MòRe

MARKET OF OLIVE RESIDUES FOR ENERGY

ROADMAP FOR SUSTAINABLE ENERGY USE OF OLIVE RESIDIUES

Official Partner

Intelligent Energy Europe

Work Package 2:	**Involvement of key market actors**
Deliverable 2.2:	**Joint report gathering 5 roadmaps**
WP2 Leader:	**UP ZRS – University of Primorska, Science and Research Centre of Koper**
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SUMMARY

Aim of the Road Map

Olive residues – a new source of biomass and alternative source of renewable energy offer huge opportunities for the increased use of renewable energy in south Europe, specially in Mediterranean countries like Spain, Italy, Greece, France and other.

Today olive residues, especially olive pits as alternative fuel, are fully competitive with other sources like wood pellets and can replace an important share of fossil fuels, particularly oil used for heating. The energy potential and calorific value of olive pits and dried olive residues is high and therefore most appropriate for increasing energy needs in Europe.

The advantage of using olive residues as alternative energy source is also in using the same technology as pellet heating appliances, for domestic use but also for industrial boilers and for large energy plants turning olive residues into heat and/or electricity.

Europe is also a global leader in terms of production volume of olive residues and in production of necessary machinery and "know how". However market development of olive residues to energy is still limited to a fairly small number of European regions.

The purpose of this Road Map is to define the steps to be followed in each partner region in order to reach the scenario potential which has been identified. Therefore, this document describes the current situation and the "vision" for each partner region and how the involvement of local stakeholders can affect this process.

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OLIVE RESIDUES – ENERGY WITH SOMETHING *MòRe*

Olive residues as a fuel

The residual biomass of olive processing for potential energy use is classified in two groups. The first group is constituted by residual biomass produced during olive tree cultivation (pruning and harvest residues). The second group is constituted by residual biomass produced during the various stages of olive oil production (olive pulp and olive pit/stone). Both groups of residues can be used as biomass for energy. Depending on the process the by-products obtained are different and usually differently used too.

In Spain olive pruning and harvest residues are collected and used for the production of pellets, while in other countries these residues are mostly used as natural fertilizer in olive groves. Olive pits, exhausted olive cake and 2-phase olive mill waste (2POMW) are usually used for energy purposes. They are characterized as biomass with an average heating value between 14,000 kJ/kg and 19,000 kJ/kg.

The by-products of both groups present, from an energy point of view, promising energy potential as long as following pre-conditions are met: sufficient annual production, high concentration of the residues at one place/area, low moisture content, low sulfur content and other harmful emissions, and finally, high thermal value. However, an appropriate technology must be employed to avoid the production of pollutants and other environmental problems, while maximizing energy effiiciency of the olive residues.

Potential of olive residues

The main olive solid residues which are generated during olive oil extraction and have energy potential are the following:

- **Virgin pomace:** The residual paste after the olive oil production. It is constituted from a mixture of olive pit/stone, olive pulp & skin, as well as pomace olive oil plus the water added in the olive mills. The moisture content is about 55-70% depending on the olive oil production process.

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- **Exhausted Pomace:** The residual paste after pomace oil extraction. It is constituted from a mixture of olive pit/stone, olive pulp & skin, as well as water moisture (approximate 8%-10%). It is obtained through a chemical process with hexane.
- **Dried pomace:** Dried pomace is the pomace after the drying phase, having low moisture content (less than 10%).
- **Pit:** The olive stone.

The energy exploitation of pomace may be approached by a number of ways such as composting, anaerobic digestion and electricity production with fluid bed technology. Pits are used as combustion material from which heat can be recovered to produce electrical energy. Due to the low ash content of pits and the type of combustion, this material (pits) is very efficient in terms of heat, low cost and environmental impact. Furthermore, the ashes produced after combustion can be used as additives in manufacture.

The average heating value of dry pomace is 3500-4000 kcal/kg while for pits is 4000-4500 kcal/kg.

Comparison of Heating Values of Olive by-products :

Kcal/kg	**Spain**	**Italy**	**Greece**	**Slovenia**	**Croatia**
Average heating value of **dry pomace** (with stones, low moisture)	3800	n.a.	3.500 –4.000	4.216	n.a.
Average heating value of **virgin pomace** (with pomace oil & pits, high moisture)	1800	1.800	n.a.	4.604 – 4.974	4219
Average Heating value of **pit/stone**	4100	4.750	4.500	4.805	4.500

As we can see from the table above, dry pomace and pits have a little less heating value as compared to coal and a little more than wood. The energy potential that can be produced in each country is depicted in following table.

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	Regional data				
MWh/year	**Spain "Jaen"**	**Italy "Liguria"**	**Greece "Crete"**	**Slovenia "Istria"**	**Croatia "Istria"**
Energy potential of **dry** pomace (with stones, low moisture)	3.183.064	n.a.	231.700 – 267.400	n.a.	n.a.
Energy potential of **virgin pomace** (with pomace oil & pits, high moisture)	4.307.906	25.000	n.a.	4.587	17.206
Energy potential of **pit/stone**	5.005.818	17.898	26.780 – 80.330	1.570	4.930

As we can see, there is a big difference in quantities in different regions.

The economics of olive residues use as a fuel

According to the regional situations in Spain, Greece and in some cases in Italy dry pomace price ranges between 0.03-0.05 €/kg and provides approximately 4500 kcal/kg of heat. Compared to wood price that ranges between 0.10-0.13 €/kg and the heating value 3900 kcal/kg it can be concluded that dry pomace is less expensive than wood and has a higher energy density. Additionally, compared to diesel oil prices that ranges between 0.60-0.65 €/lit, or 0.70-0.75 €/kg (assuming an average density of 0.85 kg/lit) and has approximately 10.000 kcal/kg of heat, dry pomace is still cheaper.

LEGISLATION

As far as handling the processing of olive residues, the reform of common agricultural policy (CAP reform olive oil) in olive oil does not provide specific provisions for the management of olive residues. Member "producer" of olive residues have national legislation governing this area, which should be in line with Directive 75/442/EEC (Article 3) (OJ L 194, 25.07.1975, p.39), as amended by Council Directive 91/156/EEC (18.03.1991) and Council Directive 96/61/EC (Article 3c) on integrated pollution prevention and control (IPPC-Integrated Pollution Prevention and Control). Directive is relating to large industrial plants as well as

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disposal and waste incineration and landfills/dumps. The main principles of the directives provide for:

- **Prevention of waste**
- **Processing and recycling of waste (for energy propose)**
- **Safe disposal of waste**

The problem with olive residues management is hampered by the lack of common policies of the producing olive oil. Each country has its laws and regulations, which are often very different and generally depart from the established guidelines. Therefore it shows a great need for the drafting and introduction of international norms, which will impose single strategy in the management of olive residues.

Current legislation and their problems

ITALY

Norms on non dangerous waste disposal:

- D.Lgs. n.152/2006 promotes the energy use of residues, especially from biomass only mechanically treated.

Norms on industrial discharge

- L. 574/1996 and D.M. 6/07/2005, for agronomic use of waters and mills discharge within the limits of 50m3/ha/y for traditional plant waters and 80m3/ha/y for continuous plant waters. The same refers to virgin pomace. The agronomic use has to be declared to the city mayor.
- DGR n. 848/2007 specifies criteria for agronomic use.
- If waters are not disposed nor spread on land, they have to be considered as waste.

Norms on fertilizers

- Virgin pomace from traditional mills can be used as fertiliser

Norms on pomace (dry or virgin) reuse

- DM 05/02/98 dry pomace is considered non dangerous waste that can be used as fuel.
- D Lgs 387/2003: determines what has to be considered "Biomass" (agricultural residues): i.e. any agricultural residue (or forest) which has only undergone mechanical processes
- D lgs 152/2006 determines the characteristics dry pomace (if treated with n-exane) has to have to be used as fuel

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Regional Energy Plan: promotes the energy form biomass to reach a 7% RES in 2010 in Liguria. Regional deliberation 1058/2005 defines dry pomace as "green biomass" . Regional Law 20/2007 states that biomass plant <35kWth do not need any approval. Beyond that limit, they need the Provincial authorization. Biomass plants >1MW need special smokes treatment filters.

The Italian law is very restrictive on the disposal of olive residues. They are considered as dangerous waste; the waters need to be depurated (but not all depurators have the proper filters to treat it) where it is not possible to disperse them (as in Liguria, where fields are too small and badly-located). Thermal use is not incentivised; only electrical use gets the feed in tariff, but costs of CHP do not allow for cogeneration in Liguria.

SPAIN

In Spain, there are several laws which regulate the management of olive residues:

- Law 54/1997, of 27th November on the electricity sector. B.O.E (Official State Gazette) number 285 of 28th November 1997.

  Its basic aim is to establish regulation of electricity sector with the objective of guaranteeing electricity supply, quality and delivering all the above at the lowest possible cost to make it compatible with an energy policy of liberalization of the market, improving energy efficiency, reducing consumption and protecting the environment. In this way the special regime for electricity generation, programmers to manage demand and, above all, to promote renewable energy may be favoured by the Law.

- Royal Decree 1955/2000, of 1st December regulating activities such as transport, distribution, marketing, supply and authorization procedures for electric power facilities. B.O.E. number 310 of 27th December 2000.

  It establishes the legal arrangements applicable to activities such as transport, distribution, marketing an supply of electric power and relationship between the different legal persons developing the said arrangements.

  It also deals with the question pursuant to records established by Law 54/ 97 on the electricity sector pursuant to electric power production facilities and the activities of qualified distributors, marketers and consumers.

- The subsidy Order of 4th February, 2009 by which is established the regulatory bases of a incentives program for the sustainable energy development of Andalusia for the years 2009-2014.

- The Royal Decree 661/2007 which established what are the tariffs according to the power used in different installations.

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- Regional Energy Plan.
  The Ministry of Agriculture and Fisheries in collaboration with the Provincial Council (Agener S.A.) has presented a project to finance the installations of biomass boilers in educational centres and municipal buildings in the rural areas of Jaén, with the aim of promoting the use and assessment of renewable energetic resources from olives. There are plans to install these kind of boilers in 95 municipalities which will heavily increase the demand of biomass, establishing an important market for a by-product which is so abundant, guarantying its use in the province of Jaén.

- The technical Code for the buildings which establishes that all new edifications or renovate buildings has to be covered with 70% of the thermal energy.

- Some time ago, the legislation did not allow burning the exhausted pomace in the thermal power station. However, with the last Decree, it is allowed to use it, but the problem is that due to the low tariffs according to the power, the use of exhausted pomace is still less attractive. As a consequence of this, a big quantity or percentage of exhausted pomace which is produced in Spain is exported (40%) to other countries with a more favorable tariff.

Electrical uses: Nowadays in Spain, the law does not benefit the construction of power plant to sell the electricity with biomass as fuel. In this way, the cogeneration plants are the most viable plants to sell electricity, being the most profitable installations.

Thermal uses: In Spain, since two years ago, the new technical Code of the Buildings has effect and obliges all new edifications or renovated buildings to cover the 70% of the thermal energy with renewable energy (solar thermal, biomass, etc..)

GREECE

Greek Law 3468/2006. Generation of Electricity using Renewable Energy Sources. The purpose of this law is, on one hand, the transposition of Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market and, on the other hand, high-efficiency co-generation of electricity and heat plants in the internal electricity market, on the basis of rules and principles.
As biomass it is considered the biodegradable fraction of products, waste and residues from agriculture, including vegetal and animal substances, forestry and related industrial activities, as well as the biodegradable fraction of industrial waste matter and municipal sewage and

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garbage.

The power generated by RES biomass, geothermal or wind plants and through high-efficiency co-generation is to be priced, on a monthly basis, as follows: 73€/MWh for the Interconnected System of the main land and 84,6€/MWh for the Non-interconnected islands. On the other side, the power generated by photovoltaic is priced at 450€/MWh and 500€/MWh correspondingly.

Due to the low tariffs, the production of power using biomass as an energy source is not very attractive.

The Greek National Management Plan of Solid Residues identifies the general directions of solid residues management inside the country. 95-99% of the total pomace produced in Greece is utilized for oil extraction. The exhausted pomace is used as a source for heating or it is exported.

An agricultural product in order to be sold has to be harmonized with the Common Agricultural Policy. Agricultural processing industries must design a waste disposal process in order to obtain a license of operation.

SLOVENIA

Slovenian legislation:

- Decree on the emission of substances and heat in the disposal of waste water from plants for the production of vegetable and animal oils and fats (Official Journal RS, nb. 45 as of the date 25.5.2007)
- Rules on the operational monitoring of the entry of dangerous substances and plant nutrients in soil (Official Journal RS, nb. 55/1997 as of the date 11.9.1997)
- Rules amending the Rules on Waste Management (Official Journal RS, nb. 13/2003 as of the date 7.2.2003)
- Regulation on maximum levels of intake of dangerous substances and application of fertilizer in soil (Official Journal RS, nb. 84/2005 as of the date 16.9.2005)
- Regulation amending the Regulation on the entry of dangerous substances and plant nutrients in soil (Official Journal RS, nb. 29/2004 as of the date 6.3.2004)
- Rules governing the processing of biodegradable waste into compost (Official Journal RS, nb. 42/2004 as of the date 23.4.2004)
- National Energy Plan.

Slovenian legislation differs from legislations of other countries. Regulation on managing the waste treats olive residues as waste and not as by-product. Slovenian legislation deals

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equally with big and small olive mills. In Slovenian Istria olive milling is seasonal phenomenon, working time is limited to max. 2 months in year, the quantities of olives processed are not comparable with the oil production of big olive oil producers (Spain, Greece, Italy). Taking into consideration all that, the Slovenian legislation should be changed according to the actual circumstances in region (working time and capacities of processed olives)[1] and olive residues should be defined as by-product and not as waste. This would force olive millers to put more attention on olive residues management.

CROATIA

In Croatia there is a "Regulation on the use of renewable energy sources and congregations". Regulation was adopted 15.06.2007. It is defined in detail the problems of all forms of renewable energy sources, except biomass. Biomass is mentioned in only one short segment. No word is mentioned explicitly about olive pits. Following the Regulation this source of renewable energy is defined as solid biomass from forestry and agriculture (lop, straw, seeds) and solid biomass from wood processing industry (bark, sawdust, chaff).
Consequently the conclusion is that this issue should be further promoted and developed. Fund for Energy Efficiency of Republic of Croatia is formed in parallel with the adoption of this regulation and has not yet really started with quality work.
In Regulation there are no defined rules of how to manage the biomass as a renewable source of energy, not defined methods using plants or their commissioning.
In Croatia there are no defined the most important tariff regulations for renewable energy, which stimulates the production of electricity, and construction (or even the acceptance procedure) and Regulations to regulate the production of heat and energy from renewable sources.
Remains of agricultural production have an important place. Agricultural SMEs are not stimulated to use renewable sources of energy. The only problem that is significant is highly complex procedure of acquiring the status of eligible producers of energy (equal to 100 kW and 100 MW). It is necessary to simplify the procedure for "male" power. The formalism must be excused because it is an incentive that must be very objective and transparent supported with some economical value.

[1] Bandelj-Mavsar in sodelavci, 2008.

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In the European Union 58% of primary energy derived from renewable energy comes from wood and other sources. In Croatia, the primary energy obtained from biomass and wood is 0.00025% and is now used exclusively for the individual examples of heating homes or smaller spaces of certain manufacturing facilities.

There is no motive supported by the political authorities and there is lack of legislation that would motivate people to invest in systems of producing energy from renewable sources.

There is no system of incentives for investors who have the intention to start with the development of power plants and other systems which base production is of producing the electricity from renewable sources.

Recommendations for the policy development

The problem with olive residue management is hampered by the lack of common policies of the producing olive oil. Each country has its laws and regulations, which are often very different and generally depart from the established guidelines. In this chapter only some general recommendations are given for the policy development. More concrete policy recommendations are defined in Deliverable 5.3. of the M.O.R.E. project.

SPAIN

The Government should revise the tariff (increase the kWh tariff stipulated in the Royal Decree 661/2007) in order to take advantages of the energy resources that are available in Spain and in the region of Jaen. This we will increase the installation of thermal power stations that use exhausted pomace. The Government should limit the export of exhausted pomace to other countries and reduce administrative paperwork in order to prioritize manageable facilities as the biomass.

ITALY

Taking advantage of the national transposition of the new EU directive on waste, the Italian government could revise the position on pomace disposal. A different solution has to be found for vegetation waters disposal, especially for territories like ours, where land dispersion is not possible.

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GREECE

The Government should increase the price of the power produced from biomass plants in order to stimulate the development of biomass energy market.

SLOVENIA

It is necessary to change the current legislation that classifies olive residues as waste. The new legislation should classify olive residues as a by-product and following this way allow national support for installing biomass boilers which use olive residues for burning, mainly olive pits and for introduction of new technology for olive residues treatment.

CROATIA

The problem can be solved only on legislative level. Authorities could arrange support for all who plan to become holders of the energy producer from renewable sources. Local governments must define their needs to fulfill energy development into their local systems so in the time of crisis local area can be independent from international energy supply. Associations must take care about environmental development on every platform (ecological, economical and energetic field). Local resources must be used through the way to appease local needs for energy, clean environment and economic sustainability.

TECHNOLOGY

As well as the laws there are different technologies used in the countries producing olive oil. Technology can be divided into three groups. In the first group there are technologies and processes of production of olive oil (a traditional, 2-phase and 3-phase method), in the second group there are technologies for treating olive residues (after olive oil extraction) in appropriate form for burning (splintered wood, drying plant, pellets production plant, pit extractor,..). In the third group there are suitable technologies which produce usable energy from olive residue (heat and electricity).

Technologies for waste management, aimed at energy production, represent an interesting alternative for the sustainable management of residues from the processing of olives. They can reduce the environmental impact and produce heat and/or electricity.

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Technology used today

SPAIN (Province of Jaén)

Jaén is the region with the main production of olive oil in Spain. Therefore the elimination of the waste is very important in this process. To eliminate the residues, the olive-mills use a 2-phase process: Olive pomace results from the production of olive oil through physical processes. With a variable composition, it is mainly used as a raw material to extract the residual oil that remains in the solid cake, prior to drying. A by-product designated as virgin pomace is obtained (humidity 62-70%) that goes through a pitted machine, while the pit is mainly used as fuel to produce heat for thermal use. Afterward, the virgin pomace goes through a process of drying and extraction and new by-product results, designated dry pomace (humidity 10%). This by-product is mainly used as fuel to produce electricity.

Thermal applications: The new technologies and materials in low-power biomass equipment (stove, compact-electric stove) guarantee high output and a high degree of comfort. Fuels used in domestic heating: wood of different types, olive pits, briquettes, pellets. The use of these fuels, mainly pellets, allows the automation of equipment. The characteristics of the fuels: low humidity, high density and homogeneous granulometry allows them to make the most of its energy resources.

Electrical application: Great advances have been made in the increase of output and the reduction of particle and CO emissions. The advances have been made principally in the design of the combustion chamber, combustion air supply, and the automatic-control systems of the combustion process. The current state of automatic boiler technology has allowed for an increase of its output from 60% to 85-90% in the past decade and in some systems a decrease in CO emissions from a value range of 5.000 mg/Nm to a value of 50 mg/Nm, has also been achieved.

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ITALY (Liguria)

Most Ligurian millers use the traditional system or the 3-phase system. Only 1 mill has the 2-phase system. Virgin pomace is dispersed on the ground or sent to pomace refineries at no cost (the refineries pay for transport). In Liguria there is only 1 small refinery that cannot treat all the pomace produced. Therefore, some millers refer to refineries located in other regions. Some (but only few) millers have pit separators within the olive production line; in this case they sell pit (or use it themselves). The remaining pomace is mostly dispersed on the ground.

Waters are dispersed on the ground (very small quantities are dispersed due to the morphology of our territory) or treated in special depurators but the cost is really high.

At the moment there is only one special process for the preparation of virgin pomace to be used as fuel. It is a demonstration plant where calcium is added with a 5% rate to virgin pomace. The pomace becomes stable, no odour and dry. It is burned in waste plants (but it is not considered as biomass). This procedure only fits to 2-phase plants.

At the moment the use of solid residues for energy is limited to domestic appliances where pit is burned. However there is high potential for thermal applications maximum 2 MW. CHP is not feasible due to high costs.

One important issue in Liguria is the need to dry the pomace because we mostly have virgin pomace. This implies the need to foresee a drier and adequate space.

GREECE (Province of Chania, Island of Crete)

94.3% of the olive mills which operate at Chania region, use the 3-phase process, 2.4% use the 2-phase and 3.3% the traditional pressing process. The resulting virgin pomace is sold to the pomace oil refineries where it's dried and then pomace oil is extracted using a solvent (hexane). The remaining product which is called exhausted/depleted pomace contains pulp, pits and low hymidity. Pits are not separated from the pulp and this final product with a calorific value aprox. 3500Kcal is sold as space heating or water heating source or it is exported.

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SLOVENIA (Istria and Goriška region)

In Slovene Istria, olive residues are usually (95.4 % of residues) composted and returned to the olive groves as fertilizer. The composting of olive residues is integrated in the processing cycle of each olive oil mill. After the 3-6 month composting period, the olive residues are spared on the surface as fertilizer, returning nutrients to the soil.

Only 4.6 % of olive residues are used for energy purposes, to generate heat. This amount of residues produces enough green energy for heating two households.

The end users of olive residues are now mainly olive millers which use olive residues for composting. Two of them use olive residues for their private energy purposes (heating). Both of them have around 60 tons of residues per year.

In Slovenia pit separators, which separate olive pits from olive pomace are not used. There are also no drying facilities and refineries to dry wet pomace in order to make them more appropriate for burning or further processing.

CROATIA (Istria)

During the few last years 2-phase centrifugation technology is replacing both the traditional press technology and the relatively recent 3-phase centrifugation in the olive-oil extraction industry. Anyway a by-product of the mills during the extraction of olive oil is a mixture of: vegetable water or dregs; solid parts of the olive, such as bone, skin fatty debris. It is defined as everything that remains of the olive milled when olive oil is removed.

The best way in most common situations through 2-phase process in Croatia is composting. The chemical composition of these wastes is suitable for composting, but their physical structure and lack of porosity do not allow this treatment approach. The addition of woody materials or straw as bulking agents is not feasible in most cases, as they are not usually available in the vicinity of olive producing areas. In these cases the compost is produced like high agricultural value, as phytotoxic compounds such as polyphenols and soluble sugars are degraded, while it is rich in organic and inorganic compounds, especially potassium. That is important for all olive growers.

Press and 3-phase centrifugation systems were unavoidably connected with the production of large amounts of highly polluting wastewater. Water is added during processing which increases total waste produced. The husk is dry and can be composted or placed back on the

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field or otherwise easily disposed of. The water phase which contains the olive juice and added water has a high Biological oxygen demand (BOD) and contains polyphenols which can foul a city sewage treatment plant.

For energy purposes is most important to the rest of the moisture in the cake to be minimal. Technology used for this drying process is building and construction of kilns in places that will be designated as storage centers for the purchase of pit. Without such infrastructure, it is simply a case that is in the case of Croatia just unprofitable business.
If there are possibilities, the best cogeneration is simultaneous production of electricity and heat. In the same time it gives the biggest social benefit and the conversion efficiency of energy from olive residues in this case is the biggest.

Upgrading various technologies for different regions

In **SPAIN** there are all appropriate technologies available and developed for use of olive residues for energy. There is only need for comfortable and larger biomass storage facilities (in private houses). In terms of currently used equipment, it must be highlighted that the technical problems are frequent, so the general conclusion is that this equipment fails very often. This failures cause maintenance costs and sharply increase the loss of time and as a consequence, the output also decreases. Many of the problems will be solved according to the advances of technology. It is expected that the technology will get cheaper little by little, not only in thermal use but also in the electrical use of consumers. In the frame of solving the problems and developing possible solutions AGENER fosters the establishment of laboratory for biomass characterization: Advanced Technology Centre for Renewable Energy (C.T.A.E.R.).

In **ITALY (Region of Liguria)** the most important issue is the need to dry the pomace because there is mostly virgin pomace. This implies the need to foresee a drier and adequate space. All requested technology can be transferred from Spain and Greece.

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Like in Spain, in **GREECE (Province of Chania, Creete)** there are a lot of appropriate technologies for use of olive residues to produce energy, only due to its residue characteristics exhausted pomace is not widely used for home heating. This problem can be resolved with further processing of depleted pomace to reach the standards of a heating source for domestic usage. Transformation of exhausted pomace into pellets form.

As far as considers **SLOVENIA (Istria and Goriška Brda)** and **CROATIA (Istria)**, for the beginning it is sufficient that best practices of small scale technology use (such as use of pit separators and individual biomass boilers,...) are transferred and implemented in practice in order to meet first needs for processing and use of olive residues for energy and promote further use of olive residues in bigger quantities and implementation of bigger scale technologies at latter stage.

MARKET DEVELOPMENT

Status of olive residues markets in MORE project regions

SPAIN (Province of Jaén)

The olive residues market is very well established in Spain. Jaen is one of the most advanced provinces regarding olive-residues-market development. Nowadays, in Spain, the use of olive residues is used in 2 different contexts:

Electrical Use: The construction of power plants was devoted to selling electricity to the electrical companies. After that, the laws changed and consequently, all the projects which were developing, stopped. That was due to the unavailability of biomass installation. Most of these plants in our region use as fuel the exhausted pomace (orujillo).

Thermal use: This technology is increasing in Spain and specially in Jaen region. The administration and companies promote the use of biomass for heating and for the production of hot water through biomass boilers in public buildings, swimming pools and in particular houses. Price of the different olive residues on the market: olive pit = 0,12 €/Kg pellets = 0,17 €/kg exhausted pomace = 0,05 €/Kg.

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ITALY (Liguria)

At present times there is still no energy market for olives residues, except some spare cases of pits separated from olive pomace but with a prominent household usage.
Moreover, the almost monopolistic and out of date management of the pomace by very small regional pomace refineries (2 officially operating in the region) does not make the market well known and fully exploitable.
Pomace is given by millers to refineries at no cost. Refineries sell the pit at a valuable price (app. 160 €/ton) and the dried pomace as animal feed.
Millers are mostly small, family based entities, which do not feel the urge to invest in any plant nor in process improvements. The morphology of the territory does not help the supply chain.

GREECE (Province of Chania, Island of Crete)

124 Olive mills at Chania region treat aprox. 130.000 tn of olives each year and produce aprox. 53.000 tn virgin olive pomace. Up to 90% of this amount is sold to the three pomace oil refineries of the region at 5€/tn. The refineries reduce the humidity of the virgin pomace using rotating cylinders heated internally by hot gases and then they extract pomace oil using a solvent. The remaining product is called olive kernel wood or depleted/exhausted pomace and contains aprox.12-15% humidity, pulp and pits. This final product is being used by the driers of the refineries as an energy source for the production of hot gases. It is also being sold at 50-60 €/tn to the olive mills for the heating of their process water. Moreover it is used for greenhouse space heating or it is exported.

SLOVENIA (Istria and Goriška Brda)

The market of olive-residues-for-energy currently does not exist. Olive residues are used for energy only by some individual olive millers. The majority of olive pomace is spread in olive orchards and olive groves in the vicinity of the mills. Waste water is partially processed and released into a sewage system. Reasons for non existence of a market with olive pomace are mostly as follows:

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- high level of humiditiy in olive residues
- too small quantities of olive residues to be processed (dried) by driers
- olive pomace is currently treated as waste and not as a by-product
- lack of commercial and entrepreneurial spirit among olive millers

CROATIA (Istria)

There is no olive-residues-for-energy market in Croatia. Olive residues are currently not used for energy purposes. Few agricultural SMEs use pits for home heating and all other residues are used as compost. In Croatia there are no prices defined for that kind of energy-generating product. This could be changed with quality business plan and knowledge transfer from countries such as Italy, Greece and Spain. In Croatia there are currently no market operators for this kind of biomass resources.

Problems in too small or no supply chain

In **SPAIN** the biggest problem in supply chain system is the distribution of biomass. This market is in the process of development, because society wants to install biomass boilers but at the same time, they also want to assure the supply of biomass. One of the main objectives for further development of this market is the establishment of more private companies and particular people trust in this source of energy. The main problem with biomass electricity power plants is related to electricity connection in the grid and to certain extent the management of high quantity of biomass. In order to solve current problems and realize possible solutions:

- companies have to carry out a distribution grid to supply biomass in a similar ways as they do with traditional fuel supply;
- as biomass managing companies they have develop and offer to the customers different logistic services;
- market operators have to establish a distribution trade with strategic points in each region;
- to do more promotion for better general awareness which would improve the use of olive residues as biomass for thermal use.

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In **ITALY** the main problems identified are the followings:

- long term investment with a rather long pay-back period, which makes the realization of the pilot implantation not much economically attractive;
- scarce political support to the pilot action;
- scarce predisposition of small local private actors to invest in the olive residues to energy facility;
- a too wide localization of olive oil production sites in the region;
- lack of public incentives schemes to thermal solutions.

In **GREECE** (**CHANIA)** the main problem for establishment of a good supply chain:

- due to its physical form of olive residues which are not easily transported;
- it requires large storage areas which makes it more attractive for heating big facilities rather than homes.

For **CROATIA** and **SLOVENIA** the main problem is the same – non-existence of energy supply chain. For development of such a market some preconditions need to be fulfilled:

- bigger quantities of olive production
- the establishment of olive residues cadastre on regional/national level
- better control of disposal process of the olive residues
- increased level of knowledge and awareness about the existing and used technologies for management and use of olive residues for energy purposes
- established financial incentives within ERDF for funding the building of such energy facilities/power plants
- giving subsidies to developers of olive residues market or co-financing supply chain (transport costs)

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PROMOTION OF OLIVE RESIDUES USE AS A FUEL

In **SPAIN** since few years ago, the administration is trying to promote renewable energy among children in schools. In Spain, the Environment Day is celebrated and special attention is paid to the advantages of Renewable Energies. Nowadays, solar energy is the most known among people. Additionally, the use of olive residues is the least promoted source. One of the problems in promoting the use of biomass is the ignorance of these different uses and all the environmental and economic benefits of this type of energy. Therefore more attention should be put on promotion of olive residues to energy use. AGENER agency has promoted activities in the biomass sector within M.O.R.E. project and is now participating in the promotion of biomass boilers installations in educational centres and municipal buildings in the rural areas of Jaén.

In **ITALY** since the beginning of the M.O.R.E. project activities ARE Liguria has started raising awareness amongst project target groups, namely olive millers and their professional associations. At Liguria level several promotional activities have so far been carried out: training sessions of olive millers, participation to local stakeholders' initiatives such as fairs, exhibitions and seminars and several press releases were released.

In **GREECE** unfortunately little attention is paid for promotion and education in the field of biomass energy exploitation. The only training sessions that take place in Greece in this field, are organized mainly by some Energy Agencies during the implementation of EU projects. Technical Universities in Greece, Departments of Environment & Energy Engineering, teach some general courses on principles about RES but the know-how on the energy exploitation and the laboratories are still insufficient.

In **SLOVENIA** and **CROATIA** there was no targeted promotion of using olive residues as fuel until now. First steps were made within activities of project M.O.R.E.. Slovenian strategy of biomass promotion is primarily focused on stimulation of use of wood biomass (wood pellets, wood chips) due to high percentage of Slovenian territory covered by forests (65%). Individual actions were taken by some olive millers who took advantage of olive residues as by-product and used them for heating of their own houses and olive mills.

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Suggestions for a new type of promotion that will promote effective use of olive residues

Spain: First step should be composition of dissemination plan comprising all necessary steps for successful promotion of effective use of olive residues for energy purposes. Second step should be the organization of promotional events (international fairs like BIOPTIMA, conferences,…) to be able to give information to both public and private sector. Furthermore, the advantages of RES should be explained in schools, universities (university and master courses in Renewable Energies) etc. in order to create a general awareness about RES&RUE in society. With the promotion of the biomass, it is expected that in a few years, the biomass could be first alternative for thermal use in the society. In the near future there is a hope that each house in Andalusia will have a district heating grid. This is easily viable in Jaen region.

Italy: There is a need for more active involvement of regional government concerned departments (mainly Agriculture and Economic Development) towards olive millers professional associations so that the message can be easily conveyed to legitimate recipients in a more effective and coordinated way.

Greece: Appropriate lessons should be introduced at technical universities; biomass special events should be organized for the promotion of the use of biomass at regional level.

Slovenia: In order to better exploit and use olive residues as potential energy source in Slovenian Istria and Goriška Brda more targeted events (promotional, awareness raising events, conferences, fairs) are needed. This kind of events should be focused to presentations of best practices, presentations of technologies used, presentations of economically viable solutions, etc. Furthermore awareness raising and knowledge about RES&RUE (including olive residues) should be implemented into "educational chain" (primary, secondary schools, higher schools and faculties in Primorska region). Promotion towards effective use of olive residues for energy should be also a part of national ECO-FUND programme, which should stimulate and co-finance private investments into implementation of new technologies using olive residues for energy.

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Croatia: Increasing levels of knowledge and awareness about the need for olive producers using new technologies in the processing of olives tuned with environmental standards. There is a need for training and certification of employees HZPSS to implement environmental control and to educate them about energy aspects of using olive residues as energy source.

SCENARIO FOR FUTURE DEVELOPMENT

Conditions for sustainable market growth of olive residues market for energy use

AWARENESS

Given the fact that Europe is energetically heavily dependent on more and more expensive fossil fuels and that it does contribute the share to global warming, it is necessary to set up a serious scenario for the future use of alternative energy sources. Among the alternative biomass energy sources the primary role goes to wood biomass, but olive residues could be considered as biomass with great potential in some EU regions. Currently there is lack of broader awareness of their energy potential and the potential yield. Lack of awareness of the olive residues energy potential is shown at several different levels:

- Political and legislative level - resulting in the absence of a legislative/regulatory basis for the management of olive residues (lack of awareness and policies at national levels-ministries, regional levels and local levels-municipalities); in some countries olive residues are not treated as a secondary product;
- The level of potential suppliers/customers - olive millers do not recognize olive residues as potential biomass for energy use and as possibility for secondary profit; olive millers do not have a capacity to address and inform potential customers about the advantages of their product in a similar way like large utilities (oil companies, etc.) There is a big lack of awareness also in broader society.
- Level of professional public - lack of awareness by relevant professional communities (olive mills associations, energy planners, installers, researchers) and conflict of

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interests between those who promote use of olive residues for composting and those who promote use of olive residues for energy purposes.

INCENTIVES

For successful promotion of wider use of olive residues as a competitive energy product to other existing energy products in the market, it is necessary to introduce specific initiatives that will support and stimulate the use of them. It is important to introduce appropriate financial subsidies at regional levels to attract users to replace the existing fossil fuel furnace for the new biomass stoves. Such initiatives are already in place in some regions and have in recent years become well established. Since the use of olive residues (pits) for heating require the same technology as already developed for heating with wood biomass (pellets), only further extension of the existing programs and financial incentives is needed to continue the promotion and the use of olive residues as biomass.

LEGISLATIVE SUPPORT

Legislative support is a prerequisite for successful implementation of the market of olive residues for energy purposes. Some countries such as Spain, Italy and Greece are already partially implementing it. It is important that olive residues are legally recognized as biomass, which can be used for energy purposes and get legal status of by-product. On this assumption olive residues may deliver an important contribution to advancing the use of "non-wood" biomass for energy purposes and can ease the fulfilling of the requests of new legislation in many EU countries which require that all new buildings provide a certain proportion of energy supply from renewable energy sources. Of course, this applies particularly to those regions of the EU, with the presence of olive oil production and consequently with olive residues.

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QUALITY OF PRODUCTS AND SERVICES

Ensuring quality products and services brings an important contribution to the sustainable development of olive residues for energy market and distribution chain. It is necessary to take into consideration the provision of quality product - olive residues, which are to be sold as biomass for energy, should have stable average energy value, low moisture content and enable easy managing in order to avoid problems in the heating process.

In order to ensure the quality of services it is important to assure continuity of the quantities through the whole heating season and quality of olive residues on demand of the market and consumer needs. This will create a long-term consumer confidence and finally make olive residues in respective regions a competitive energy source able to deliver high quality renewable energy with competitive prices related to other energy sources (fuel oil, gas, pellets).

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