

## **Executive summary:**

STINNO, realizing the vital importance of clear and sufficient water resources and aiming at the strengthening of industrial wastewater treatment know-how exchange between the regional public administration bodies, as well as deepening of relations between the Finnish, Swedish and Greek R&D-driven clusters, institutions and companies in this significant sector. All cluster regions have their own specific features and areas of priorities. Two other partners came from UK/Lancaster and Italy/Terni. All partners had their specific knowledge related to main topics of the project.

We combined in this project Finnish and Swedish knowledge of cutting-edge technologies and turn-key solutions in niche R&D sectors with the Greek understanding of end-user concerns and hands-on R&D knowledge. The challenges are related to farming of olive trees. The farms are family owned and many times relatively small. The incomes are not so high in those farms. How could they have incomes to do investments? One answer could be to co-operate with others farmers in local level, for ex to form association to help farmers and be as a spokesman towards local and governmental authorities. To influence legislation and governmental decisions farmers need a spokesman from the association. The farmers also need practical information of different funding possibilities and different cost and energy efficiency technologies and methods to handle waste as side products.

Triple helix setting is particularly important when eco-innovations are fostered and eco-innovators are supported. Eco-innovations are considered to have a business potential and to be sources of regional growth. Eco-Innovation is defined as eco-innovative products, techniques, services or processes which all will be needed in the case of olive mill waste management. STINNO project has focused on finding cost and energy efficient solutions and innovative technologies and methods to treat and utilize the wastes from olive oil process.

The STINNO approach is the bridge between both sectors and between countries, in a form of "triple" Triple Helix. Differences have been noticed as one partner put forward at a project meeting: a fragmented Triple Helix as in Italy and more and more in UK is a collaboration that works in closed entities but doesn't run through society as a whole, in contrast a streamlined Triple Helix used in Finland and Sweden is more steered from above (compare with national innovation systems). Also the waste water clusters involved can be considered a part of the Triple Helix rather than the other way around. Future development of such a collaboration can take different turns for example introducing more involvement from the civil society/non-governmental sector, which in the STINNO case could be an olive mill association.

Solutions should be economical and sustainable for small producers, and they should be suitable for seasonal use. The economical sustainability has the highest importance in the case of olive oil production. Other findings during the project was legislation which is needed for a clear and sustained environmental legislation. From a financial point of view the opportunities for energy and fuel would both generate income and an energy solution for olive mill owners. Lastly technical hindrances are always present. Maintenance and transportation need to be effective and cost efficient through the whole process. The technical solutions must show results that can be measured and are comparable with legislative

standards. Also the technology must cope with the core question regarding what is waste and what needs treatment. Awareness raising is also the key factor to spread out different solutions and opinions among stakeholders.

There are several opportunities to cooperate and intensify the cooperation in the field of waste water treatment. All the regions are performing well in terms of research. However, how to turn research in to practical solutions with a business model, this is the common challenge. This challenge could be tackled as a joint future project.

**Project Context and Objectives:**

The STINNO project introduces 3 research driven clusters and 12 partners from 5 European countries. The regions of Päijät-Häme in Finland, Kalmar in Sweden and Western Greece have a common objective to strengthen RTD resources and become world leaders in sustainable and cost and energy efficient industrial waste water treatment methods. The regions have clear focus on clean technologies and they complement each other as they are in different stage in cluster development, RTD policies, disciplines and sustainability. Together with expertise of the RTD partners, enormous amount of knowledge on waste water treatment, methods and techniques involved is generated.

Finland, Sweden and Greece rely not on huge quantities of RTD activities and companies, but as small economies, on developing niche sectors of RTD. For niche economies value-added networks are the solutions. This mindset can also be seen in STINNO. The whole waste water treatment sector of agrochemical industry is evaluated, olive mill waste water sector being a case study. The reason for this particular focus is the enormous environmental problems the untreated olive mill waste waters are causing.

The triple helix setting applied in the STINNO project suggests strong involvement by regional public administration, research and development organizations and companies. The STINNO project is carried out through seven Work Packages (WP). The project consists of three activity areas related to the targeted field of expertise and in addition, the management and coordination, dissemination and mentoring entities. The work packages 3 and 4 form the analysis part for the basis for the JAP and roadmap creation in WP5. In WP6 the results of WP5 will be taken further. To ensure the information flow and efficient mutual learning, WPs 2 and 7 are implemented in parallel with the other WPs throughout the project duration.

To do tasks to establish JAP were very important themes to discuss and proceed. Regions became closer and closer and start to work together more tightly. During the project different regions learnt from each other's very much. The starting point was cultural differences and way of thinking. We shared our capacity of knowledge. The project helped us to transfer our knowledge. We create win-win situation. Combining different thoughts we create many ideas to be solved in future projects.

By combining the Finnish and Swedish views for reaching cutting-edge technology turn-key solutions in niche R&D sectors, and adding the Greek understanding of end-user concerns and hands-on R&D knowledge, the project consortium aims at achieving long-term commitment and successful, concrete Joint Action Plan strategies.

Joint Action Plan is prepared in order to stimulate and boost the research driven clusters in their pathway to growth and success. The Delphi-method was loosely followed in formulating the vision and JAP. The process started with a small work shop in project meeting in Kalmar, Sweden in November 2010. This was followed by a survey, conducted in order to measure expectations, commitment, vision and to reveal already identified joint opportunities. All together 9 partners responded to the survey. Based on these data sets, the key areas of Joint Action Plan were proposed and vision was formulated. Then the first draft of JAP was send to consortium partners for comments and the JAP was discussed in project

meeting in Lahti, June 2011. Based on the feedback and discussion, Joint Action Plan was agreed.

The STINNO consortium aims to be on the cutting edge of the waste water treatment sector. The vision is to be "Transeuropean network for waste water treatment knowledge aspiring regional growth and clean environment". In order to achieve the vision, consortium identified three types of joint actions:

1. Creating effective knowledge transfer mechanisms between cross-regional triple helix
2. Focusing research on finding economical and practical processes to waste water treatment.
3. Internationalization and supporting Waste Cluster initiative

First type of joint action relates to way of working in the regions and between the regions. This triple helix approach is explained in more detailed in next paragraph. Joint actions concerning research are targeted towards practice. The main findings were that there are several existing solutions and technologies but the commercialization is the bottle neck. In order to overcome this, the research should be supported with practical knowledge generation such as pilot scale studies. Also multidisciplinary could bring new dimensions to problem solving.

Internalization was identified as one joint action. The geographical distance between Greece and Northern Europe creates certain challenges. However, it also creates possibilities. As the Nordic countries see the Baltic Sea region, especially Russia, interesting area, the partners in Southern Europe consider Mediterranean area including countries of Northern Africa as one of the target areas. In the long run, Eastern and Central European countries such as Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, and Slovenia are regarded as attractive targets to establish technological and research links.

The overall objective of STINNO project was to create growth in the participant regions. In order to achieve this, STINNO project stimulated the internationally acting regional clusters via strengthening their regional innovation systems; created value-added networks; developed platforms for technology solution developers and increased energy efficient treatment and recycling and reuse, increased knowledge transfer in the field of sustainable treatment of industrial wastewater.

#### **Objective 1:**

To strengthen the research potential and infrastructure of the participating EU regions in Finland, Sweden and Greece by encouraging and supporting regional industrial wastewater regional research driven clusters. Emphasis will be given to the fact that knowledge bases and strategies of the participating research driven clusters are different. This stems from different regional circumstances but, at the same time is an interpretation about, and a choice for, the future. Based on the experience and state of the regional research-driven clusters the project will foster mutual learning and co-operation to combine knowledge. This will construct new knowhow and increase awareness in the regions about various existing possibilities to strengthen the regional competitiveness by investing in research.

Since the beginning of the project the focus have been in fostering the mutual learning and combining knowledge of the participating regions. This have been done by researching among other things EU Policies, by identifying and evaluating the regional research-driven clusters, mapping regional research agendas, and realising international overview of the cluster policies (WP4). Also the research done in WP3 and further development of the results from WPs 4 and 5 in WP6 are supporting this objective.

**Outcome:**

- To share best practices field of funding, business, innovation
- To organize site visits in Sweden, Italy, Greece
- Dissemination plan
- Overview of cluster policies
- Awareness raising campaign

**Objective 2:**

To stimulate the clusters through the development of Joint Action Plan. The power of the project consortia lies in the fact that the clusters in different regions approach and develop industrial wastewater management from different angles. On the basis of the project consortium complementariness strategies will be prepared for research for the industrial wastewater treatment of each region and work plans on how, with whom and which funding instruments should be utilized to implement them. This will be done in an interactive way so that regional clusters may get the best out of other and create synergies implementing them in the Joint Action Plan.

The Joint Action Plan (JAP) was created in co-operation with all the beneficiaries. Joint Action Plan was formed, priority areas of R&D were identified, best practices were identified based on WP3 and WP4 and the Action Plans were positioned in relation to the wider environment. The vision is to be "Transeuropean network for waste water treatment knowledge aspiring regional growth and clean environment".

The purpose of Joint Action Plan is to stimulate research driven clusters in their pathway to growth and success. In order to achieve the vision, consortium identified three types of joint actions: (1) Creating effective knowledge transfer mechanisms between cross-regional triple helix, (2) Focusing research on finding economical and practical processes to waste water treatment (3) Internationalization and supporting Waste Cluster initiative. Also the Joint Collaborative opportunities were identified. The identified Joint Opportunities were collected from the partners using a questionnaire. Based on this there were three types of opportunities identified: knowledge transfer, research topics and RTD Policies. The synergies between the JAP and the WCI members will also be evaluated.

**Outcome:**

- Create synergies between research driving clusters and business
- Joint collaborative opportunities

**Objective 3:**

To create the preconditions for reaching the future global market by preparing the Joint Action Plan implementation steps in industrial wastewater treatment for the participating regions. Through a shared process of benchmarking and strategic planning each of the regions are forced and encouraged to re-think how they see the future and what action

needs to be taken in order to foster industrial wastewater management. Implementation of the Joint Action Plan will be prepared by identifying agendas and projects for further research and pilot cases and defining models and a roadmap between research-driven clusters and international markets.

Based on the formed Vision and the Joint Action Plan (WP5) the practical implementation plans will be created realising the tasks in WP6. As the basis are used the results from the WPs 3, 4 and 5.

**Outcome:**

- Offer and demand directory
- Research and development road map
- Technology foresight

**Objective 4:**

To increase of the competitiveness of the partner organisations through mentoring. More developed and experienced partner regions will be acting as mentors for less developed regions by allocating best practices of regional processes and funding strategies and models in carrying out research and commercialization activities.

The project's WP7 Mentoring specifically targets the transfer of know-how. Mentoring plan is done and the first mentoring forum has been carried out in Sweden. Partners found out it to be a very useful tool to share expertise and competence among partners. Using mentoring competitiveness can be increased at regional and at international level. The coming mentoring forums are planned and presented in Mentoring Plan (WP7).

**Outcome:**

- To market own competence
- Future project ideas to be proceed

**Objective 5:**

To deepen the understanding of ecological utilization of water resources. Water resources will become a more important issue in the future from the social and environmental point of view and sustainability and energy efficiency will receive growing attention. At the same time new markets are emerging. The project will identify the key local, regional, national and international target groups which are essentially responsible for implementing industrial wastewater treatment and increase their awareness of existing challenges and possibilities.

In WP3 the comprehensive studies of the situation of waste water treatment in participating regions were realized. Also detailed analysis of the state of the situation of the EU, national and regional policy frameworks and of the current technology solution situation on the cluster regions were made to reveal the level of understanding in different regions and to enable better comparison and knowledge change between the regions.

**Outcome:**

- To find out innovative ways to handle waste water from cost and energy efficiency point of view

**Objective 6:**

To provide policy recommendations and suggest joint future actions in industrial wastewater quality indicators and EU legislation. The Project will collate information on what is the state of industrial wastewater treatment. On the basis of this data information will be refined, policy recommendations set and further actions suggested. This concerns, in particular, the case study that the STINNO project consortium has chosen, namely olive mill waste. These specific objectives will be achieved through seven work packages.

This objective will be in focus in the end of the project when based on the results of the whole project some policy recommendation can be made. Especially policy makers can benefit from the results of WP6 when producing regional research strategies. Specific recommendations will also be provided in order to support RTD policy makers in setting up agendas for energy efficient wastewater treatment.

**Outcome:**

- Comparison of the legislation in participating regions

## **Project Results:**

### **WP1 – management and coordination**

LSBP is responsible for management and coordination of the project. Consortium Agreement has been prepared and signed by all the partners. Coordination operations have been carried out by LSBP, including teleconference preparations, contact with the EC and partners and other stakeholders. A periodic report form has been created and with this form the partners report on their budget and activities every six months. The first 18 months LSBP has been responsible for deliverables 1.1, 1.2 and 1.3. LSBP has helped partners to carry out their activities since the beginning of the project. There have been three face-to-face meetings supporting the progress of the project, kick-off meeting in Marrakech, Morocco. Second in Kalmar, Sweden, and the last one in Lahti, Finland.

Coordinator has been a contact point in Waste Cluster Initiative (WCI). Coordination asked member of this Waste Cluster Initiative to organize final meeting together, but they did their own meetings. Lack of financing WCI did not succeed. Coordinator contacted with the coordinators of other projects now and then. And we marketed our final meeting also through them.

M19-36 coordination has been more active to collaborate with partners of STINNO.

Coordination has had SKYPE meetings with representative of SSSE and Kalmar county related to Baltic Sea Strategy. Regions of Lahti and Kalmar use Baltic Sea Strategy as working document establishing new projects. Both regions want to share their experience with stakeholders who are making Mediterranean Macro region Strategy.

A periodic report form has been created and with this form the partners have reported on their budget and activities every six months. LSBP has helped partners to carry out their activities since the beginning of the project. There have been face-to-face meetings (see WP1 list of meetings later on) supporting the progress of the project organized in partner countries back to back with study tours and workshops related to different tasks of the project.

Coordination asked from Lancaster University to organize extra meeting in Lancaster to have Mentoring forum over there. LSBP invited the Finnish companies to participate study tours in Italy and in Greece. Two representatives from Finland participated in study tour in Italy. Final conference was organized in Lahti, Finland by LSBP. It was successful final meeting which contain all aspect of the whole project. The idea for final meeting was triple helix approach and to show different best practices from Finland. In the final meeting we focused on smart specialization and practice-based innovation what has done in Lahti region among companies, authorities and research organization. We included programme of Final meeting also study tour to Heinola Fluting.

### **Results:**

Coordination has worked as a contact point between EU, partners and other stakeholders. Coordination has helped to organize project meetings with the local partners. After 1,5 years many changes in coordination affected negatively into project management. But fast correction in LSBP changed the direction of the project back into track. Afterwards the project



consortium got through this crisis very well. It tightened the consortium itself. It was like a wakeup call.

Work with other waste related projects (SOWAEUMED, WASTEKIT and TEMP) was not as effective as it could have been. We changed information with them. But ideas and results were changed between other projects like SWAM, FRESH (Interreg 4c) and other local and national funded projects during the project lifetime.

Coordination was a contact point between different actors. Coordination was helping also with organizing the meetings and other activities. Final conference was organized by coordination. It was successful meeting with fruitful and concrete programme. Coordination disseminated the project every time when presented international affairs of LSBP itself.

All deliverables has been completed by LSBP.

## **WP2 - Communication and Dissemination**

The objectives of the WP are to communicate and disseminate STINNO results and outputs. The work started at M1. The WP-leader is also responsible for the website, both external and internal. Both sites are now up and running and partners have uploaded there a lot of materials related to progress of the project. Changes will be made during the coming months to make it an efficient tool of communication, based on the partner's requests and needs discussed in Lahti meeting, June 2011. A media monitoring system has been purchased according to the project description and has been tested by the WP-leader. The Dissemination and communication plan is completed. A flyer/poster and a template for reports have been produced. The flyer is available at the website. Preparations of the press release in Greek has been carried out and a poster has been produced for WIRE conference and "Are EU innovation and research policies making a difference in regions of the Baltic Sea?" - conference in Lahti Finland. Media such as television and newspapers has been frequently informed about STINNO activities, and the STINNO website is kept updated with latest information.

The project has been disseminated according to the project description. The workshop in Greece, June 2012 was heavily spread in local and national media in Greece. The Twitter account was established and the twiit flow has been a useful tool for dissemination and gathering of information. A website based on Google Maps which shows best practices, water clusters and STINNO activities has been produced (<http://www.stinnomaps.com> see online).

Research performed by scientific partners of STINNO resulted in the publication of three papers in international peer reviewed journals. These papers are related to Best Available Techniques (BAT and BREF) for the treatment of olive mill wastewaters (OMW), sustainability and a benchmarking analysis and valorization of olive mill byproducts. Six more papers related to OMW treatment methods were published in Conference and Workshop proceedings. In the framework of Dissemination activities, members of STINNO consortium (the coordinator and research members) have been paid more than 20 visits to symposia, conferences, workshops, cluster meetings, etc. and gave oral presentations on issues related to STINNO goals (Presentation of Olive Mill Waste Management Technologies, Sustainable olive oil production, How regional eco-innovative waste water clusters do get concrete from triple helix approach-case STINNO, etc).

Same kind of action was performed in tasks 2.3 and 4.8. So we combined those tasks. As part of the end-user dialogue a special awareness raising campaign was launched in Western Greece and performed by FORTH in cooperation with PSP.

The members of STINNO visited different olive cultivated areas where olive oil is produced and at the same time olive mill wastewaters are co-produced. Members of the scientific group choose to present their results in audience where olive farmers or olive mill owners were participated. The list below shows the dates and places where such event were performed (workshops, meetings, conferences, etc), while figure shows the map of Greece and the towns where the awareness campaign was performed. (Map has been attached.)

8/10/2010 Workshop: "Presentation of Technologies on Olive Mill Waste Water Treatment", EU project presentation- Life\_Oleico in Chania, Crete, Greece, Prof D. Vayenas 'Aerobic Biological Treatment of Olive Mill Wastewaters'

15/10/2010 Workshop: "Presentation of Technologies on Olive Mill Waste Water Treatment", EU project presentation- Life\_Oleico in Kalamata, Greece, Assistant Prof C. A. Paraskeva 'Exploitation of Olive Mill Wastewaters as biological herbicides and fertilizers'

21/6/2010 Workshop organised by the Network for Waste Valorisation and Sustainable Management of Resources, Patras, Greece, Assistant Professor C. A. Paraskeva 'Exploitation of Olive Mill Wastewaters byproducts'

7-9/7/2010 SWAM - 2nd Network Meeting & 1st Round Table & 1st Info Day, Patras, Greece, 7-9 July 2010, Prof. Gerasimos Lyberatos, Chem. Eng. Dept, University of Patras, Greece, 'Niche Research Topics on Wastewater Treatment & Reuse (TBC)'

7-9/7/2010 SWAM - 2nd Network Meeting & 1st Round Table & 1st Info Day, Patras, Greece, 7-9 July 2010, Prof. Petros Koutsoukos, Chem. Eng. Dept, University of Patras & FORTH/ICE-HT, Greece, 'Water Quality and Research Challenges (TBC) '

22-24/11/2010 Linnaeus ECO-TECH '10 Kalmar, Sweden, November 22-24, 2010, Paper: FUNDAMENTALS AND TECHNO-ECONOMICAL ANALYSIS OF EXPLOITATION OF OLIVE MILL WASTEWATER TO HIGH-ADDED VALUE BY-PRODUCTS, C.A. Paraskeva, E.C. Avanti, V.G. Papadakis

3/03/2011 Workshop: "Presentation of Technologies on Olive Mill Waste Water Treatment ", EU project presentation- Life\_Oleico in Lamia, Greece, Assistant Prof C.A. Paraskeva 'Exploitation of Olive Mill Wastewaters- Technoeconomical Analysis'

26-28/05/2011 8th Panhellenic Scientific Conference on Chemical Engineering, Thessaloniki, Greece: "Technoeconomical Analysis of Exploitation of Olive Mill WasteWaters to High-Added Value By-products", D.P. Zagklis, E.C. Arvaniti, C.A. Paraskeva, V.G. Papadakis

22/07/2011 Workshop 'Olive oil: A source of Life and Pollution', Alissos, Achaia, 'Existing methods for olive mill wastewaters- pilot application of membrane filtration, C.A. Paraskeva

16-18/9/2011 International Conference of AgriBioMediterraneo, IFOAM: 'Organic Agriculture and Agro-Eco Tourism in the Mediterranean", 16 - 18 September 2011, Zakynthos, Greece, Assistant Prof C. A. Paraskeva 'New techniques in olive mill wastewater treatment'

8/3/2012 First Training Workshop on: "Membrane based Wastewater Treatment and Reuse", Centre of Biotechnology of Sfax, Tunisia, BioNexGen, March 8, 2012, Sfax, D.P. Zagklis, S.S. Kontos, E.C. Arvaniti, V.G. Papadakis, & C.A. Paraskeva, 'Implementation of membrane filtration in the treatment of Olive Mill Wastewaters and a techno-economical study',

13/6/2012 WORKSHOP "OLIVE MILL WASTEWATER -A TRIPLE HELIX APPROACH",  
CHAMBER OF COMMERCE OF ETOLOAKARNANIA, AGRINIO, GREECE

- Christakis Paraskeva 'Technical suggestions for OMW treatment
- Dimitris Vayenas, "OMW treatment in Amfilochia's olive mill"
- Sakari Toivakainen, Olli Dahl, "Comparing waste water treatment methods - case olive oil vs. pulp and paper"
- Sakari Toivakainen "OMW treatment cost and energy efficiency studies - novel ideas for sustainable olive oil production"
- Suvi Konsti-Laakso, "Living labs as a regional innovative system tool"
- Stathis Papachristopoulos, "STINNO & SWAM projects' experience: Directions from the Regional Authorities"
- Vagelis Papadakis, "OMW treatment and business opportunities"

16-18/10/2012 International Symposium, PROSODOL, 'Olive Oil Mill Wastes and Environmental Protection', Chania, Crete

- S. Toivakainen, O. Dahl, H. Jokinen, 'Sustainable olive oil production'
- J. Kilpi-Koski, S. Toivakainen, S. Konsti-Laakso, O. Dahl, 'How regional eco-innovative waste water clusters do get concrete from triple helix approach-case STINNO'

- C.A. Paraskeva, D.P. Zagklis, E.C. Arvaniti, V.G. Papadakis, 'OLIVE MILL WASTEWATER TREATMENT METHODS: SUSTAINABILITY AND BENCHMARKING'

19/10/2012 International Conference on Environmental management in Wineries and olive mill, Nicosia, Cyprus, Assistant Prof. C.A. Paraskeva, 'Exploitation of olive mill and wineries byproducts'

The project awareness raising campaign introduced the concept that the olive mill by-products are resources and not waste and thus encouraging the olive mill owners to apply clean technologies.

OMW contains useful compounds which can be isolated by different technologies and be exploited: in fertilizers, in food industry, in animal food, as growth medium for algae, in production of biopolymeric-plastics, in bioenergy production, in bio-composting process, in biopharmaceuticals and in the production of antioxidants (phenolics compounds) which have significant economical added value.

In those meetings modern and conventional techniques for the effective treatment of OMW and the possibility to isolate compounds with high added value were presented in an audience consisted of scientists, representatives of local authorities, specialist staff in the region authorities, farmers, Oil Mill Owners and ecological organizations. After the presentations in workshops, a fruitful and meaningful dialogue with stakeholders was always followed. It demonstrates the real interest on the part of producers and owners of mills to investigate, but the high cost of the proposed processes make them reluctant to proceed with the adoption of any of the proposed methods.

## **Results:**

Communication and dissemination is very important subject for the projects during the lifetime of the project. STINNO has for example its own website, leaflet, Twitter & LinkedIn accounts and media monitoring system. Those are very efficient tools to do marketing and to make the project better known among stakeholders. All partners have done dissemination activities in local and national levels in their own countries. They have contacted media by themselves whenever suitable for project activities. Partners have participated in seminars, conferences and also written proceedings and articles about STINNO results. Dissemination action as an awareness raising campaign has mainly done in

Greece. It was very successful campaign highlighting and spreading the results and suggestions produced during the project.

The most difficult part in communication and dissemination actions is the post dissemination. STINNO project wants to be memorable project in our minds and also mind of other stakeholders. Our answer for this is post-dissemination plan where for example the STINNO map is produced to enable the results and activities of project to be found in one place. The consortium worked so well together that we want to consider our partners in future projects as a partner. Final conference was organized by LSBP, the coordinator. Many participants were satisfied about the programme. We also invited members of WCI and other EU funded project, like FRESH and SWAM.

All deliverables has been completed by Regional Council of Kalmar.

### **WP3 - Analysis of regional waste water policies, disciplines, research agendas, technologies and markets**

The WP3 has been professionally driven and the quality of contributions has been in all cases suitable to reach the project objectives. Actually, although the problem of OMWW treatment is difficult to solve due to the huge quantities produced in a short period of time and Northern EU countries, like Sweden and Finland, are not totally aware of the real situation in Mediterranean Countries, a valuable effort has been done over the WP3 by all the partners in order to provide a general framework for understanding wastewater treatment policy, disciplines, research agendas, technologies and markets (i.e. Aalto representative spent 2 days - 11 and 12 May 2010 - visiting different processes for olive oil extraction together with IAMAW specialists). All the contributions have been collected in Internal Documents (IDs) and in the Deliverables 3.1. and 3.2. Regional and national plans, projects, programs and activities related to industrial wastewater in the three cluster regions have been collected and discussed in the ID written by FORTH (Report Task 3.2 FORTH) with the contribution of the STINNO partners. However, SWOT analysis will represent a crucial moment to think about the use of triple helix model and the regional research driven cluster to overcome barriers to the innovation in wastewater treatment sector of agrochemical industry. Basically, the WP3 outcomes achieved to represent a suitable basis for other WPs.

The technology foresight was made by LNU and sent to the STINNO and waste cluster partners to assess promising technologies (WP 3.6). This information was used further on in the development of the directory of offer and demand. The suggestions in the foresight was to have a treatment system that is: user-friendly, cost-effective, use mills own waste as part of treatment. Examples include settling/sedimentation, sorption, natural systems. If these could be combined with a process of added value from for example phenols it would help the cost effectiveness of this. A large list of patents in five different categories were developed and is still useful for partners and end-users including the different categories: anaerobic bio treatment, aerobic bio treatment, Phytoremediation, AOP, filtration, adsorption, photo catalysis, electrocoagulation, waste to energy, waste to product and combined processes.

### **Results:**

There are already many processes available for OMWW treatment according to all references from the patent and literature survey made previously. The problem is that the cost is too high for end user to afford. The

studies should be focused on comparison of different pilot treatment processes and identify the most cost-effective and sustainable solutions for the end users.

A hazards identification and characterization of risks for discharge the effluent from these methods to the recipient should be carried out. Possible synergies between wastewater and solid waste management in the olive oil and wood production industry could be found because these wastewaters have similar characteristics (seasonal production, high COD, high BOD, high polyphenols content, high toxicity, etc). Best practices can be shared between these two industries. Also advantages and disadvantages with centralized treatment and local treatment system could be analyzed and compared from environmental and economical point of view.

Many treatment processes can also treat the wastewater or solid waste and produce energy at the same time. Research should be focused on optimizing such processes in order to improve energy yield. After treatment both the water and the sludge are used in the olive agriculture for irrigation and/or as fertilizer. Suitable toxicity standard test must be developed and used, and the results should be controlled.

Work of this work package was used also when JAP was made by LUT. Technology foresight was very important report where we saw what kinds of technologies are useful for purification of olive mill waste water. R&D capacity in different region is different. That is for sure. At least the economical situation is so different when the proposal was made and during the project lifetime the economical situation changed dramatically. All regions are different regarding R&D. For example in Patras and in Kalmar there are universities and those are very active to collaborate with companies. But in Päijät-Häme region differs from others that there is University Consortium which consist 4 mother universities and one polytechnic of applied sciences. It is quite effective system. In Päijät-Häme R&D is based on practice based innovations and active work with companies.

R&D state of art (3.1 and Technology Foresight (3.2) has completed.

#### **WP4 -Policies for the Support of Regional Research Driven Clusters**

The WP4 has been started since the beginning of the project, and has successfully been completed 18 months later, on 1/6/2011 in full accordance with the Technical Annex (all Tasks 4.1-4.7). Task 4.8 on "Awareness raising campaign" is identical to Task 2.3 and thus it should be presented in WP2. WP4 was successfully completed producing significant Internal & External Deliverables that are valuable on identifying the state and needs of each cluster & region. It has to be emphasized that apart the Deliverables D4.1, D4.2 & D4.3 very important Internal Deliverables (ID) have been produced (on Tasks 4.1, 4.2, 4.3 & 4.7). All this information, Internal & External Deliverables, is being used as an input on JAP formation. No significant deviations are reported.

The main task of the PP3 Regional Council of Päijät-Häme was to evaluate the innovation support system (task 4.5.) and financing strategies (task 4.6). These tasks were completed in co-operation with PP1 Lahti Science and Business Park Ltd in December 2010 M12. The deliverable 4.1.

(Evaluating the innovation support systems) a report "Evaluation of innovation support systems and financing strategies - Sustainable Innovations and Treatment in Industrial Waste Water Clusters" was presented and discussed in the partner meeting in Kalmar, Sweden in November 2010. PP3 has been discussing with other partners specially in definition of the vision and Joint Action Plan (task 5.4.) and in

preparation of regional R & D Roadmaps (task 5.5.) to use and apply the results of the tasks 4.5. and 4.6. In the final conference in November 2012 two presentations were given by PP3 Regional Council of Päijät-Häme about the supporting regional research driven clusters.

### **Results:**

The main achievements/results of WP4 are: (1) Identification of the clusters in the partner regions and assessing the state of development in them, (2) Assessing the regional industrial waste water treatment capacities and potential from the cluster policy point of view, (3) Assessing the innovation supporting structures and activities of the research-driven clusters, (4) Producing a financing strategy for the partner regions and their clusters, (5) Guiding regions to more efficient use of own resources, (6) Benchmarking and identifying Best Practices from all the participating regions and worldwide (European & International trends) and (7) Launching an awareness-raising campaign in Western Greece (see also WP2).

It was very interesting to see how those three regions differ and what are the common objectives for those regions. In Päijät-Häme our regional development plan is based on three focus areas: cleantech, industrial design and practice-based innovations. Kalmar region our national innovation system is similar. They are also using very much triple helix approach. During this project in Kalmar actors are starting to work together more closely. In Western Greece there is lack of national funding but they are very good at participating EU projects. They need more support for regional funding and it is a problem that they do not have so many companies. Services for companies are quite level in each region. Making the SWOT analysis made it possible to recognize the differences and similarities between partners and how we could complement each other (WP 4.7). Common strengths were the deep technology expertise whereas common weaknesses were the difficulty to engage companies and to get financial resources. Opportunities common for all partners were the global trend of water related environmental problems as well as a strong regional clean-tech focus. Finally the common threats were the global economic crisis, difficulty to produce spin-off innovations and lack of financial support.

Also research knowledge has been gained in areas of both environmental science and administrative/social scientific in the form of the two (when writing) draft papers: "Valorization of solid waste products from olive oil industry as potential sorbents for water pollution control - A review" where Amit Bhatnagar is the main author and "STInno - Theory and practice in a cross national water Technology Cluster" where Joacim Rosenlund is main author and Jackie Seddon secondary author. Conclusions in this latter paper are that while STINNO provided a functional network of Triple Helix partners, more focus should have been put in the beginning to develop trust and collaboration between sectors and partners. Part of this confusion comes from the waste cluster initiative which provided complexity in the beginning.

All these results were used when making JAP and R&D road map.

### **WP5 - Development of Joint Action Plan and Roadmap**

WP5 focused on Joint Action Plan and regional R&D roadmaps. The work package was therefore touching managerial and strategic work in the clusters. The main results of WP 5 can be concluded as follows:

The common vision for the STINNO-regions was created. The STINNO consortium aims to be on the cutting edge of the waste water treatment sector. The vision is to be "Transeuropean network for waste water treatment knowledge aspiring regional growth and clean environment".

The Joint Action Plan was created. The purpose of Joint Action Plan is to stimulate research driven clusters in their pathway to growth and success. In order to achieve the vision, consortium identified three types of joint actions:

- Creating effective knowledge transfer mechanisms between cross-regional triple helix
- Focusing research on finding economical and practical processes to waste water treatment.
- Internationalization and supporting Waste Cluster initiative

The main conclusion that was that in olive oil -case, the solution is not reached with solely technology research inputs. There are several solutions existing and piloted solutions but the key question is to find feasible ones that meet the socio-economical needs. It can be argued, that this similar situation applies to other waste water treatment-related environmental problem which could be the future market beyond the olive oil industry case. Adopting this more market-oriented than research-oriented approach in cluster development and in cluster operations, the regions could find common actions.

Regional R&D strategies should focus on such fields that generate economical benefits for olive oil producers or the current end-user whatever market is touched. There are several possibilities to generate income from wastes, such as in form of energy and other products. This way the whole olive oil industry can become competitive and investment to waste water treatment technology is possible, even desirable. In the same time, wastes can create new companies and entrepreneurial opportunities in the region.

There were several ready technologies that are ready for commercialization or they need to be developed towards market requirements. In addition to purely science-based knowledge generation, regional R&D effort should also address so called "doing-using-learning"-model of innovation (see Harmaakorpi & Melkas, 2012) By doing so, the gap between research and innovation can be narrower. It could include end-user concerns early to solution generation (latest in piloting phase) in order to avoid generation of solutions that do not meet the end-user reality. This phase particularly requires new kinds of knowledge generation processes than purely scientific and the main operator in this phase is the cluster body.

Possibly policy recommendations as results of JAP and R&D roadmap

- The legislative barriers of usage of waste streams should be removed and overall the legislative differences in olive oil producing countries should be consolidated.
- Better knowledge transfer between policy making and research should be encouraged
- Research-driven clusters should move towards "market-driven" clusters. The R&D input should be targeted to the phase where new scientific knowledge is transformed to products and services.

## **WP6 - Measures towards the internationalization, commercialisation and piloting of the Joint Action Plan**

The WP6 concentrates on developing the results of the previous WPs further. This WP has started after M12 so the main results will be achieved later on. In the first 18 months study tour was organized and survey of BAT and BREF was made.

During the 2010 Eco-Tech conference LNU arranged the Waste cluster meeting, part of WP1, which not only benefited STINNO partners but also partners from other projects as well as dissemination and networking with conference participants from 30 different countries. The project meeting during Eco-Tech included discussion about dissemination, mentoring and JAP. During this period knowledge was also gained about regional and national policies together with SSSE and the Regional council in Kalmar. The study trip to Ragn-Sells (WP 6.2) was arranged during Eco-Tech 2010, a report was delivered regarding this. Ragn-Sells is a waste recycling and management company and there the STINNO partners saw the Högbypörp recycling plant in Stockholm where treatment for organic material, ashes and slags, soils and production of solid fuels were shown. Other local visits during Eco-Tech included Kalmar Energy, Waste and water handling at the Slaughter House, Kalmar Biogas plant and KSRR Wetland at Moskogen.

SSSE organized a mingle evening at the meeting in Kalmar in late 2010 and a study tour for the STINNO partners and other participants of the conference. To initiate concrete financing instruments for each partner region in order to implement the JAP the study tour was realized in November 2010, Kalmar, Sweden. The study tour included stops at the Kalmar Energy Heat Power Plant, the wastewater treatment at AB Gustaf Kähr, Kalmar Dämme (constructed wetland), Kalmar Biogas and Kalmar Slaughter house water management system. The RagnSell was visited on the way back home by participants - one group to Stockholm and one group to Växjö Municipality, LnU and RagnSells in Halland on the way to Copenhagen. The Study Tour was planned in M22, but was achieved already in M12.

STInno will provide conclusions and assessment of BAT and BREF in order to improve the market entry and RTD coordination. Policy makers can benefit from the results when producing regional research strategies. Specific recommendations will also be provided in order to support RTD policy makers in setting up agendas for energy efficient wastewater treatment. The report is due on M30. However, FORTH has already started the survey and presented its result at the meeting in Lahti, Finland, June, 16-17, 2011.

SSSE planned and organized one workshop with Swedish technology and knowledge providers in June 2011 for task 6.3. This included not only the practical arrangement around the workshop, but also the invitations, material and administration of the outcomes of the workshop. Contacts with companies to make them participate and to get the feedback afterwards. This was executed together with the Linnaeus University. IAMAW participated through videolink with a scientific presentation.

During the meeting in Greece we had also workshop with the olive mill owners, policy makers and others engaged in olive oil production.

SSSE together with LnU searched for a student that wanted to discover the indirect societal costs for the environmental damages caused by olive



mill wastewater. Contacts with economic institution, academy-private sector office at the Linnaeus University was used. Publication of work description was put on the master thesis web page and contacts with teachers at economy and tourism taken. No student was found.

SSSE produced Deliverable 6, Directory of offer and demand. The main work has been how to present and combine the work done in previous tasks in order to get a structure and logic. It has also been difficult to only include the absolutely necessary information in order to ease the size of the document. The work with the Deliverable has been prepared and presented at three project meetings with feedback comments etc.

SSSE applied for funding nationally (VINNOVA forska och väx, D-nr 2011-03201) to raise funding for a business possibility research on the mobile treatment plant. This application was rejected with the motivation that the application would need a potential customer in the project to be considered potentially successful.

SSSE prepared and worked with the idea with a mobile treatment plant further, what was needed for market research, for calculating economical and societal benefits etc, but two weeks before the final workshop, the companies were hit by the economic crisis in Sweden as well, what resulted in that SSSE 'lost' the participation of companies providing the technology.

### **Results:**

The report prepared by FORTH on Best Available Techniques a Best References (BAT and BREF) evaluated most of the existing results on Olive mill wastewater treatment methods. This document provides an updated picture of the technical and environmental situation of the olive mill wastewater treatment. It contains a brief description on treatment problems of olive oil industry and olive mill wastewater treatments. It emphasizes on the known methods for the olive mill wastewater treatments and solid wastes treatment. Characteristics of each method are given, together with suggestions how the new by-products (after treatment), could be used. It is clear that THERE IS NOT A UNIQUE AND BEST AVAILABLE SOLUTION that can be accepted by all, who are being involved in olive mill process. In conclusion, it was shown that the solution will depend on the specific needs of the local olive area. The selection of the most suitable or appropriate valorization strategy will depend on the social, agricultural or industrial environment of the olive mill. Although some methods are strongly consolidated in this sector, other options, more respectful with the environment, should also be considered. The existence of so many technical methods (even though that these techniques are not so economical attractive) shall force local authorities to take measures against the damages in the environment (soil, waters, air) occurred by the uncontrolled disposal of either solid or liquid wastes produced in olive mill processes.

The task 6.4 was done by Aalto University. Task 6.4 was found out that the price of energy is likely to increase in the future. Hence also the olive oil production should be thought from the renewable energy point of view. High organic load wastes from olive oil production should be used for energy recovery. The holistic view of olive oil production considers all of the side streams as recoverable and recyclable. The industrial symbiosis is a novel perspective for olive oil production. To sum up, it serves sustainable development not only for the olive oil industry but

also for the communities and environment in the olive producing countries.

The objective of this case study was to develop novel ideas for sustainable olive oil production and solve the wastewater treatment problem. The main conclusions are:

- Olives and its by-products have a high renewable energy value;
- Pomace combustion produces surplus energy;
- OMWW could be treated with the recovered heat from pomace;
- Production of carbon neutral olive oil could be possible;
- Substantial reduction in waste volumes can be achieved.

The solid waste stream, i.e. pomace, has a fairly high energy value, which can be utilized for energy production in combustion. The energy content is notably higher, if the pomace is not de-oiled. Actually, the energy price might be higher than the recovered oil price, which could improve the pomace utilization in energy production even further.

The wastewater streams can be integrated with other wastewater treatment processes in the surrounding infrastructure, i.e. together with other olive oil mills or municipal wastewater treatment plant. That would eliminate the need for any individual wastewater treatment processes, which often are very energy intensive. In addition, as olive oil mills are very small and local farmers' businesses, the mill personnel is generally very poorly informed about correct wastewater management or for other reasons does not apply demanded methods - mainly because of their investment and operating costs. Nevertheless, if the environmentally sound process would also produce energy for the mill owners, the novel practice would suddenly be seen attractive.

Generally, the replacement of the three-phase extraction systems by the two-phase technology would decrease wastewater amounts and water footprint of olive oil production. For some reason, typical belief is that the 2-phase pomace is difficult to treat because "it is moist", but the actual moisture content is not much higher in pomace from the 2-phase process. Thus the 2-phase process would present the more sustainable method for olive oil production, as the environmental management of the olive oil process would be fairly easier with only one solid by-product and without wastewater. That would also be environmentally sustainable development, as Mediterranean area suffers severe water restrictions. On the other hand, using the wastewater for irrigation would minimize the water footprint of the three-phase process in a sustainable manner.

The solid by-products represent an important source of nutrients. Therefore, the use of olive mill wastes as soil conditioners or fertilizers would close the cycle of residue-resources and thus improve the sustainability of the agriculture in Mediterranean, as the area suffers from desertification. [3]

All in all, technological applications and knowledge is existent for the sustainable olive oil production. It is only a matter of local administration and legislation, whether the combined and centralized, integrated industrial ecosystems are seen as the public interest.

The solid by-products represent an important source of nutrients. Therefore, the use of olive mill wastes as soil conditioners or fertilizers would close the cycle of residue-resources and thus improve the sustainability of the agriculture in Mediterranean, as the area suffers from desertification.

**Results:**

Directory of offer and demand was made to help end-users to find suitable technologies for them. 'Demand' includes both the needs for the end-users to be able to develop their business towards a more sustainable situation and also the needs for the solution providers to be able to work with RTD that can meet the end-users needs. 'Offer' includes technologies, demonstration sites etc that are recommended technologies from 6.5, and technologies from the wood industry that could be beneficial for the olive industry. These are demo site or for purchase.

Results of workshop in Greece can be summarized three different categories. The legislation has to be clear and sustained environmental legislation so investments in environmental technology become worthwhile in the long run. Preferably this should be done sooner rather than later. Other issues that can be solved from a sociopolitical level are the control of odors, responsibility for these and the wastewaters and to improve the communication between business, research and political sector.

From a financial point of view the opportunities for energy and fuel would both generate and income and an energy solution for olive mill owners. This involves a view of waste as a useful resource. If it is possible to "sell the problem" to other entrepreneurs this would lighten the load for the mill owners. For this to be possible partners must learn to work throughout the whole value chain from producers to transport and even to tourists in the end.

Lastly technical hindrances are always present. Maintenance and transportation need to be effective and cost efficient through the whole process. User friendly technology that is cost efficient and reliable is always more attractive. The technical solutions must show results that can be measured to be able to live up to legislative standards. Also the technology must cope with the core question regarding what is waste and what needs treatment.

Task 6.4 was found out that the price of energy is likely to increase in the future. Hence also the olive oil production should be thought from the renewable energy point of view. To sum up, it serves sustainable development not only for the olive oil industry but also for the communities and environment in the olive producing countries:

- Olives and its by-products have a high renewable energy value;
- Pomace combustion produces surplus energy;
- OMWW could be treated with the recovered heat from pomace;
- Production of carbon neutral olive oil could be possible;
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All in all, technological applications and knowledge is existent for the sustainable olive oil production. It is only a matter of local administration and legislation, whether the combined and centralized, integrated industrial ecosystems are seen as the public interest.

**WP7 - Mentoring**

WP7 was designed to develop tools and forums to support the delivery of the of the project and ensure it had the Strategic Impact outlined in Annex1 - Strengthening the research potential and infrastructure of the participating regions in Finland, Sweden and Greece by encouraging and supporting regional industrial wastewater

The mentoring plan was created by circulating questionnaire among partners and also one mentoring event has been organized in 2010, Kalmar, Sweden. And three other mentoring forums will be organized by Lancaster University: in Italy And in Greece. The creation of synergies has been ongoing and as a result STINNO project has been in co-operation with other projects mentioned in the Annex 1.

Based on the processes described in the Annex I, the specific impacts of the STINNO project are expected to be as follows:

1. Strengthening the research potential and infrastructure of the participating EU regions in Finland, Sweden and Greece by encouraging and supporting regional industrial waste water research driven clusters.
2. Stimulating the clusters through the development of the Joint Action Plan.
3. Creating the preconditions for reaching the future global market by preparing the Joint Action Plan implementation steps in industrial waste water treatment for the participating regions.
4. Creating the preconditions for reaching the future global market by preparing the Joint Action Plan implementation steps in industrial waste water treatment for the participating regions.
5. Deepening the understanding of ecological utilization of water resources.
6. Providing policy recommendations and suggest joint future actions in industrial waste water quality indicators and EU legislation.

The structure of the project consortium, having partners from different parts of the European territory, helps in spreading excellence. All the partners are actively involved in international networks, e.g. WP3 leader IAMAW has members from all the Mediterranean countries. Also the R&D partners of the project have prominent worldwide networks of research. The coordinator, Lahti Science and Business Park, has the mandate of the International Association of Science Parks to act as the coordinator of IASP Enviroparks, which consists of 35 environment focused science parks all over the world.

The project's WP7 Mentoring specifically targets the transfer of know-how. In the mentoring plan of WP7 special attention will be given to interaction with non-partners of the project and how to actively spread excellence. WP2 Communication and Dissemination has a strong focus on branding and media connections which will be of concrete help when spreading excellence and disseminating knowledge.

Finally, the website of the project will be not only for communication between the project partners, but it will also be freely accessible to non-participants. It is expected to remain active after the project has finished, as a valuable public source of triple-helix strategic work and research information. This knowledge-preservation through the website is of special importance since it will in effect act as a legacy of the project. The address of the project public website: <http://www.stinno.eu>.

The proposal was written in late 2007, mentoring was one of the funder's requirements and as discussed in the last report a mentoring plan had been developed and a methodology approved by the EU. However, this was based on a comparably low survey response, which on reflection should have prompted a more cautious approach to the mentoring programme.

The planned workshop due to take place during the project steering group meeting in June 2011 was at the request of the lead partner cancelled, this was necessitated to allow the a review of the project as whole to reconsider how we would deliver STINNO. However it was during this project meeting that we reviewed communications, roles, responsibilities of the partners and commitment to the project during and open and frank discussion.

This helped to clarify issues with respect to each project partners discussions expectations and aspirations and was the beginning of a more open discussion on the requirements of the group in terms of knowledge needed to successfully deliver the programme.

The project team at Lancaster set about trying to create the right tools and platforms to facilitate mentoring and knowledge exchange in the programme. For example, in attempting to deliver the milestone 7.3 LU reviewed the linked-in group designed to support this remotely and issued user guidance.

The LU team reviewed the comments that the partnership needed less support in the technical areas (which had informed the planned mentoring programme). The issues in the partnership were more complex, more challenging than that, comments taken on board at Lahti pointed towards more expertise and opportunities for reflection on the softer areas such as working in a triple helix, unlocking creativity.

To this end the team, the LU reconsidered the mentoring programme,

- Looking at new ways of working with groups;
- How can we unlock creativity;
- How can we help others in the triple helix to look at issues and opportunities in new ways;
- Re there tools and techniques we can use.

More success was had during the Terni steering group meeting (Italy, December 2011) the team cherry picked from the proposed WP7 programme a topic that fitted with the principles outlined above and considered novel approaches. Two presentations were given: on Cluster Development Theory - learning from North West Europe and how this impacted on triple helix and the emerging quadruple helix. This was delivered by video presentations and DVDs were burned for partners to take back to their own networks.

The second part of the workshop constituted a review and evaluation of WP7 and partners were able to give honest opinions on the Work Package. LU then presented some possible ways forward beginning with an additional project meeting (& Study Tour) in Lancaster which would look at more intense collaborative workshop based on a UK approach known as a 'Sandpit' which would later become a more tailored workshop known as an ideas exchange.

The Lancaster (UK) project meeting and study tour took place in March 2012, a 2 day workshop designed to get a common understanding and more importantly unlock with creativity with respect to the STINNO project case study - Olive Mill waste water; and consider wider opportunities the partnership might wish to tackle and begin to develop some new project concepts. The workshop was well received and proved a fruitful exercise in providing an effective environment for mentoring and knowledge

exchange, and providing a focus for the technical aspects of the projects.

A workshop report was published and informed the work within the other WPs subsequent activities, project meetings and the final conference. Transnational teams subsequently developed the concepts, some of this work, Ecolabelling for example, was presented during the short WP7 session at the Greece meeting where we presented the Lancaster report to the wider group and it was agreed that outcomes should be incorporated into the JAP and the approach and findings should form the key findings of the workshop planned for the final conference.

For the final conference the LU team was asked by the lead partner to undertake a WP7 workshop that would allow the project partnership to evaluate their experiences of the project, consider if they had engaged in mentoring, by considering impacts, benefits and learning gained. For continuity the team worked with the Lancaster workshop facilitator and brought in an illustrator with the ambition of capturing this project self-evaluation in an imaginative, concise and hopefully memorable fashion.

### **Results:**

During this WP we were discussing about mentors and their benefit for the organization. This issue was not so well-known among partners. We also thought how we can get benefit from each other's knowledge and expertise. STINNO was built up from 12 partners. There is enormous amount expertise and knowledge among STINNO partners and the question was: How can we use it efficient way? Actions in this WP helped partners to think differently and take into consideration very unexpected ideas and way of brainstorming things. Especially the project evaluation workshop in the end of the project was given good feedback by the consortium. We learnt from our expertise's and respect others. We also practiced to use our capacity to solve the problem. We were very creative during the forums. Again with the unusual thoughts and ideas we found out many good ideas to proceed: like mobile treatment vehicle (mentioned already), spokesman for olive mill owners, collaboration, side products.

### **Discussion and summary**

During M19- M36 the project was focusing mainly very practical and concrete issues. For example we had study tours in Italy and Greece. All the partners saw in very practical level way how olive oil has been made in different countries.

Impacts of laws in different countries are not similar as we can image. But how to affect decision-makers is one of the crucial things. Also what can you made from waste of olive oil process? Changing the way of thinking is very important lesson learnt during this project. The conclusion is that you should be open-minded. We all have to learn step by step to think benefits of different ideas. We need innovation that is for sure.

The results of this project is not only for ex awareness raising campaign but also how can we work with each other and also other stakeholders who might help you to reach the goal. Working model of STINNO was using Triple Helix approach. It was found out to be very efficient way to reach your goals and targets.

The project is on track to produce all the deliverables that are described in the Annex I. The deliverables have been produced and delivered with only few small delays those haven't had any significant impact on other Tasks or Deliverables. The projects Milestones this far have also been completed. The next steps and the future of the project were discussed in the last partner/progress meeting in Lahti. (Suggested methods for olive mill waste waters has attached.)

Olive mills need technologies which cannot cost too much. They have to cost and energy efficient methods.

### **Conclusions**

- There are methods (hundreds in the literature, tens in the market). But none of the proposed methods has zero cost
- There is not a unique solution; the solution will depend on the specific needs of the local area
- The selection of the most suitable or appropriate valorization strategy will depend on the social, agricultural or industrial environment of the olive mill
- Starting from 1.1.2011, we pay fines for the damage to the environment
- Local authorities shall take measures against the damages in the environment (soil, waters, air) occurred by the uncontrolled disposal of either solid or liquid wastes produced in olive mill processes.

### **Potential Impact:**

The socio-economic impacts can be quite large in order to quantity and quality of olive mills. Olive mill owners must consider other side products as well. Where can they have more benefit and small scale business possibilities? They need to work together in the villages.

The price of energy is likely to increase in the future. Hence also the olive oil production should be thought from the renewable energy point of view. High organic load wastes from olive oil production should be used for energy recovery.

The olive oil process is compared with the pulp production; pomace is comparable with black liquor in pulp mills, which is a chemical stream after pulp cooking process. Both are vegetable organic matter and have a high organic content. The moisture content for pomace is about 50% in the 3-phase process. According to several studies, the 2-phase process generates pomace with a moisture content of 65%. For comparison, the moisture content of black liquor is about 85% before it is dried and burned for energy in a recovery boiler. The dewatering process demands energy but for example in pulping industry, the black liquor combustion produces after all more energy than the whole pulp mill needs even though the initial moisture content is very high.

Olives are a natural organic product, which can be seen as a renewable energy source. Pressing olives into olive oil produces pomace as a leftover solid material in both 3- and 2-phase processes. Pomace is generally perceived as solid waste. However, lots of renewable energy remains in the pomace; the net caloric value of de-oiled pomace is about 16.7 MJ/kgw10% .

The energy consumption for both 3- and 2-phase processes is represented in Table 2. The potential energy recovery from pomace is about 1000

kWh/1000 kg of olives used, which is nearly 15 times more compared to anaerobic digestion of OMWW.

However, the table above is very rough estimation of the energy balance. The energy consumption of pomace dewatering is based only on the heat value and vaporizing heat of water, i.e. the net energy demand for pomace drying. In reality, the energy consumption of the pomace drying is higher due to the boiling point rise, which is caused by the solid matter. In addition, the dewatering process could produce steam as output [24], which is not taken into consideration. Also, the dryers have a certain efficiency, which affects the energy consumption. For example the IMPROLIVE project reported, that the power consumption is 0.71-1.11 kWh/kg of water, which correlates to 63-98% efficiency.

The energy need for the dewatering of solid waste is included in the energy consumption calculations. The energy recovery potential is also marked to the figure, and finally the last columns represent the energy surplus.

The olive oil mills provide a huge potential for an energy surplus. For example in Turkey, several olive oil mill owners utilize the pomace for heating the factory.

Based on that evidence we can say that olive mill industry there is lots of socio-economic effects. The pomace can be used as fuel. Energy can be used in the olive mill factory. People from the villages can get benefit from the value chain of olive oil process. There is place for new small and medium-sized enterprises (SME)'s. More entrepreneur - more business - more employee! When you have work you belong to society as full membership. You are worth. But without work you are alone and you suffer.

You have to considerer as well the nature. We have to clean olive mill waste waters (OMWW) for our shake. Clean environment affects our mind in positive way. Although there is not only one suitable technics there are money but you have to considerer which to use case by case. And the cleaning methods should be cheap and efficient. Payback time affect olive mill owners' daily life. Is it worth to invest very expensive technologies which may not work proper way? But it is for sure that there are energy to be used and many technologies to go on while talking about olive oil process.

## **Main dissemination activities and exploitation of results**

### **Awareness raising campaign**

As part of the end-user dialogue a special awareness raising campaign was launched in Western Greece and performed by FORTH in cooperation with PSP.

The Greek partners of STINNO, main responsible for the task, visited different olive cultivated areas where olive oil is produced and at the same time olive mill wastewaters are co-produced. Members of the scientific group choose to present their results in audience where olive farmers or olive mill owners were participated. The places where the awareness campaign was performed is shown on <http://www.stinnomaps.com>.

### **Website**



A website was constructed soon after the kick-off meeting, as well as a logotype and powerpoint template. A dissemination and communication plan was produced M6. The website uses the same system as The Kalmar Regional Council. This makes problem solving, updating and maintenance easier. Costs were also heavily reduced and are only related to the website domain except some minor programming.

### **Internal communication**

All partners were given access to STINNO internal website. The internal website has mostly been used to store and share working documents. An active communication between the consortium is also important to achieve good results. During the initial phase of the project, the webbased conference tool Adobe Connect was used. Unfortunately technical troubles with firewalls and weak internet connections among the partners, didn't made it possible to continue with the use of Adobe Connect. The project leader provided the consortium with telephone conference facility. Meetings have been held regularly, as well as Skype meetings with partner-to-partner.

### **External dissemination activities**

Added to the awareness campaign, STINNO project has been disseminated at various events, like WIRE 2010.

The two partners Lahti Science and Business Park and Sustianble Sweden South East A are also partners in the Baltic Sea Region project StarDust. Within the pilot Clean Water, there have been carried out several dissemination activities of STINNO.

During Linneaus ECO-TECH 2010 in November 2010 in Kalmar, arranged by Linneaus University, the 2nd Waste-Cluster meeting was held. STINNO was disseminated at a poster session and STINNO partners also took part in cluster-event with local companies from the Kalmar region. A study tour was held in the Kalmar region, as well as other interesting sites in Southern Sweden.

In December 2011, a study tour in Italy with the whole consortium were carried out. The partners met relevant stakeholder from both research and business sector working with olive oil production.

During the mentoring session in Lancaster in March 2012, a study tour was arranged by Lancaster University.

In June 2012, the consortium arranged a workshop "Olive mill wastewater - a triple helix approach", together with Chamber of Commerce of Etoloakarnania in Agrinio. Stakeholders from academia, business and public sector met and STINNO results and findings were disseminated. A study tour to innovative OMW solutions were also arranged.

Partners from Finland and Greece particitated and presented STINNO findings at the Symposium 2012 "Olive Mill Wastes and Environmental Protection" in Chania, arranged by PROSODOL/LIFE-project, October 2012.

### **Twitter**

A Twitter account (@STInno\_OMW) was registered for the consortium. The twitter account has regularly been updated by WP2 leader. Twitter is an efficient tool to spread information, as well as gathering information

and to stay updated. The @STInno\_OMW will be active after the project has been finalised.

#### LinkedIn

A LinkedIn group was created for partners and other relevant external partners. The LinkedIn group will exist also after the project as agreed in the post-project dissemination plan.

#### Other dissemination activities

As a result from the STINNO partner meeting, the idea of making olive oil in Finland was developed. The idea was to better understand the process of making olive oil to make it possible to compare with forest industry wastewater. The characteristics of olive mill wastewaters (OMWW) were studied by the Clean Technologies group at Aalto University. Professor Olli Dahl has operated as a team leader (Aalto Clean Technologies group) and expert during the project STINNO especially on Work Packages 2, 3 (task 3.3) and 6 (task 6.4). He has also given presentations on STINNO partner meetings and participated in the writing process of publications and reports.

For the experiment 20 kilos of olives were sent from Greece to Finland where it was processed to olive oil in a laboratory scale. OMWW generated during the process was examined with the methods commonly used in the pulp and paper industry research sector. Based on such a research the similarities between olive oil and forest industry wastewaters were easy to compare.

The biodegradability of the OMWW was studied with two different sources of microbes; from the municipal activated sludge plant (ASP) and from the kraft pulp mill ASP. The results were compared with the biodegradability of different wastewaters from forest industry. It was noted that the OMWW is rapidly degradable and the ratio between BOD5 and COD is relatively high. The high energy value of solid waste from the olive oil process (pomace) and the lack of utilization of this renewable energy source were also one of the main conclusions of this study. The energy potential of pomace was studied more closely in the task 6.4 based on the literature. The findings from this comparative study were presented in a workshop in Agrinio (Greece) and at a conference in Chania (Greece).

#### Other:

Leaflets and other information material have been produced within the project. The JAP is disseminated through a calendar.

WP7 directly has seen the development of the following physical documents

- Mentoring Plan and approach available on the project website.
- LU Study tour Report available on the project website.
- LU workshop report available on the project website. (Working Document)
- LU/Kalmar publication. Available via the project website.
- Final workshop publication.
- Project partner and meeting guidance.

The nature of the Work Package 7 means that it is there to enable the socio-economic impact of the other work-packages.

The meetings of the project consortium were very fruitful each time and via those the consortium started to work very well together making the

project work more concrete. The results of each partner and WP were discussed and communicated to other partners and that way it was possible to take the results to partner organisations and that way to their stakeholders. The project meetings can be considered as a way of disseminating the project work among the participating countries.

### **List of project meetings**

- Kickoff meeting in Marrakech, Morocco. January, 2010.
- Partner meeting and study tour in Kalmar, Sweden. 22nd - 25th November, 2010
- Partner Meeting in Lahti, Finland. 16th - 17th June 2011.
- Study tour and project meeting in Italy Dec. 2012
- Mentoring workshop and project meeting in Lancaster March 2012
- Project meeting and workshop for stakeholders in Greece June 2012
- Final meeting in Lahti November 2012

- The address of the project public website, if applicable as well as relevant contact details.

<http://www.stinno.eu>, <http://www.stinnomaps.com>

STinno logo has attached.

### **SYNERGIES WITH OTHER PROJECTS**

The project has olive mill wastewaters as one specific case study but at the same time will screen the broader agrochemical industry. As such the Technical Annex to the STINNO project asks partners to create synergies with certain other EU funded activities such as

- SOWAEUMED (dealing with solid waste and water treatment between European and Mediterranean countries)  
<http://grupsderecerca.uab.cat/sowaeumed/>
- TEMP (main goal is to enhance the S&T cooperation in the Textile and Clothing field between Portugal, Italy and Tunisia) <http://www.temp-eumed.eu/>
- WASTEKIT (waste management focusing on knowledge and integration to create transnational economic development <http://www.wastekit.eu/>)

by means of participating in joint meetings and a continuous exchange of knowledge and information.

As part of the preparation of deliverable7.1 the WP Leader contacted the lead organisations for these projects to establish a communication channel and to assess how the mentoring activities fits within their project and how we could provide the necessary report.

Feedback was as follows:

WASTEKIT Project - "We do not have a similar deliverable-- collaboration with the North-african countries is less a priority for us since we are really about waste management in our four regions"

SOWAEUMED project - " there is no similar deliverable --- -SOWAEUMED partners put emphasis on assisting at different meetings in the Mediterranean region as well linking with other projects involving Mediterranean partners -- or participating in other Cluster initiatives. TEMP - " ours actions are based on the textiles sector and mentoring does not feature in our project deliverables however we would be happy

to let you use our contacts in Mediterranean and North African regions to assess if they have an interest in participating in mentoring activities"

Given the above, so far the Work Package can be regarded satisfactory.

List of Websites:

<http://www.stinno.eu>

<http://www.stinnomaps.com>