PHYTO2ENERGY NEWSLETTER #3

AUGUST 2017

IN THIS ISSUE:



## EDITORIAL

Izabela Ratman-Kłosińska
Project Co-ordinator
*Institute for Ecology of Industrial Areas (IETU)*

Dear Readers,

Phyto2Energy is in the third year of its implementation. With this introductory article I would like to make a summary of our up-to-date progress. Our fellows continue our experiments with the four energy plants species: *Miscanthus* x *giganteus, Sida hermaphrodita, Spartina pectinata* and *Panicum virgatum* at the experimental fields in Bytom, Poland and in Leipzig, Germany. Year third was quite important as the data obtained on the plants themselves, the biomass yield, its properties as fuel and the gasification process are relevant from the view point of a practical implementation of the phytoremediation driven energy crops production in full scale and a safe use of the produced biomass as an energy carrier. The knowledge which the consortium has jointly generated is unique.

The key findings of IETU and VITA 34 show that a detailed characteristics of the soil conditions is critical for the success of the approach. Key factors should be carefully analysed such as bioavailability of heavy metals in soil, content of organic matter, physical properties of the soil (compaction) and nutrients availability. Also the field experiments showed that different plant species demonstrate different potential for phytoextraction. For example *Spartina pectinata* demonstrated the most promising potential for phytoextraction at sites contaminated with Pb as the main contaminant (Pb phytoextraction by *S. pectinata* is up to 1.8 kg/ha/during 3 years from contaminared arable land), whereas *Sida hermaphrodita* and *Miscanthus* x *giganteus* for Cd contaminated sites (Cd phytoextraction by *S. hermaphrodita* is up to 0.05 kg/ha/during 3 years and *M.* x *giganteus* is up to 0.04 kg/ha/during 3 years from contaminated arable land). *Miscanthus* x *giganteus* turned out to be promising Zn phytoextractor and can extract up to 6 kg /ha/during 3 years. In terms of biomass production the highest biomass yield was found for *M.* x *giganteus* and *Spartina pectinata* cultivated at Polish site. Comparison of the site conditions in Poland and in Germany proved that the main reasons responsible for the fact that the yield produced in Germany was not as successful as in Poland were soil specific conditions such as high silt and high organic matter content . They may substantially reduce the availability of nutrients accessible to plants. In consequence plants need more energy and water to generate a unit of biomass.

The experiment with the treatment of plants with EmFarma Plus™ showed that the formula could stimulate biomass production of *M.* x *giganteus* and *S. hermaphrodita* however plants response to the treatment are site and growing season specific. The studies carried out joitly by IETU, HMGU and Probiotics fellows focused on the effects of the inoculums application on the structure and function of the soil microbiome showed a clear positive effect on the plant growth thus the production of the biomass.

The works on the development of a prototype new inoculum promoting the growth of energy crops growing on heavy metal contaminated soils were focused on the three selected *Pseudomonas putida* strains. They were investigated for transcriptional response under metal and antibiotic stress, minimum inhibitory concentrations (MIC) of Pb, Cd and Zn as well as eleven selected antibiotics used in veterinary treatments. Based on the preselected 3 *Ps. putida* strains were selected. The composition of the prototype of bioinocula was further optimised. A composition for the prototype formula has been proposed: component "A" – freeze dried P. putida biomass, component "B" – NaCl solution (0.85%), and component "C" – growth medium (4% molasses solution +1% inulin). To establish the above composition of the prototype formula growth medium under the batch and bioreactor conditions was tested. Traditional microbiological media and agro-industrial waste were tested. A liophilization procedure was developed for the mixture of the strains and each strain alone. Conditions of liophilization procedure were also evaluated such as temperature and pressure. Unfortunately, despite our plans the experiment with the application of the prototype formula in field conditions had to be suspended. Recent scientific developments suggest that some of the Ps. putida strains may pose potential risk to human health. The three bacteria strains that we have been analysing in the project were of indigenous origin and had been isolated from the rhisosphere of our test plants. However in order to eliminate the potential risk further detailed studies of these strains would need to be conducted by specialized test bodies. These examinations go beyond the scope, budget and duration of the Phyto2Energy project. Instead, the works have concentrated on the optimization of the liophilization process including selection and testing of the lyoprotectant agent, evaluation of the survival ratio of the bacteria in mixture as well as each strain alone. The research also included characterization of the metabolic and biochemical properties of *P. putida* after liophilization process. Some physiological properties of *P. putida* are now evaluated after freeze - drying.

The works will provide a unique knowledge that can be used in the future practice of the company to use liophilisation process as means of the innoculum commercial form.

The last element of the value chain based on the phytoremediation driven energy crops production and biomass conversion into energy that has been studies in the Phyto2Energy project is the gasification process. The gasification tests performed so far provided some interesting observations. For example although most of the heavy metals contained in the biomass are moved into solid products of the gasification, in the case of Cd it has been observed that some of its content may transfer into gaseous form as well. It is an important indication for gasification of fuel with Cd content. Additionally, areas of the possible gasification process operations improvement were identified and tested (SUT, ISPE). Pelletizing of the *Miscanthus* feedstock has been performed. Additionally, halloysite as a catalyst was tested as an additive to the pellets. The mineral captures K and Na in aluminosilicate structures helping eliminate formation of low-melting, corrosive eutectic compound which may affect the process and installation. The use of catalyst resulted also in additional improvement of LHV value. Gasification tests of pellets showed that since the moisture content of pellets is lower than non-pelletized feedstock the low heading value (LHV) of the gasification gas achieved after gasification was higher by 20%. Additionally, pellets are characterized by uniformity of shape, so air gasification during the process can easily penetrate the fuel bed inside the reactor. Fellows worked also on the Cost Benefit Analysis (CBA) of the approach. They implemented improvements in an excel tool for performing CBA concerning the costs of land preparation, cultivation of plants, biomass ha etc.). This tool will be helpful for practitioners e.g. owners or managers of the contaminated sites that may rise interest in setting up plantations of energy crops on contaminated sites for the purpose of producing fuel for gasification or gasification installation owners assessing the availability of fuel for planned installations. The tool may also find application for setting up an innovative business model based on the Phyto2Energy approach.

We have reasons to be proud about the promotion and outreach of the project. Beside organizing regular open seminars with the fellows, thanks to the joint efforts as many as 12 papers were



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submitted for publication in prestigious scientific journals. Results of the project were also presented in international conferences where our fellows gained international recognition.

The poster presented by Urska Zadel from HMGU has been awarded 1st prize on the International Symposium on Biosorption and Biodegradation/ Bioremediation in Prague and poster presented by Alicja Szada-Borzyszkowska on National conference "Current Environmental Issues" (in Polish also has been awarded 1st prize.The AGROSYM 2016 Committee selected the presentaion of the Phyto2Energy results presented by Dr. Marta Pogrzeba the best oral presentation during the VII International Scientific Agriculture Symposium "AGROSYM 2016" hold in Bosnia and Herzegovina.

I would like to use this opportunity to welcome you to the Phyto2Energy open Technical Seminar that will be held on the 2nd October 2017 at the Institute for Ecology of Industrial Areas in Katowice. Our fellows will be presenting the Phyto2Energy developments and practical aspects of the demonstrated approach. The seminar will also be an opportunity for researchers from academia and business sector to learn about the benefits of cooperation under the Maria Skłodowska-Curie Actions.

I cordially welcome you to read more about the developments of the Phyto2Energy project in this newsletter and invite you to follow us on our web site www.phyto2energy.eu and Facebook.

# SAVE THE DATE

# Phyto2Energy - Technical Seminar

## 2nd October 2017 | 10:00-14:00 | Institute for Ecology of Industrial Areas

Phyto2Energy consortium and fellows cordially invite you to attend a Technical Seminar that will present the results of the project. Throughout the three and a half year of Phyto2Energy implementation, we have gained some interesting experiences and worked out new, unique knowledge on the opportunities of implementing a complex approach combining phytoremediation of heavy metal contaminated sites with energy crops production and their conversion to energy using gasification. Our goal in the project was to demonstrate that such approach may become an alternative for managing agricultural areas and postindustrial sites contaminated with heavy metals while delivering an environmental and economic added value. The project has been implemented jointly by fellows from research and commercial sector from such countries as Poland, Germany and Romania under the flag of the 7th Framework Programme of the European Union, in the frame of the Maria Currie – Skłodowska Action: Industry-Academia Partnership Pathways.

### SEMINAR OBJECTIVE

The objective of the seminar is to present and discuss the results achieved after three and a half year of project implementation. In particular we would like to present:

- **Results concerning the applicability of the pre-selected energy crop species such as miscanthus (*Miscanthus* x *giganteus*), virginia mallow (*Sida hermaphrodita*), cordgrass (*Spartina pectinata*), and switchgrass (*Panicum virgatum*) for phytoextraction and phytostablisation and the associated biomass production**
- **Studies on the identification of plant growth promoting microorganisms as enablers accelerating plant biomass production and the clean-up of the contaminated areas**
- **Works on a prototype formula of a bioinnoculum stimulating biomass yield for phytoremediation purposes**
- **Results on converting the produced biomass into energy using gasification taking into account environmental and economic considerations.**

Speakers at the seminar will be the fellows from IETU, Vita 34 BioPlanta, Probiotics Poland, HMGU, SUT and ISPE involved in the implementation of the project.

### WHO AND WHY SHOULD ATTEND

We extend our invitation to:

- students and researchers interested in renewable sources of energy, thermal conversion of biomass, heavy soil remediation,
- farmers interested to establish plantations of energy crops on low quality soils,
- contaminated sites owners,
- companies dealing with gasification equipment,
- biofuel producers,
- institutes and companies dealing with production of biological formula for biomass growth stimulation.

### WHERE AND WHEN

The seminar will be hold on **2nd October 2017** at the Institute for Ecology of Industrial Areas, 6, Kossutha St. 40-844 Katowice, Poland.

Tentative hours 10:00 – 14:00

Detailed agenda will be presented soon on project web site www.phyto2energy.eu

### INTERESTED?

For info about the project visit our web site – address above or contact us:

**Izabela Ratman-Kłosińska**
Project Coordinator
Phone no.: +48 32 254 60 31 ext. 243
Mobile: +48 691 566 888
e-mail: i.ratman-klosinska@ietu.pl

**Marta Pogrzeba**
WP1 Leader
Phone No.: +48 32 254 60 31 ext. 252
Mobile: +48 602 484 667
e-mail: m.pogrzeba@ietu.pl

## OPTIMISATION OF PHYTOREMEDIATION PRACTICES

M.Sc. Swantje Prahl
M.Sc. Kathrin Kopielski
*Vita 34 Bioplanta*

In November 2016 Swantje Prahl and Kathrin Kopielski, spend one month at the Institute for Ecology of Industrial Areas (IETU) in Katowice, Poland, for our first secondment. We are both involved in the Phyto2Energy project in workpackage 1 „Plant species selection and testing for Phytoremediation driven energy crops production at HMC sites", representing Vita 34 as an industrial partner.

During secondment we held a presentation within the IETU seminar about the results on heavy metal uptake at the German field trial. The lecture finished with a lively discussion with the participants from IETU staffs and the University of Silesia, as we focused our presentation on the utilization of the project results from engineering point of view.

Thereby we drew a scenario for a full scale remediation setting, as one main outcome of the project will be the selection of plant species with both, high biomass production and of course efficient heavy metal uptake. After project end we will be able to plan full scale remediation measures using the tested energy crops. Thereby consulting will be possible for expected time needed for remediation, depending on level of contamination and target value(s) for remaining heavy metal concentration(s) in soil.

Commonly for professional reasons the scientist attending the IETU seminar concern themselves with more scientific investigations but less with engineered related topics. This was the reason for the animated discussion that mirrored the great interest of the commercial utilization of project's results.

**Swantje is well experienced in plant biotechnology and is doing her doctor's degree at Vita 34. Within the Phyto2Energy project she is involved in field and laboratory works as well as in statistics and evaluation of test results.**

**Kathrin works as a project manager at Vita 34 is specialized in brownfield and groundwater remediation. For Phyto2Energy Kathrin manages the field trial and planning of sampling campaigns. Additionally, she develop statistics, reports and participate in dissemination activities.**

The secondment offered us new perspectives on being a part of a great and highly qualified consortium, reflecting views from different professions and wealth of experience. The direct cross-interlocking of scientific work according to the latest state and developing of engineered services meets highest standards and contributes significantly to the exchange of knowledge.


**Swantje Prahl (left) and Kathrin Kopielski (right) in the lab of Vita 34, Leipzig - Germany**

Overall, it is to be emphasized that also the exchange of Polish colleagues to Vita 34 was constantly a surplus value for us and our colleagues as all participants benefitted remarkably from each other expert knowledge and experience.

## DEVELOPMENT OF THE NEW INOCULUM

M.Sc. Urška Zadel
*Helmholtz Zentrum Munich, German Research Center for Environmental Health (HMGU)*

As a fellow in Phyto2Energy project I am involved in the work package 2 that is investigating plant-microbe interactions for improving the biomass production and remediation on heavy metal contaminated land.

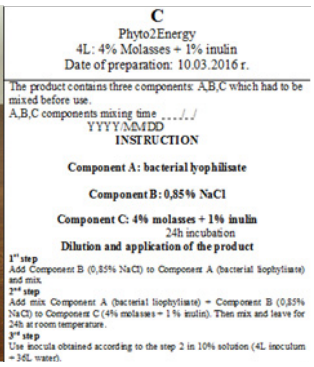
In August 2016 I traveled to Poland to start my first secondment in a company ProBiotics, more specifically in their Microbiology department in Turek. There I was introduced with their department work focuses and some of the current projects. After the short introduction of my work at my home facility we started with work on Task 2.6 Laboratory microbiological work on the new inoculum – data collection. During the project we obtained bacterial isolates from energy plants growing on metal contaminated site in Poland and tested them for plant growth promotion (PGP) properties. Those isolates mainly belong to genus Pseudomonas. In order to better understand dynamics of expression and regulation of genetic treats responsible for metal resistance those isolates were first tested to assess a range of resistance to heavy metals. Further, resistance to heavy metals can co-occur with antibiotic resistance. To further analyze this potential co-expression we had to determine inhibitory concentrations of a range of commonly used veterinary antibiotics that are therefore also commonly present in soils.

My second visit to Poland was in March 2017. There I was introduced into Community analysis using the Biolog MicroPlates and also received an introduction into work with a lab scale bioreactor. My main work there was based on a Task 2.8 Isolation and biochemical characterization of indigenous metal-resistant bacteria from soils and plants tissues, identification of pathogenic fungal species, optimization of inocula composition, testing indicator system for phytoremediation effect. Some plant growth promoting bacteria can efficiently control soil-borne diseases by suppression of several plant pathogens and antibiotics production have been proven to play a major role in this process. Since bacteria with those characteristics prevent the loss of plant biomass due to diseases, we wanted to evaluate our isolates for production of anti-fungal metabolites. On that topic my work was based on optimization of the analysis.

Research stays gave me the opportunity to get an insight into work in the industry. For a scientist this is a nice experience because the scopes of academia and industry are lots of times different and for an efficient collaboration towards applicable goal mutual understanding is important. Exchange also improved our collaboration and enabled me to meet people from different departments and discuss with them their areas of expertise. Hospitality of host organizations also introduced me into their culture and I had an opportunity to discover their cuisine and some other parts of their beautiful country.

**Urška - experienced in microbial biology. She is involved in Performance of greenhouse experiment and determination of changes in microbial communities when exposed to metal stress. Sample and analyze changes in microbial communities in field samples. Urska started her secondments in August 2016.**


Liophilisation of Pseudomona putida strains for the new inoculum




Components of the new formula

## BIOMASS AS A LOCAL ENERGY CARRIER

PhD Valentin Rusu
M.Sc. Elena-Cristina Tomescu
*Institute for Studies and Power Engineering (ISPE)*

In October 2016 we traveled to Poland to start our first secondment in the Silesian University of Technology (SUT), more specifically in the Institute of Thermal Technology in Gliwice. Togther with Elena, we are involved in WP3 - Biomass valorization and use as local energy carrier. Our work is focusing to identification of areas for process operations improvement, development of a cost effectives and environmental benefits analysis for gasification of HMC biomass and gasification tests of biomass with char/ash sampling, TGA+FTIR tests.

As a dissemination and outreach activities prepared together with the WP3 Leader a seminar, where we have presented waste-to-energy projects in Romania and Romanian experiences in municipal solid waste system. The seminar took place on 18th October 2016 at SUT premises (Institute of Thermal Technology, Gliwice).

**Elena - Cristina Tomescu is involved in Phyto2Energy project as early stage researcher from Industrial Partners from Institute for Studies and Power Engineering (ISPE), Romania. Elena is specialist in biomass valorization; specialist in remediation technologies for contaminated soils and groundwater and specialist in solid waste landfill closure and monitoring.**

**Valentin Rusu is is a PhD expert in environmental legislation in Romania and implementing EU directives, strategic environmental assessment for plans and programmes, environmental impact assessment studies and environment balances required to obtain environment approvals and operation authorizations for various objectives and waste management consultant.**

We had the opportunity to attend also at the Institute for Ecology of Industrial Areas (IETU) to the seminar related to the chosen physiological parameters analysis of Miscanthus x giganteus and Spartina pectinata cultivated on soil contaminated with heavy metals, presented by Szymon Rusinowski. At this seminar which took place on 20th October 2016, our colleagues from ISPE team, Ioana Cristina Dima and Iuliana Cardasol prepared overview of the project and activities in WP3, in which ISPE is involved and the RES potential in Romania, especially in biomass production.

Poland is a beautiful country with a rich and fascinating history. I stayed during the secondment in Katowice, but my favorite city in Poland is Kraków, a city where tradition meets modernity in full harmony.

For us the participation in Phyto2Energy project and our secondments to SUT are a great opportunity to improve and exchange our professional experience.

## FINAL LAB TESTS AND ANALYSES OF BIOMASS

M.Sc. Ioana-Cristina Dima
*Institute for Studies and Power Engineering (ISPE)*

In Phyto2Energy Project the main task where I am involved is Task 3.7 Final lab tests and analyses of biomass as biofuel feedstock according to the defined control parameters.

In October 2016 I traveled to Katowice, Poland in order to accomplish my secondement. I participate also to Seminar: Waste-to-Energy Projects in Romania; Romanian experiences in municipal solid waste system, which has been organized by the Institute of Thermal Technology, SUT. ISPE Fellows presented waste-to-water Projects in Romania and Romanian experiences in municipal solid waste system. The Seminar took place 18th October 2016 at SUT premises (Institute of Thermal Technology, Gliwice). Elena Cristina Tomescu and Valentin Rusu from ISPE prepared 2 presentations.

The work inside of the P2E project supports me to find how useful is the exchange experience between the research division and industrial partners.

During the secondment at IETU, I had the opportunity to participate in IETU Seminar related to the chosen physiological parameters analysis of Miscanthus x giganteus and Spartina pectinata cultivated on soil contaminated with heavy metals, presented by Szymon Rusinowski,

IETU and the role of the ISPE partner in Phyto2Energy Project were presented by Ioana Cristina Dima and Iuliana Cardasol, ISPE and took place on 20th October 2016.

We prepared an overview of the project and activities in WP3, in which ISPE is involved to and characterized RES potential in Romania, especially in biomass production.

Session participants asked many detailed questions. The discussion was an important element in organizing research results. The session was an important element to promote the project topic to broad group of the scientist's representatives.

The role of the ISPE partner in Phyto2Energy Project presented by Ioana Cristina Dima and Iuliana Cardasol on 20th October 2016 - IETU

**PHYTO2ENERGY AWARDS 2016/2017 FOR:**

**The best oral presentation** - Macroelements and heavy metals content in *Panicum virgatum* cultivated on contaminated soil under different fertilization - Marta POGRZEBA, Jacek KRZYŻAK and Szymon RUSINOWSKI

**1st prize poster** - The influence of different soil fertilisation on arbuscular mycorrhiza colonisation and heavy metals accumulation by *Miscanthus* x *giganteus* - Alicja SZADA-BORZYSZKOWSKA, Katarzyna NOWAK, Jacek KRZYŻAK, Szymon RUSINOWSKI, Maciej SOJA, Marta POGRZEBA

**1st prize poster** - Assessment of Plant-Associated Bacterial Community of *Miscanthus* x *giganteus* and its response to metal stress - Urška ZADEL, Joseph NESME, Viviane RADL, Bernhard MICHALKE, Peter SCHRÖDER, Michael SCHLOTER

Moreover from the discussion with the seminar participants we try to identify the common and complementary interest of research area for IETU and ISPE. This information can be used in the future for the new research project proposal.

The secondments are about giving people access to experiences and opportunities that they wouldn't get in their current role. The process gives secondee employees to expand their career development.

The secondment period in IETU was favorable for me to get in touch with the research work. Visiting the lab offered me the chance to use its facilities for the proper performance of the research work.

I have the opportunity to talk to people from different departments within the institute during the secondment. I also had the occasion to exchange ideas and discuss about topics of common interest in our research.

The collaboration with experienced researchers from the project network help me also to improve my communication skills on the oral presentation and the capacity to write scientific articles and project proposal.

P2E project also offer me an additional opportunity to discover Poland culture, cities and cuisines and to find more about the UE diversity and common values.

For ISPE it is very important to collaborate and to remain closer to the academic research teams in order to have direct access to the state-of-the-art research results and to develop in this way competitive and sustainable products, also build a sustainable working relationship with IETU.

P2E project results and connection can use on the future to develop a business plan for a sustainable techniques to clean the soil and to produce green energy. The quality of the obtaining results can attract more EU and local funds for research for techniques development and appliance. It was a very fulfilling and productive experience that surely helped me in my organisation.

**ISPE Fellows in IETU: (left) Valentin Rusu, Elena-Cristina Tomescu, Iuliana Cardacol, dr. Marta Pogrzeba (IETU, WP1 Leader), Szymon Rusinowski (IETU), Ioana-Cristina Dima, dr. Sebastian Werle (SUT, WP3 Leader)**

## 3RD YEAR TRANSFER OF KNOWLEDGE ACTIVITIES

| | |
|---|---|
| 14 | Researchers on Secondments |
| 8 | Experienced Researchers |
| 6 | Young Researchers |
| 26 | Secondments between academia & industry |
| 22 | Personmonths spent by researchers on secondments |
| 9 | Internal trainings & seminars |
| 1 | Project Meeting |
| 33 | Outreach & project promotion activities |
| 9 | Conferences |
| 5 | Open seminars for general public |
| 3 | Posters |
| 10 | Articles |
| 4 | Abstracts published |
| 2 | Broadcast |

## PROJECT DETAILS

PROJECT FULL TITLE:

**Phytoremediation driven energy crops production on heavy metal degraded areas as local energy carrier**

PROJECT ACRONYM: **PHYTO2ENERGY**

PROJECT SCHEME:
**Industry-Academia Partnerships and Pathways**

GRANT AGREEMENT NO.: **610797**

CALL IDENTIFIER: **FP7-PEOPLE-2013-IAPP**

PROJECT START DATE: **February 1st, 2014**

DURATION OF THE PROJECT: **48 months**

## PROJECT CONSORTIUM

### Project co-ordinating unit:

IETU

**Project Co-ordinator**

*Izabela Ratman-Kłosińska*

Institute for Ecology of Industrial Areas (PL)

ul. Kossutha 6, 40-844 Katowice, Poland

e-mail: i.ratman-klosinska@ietu.pl

phone no.: 322-546-031 ext. 243

### Project partners:

HelmholtzZentrum münchen
Deutsches Forschungszentrum für Gesundheit und Umwelt

Helmholtz Zentrum München, German Research Center for Environmental Health GmbH (DE)

ISPE

Institute for Studies and Power Engineering (RO)

ProBiotics Polska

ProBiotics (PL)

Silesian University of Technology, Institute of Thermal Technology (PL)

VITA 34 THE STEM CELL BANK
BioPlanta

VITA 34, BioPlanta (DE)