

#### FINAL PUBLISHABLE SUMMARY

# 1.1. Executive summary

The BIOPROM project, a Co-ordination and Support Action, bringing together experts working with and on new concepts for communicating "science in the area of the knowledge-based bioeconomy (KBBE)" to the public combined different experiences and know-how in order to develop synergetic support measures with the main goal to promote bioeconomy in the regions. The BIOPROM project has been designed to establish a network of science centres, science museums and organizers of exhibitions to prepare common tools when communicating science in the field of bioeconomy to the public. Special activities have been targeted to the young generation, in particular high school students and university students to stimulate their interest and mobilize their talent for building the bioeconomy.

The main objectives of the BIOPROM project were to increase the efficiency of national and European initiatives in communicating science and research, especially in the field of bioeconomy, by identifying and promoting the success factors of several science centers and museums in Europe. Common workshops have been organized with experts from science communication and exhibition building in order to set up a concept for the BIOPROM exhibition. The consortium also organized a public debate on the BIOPROM project and the topic of bioeconomy during the EU Danish presidency "bioeconomy in action" conference 2012 in Copenhagen. A survey done by the BIOPROM partners has shown that there is a high need of explaining bioeconomy to the public and to keep it simple from a scientific point of view. The central goal of BIOPROM has been to develop and produce a bioeconomy related interactive travelling exhibition which has been hosted at the partnering science centers in Wels, Austria, Rome, Italy, Aberdeen, UK, and Tallinn, Estonia, with about 200.000 visitors.









# 1.2. Summary description of project context and objectives

# 1.2.1. Achievement of general objectives

BIOPROM activities addressed the potential and impact of the bioeconomy on daily lifes and work, as well as in the perspective of global challenges and of local and regional economy and social conditions. In general, there is a lack of awareness about the potential within the knowledge-based bioconomy (KBBE) both in terms of manufacturing industry, policy makers, consumers and even investors. BIOPROM facilitated a long-term strategy, a strategy for communication and stakeholder involvment. Stakeholders were involved and engaged from the beginning of the BIOPROM project. The main stakeholders were the public, teachers, families, children and other interested people.

The main tool used within BIOPROM was the interactive exhibition "Mission Possible: will bioeconomy save the world?". An interactive exhibition placed at a science centre, children museum or family centers has the potential to attract many people in a short time. Visitors got far more aware about the challenges in Euope and learned by do-it-yourself (DOY - experiments) and not through monotone presentations. The overall objective of BIOPROM to develop several activities at science centers together with experts in the field of bioeconomy while engaging in an interactive debate to promote the bioeconomy in Europe has been fully fulfilled and achieved. More then 200.000 people were directly involved into the promotion of the bioeconomy as visitors to the exhibition, events and workshops. A main group of visitors have been children but also many adults who learned about bioeconomy in their daily lifes and work got a feeling about the challenges in the world that have to be solved.

# 1.3. Achievment of specific objectives

(i) To increase the efficiency of national and Euorpean initiatives to communicate science and research, especially bioeconomy, by identifying and promoting the success factors of several science centres and museums in Europe.











In workpackage 3 the BIOPROM consortium performed a survey to find out what has already been done in the participating EU Member States in order to communicate science and technology in the field of bioeconomy. In addition, already available survey results have been collected and assessed in order to identify the needs and expectations of the public. The survey and the resulting reports helped to increase the efficiency of national and European initiatives to communicate science and research by identifying and promoting the success factors of several science centres and museums in Europe in the field of bioeconomy. The knowledge of what the public knows about bioeconomy and how the exhibition has to be structured was the result of this action. The objective has been to perform a survey to find out the expectations and needs of the public when visiting a science centre and on what they expect from the topic of bioeconomy. In addition, it was the aim to integrate and discuss with students and young researchers about the field of bioeconomy.

The objective has been fully achieved with very interesting survey results that allowed the BIORPOM consortium to design and produce a high-quality interactive exhibition.

(ii) To coordinate the collaboration between institutions running science exhibitions and communication events by setting up a European network of experts in science communication and organising exhibitions.

BIOPROM established a network of different stakeholders and institutions working within the communication of bioeconomy topics. A European network of experts in science communication and organising exhibitions has been put together and cooperates further after the end of the project. Main contacts have been made at the European Network of Science Centres & Museums (ECSITE) annual conferences in Toulouse, France (2012), Gothenborg, Sweden (2013), and Den Hague, Netherlands (2014). In addition, the individual networks of each science center have been included and relevant experts integrated into the communication about the bioeconomy.

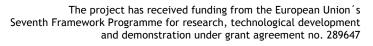
The objective has been fully achieved with a broad network and active collaboration between different institutions.

(iii) To organise common workshops and debates within the network while engaging different













#### stakeholders

A series of workshops has been organised to define the content for the BIOPROM exhibition. These workshops integrated several stakeholders in order to assess and identify the needs of the public in gaining knowledge in bioeconomy. One of the five workshops was organised during the EU presidency in Denmark within the "bioeconomy in action" conference 2012. 35 stakeholders have attended the workshop in order to discuss bioeconomy and the efficient communication of related topics.

This objective has been fully achieved with workshops and debates to design and structure the exhibition.

(iv) To organise a coordinated BIOPROM touring exhibition in the field of bioeconomy at the different locations within the BIOPROM network and to foster the creation of awareness in the field of the bioeconomy to the public, especially young people and students

The BIOPROM travelling exhibition with the title "MISSION POSSIBLE" has been designed based on the results of the workshops and the survey. The "MISSION POSSIBLE" exhibition started at Explora in Rome, Italy, moved then to Satrosphere, Aberdeen, United Kingdom, travelled on to Welios, Wels, Austria, and was finally hosted by Energiekeskus, Tallinn, Estonia. One focus was to attract young people to the exhibition as BIOPROM followed a slogan "Todays kids will be the adults of tomorrow". The exhibition has been structured into three main areas being "Agriculture & Fisheries", "Food & Well-being" and "Biotechnology & Life Sciences". Each area consisted of exhibits, printed information on panels and workshops or hands-on experiments. Visitors received support and help from trained guides when discussing the experiments. Young people and students have been integrated through several competitions like the photo contest, exhibit competition and science communicator competition.

The objective has beenn fully achieved with a very successful travalling exhibition "MISSION POSSIBLE". Finally, about 200.000 people (from young to old) visited the "MISSION POSSIBLE".

(v) To increase the engagement of civil society organisations, policy-makers, schools, teachers, and young people and other decision makers in communication and educational matters by promoting policy











#### recommendations and guidelines on the organisation of exhibitions and other events.

The integration of researchers, sciencists, school teachers, young school children, and students was based on a two-fold approach. The first initiative was to integrate these stakeholders during the survey phase and the second part was to integrate with the scientists, students and school teachers, as well as university teachers who were very important stakeholders to support the development of the travelling exhibition "Mission possible". Based on the analysed needs of these different stakeholders, specific actions have been set up to integrate them into the project and to prepare the exhibition and parallel events based on their needs. In addition, actions were implemented to integrate with decision-makers and civil society organisations. In parallel to the exhibition, each involved Science Centre organised several so called "side-activities" together with the University partners and regional stakeholders. The Science Centres also worked together with other regional universities, schools, farmers, institutions and/or industry. Each Science Centre had a strong focus on their regional topics and challenges within the bioeconomy. During the project, it has been learned that the partnership between Science Centres, Schools and Universities is an important and major factor for success. Based on such partnerships, events are organized in a more professional way and scientific content is communicated much better and qualified to the audience. For the Science Centres it is also a sort of image improving factor having the Universities "on board". As a result, these partnerships led to a series of talks, debates and lecture events with researchers from local universities as keynote speaker, discussion partners or moderators. These lectures included subjects such as food waste, genetically modified crops, the economic cost of going green, and how biofuels made from algae can be up-scaled for industrial production, and many more.

The objective has been fully achieved and complemented very well with the exhibition. Using the exhibition as a platform for all kind of activities and actions is a very successful approach.

#### 1.4. The main results and foregrounds

During the first twelve months of BIOPROM five workshops have been organized where the BIOPROM Consortium discussed and defined the main content for the travelling exhibition and analysed results from a survey defining the needs of visitors and the public related to the topics of











bioeconomy. It turned out that the public needs very basic information and knowledge in order to learn about the advantages of the bioeconomy. Based on these workshops discussions and results, but also the involvement of other stakeholders, as external experts and scientists, the BIOPROM consortium developed the "MISSION POSSIBLE" exhibition.

For the survey the BIOPROM consortium developed two questionnaires, one was designed for younger participants that were coming to the science centres with their parents or teachers who could always give support if they were unsure of parts of the questionnaire. The second questionnaire was designed for university students and young researchers as it was felt that they would request more background information and might not be able to ask questions in large classes and therefore the questionnaires had to be as informative as possible. The qualitative survey for children about the topic has been done through a Focus Group approach: a research method whose participants are able to communicate with each other. This survey technique responds to specific rules of preparation, organization and management. Based on the survey results, as well as during the talks with experts and other stakeholders it turned out that there is high confusion about the term knowledge-based bioeconomy. For example a large proportion of visitors said that they know the term bioeconomy but most of students did not. For us in the consortium it was decided that the term bioeconomy is mis-interpreted. For example in Austria the term bioeconomy is mostly connected with organic food and agriculture because in Austria the term "bio" is used for the meaning of "organic" products. From further analysis, it was seen that a simple and comprehensible way of communicating bioeconomy is needed. Especially, due to the fact that the field of bioeconomy is such a diverse topic that integrates several disciplines from agriculture to biotechnology and energy. The BIOPROM consortium structured the "bioeconomy" into three main areas which are "agriculture & fisheries", "food & well-being" and "biotech & life sciences". These areas are also the main parts within the exhibition and cover most of the suggested and discussed topics of the survey. The Consortium also decided that the selection of the main sub-topics within the three main ones has to be done by the respective science centre or museum in order to integrate a regional approach into the exhibition. One main issue was to decide about communicating the topics of bioeconomy to the public and stakeholders. The survey results of the visitors showed clearly that the BIOPROM exhibition needs to focus on hands-on experience,











science shows/demonstrations and lab stations. The visitors also expected a strong focus onto specific workshops and experiments and information through the website, but also public expert lectures.

BIOPROM is presented via a well-designed website (www.bioprom-net.eu) in different languages, and a Facebook profile (www.facebook.com/biopromnet) and has designed several roll-ups, specific exhibition flyers and general project flyers. Promotion and networking activities with other stakeholders have been started at the "Bioeconomy in Action" conference in Copenhagen in March 2012. This first stakeholder workshop at the Science Centre Experimentarium in Copenhagen during the Danish EU Presidency attracted more than 35 participants (stakeholders) to listen to the presentations of the experts and got involved into the discussions around bioecnomy and BIOPROM. The workshop also included a debate and discussion on bioeconomy and science communication itself. Further workshops were organised in Rome, Italy, Innsbruck, Austria, and Toulouse, France. The BIOPROM coordinators used a specific concept during these workshops to develop the exhibition which included the following phases:

- Brainstorming sessions and definition of the survey groups and the established survey form.
- Anaylsis and discussion of the survey results and definition of the main goal of the exhibition.
- Set up of a first concept for the exhibition.
- Definition of areas of interest (Food & Wellbeing, Agriculture & Fisheries, Biotech & Life
   Sciences) and definition of main workshops / experiments / exhibits.
- Set-up and design of an exhibition script.

In order to collect all relevant information and ideas from the workshops a specific BIOPROM wiki was established and used. The project partner Hüttinger (Exhibition engineer) set up the wiki also as they needed all relevant information in order to produce the exhibition.









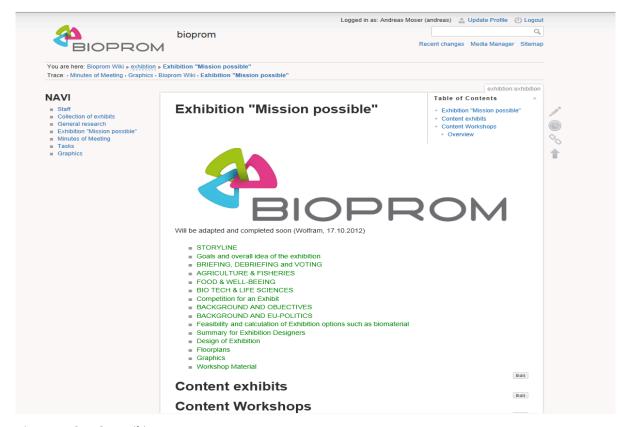


Fig. 1.: BIOPROM wiki

During the second twelve months of BIOPROM the developed concept of the travelling exhibition was turned into a ready to use travelling exhibition by the BIOPROM consortium. Based on intensive discussions and survey results, but also the involvement of other stakeholders as external experts and scientists it was possible to set up a high-quality exhibition. The official name of the exhibition is "MISSION POSSIBLE". Promotion and networking activities with other stakeholders have been continued through the participation at the ECSITE annual conference in Gothenburg, Sweden, from June 6 to June 8 2013. ECSITE is the European Network of Science Centres & Museums. The project BIOPROM together with details about the travelling exhibition were presented with a stand at the conference venue. More than 1050 delegates from 47 countries in Europe and worldwide participated at thise ECSITE conference.











The travelling exhibition was officially launched in Rome, Italy, on the 21th of April 2013 at the children museum Explora. The exhibition toured then through the cities Aberdeen, UK, Wels, Austria and Tallinn, Estonia. The exhibition focuses on the three selected main areas with 30 infowalls on different topics within bioeconomy. In addition, each area offers several workshops and hands-on experiments to get into the bioeconomy and its challenges. Furthermore, hands-on exhibits are included and also info-screens with more detailed background information. The story behind tells that visitors enter the world of bioeconomy and support the world with their MISSION POSSIBLE. On this MISSION POSSIBLE different "virtual" experts and people are involved and need support from the visitors. In this world they have to produce their own food, energy and resources for living and therefore to understand bioeconomy. The scientists and experts ask for support in their MISSION POSSIBLE and to use natural and biological resources to produce their daily products. The visitors will be able to be part of this MISSION POSSIBLE. The visitors enter the MISSION POSSIBLE through an entrance area and will support the scientists and experts in producing their daily products through a series of workshops and experiments. The workshops are based on three areas of importance in a bioeconomy which are agriculture & fisheries, biotech & life sciences, and food & well-being. Expamples for such hands-on workshops are listed on the bioprom-net.eu website. (Lemon Light: What is a battery and how does it works? Is it possible to produce a biobattery and what do you need? - energy from biological sources; Starch test: What is starch and how can it be used? Where is it found and what do you need to recognize it?; Drop of water: Do you know the life inside a drop of water? What do you need to make a filter for water and what is the water cycle?)

Visitors should understand that they already live in a world of bioeconomy where biological raw materials are used to produce products like energy, bioplastic, food, and many more, as well as to recognise the main challenges behind. Visitors received an introduction in the entrance area of the exhibition in order to get an overview of the main challenges in our world (population growth, decrease of oil availability, increase in energy consumption, increase in food needed, food security, decrease of greenhouse emissions, and many more) through a selection of videos. The videos have been available at the entrance area computer and the guide(s) were able to choose which videos fit best to the respective group. Depending on the age of the people visiting the exhibition the









relevant videos have been chosen and presented. After the video introduction, the guide(s) explained the "Mission Possible" to the visitors. The visitors received guidebooks where the main challenges were described and in addition which workshops are required to be done in order to help the "bioeconomy" or scientists living there. Visitors got the chance to write down the answers and ideas they got through the experiments and exhibits into their guidebook and to take it home. After fulfilling the mission, the visitors entered the "debriefing area" where they could give feedback onto a "post-it wall" or "feedback tree" with ideas to push bio-economy, to foster the use of biological resources, or just giving comments about the exhibiton. Three different levels of difficulty were offered in order to take into account the different ages of the children.

During the last 15 months of BIOPROM, the travelling exhibition "MISSION POSSIBLE" travelled to Aberdeen, UK, on the 29th Nov 2013 at the Science Centre Satrosphere, and next in Wels, Austria, on the 3rd June 2014 at the Science Centre Welios and finally in Talliinn, Estonia, on 17th Oct 2014 at the Science Centre Energiakeskus. During each host of "Mission possible" several side activities were launched together and for different stakeholders about specific bioeconomy related topics in the region.

Each involved Science Centre promoted their host with a lot of different promotion activities, such as TV, Radio, Print Media, Website, Facebook, and other channels. Until the end of the BIOPROM project about 200.000 visitors visited the exhibition, its side events and workshops.

Going into detail each science centre had the following amount of visitors at the exhibition:

74.722	"Explora", Rome: April - November 2013
25.070	"Satrosphere", Aberdeen: November 2013 – May 2014
18.502	"Welios", Wels: June – September 2014
38.000	"Energiakeskus", Tallinn: October 2014 – January 2015
156.294	Total (only visitors to the exhibition, excl. Side events, etc.)

"Todays kids will be the adults of tomorrow", under this slogan the BIOPROM consortium had a strong focus onto children and young people. Even if at present the word bioeconomy can create uneasiness (e.g. concerns regarding "food vs. fuel", "genetic modification"), in the near future it will hopefully be part of everyday vocabulary and of a possible solution to address the ecological,











environmental, energy, food supply and natural resource challenges that Europe and the world are facing already today. Consequently, one of the main goals of the BIOPROM project was to raise peoples' awareness about the importance of natural resources, food security and sustainable economic growth and behaving in a more responsible way.

The visitors started at an introduction and briefing area where videos have been shown and introduction speeches were organised.



Fig. 2.: briefing area at Explora, Italy

Then the visitors entered the exhibition that included printed information on the wooden wall panels. This information was targeted onto global issues but also regional aspects and topics. In each area one info terminal provided information via the BIOPROM website.

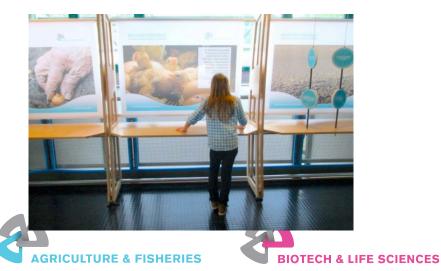








Fig. 3.: wooden wall panels.

One main part of the exhibition are the workshop areas where the visitors will be informed about selected topics and did hands-on experiments together with guides.



Fig. 4.: workshop in action

Workshops / hands-on experiments have been designed by the BIOPROM consortium and comprise photosynthesis, fleeting farmland, life in a drop of water, potato clock, life in 1cm2 of soil, measure up, starch test, healthy people / healthy planet, biodegradables, watching algae grow, a.m.m.

Experiments have been instructed through a workshop touch screen including a final explanation of he meaning of the experiment. The workshop instructions are available in different languages german, english, italian, estonian and russian.











# MISSION POSSIBLE Will bioeconomy save the world?





Fig. 5: workshop screen examples & language selection

Interactive hands-on exhibits have been included into the exhibition like "you are what you eat" (touch screen game – showing correlation of food visitors select to the ecological footprint and food contents they eat, e.g. sugar, fat, etc., catch a fish (overfishing game) and biomass game (smell and touch biomass), algae reactor and ecosystems.













Fig. 6.: example for a hands-on exhibit

The exhibition also included "Both sides of the coins". On these coins, the visitors can learn some interesting things about bioeconomy by answering questions. On the one side, they can find pictures and questions and on the other side of the coin the answers are provided.

When leaving the exhibition visitors came again into the briefing zone which was de-briefing and feedback zone. Visitors were able to note and write down feedback about the exhibition and bioeconomy onto post-its and feedback trees.













Fig. 7.: examples of feedback post-it

In parallel to the exhibition each involved Science Centre together with the University partners organised several so called "side-activities". Such side activities also included a bioeconomy photo competition, a young science communicators' competition, an ideas competition with schools.

In addition, BIOPROM was presented via a project website (www.bioprom-net.eu) and a Facebook profile (www.facebook.com/biopromnet), three role-ups and, 2 banners, a basic flyer and a special exhibition flyer as well. Promotion and networking activities with other stakeholders have been continued with the participation at the ECSITE annual conference in The Hague, Netherlands, from May 20 to May 24 2014. ECSITE is the European Network of Science Centers & Museums. The project BIOPROM with a strong focus on the travelling exhibition "MISSION POSSIBLE" was









presented with an oral presentation to about 400 experts within the session "travelling exhbitions". More than 954 delegates from 50 countries in Europe and worldwide participated.

As one of the final key results, recommendations were developed based on the experiences within the BIOPROM project with a strong focus on the usage of the interactive travelling exhibition "MISSION POSSIBLE". These recommendations should help policy makers, Universities and Industry to think about new ways of communicating science and innovation to the general public, especially young people.

# 1.5. The potential impacts

The BIOPROM project was very ambitious in terms of its overall strategic and scientific impact as well as in its impact on society, the education system and the education policy in Europe and its member states. The BIOPROM "Mission Possible" exhibition resulted in different kinds of impacts in the different regions where the exhibition was hosted.

The BIOPROM project contributed to a greater visibility of European research and researchers by bringing together the experience and tools of science centres and museums. With the focus on younger people the main impact was to educate on bioeconomy related issues on our world and to attract young people to select studies and work within the bioeconomy.

The main expected final result of the BIOPROM project was to "edutain" (education-entertainment) about 200.000 visitors during the exhibition on bioeconomy topics. Visitors learned through handson experiments and interactive exhibits but also through facts & figures about bioeconomy. The main impact has been expected to be the increase of awareness on bioeconomy and its chances for the future. The people understood the advantages of bioeconomy and its applications in their daily lifes.

The science centre partners extensively worked together with schools and teachers in order to reach the young people. Schools have been a central target group and have a major impact on understanding the science and technology behind the bioeconomy. The combination of theoretical education in schools with the hands-on experiments and worshops at the BIOPROM exhibition









supported to modernize science teaching and transfer of know-how to the young school children and students.

BIOPROM has organized parallel events with stakeholders and policy-makers in order to foster the public debate and discussion on the advantages of the bioeconomy as a chance to substitute fossil fuels resources with bio-resources and thus support the protection of the environment in Europe.

# 1.6. Main dissemination activities and exploitation of results/foregrounds

One of the main objectives of the BIOPROM project was to develop and promote new concepts for communicating knowledge-based bioeconomy (KBBE) topics to the public. The BIOPROM project had a very strong communication and promotion focus so that suitable exploitation, dissemination and promotion activities were defined and implemented. The main BIOPROM dissemination objectives have been settled within the strategic dissemination & exploitation strategy and have been defined in the following way:

- To support dissemination of KBBE science to the public in the most suitable way. The BIOPROM exhibition demonstrates technologies via concrete and interactive examples.
   Focus is given to the educational aspect reaching a considerable amount of young people who will be the ambassadors of KBBE in the coming generations.
- To reach the largest possible amount of relevant stakeholders and groups and the public.
- Organising the most effective networking of experts to promote the in depth understanding of bioeconomy related topics.
- To use the most innovative relevant dissemination and exploitation tools.

BIOPROM prepared policy recommendations and new concepts on communicating science and technology topics within the bioeconomy. The communication of these new and innovative concepts has been done by dissemination activities which have been the website in five different languages (DE, IT, UK, RUS, EST; <a href="www.bioprom-net.eu">www.bioprom-net.eu</a>), a facebook page with currently 500 followers (<a href="www.facebook.com/biopromnet">www.facebook.com/biopromnet</a>) as well as the facebook pages of each science center (about 19.000 followers), a special twitter account in Rome and Aberdeen, a project flyer, posters, roll-ups, and many more. Dissemination of the BIOPROM concept and project took place at the ECSITE conferences in Toulouse, 2012, in Gotheborg, 2013, and in The Hagua, 2014. At each











conference BIOPROM and MISSION POSSIBLE was presented with flyers, a fair stand and at least a presentation within the travelling exhibition session. BIOPROM had a close partnership with COMMNET. COMMNET organised three communication training workshops at the sites of BIOPROM MISSION POSSIBLE. In addition webinars and participation at conferences brought it down to a round figure.

In terms of exploitation the BIOPROM consortium agreed to set up a non-profit organisation in Austria that will manage the MISSION POSSIBLE after the end of the project. This organisation is called easyscience (<a href="www.easyscience.eu">www.easyscience.eu</a>) and will be responsible to rent the exhibition MISSION POSSIBLE or to integrate it into other dissemination activities within EU projects. The income from rents will be used to update the exhibition and to use it partly as maintenance budget.

### 1.7. Public website and websites

http://www.bioprom-net.eu

Mr. Andreas Moser

moser@rtd-services.com

rtd services

**Gewerbepark 10** 

**A-6094 Axams** 

Austria

#### **Partner Websites and Contacts:**

- → Explora, il museo dei bambini di Roma, Italy: <a href="https://www.mdbr.it/en/">https://www.mdbr.it/en/</a>
  Contact: Ms. Patrizia Tomasich email: <a href="mailto:ptomasich@mdbr.it">ptomasich@mdbr.it</a>
- → Satrosphere, Aberdeen, UK: <a href="http://www.satrosphere.net/">http://www.satrosphere.net/</a>
  Contact: Mr. Grant Peterkin email: <a href="mailto:grant.peterkin@satrosphere.net/">grant.peterkin@satrosphere.net/</a>
- → Welios, Wels, Austria: <a href="http://welios.at/lebenswert/">http://welios.at/lebenswert/</a> Contact: Mr. Michael Holl – email: <a href="holl@welios.at">holl@welios.at</a>
- → Energiakeskus, Tallinn, Estonia: <a href="http://www.energiakeskus.ee/">http://www.energiakeskus.ee/</a> Contact: Ms. Kertu Saks email: <a href="http://www.energiakeskus.ee/">kertu@energiakeskus.ee/</a>
- → University of Applied Science, Wels, Austria: <a href="http://www.fh-wels.ac.at">http://www.fh-wels.ac.at</a>
  Contact: Mr. Rudolf Kraft email: <a href="mailto:rudolf.kraft@fh-wels.ac.at">rudolf.kraft@fh-wels.ac.at</a>
- → University of Aberdeen, UK: <a href="http://www.abdn.ac.uk">http://www.abdn.ac.uk</a>











Contact: Ms. Amy Hayward – email: <a href="mailto:amy.hayward@abdn.ac.uk">amy.hayward@abdn.ac.uk</a>







