating schemes of up to 10 individual houses, office blocks, or groups of flats etc., and will be particularly suitable for housing association properties and other social housing situations. This particular system will produce ample volumes of hot water for distribution between the connected buildings, in addition to a large proportion of the electrical requirements, at reduced cost in relation to fossil fuel energy production.

What makes this a good practice?

The total installation is combining innovative techniques (Green Turbine, gasification boiler), resulting in a high efficiency CHP unit. 1 kg of wood chip below 20% mc will produce 1kWe + 2kWthermal. It brings significant financial saving for those that have the raw resources.

Find more information on this Good practice on www.agriforvalor.eu

[22] Source: www.greenturbine.eu

Feldfunktion geändert

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

4.27 Household and office items from lignin fibres

TECNARO GmbH is a spin-off company of the chemical technology institute Fraunhofer-Institut Chemische Technologie (ICT), and is founded in 1998.

The basis of Arboform is Lignin, which is a solid substance in wood emerging as a by-product in the pulp and paper production. There are many sources of lignin. The paper industry produces around 60 million tonnes a year. It is usually burned or processed into animal feed or cement. In combination with resins, flax or other natural fibres, lignin can form a mass that can be processed like any other thermoplastic material. Arboform is available as granulate which can be moulded into a wide range of household and office items.

Figure 28: Possible product made of Arboform by Tecnaro[23]

The bioplastic Arboform can be formed into different very precise shapes and is extremely stable. Just like wood, it eventually decomposes in landfills, instead of lingering around for thousands of years like "normal" plastic.

The basis of the product, lignin, is available in large amounts as by-product from different kind of industrial processes, such as the paper industries and wood processing industries.

However, it can compete with fossil fuel based plastics, the price is still a barrier. Regular plastics cost between €1 and €5 per kilogramme, while the price for Arboform starts at €2.50 per kilogramme.

Because of its properties and environmental friendly impact it is an interesting product for many applications. For instance, there is an increasing demand from the automotive sector and companies producing building materials. There also is an increasing demand for applications in in children's toys, furniture, castings for watches, designer loudspeakers, degradable golf tees and even coffins. The product is fully degradable after its life cycle.

[23] www.tecnaro.de

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696394.

What makes this a good practice?

The product replaces plastics made out of fossil fuels by renewable resources, having positive effects on CO_2 emissions and is diminishing non-degradable wastes. As resource lignin is used, a by-product of the paper-industries, reducing industrial wastes waste.

The setting up of the company is a good example of good collaboration between science, business and government.

Find more information on this Good practice on www.agriforvalor.eu

4.28 Sweetener from wood

Danisco originally is a Danish company having business in the food sector and in enzymes. Since 2011 Danisco develops, produces, and markets food and beverage ingredients, enzymes and bio-based solutions.

One of the products is the sweetener Xivia, which is the trade name of xylitol extracted from wood. Xylitol is a naturally occurring sweetener with all the taste and sweetness but only half the calories of sugar and Xivia is said to leave no aftertaste and to protect teeth from cavities.

In patented and proprietary processes, the raw material base for the production in both Europe and North America is hard wood sources – predominantly Birch and Beech. Both of these tree species are very rich in hemicellulose, the major component of which is xylan, a natural polymer of xylose ("wood sugar"). Danisco uses 100% wood based xylose in the production of xylitol in what is called the DuPont Wood Based concept (DWB).

Figure 29: Sweetener from wood[24]

[24] www.danisco.com

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The technique contributes to lowering side streams (black liquor) of the paper and pulp industries. The integration of xylose production with a pulp and paper plant takes advantage of the high carbohydrate content of the side stream and utilises this waste stream as feedstock. The xylose in this feedstock is already in a hydrolysed form, and therefore in the DWB process there is no use of acid for hydrolysis. Once xylose is extracted, the remaining side stream with reduced xylose content and reduced energy value is returned back to the pulp and paper plant for incineration and energy production.

What makes this a good practice ?

The results of a LCA analysis demonstrate that the DWB process is 84-99% less impactful than the BHP concept, leading less impact on the environment.
The carbon footprint of DWB xylitol is 90% lower than when produced by the BHP concept. The DWB method requires significantly less energy (85% lower), has less impact on toxicity for both land (94% less) and water (99% less), and has less impact on ozone layer depletion (86% less).

Find more information on this Good practice on www.agriforvalor.eu

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