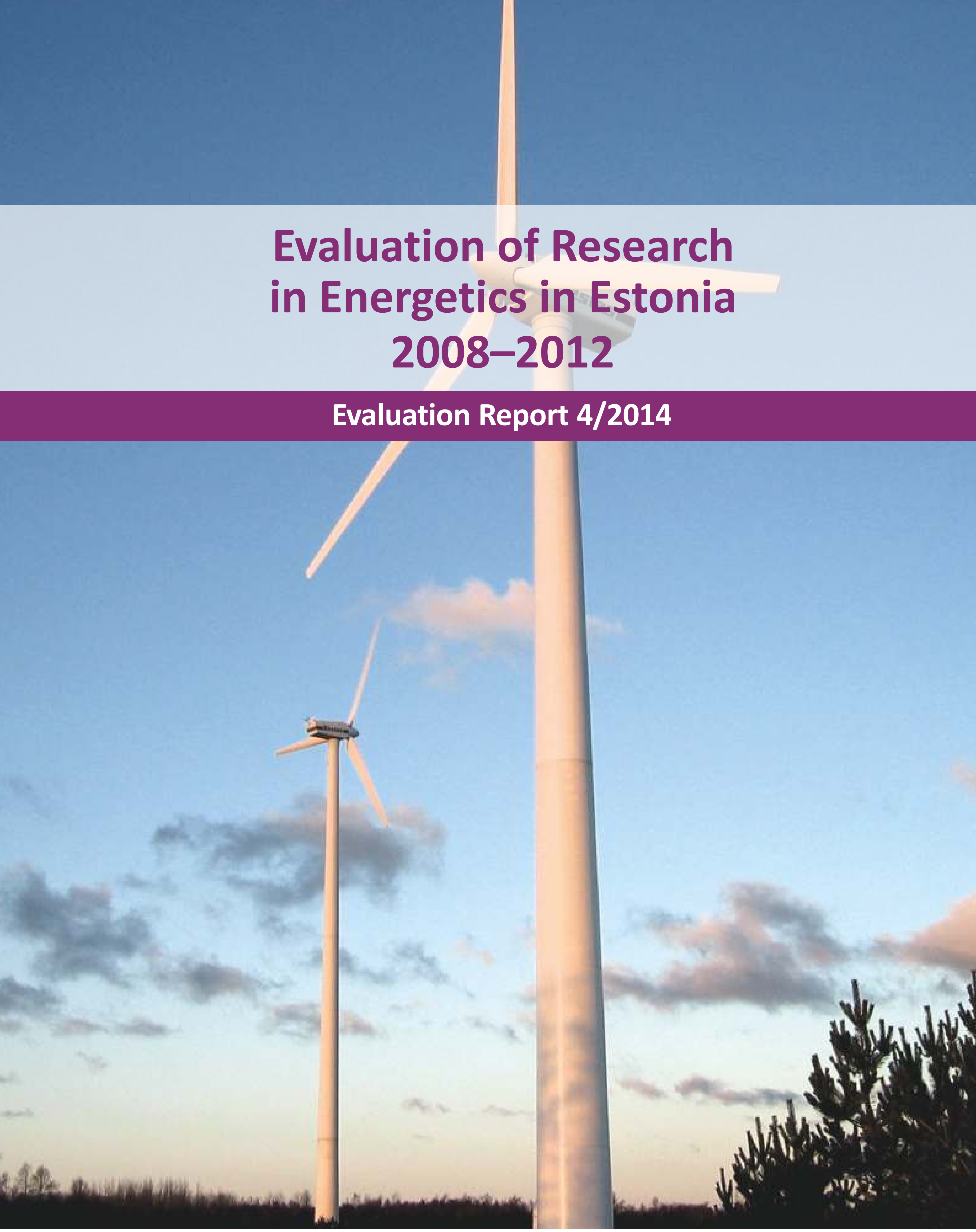
Evaluation of Research in Energetics in Estonia 2008–2012

Evaluation Report 4/2014



Eesti Teadusagentuur
Estonian Research Council

Evaluation Report 4/2014

EVALUATION OF RESEARCH IN ENERGETICS IN ESTONIA 2008–2012

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1. Preface

Estonia is a member of the European Union since 2004 and of the euro zone since 2011. In the vicinity of the other Baltic countries and Finland it has developed to a developed industrialized country. Although small, its educational and research infrastructure includes several universities and a number of research institutes. Considering global efforts to curb emissions of greenhouse gases and dwindling resources, especially in the energy area, a strategy how to develop an energy infrastructure for the future that serves environmental needs but also specific national political and societal aspects is necessary. An integral part of such a strategy is to establish a research infrastructure in Estonia that is internationally competitive and at the same time serves the interests of the country in terms of economy and infrastructure.

On these grounds the Estonian Ministry of Education and Research in cooperation with the Ministry of Economic Affairs and Communication initiated an evaluation of the Research in the area of energetics in Estonia. The goal set for the international evaluation by the Steering Committee was to assess the research quality, the significance of public and professional activities to Estonian society and quality and relevance of training of young researchers. The institutional assessments involved Tallinn University of Technology, National Institute of Chemical Physics and Biophysics, Estonian University of Life Sciences and University of Tartu. A six-member committee was formed and site visits to Estonia took place in the end of September 2013.

As all Estonian research and educational institutions in the domain were involved, the Evaluation Panel saw a picture in the full sector with very big importance for Estonia. On behalf of the Steering Committee I would like to thank all panel members for their commitment and contribution throughout the evaluation process.

Professor Enn Mellikov, Chairman of the Steering Committee
Tallinn, April 2013

2. Executive Summary

On the background of developing a future strategy in energy research, the Estonian Research Council established a committee of foreign experts to evaluate the current status of research and to initiate recommendations for future developments. The committee visited four research institutions: the Tallinn University of Technology (TUT), National Institute of Chemical Physics and Biophysics (NICPB), Estonian University of Life Sciences (EULS) and University of Tartu (UT). The committee found that major areas of energy research are represented at these institutions, while the quality of research varied considerably compared to an international level. The education of PhD students generally follows a fairly rigorous scheme which appears very good. However, differences in conditions and payment, even within one organization, should be eliminated. International exposure, an important educational element, should be made compulsory for students in the PhD programmes by requiring research stays in foreign countries. The evaluated areas covered science and engineering-related energy research. The number of research topics was generally sufficient, covering most of the necessary areas. What was consistently missing was an interconnection with computer science and informatics. Any future energy infrastructure needs a highly developed degree of IT involvement in order to deal with the complexity of energy supply and consumption, specifically in the context of renewables. The various research areas were rather independent of each other; interdisciplinary approaches, necessary because of the complex structure of energy research, were largely missing. While there is a certain specialization of the evaluated institutions, e.g., engineering and materials science at TUT, physical techniques at NICPB, bio-related energy research at EULS, and electrochemical energy research at UT, an overarching concept of interaction and collaboration between the institutions is practically non-existent. While we understand that people feel more locally oriented in a small country like Estonia, it is essential to pool forces to set-up schemes, where the various parts contribute to a national concept in a complementary way. Such a national plan should be developed based on the expertise of research institutions, requirements of the business sector, needs of the people and the national necessities of the government. Future funding should primarily be oriented towards the quality of research, by having international panels evaluate research proposals (as in Scandinavian countries) and by increasing involvement in European research (i.e., Horizon 2020). Incentives should be provided to reach these objectives. Estonia has the potential to develop a modern energy infrastructure, given its natural resources. In order to accomplish this, it needs an internationally competitive energetic research base that can even develop to be the model for the Baltic Sea area.

3. Introduction

The evaluation committee from four different European countries (the list is in the appendix) compiled this evaluation on the basis of material provided by the research institutions, information available on the internet and on-site visits to all locations mentioned. During the visits, discussions were conducted with the leadership of the respective institutions, as well as the professors, researchers and PhD students involved in energy research. The purpose of the evaluation is to identify the current strengths and potential improvements. It also addresses how such research can be embedded in the national strategy for an Estonian energy infrastructure.

4. Evaluation of Institutions

4.1 Tallinn University of Technology

4.1.1 Quality of Scientific Research

Tallinn University of Technology (TUT) is the leading engineering R&D University in Estonia. This statement is also valid with regard to the field of energetics, which absorbs approximately one fifth of the research expenditure at TUT. The research in this field is of international quality for some areas, including material sciences, power electronics, and parts of oil shale combustion, and power-system dynamics and control. There have been investments into equipment and other allocations that should enable significant research outcomes to emerge with respect to aspects of demand-side management and micro-grid management. It is difficult to estimate the quality of the planned research on oil shale combustion techniques with or without the co-firing of biomass. The research outcome in oil production from oil shale and energy-efficient buildings has yet to reach a consistent international standard. Also, interaction should be established between faculties dealing with energetics on the one side, and faculties of information technology and social science on the other side, with a view to more interdisciplinary projects being developed.

In the following section, some departments are discussed in greater detail.

4.1.1.1 Department of Material Science

There is a clear orientation towards inorganic and organic material research for photovoltaics in the Material Science group. Common techniques studied include thin film deposition, sol-gel, electrochemical and spray pyrolysis together with metallic nanoparticle modification. Also, new approaches are pursued using active particles embedded in polymer matrix. Various characterization techniques are used, such as XPS, UPS, X-ray, SEM and Raman microscopy. A minor aspect of the research is geared towards hydrogen production, where only photo-electrochemical water splitting is being investigated. Internationally-recognised research on the electrical and optical properties of photovoltaic materials has studied the formation of different materials and determined their chemical composition and structural defects. As a part of a National Centre of Excellence, the laboratory of thin-film chemical technology in the Department of Materials Science is undertaking internationally important research on solar cells; work is done to achieve the low-cost manufacturing of solar cells (now at pre-prototype commercialisation) and photovoltaics based on a layer of zinc oxide nano-rods formed by chemical spray pyrolysis. Research is complemented with small-scale device fabrication and performance characterisation. In addition, research in powder technologies is undertaken at the Chair of Semiconductor Materials Technology.

Doctoral students in the group come from 10 different countries. The work of this group is connected to a Centre of Excellence. The work corresponds to international standards and is internationally competitive. In terms of exploiting the knowledge, a connection with device development and possible integration into electricity supply systems is not yet observable.

4.1.1.2 Departments of Electrical Engineering and Electrical Power Engineering

TUT is Estonia's only university with expertise in power systems and high voltage engineering, and the optimization of electric energy systems. Given the age profile of academic staff, it is essential that new staff be selected and appointed on the basis of a clear strategy to develop areas of real or putative research strength. Although there is a fairly large number of publications, their impact is rather limited, as the majority of the publications are not published in leading international journals. While there are longstanding connections with the Baltic States and Finland, broader international links (e.g., USA, UK, other western European countries) need to be created.

Emerging research on intelligent networks and power electronics, especially on DC/DC converters is being performed. This is interesting work and has also resulted in international publications. The group should focus more on science and make an effort towards achieving high-quality publications (majority in peer reviewed international journals), and, thus, greater scientific impact.

It is evident that research infrastructure and capabilities are sufficient for research in the field of electrical drives and machines. However, contemporary critical research issues must receive focused attention.

4.1.1.3 Departments of Thermal Engineering and Chemical Engineering

Much of the current energy-related research in these Departments focuses on the combustion of oil shale. The specific research activities include measurement of fuel properties, preparation of samples, oxy-fuel combustion, modelling of circulated fluidized-bed combustion chamber, and reduction of corrosion and pollutants (including carbon dioxide from minerals). It is planned to study pyrolysis and the co-combustion of biomass in a new modern laboratory.

The research work of these groups is original particularly due to its distinctive focus on oil shale as fuel. The quality of work is good and group members are internationally leading researchers on the subject of converting oil shale energy into electricity. However, considering the importance of oil shale for Estonia, there are some significant deficiencies:

a) research on the conversion of oil shale to liquid fuels is very limited

b) it is not evident that excellent new equipment is used in an effective way to maximize research capabilities and results

c) capabilities and activities connected with process simulation need to be supported to a significantly greater extent.

The groups involved should work together to develop a new strategic orientation towards key processes for various possible uses of oil shale and key by-product materials. The trade-offs between thermodynamic performance and costs need to be studied extensively for these processes. Finally, an increase in internationalization and interdisciplinary work would improve the performance. The research activities of these groups are very relevant for the industry and government of Estonia and the country's future energy policy.

Oil shale-related activities, research into oil shale properties and thermal conversion of oil shale have changed direction towards more internationalization in an attempt to connect with wider audiences. Since there obviously is technical and scientific competence, these should be applied in other fields additionally to Estonian oil shale.

Research on nearly zero energy buildings conducted at the Department of Structural Design focuses on durability and energy performance simulation. Research activity lacks critical mass (with respect to scientific output) and the impact of the work on the field internationally has been limited to date. There are good links to the Federation of European Heating, Ventilation and Air-conditioning Associations and to similar research work, particularly in Finland. As the work of this group has a high societal impact, staff questions should receive more attention and activities should be enhanced, since energy saving issues can be most pronounced in the building sector.

4.1.2 Research Environment and Organisation of Research

TUT aspires to be an internationally leading research university that fully participates in the Estonian society and stays engaged with the industry. It has 14,500 students, of whom 1,000 are foreign. It is the leading engineering research and development university in Estonia. 19.4% of their research is done in Energetics; of which 34% in energy resources and power generation, 29% in energy generation, 21% in materials for power generation, 9% in thermal engineering, and 7% in societal energy policy, economy and safety. Recently, substantial investments have been made into buildings and equipment. It seems that there is an adequate amount of space and sufficient equipment for research into energetics.

4.1.3 PhD Education

A PhD-degree programme is supposed to be completed in four years, three papers are required to be published before program completion. The actual average graduation time at TUT is approximately 5.5 years. The curriculum is based on faculty decisions. There are several Doctoral Schools, including Energetics and Geoengineering. Doctoral Schools appear to be very helpful to students in completing their degrees. State-paid full-time stipends amount to about 400 €/month. Now a new stipend system is in place (23 days old). About half of the PhD students also work in the university, whereas some other PhD students are employed by industry. The university has a vice rector for entrepreneurship and international affairs.

Fifteen (10 men and 5 women) PhD students from TUT were met formally during the evaluation. Most had chosen an aspect of energetics as the topic of their PhD dissertation because it was a natural continuation of their MSc studies. This group of students saw both the jobs prospects in Estonia and opportunities to lecture abroad as attractive.

Some students indicated that the co-ordination at the start of their research projects could be better. The students make annual reports to their supervisors. Mechanisms for the annual evaluation of supervisors by students are, at best, informal; although it was noted that students were aware that older professors often seem less eager to supervise. National Doctoral Schools seem to have provided opportunities for informal reviews of papers before publication. About half the PhD theses are essentially collated publications. Some PhD students do help in laboratory work and some assist in teaching. About 50% had visited other research laboratories elsewhere, something that was valued very positively.

4.1.4 Interaction between Research and Society

In many areas the non-teaching work consists in development and testing rather than research; this is undoubtedly valuable to industry and society, and, indeed, to teaching. However, a suitable institutional context needs to be developed, ensuring that development and testing do not get confused with, or dilute in research activities.

4.1.5 Recommendations

Only 9% of TUT research is on the subject of thermal issues and buildings. To achieve critical mass, this field has to grow, and the underpinning capabilities must be augmented, particularly in the field of analytical heat and mass transfer.

Given the limited involvement (8%) in FP7, greater attention should be paid to pursuing the opportunities for European research funding in Horizon 2020.

The overall coordination of energy research across TUT should be improved to ensure clarity and coherence of strategy and its implementation. Research expertise seems to be held by temporary research staff; lecturers and associate professors can have high teaching loads leading to limited engagement in research. This will continue to present challenges in implementing a truly sustainable research culture.

As more than 80% of electricity is currently generated from oil shale, TUT should pay particular attention to research that determines how and in what circumstances it would be better to convert oil shale to liquid fuels and retort gas for power production, while further developing research in the renewable energy area, also in co-operation with the Estonian University of Life Sciences.

Consideration needs to be given as to how the Faculty of Information Technology and Faculty of Social Science should interact with, contribute to, and help define the scope of energetics research at TUT. The university should consider how they can engage their excellent resources in informatics to adopt a distinctive field in energetics research that would have the potential of being at the forefront internationally.

It is recommended that the 130 current PhD students in energetics, particularly across the different departments in engineering, should be organized as cohorts within much larger and broader research groups. This would enhance synergies and allow experiences and equipment to be shared more effectively. The funding model for PhD students needs amending to accelerate the completion of high quality doctoral studies. At present the financial need to do often unrelated work slows down the progress of PhD thesis.

4.2 National Institute of Chemical Physics and Biophysics

4.2.1 Scientific Quality of Research

The research done in the National Institute of Chemical Physics and Biophysics (NICPB) is related to materials research for SOFC; in particular, new electrolyte materials are investigated. Solid state nuclear magnetic resonance (NMR) is well suited for studying the molecular mechanism of charge transport, and analysing high vacancy structures in ceramic materials. The institute is highly competent in successfully applying NMR to various problems. The purpose of research on new spin materials is reaching at understanding of the structure and structure–function relationships in materials, using nuclear magnetic resonance facilities, as well as THz and Raman spectroscopy methods. These materials may find use in next generation fuel cells, Li-ion batteries and super-capacitors. Research into the toxicology of metal-oxide nanoparticles is well cited. It seems that cooperation is limited to one company, who offers partnership in the context of a larger research project, for the purposes of which investigations are performed. An obvious link to a group at the University of Tartu does not seem to exist formally or is not evident. There is research on CO_2 sequestering using activated kinetics and current research and treatment of oil shale ash from combustion and retorting facilities. Synthesising calcium-alumino-silicate hydrates from oil shale ash is studied for the production of geo-polymers. Research is used to develop an overall strategy for recycling different oil shale solid wastes.

4.2.2 Research Environment and Organisation of Research

Energetics research at the NICPB forms a small part of fundamental research activities in the characterisation of material properties. A substantial computational, NMR, THz and low temperature infrastructure has been created. To link NICPB to the goals and priorities of both Framework 7 and Horizon 2020, an International Science Advisory Board is in place.

4.2.3 PhD Education

NICPB does not award PhDs by itself. PhD students come from partner Universities and are involved in projects that use the laboratory facilities. The PhD students are supervised by qualified NICPB staff.

4.2.4 Interaction between Research and Society

The programme focuses on solid-oxide fuel cells (SOFC), particularly on materials' degradation in cooperation with Elcogen Ltd. The toxicology research has influenced the classification, and, thus, waste treatment policies and procedures for handling fresh-coke, a by-product of the oil shale industry.

4.2.5 Recommendations

The NICPB should find use formally as a national platform resource to ensure the greater use of the world-class facilities by researchers elsewhere in Estonia.

4.3 Estonian University of Life Sciences

Similarly to institutions in many countries, the Estonian University of Life Sciences (EULS) has evolved from a typical agricultural university to a more broad-based life-science university in recent years. These changes should be managed carefully to maximise their impact on the Estonian economy and society. EULS performs studies in fields related to sustainable energetics, promotes interdisciplinary research between technical sciences, biosciences and environmental sciences in order to create synergy between energy engineering, biomass production, waste management, and energy efficiency of buildings, in-line with European Union research priorities. During the evaluation period, 9% of EULS carried out research on energetics. In 2008–2012 the EULS staff wrote 959 publications of which 30 (3.5%) directly relate to energy; 1 patent was registered, and some other publications indirectly related to energy were also published (EULS's research focus is on small-scale energetics, while topics in large scale energetics are addressed at Tallinn University of Technology). Approximately 85% of EULS research in energetics relates to renewable energy. Research output, if at an international level, is useful for the Estonian society and beyond.

The quality of scientific research varies within EULS. There is significant expertise in biomass production and in the environmental aspects of energy utilisation. Research on these topics is at an international level and contributes to the Estonian economy and society. Research outcomes will have a significant impact on the expanded utilisation of biomass in power generation and heating applications. More collaboration with other Estonian institutions and enterprises especially from the private sector may improve the research.

4.3.1 Quality of Scientific Research

4.3.1.1 Forest industry, including short rotation forests

Forest industry studies are focused on the utilization of wood energy. Studying short rotation forests is a new part of the forestry research, focused on ecology, biomass productivity and biodiversity of plantations. Short rotation forest research is very promising and is aiming for the international level. Research on energy efficient utilisation of wood and various wood-derived biofuels provides useful results. Research outcomes have attracted significant attention in the Baltic/Nordic countries. This research would greatly contribute to the woody biomass potential in Estonia that could be used for supplying bioenergy.

4.3.1.2 Biomass from energy crops

According to evaluation from different perspectives, biomass energy resources are to contribute to the increasing bioenergy potential in Estonia and may facilitate the development of a sustainable bio-economy. The team of researchers seems well qualified and oriented towards new techniques.

4.3.1.3 Energy engineering

The main subtopics relate to the production and use of renewable energy carriers. Research outcomes may have importance with regard to the embedded utilisation of renewable energy sources, and distributed power generation. The publications are few and poorly cited. This research is not competitive internationally in its current form. As it is important for Estonian economy and society, synergy could be achieved through cooperation with TUT.

4.3.1.4 Land resources management

GIS-based assessment of agricultural land and land's suitability for growing energy crops is an important topic for EULS and its research activities in the field of forestry and biomass production from energy crops. To have real impact on EULS research and the entire Estonian economy, higher scientific quality is required.

4.3.1.5 Biogas

Studies are carried out by a Unit of Bioconversion of Crops and Wastes (UBCW). Although various EULS specialists seem to be involved, the research expertise is still insufficient to be relevant for the field of biogas-energy. International collaboration with other groups is strongly recommended.

4.3.1.6 Bioenergy technologies

Research on the use of biofuels for transportation is on a national level. There are too few publications with almost no citations. G2 and G3 biofuels are currently being researched in several labs worldwide and the research at EULS is not innovative. Engine research with regard to combustion and heat transfer lacks expertise; in its current form, it has a very small impact on the Estonian economy and is scientifically irrelevant internationally. Collaborative projects with partners having a strong technical background should be developed. Research on the cost-benefit analyses of the cultivation of energy crops is promising, but more economic and social expertise is required to achieve an impact.

4.3.2 Research Environment and Organisation of Research

Many research topics addressed are mature and the EULS contribution to existing knowledge is often minor. To have real impact, research into energy engineering, bioenergy and biogas technologies needs to be carried out in much closer collaboration with experts from other institutions. With some exceptions, research staff needs more international experience. The involvement of EULS in international research networks and collaborative international projects needs improvement.

The Estonian University of Life Sciences focuses its research activities on the management of sustainable natural resources. There are 76 persons involved in energetics-related research. Substantial structural fund investments have been made into laboratory equipment since 2008. A cross-university Centre of Renewable Energy is in place (established in 2006) to strengthen and coordinate renewable energy research activities. 85% of research in energetics is done in the area of renewable energy.

According to the EULS staff and PhD students, the Centre of Renewable Energy facilitates internal collaboration and dissemination of information at the EULS level. However, the role of the Centre of RE could be improved by the Centre assuming a more strategic role and acting as an umbrella institution to energy research at EULS.

Research equipment, especially devices used for high quality research, is sometimes outdated or insufficient for carrying out energetic research at an international level. In some topics, there seems to be a lack of strong professor-level leaderships and top quality scientific know-how.

4.3.3 PhD Education

There are 32 PhD students in engineering, supervised by 10 professors. 20–25% of PhD students work outside the EULS, the remainder being paid from ongoing research projects. Some PhD students help carry out laboratory work and some assist in teaching. About half had visited research laboratories elsewhere. 7 PhD students came to the meeting with the members of the evaluation panel.

All PhD students need at least 3 publications to be allowed to defend their theses. Many PhD students benefit from international technical expertise outside EULS.

At EULS, PhD students go abroad twice a year to collect international experiences. Three different funding streams provide support for up to one semester abroad. Energetics related PhD students from EULS participate in the national energy doctoral school, funded from EU sources. PhD students are ambitious and motivated; they are interested in their topics and seem motivated to achieve practically useful results.

PhD topics are sometimes more agricultural or environmental than of a technical nature. The critical mass for PhDs in energetics is not there and, therefore, the PhD programmes in energetics need improvement.

4.3.4 Interaction between Research and Society

EULS is currently at a stage of changing its profile from an agriculture-oriented university to life science-oriented university. One of the adopted directions is involvement in renewable energy, which is and will be of significant importance for Estonia. However, EULS is unable to carry out renewable energy research at an international level in all topics, and EULS expertise is insufficient on the PhD level. It may take a few years to elevate the research quality in energetics to an international level. If the activities benefiting from international expertise were expanded, they would accelerate the internationalisation process.

EULS could play an important role in developing bio-economy and low-carbon economy. Estonia has a huge biomass energy and wind energy potential, and can become a strong and at the same time low-carbon economy, when the domestic oil shale reserves are also taken into account. Estonia can, thus, achieve some environmental/climate protection related advantages over other countries in Europe. This will increase the competitiveness of the Estonian economy as a whole through supplying inexpensive low-carbon energy in the country.

4.3.5 Recommendations

Some topics are addressed on an international level and they only need more international visibility and improved knowledge transfer from the EULS to the economy and society. However, in case of some topics, significant improvement, collaboration and new priorities are needed. In general, higher-level technical expertise must be engaged for underperforming topics to raise the quality of scientific research to international standards. This would improve the utilisation of expensive equipment already in place. The institution's policy of academic output requires review and taking appropriate action. More international collaborative research projects are strongly recommended.

Renewables based on biomass and waste will play a much larger role in the future. EULS should upgrade research quality and raise the research input in this area to a high international standard. Bioenergy topics should be addressed in parallel with other bio-economy topics like food production and forestry to exploit trans-disciplinary synergies. The Centre of Renewable Energy should develop an integrated strategy built on current expertise and extend it to become the umbrella institution of energy research at EULS. The Centre should be more actively involved in transferring knowledge involving EULS research outcomes into the Estonian economy and ensuring more benefits to the Estonian society.

There are two types of PhDs, funded by government and the university; the latter are evaluated twice, the former once, per year. This inconsistency should be eliminated. It might be considered that some PhD students at EULS should be obliged to have co-supervisors from Tallinn University of Technology or from international universities to improve quality.

4.4 University of Tartu

Research in Energetics in University of Tartu (UT) seems to be focused on a few specific areas.

4.4.1 Scientific Quality of Research

Research activities include carbon preparation and characterization, and defined pore size distributions. Carbon is used as catalyst support for PEMFC and as electrode material in super-caps. Adsorption processes (of hydrogen, methane) in carbon are also evaluated for energy storage potential. Materials are prepared through layer-by-layer deposition using e-beam and sputtering.

For super-caps, membranes are evaluated as separators, and ionic liquids are tested as electrolytes. So far, the largest capacitor made is 4000F at 3.2 V (approx. 150–200 ml volume). For PEMFC, self-made cells were evaluated. For SOFC, different cathode materials; influence of porosity; alternative anodes (no Ni) on a ceramic basis, used for methane direct oxidation, 0.3 W/cm^2; proton conductors; and contamination problems were evaluated. Premises include a clean room for preparation of SOFC (and other) materials.

Analytical work is performed in the fields of reaction analysis, spectroscopies, and scanning probe techniques. The infrastructure (labs and equipment) is very good and seems to be used wisely. The topics, work results and international cooperation structure seem up to date. The people are very well motivated.

The research focus is primarily on electrochemical energy conversion and storage. Materials with regulated porosity, double-layer hybrid and ionic-liquid super-capacitors and aqueous and polymer-based electrolyte super-capacitor cells with porous partially-graphitised carbide play an important role. Cathode materials for proton exchange membrane fuel cells are also studied. This work has produced research outputs, some with very strong international impact. In addition, there are some emerging researches on the assessment of nuclear energy options in Estonia.

Professor Enn Lust, Director of Institute of Chemistry and Professor of Physical Chemistry heads international level research in electrochemistry with regular publications in high-level scientific journals. The group has good new facilities and interacts scientifically with other research universities. Co-operation within Estonia seems to exist but was not made apparent. Several other researchers in his group have independent research profiles, notably Gunnar Nurk (SOFC), Alar Jänes, (super-capacitors); this reinforces the activities of the whole group.

Professor of Geology and Mineralogy Kalle Kirsimäe heads a group focused on the area of energetics, particularly oil shale and its ash, effects to effluents and, to a smaller degree, biofuels. The research is of a high international quality, but the output, specifically in Energetics, is small. Alan Henry Tkaczyk, associate professor of Technical Sciences has studied the energy options of Estonia and radionuclides in power plants; although the group produces high quality research, it is very small.

4.4.2 Research Environment and Organisation of Research

80% of research on energetics at the University of Tartu is performed on the subject of electrochemical devices in energy. The University is also home to National Centre of Excellence High-Technology Materials for Sustainable Development. In addition, some researchers work on energy policy and environmental impact, with one person researching nuclear options.

The laboratories and equipment are very good and seem to be used wisely. The topics, work results, and structure of international cooperation seem up-to-date. The people are very well motivated.

4.4.3 PhD Education

There are no PhDs in energetics as such at University of Tartu, as PhDs are awarded in related fields. 7 PhDs are currently in progress in energy-related electrochemistry. From 2008 to 2012, 17 PhDs related to energetics were awarded. University of Tartu participates in National Doctoral Schools on earth sciences and functional materials in technology.

According to the discussions with students, there seem to be some gaps in the formally organised PhD education in areas such as writing scientific papers, science and the society. Currently, information on these topics is provided by thesis supervisors.

It was clear from a meeting with four PhD students in energetic electrochemistry that via regular seminars, weekly in some cases, and strong personal interaction, excellent supervision is provided. The academic supervisors appeared committed to their students' success.

4.4.4 Interaction between Research and Society

There are links with companies in the super-capacitor industry and SOFC companies, particularly in the USA, Germany and Finland. The research regarding phosphate is of a high international social interest, considering the ecological state of the Baltic Sea.

As the University of Tartu provides education in sociology and informatics, it would be natural to assume that there is some co-operation in the field of the role of energetics in Estonia in the future.

4.4.5 Recommendations

The University of Tartu has the potential to make more significant contributions to the evidence base for public policy and research into behavioural influences on energy use. Appropriate measures should be taken to encourage the development of capabilities or interest in these areas.

The obvious and potentially mutually beneficial link to the groups at the NICBP does not exist. Energy research should unite traditional academic disciplines and, in many instances, contributions and perspectives that transcend disciplines are required in order to be successful. To realise its latent potential in this field, the University of Tartu should give consideration as to whether, and how, it could best organise such activities across its established organizational schemes.

5. Overall Assessment of Research in Energetics in Estonia

5.1 Scientific Quality of Research

Energy has been one of seven national research foci. To-date, the bulk of research spending has been invested into buildings, apparatus and equipment. The fact that much of these investments have been relatively recent provides an excellent basis for world class research in energy science and engineering. With some notable exceptions, however, the impact, particularly of the engineering-based energetics research, is generally modest by international standards. However, many of the groups of facilities and skills now developed are capable of maturing into successful long-term research activities, if nurtured correctly and supported strategically by their institutions and national research funding organisations. It is suggested that the universities and research institutes develop a national strategy of energy research together with the Academy of Sciences and governmental bodies. This should take into account the general needs of an industrialized country in the 21st century interlinked with global considerations, specific infrastructure in terms of Estonian resources, and the research expertise in Estonia both in existence now and capable of being developed in the near future.

5.2 Research Environment and Organisation of Research

All institutions need to develop institutional strategies for energetics research based on the national plan and their respective expertise, so that a clear agreed upon list of priorities could be referred to with respect to the following aspects:

a) long-term decisions on new academic appointments
b) the best use of on-going basic infrastructure funding to underpin future investment in equipment
c) establishment of critical mass, both of academic staff and PhD students in the research areas of particular strength for each institution.

All research funding is essentially project-based. There are three options to overcome this limitation to the development of coherent research activities:

a) a national structural fund is established that enables the development of specifically targeted research expertise in universities and research institutes
b) consideration should be given to using some of the funding provided (a structural overhead) to meet the basic running costs of infrastructure
c) institutional research seed funding for new academics or established groups should be awarded through national competitions and various types of internal competitions.

In addition, Government and its agencies as the financing institutions need to encourage co-operation

a) on an international level
b) between the various institutions in Estonia
c) between different disciplines related to energetics.

In relation to the latter, cooperation between science and engineering, and the implementation of informatics would build on naturally leading areas of expertise. Another area that needs extensive development is underpinning theoretical work. Developing models of basic energy conversion processes is a subfield in science and engineering; the models are included into tools for simulating complete processes. This approach has become essential in energy research. Such an expertise needs to be established also in Estonia in conjunction with other ongoing research.

Estonia is a small country; this calls for collaborative research with international partners. A decisive focus on transdisciplinary research topics to further strengthen Estonian universities and develop innovative sustainable solutions at the intersection of various fields is especially important for energy research. For example, life-science-oriented universities such as EULS would benefit from a transdisciplinary collaborative research strategy to develop expertise in renewable energy, but also in the food, agriculture, paper/pulp, forestry/wood products, biofuels and biochemical sectors.

5.3 PhD Education

The education of PhD students is an integral part of energy research. Therefore, careful integration with ongoing research projects is important. This synergy was evident in all institutions to varying extents. Perhaps because of the duration of the PhD studies, PhD supervisors are, on average, somewhat older than in many other countries. There seems to be a line of new supervisors at the UT and EULS. The overall energetic team at TUT seems to have a proportionally smaller number of younger PhD supervisors, while some older professors apparently seem reluctant to engage in PhD supervision.

Apparent inconsistencies in the organisation of PhD education, across and within institutions, need to be ironed out. Consideration should be also given to the formal annual assessment of supervisors by PhD students. Institutions should ensure that they have transparent and consistent admission and progression criteria for PhD students. The balance of interests (with respect to PhD work, other project work and duties) of each PhD student and their supervisor should be managed by each university to ensure that prompt degree completion is encouraged and facilitated. Further on, the following recommendations are made:

a) evaluation of PhD students should be independent of financial resources
b) the requirement to produce three publications ensures external benchmarking of the research outcomes
c) some PhD projects may benefit from greater links with researchers working in the areas of contemporary information and communication technology
d) international experience should be mandatory for all PhD students
e) consideration should also be given to setting up visiting research scholar programmes to provide international perspective to PhD supervision
f) it would be important to ensure that PhD students are managed, providing a sufficient critical mass of supervisors, facilities and career development support in all institutions.

5.4 Interaction between Research and Society

Social energy policies and the ways these affect energy markets, economy and security are determined by politics. In energetics, it is the role of universities to contribute into providing the underpinning evidence-base and knowledge transfer, as well as make scientific discoveries and innovations. Many research fields and cognate industries are evidently strongly connected. Such interactions are important and should be retained. It is unclear on the national level how, and indeed if, the Energy Council of Estonian Academy of Sciences draws formal insights from the Estonian energy research community, beyond being its member, to ensure that the full range of evidence-based scientific-engineering, environmental and economic perspectives are used for policy decisions. It is suggested that the Academy of Sciences review its respective mechanisms, possibly as part of a wider review to define a unique distinguishing role for the Academy in a much-changed research environment.

It is necessary to compile a national plan on the future development of energy use and generation in Estonia that integrates public interests, small and large businesses, and research institutions. All institutions need to contribute with their specific abilities. Research institutions can find their role in the context of national priorities and international research developments.

Energy use and current developments towards the greater use of renewables need to be explained to the broader public. Major changes and developments in the energy sector need public support, so things need to be understood. The Energy Discovery Centre which is located in the former Tallinn power plant building (currently undergoing refurbishment) partnered by TUT could fulfil such a role. The Energy Discovery Centre has not had much contact with researchers because researchers are apparently overloaded! This seems to indicate a need for funding dissemination/ public understanding of science to encourage researchers' participation in such a fundamental supportive activity. In the future, it should bring together policymakers, energy providers, universities, university students, teachers and children in questions of energy awareness. The field needs to be developed further.

5.5 Recommendations

The evaluation committee has already made a number of suggestions regarding certain structures in research. It feels that there is a lot of potential in the country to develop a modern energy infrastructure; however, some developments are needed to steer towards this goal in a more rigorous way. Three main questions need to be considered:

a) What are the primary energy resources in Estonia?
b) What are the possibilities to convert those in a future infrastructure?
c) What are the possibilities to save energy and reduce consumption?

From these questions, the main lines of research are derived.

The current reliance on oil shale needs to be fundamentally changed to utilize more renewables such as wind energy, solar energy and bio-derived energy. The current discussions on converting oil shale to liquid fuels and chemicals should be taken on a practical level and quickly developed further. This has substantial influences on the infrastructure. Energy saving, e.g., in buildings and individual traffic as well as in industrial processes, can significantly reduce the energy consumption over the next years. As a consequence, the structure of energy research has to adapt as well.

In Estonia, the occupancy of buildings is a major driver for energy use. Building innovation will be driven by research on energy-efficient building-fabric and glazing materials, distributed energy generation, controls, occupant behaviour and various demand-side interventions. The relevant research-base in energetics in these and associated topics needs to grow, if it is to be sufficient to support the plans for an innovative building industry in Estonia.

Estonia with its huge potential of biomass and wind energy as well as a domestic oil shale reserve can become a strong and, at the same time, low-carbon economy. Estonia can, thus, achieve some environmental/climate protection related advantages over other countries in Europe. This will increase the competitiveness of the Estonian economy as a whole by enabling the supply of inexpensive low-carbon energy in the country. Expanded use of biomass energy can boost bio-economy, which has a significant potential in Estonia.

More capability in wind energy research is required in Estonia. It is not sufficient to import technologies from other countries; one must be an active partner in developing a potent local industry. Research in photovoltaics needs to be stabilized and kept on an internationally respected high level. These measures should be supplemented with creating connections to industry, firstly on the level of spin-offs from research institutions. Also, the question of decentralized energy production, storage and consumption, a model especially appealing for renewable energy, needs to be researched, and various models, e.g., in conjunction with fuel cells, need to be evaluated. All this has implications to the grid structure; it is necessary to perform more intense research on power networks for supporting the national grid and harnessing more power from renewable energy sources.

PhD students are generally researching important and timely areas under knowledgeable and committed supervision. In all institutions, the staffing strategies should seek to ensure that PhD supervisory capacity is maintained, particularly in new and emerging aspects of energetics.

The committee feels that Estonia has the potential to develop into a model region in Europe with regard to providing and consuming energy, especially in conjunction with renewables, but this example needs to be based on powerful internationally competitive research. Estonia has all the necessary ingredients; competences need to be further developed and brought together in the right way. Consideration should be given to enhancing and developing strong national networks, facility platforms and a multidisciplinary national energetic doctoral school with a particular emphasis on avoiding fragmentation. Such initiatives should devote specific resources to providing a nurturing and vibrant research environment for young researchers.

6. Appendix

1. Directive of the Minister of Education and research No 128 (19.03.2013): Approval of theme, participants, personnel and detailed organisation of the 2013 targeted evaluation of Research in Energetics.

ANNEX II TO THE CONTRACT FOR SERVICES
Ministry of Education and Research
Directive of the Minister (non-official translation)
Tartu *19 March 2013 No. 128*

Approval of theme, participants, personnel and detailed organisation of the 2013 targeted evaluation of research in energetics

On the basis of Subsection 20^2(3) of the Organisation of Research and Development Act:

1. To organise the 2013 targeted evaluation in the research in energetics, sub-field of the natural sciences and engineering field (hereinafter evaluation).

2. I assign research in energetics and related fields as the theme of the evaluation:

- Energy resources and power generation (wind, solar, biofuels, hydro, oil shale, fossil fuels);
- Electricity generation, conversion, system operation, transmission and distribution (power plants, smart energy networks, power electronics);
- Materials for power generation and energy storages (ultracaps, PV, electrochemical batteries, fuel cells);
- Thermal engineering and energy efficient buildings;
- Energy policy, economy and security (environment, energy markets).

3. I assign the following institutions as participants in the evaluation:

- University of Tartu;
- Tallinn University of Technology;
- Estonian University of Life Sciences;
- National Institute of Chemical Physics and Biophysics.

4. I appoint the following members of the international panel responsible for carrying out the evaluation (evaluation panel):

- Ulrich Stimming, Technische Universität München, panel chairman;
- Wojciech M. Budzianowski, Wrocław University of Technology;
- Brian Norton, Dublin Institute of Technology;
- George Tsatsaronis, Technische Universität Berlin;
- Esa Vakkilainen, Lappeenranta University of Technology.

5. I approve the detailed procedure for executing the evaluation (appended).

6. This directive may be challenged within 30 days of publication, by filling a complaint with Tartu Administrative Court in accordance with the Code of Administrative Court Procedure.

/*Signature*/
Jaak Aaviksoo
Minister

To be issued to: participants in the evaluation, Research Department of the Ministry of Education and Research, Estonian Research Council, persons specified in the Minister of Education and Research directive No. 32 of 14 January 2013, “Formation of committee for preparing the 2013 targeted evaluation of research in energetics”.

Annex

APPROVED
by Minister of Education and Research directive No. 128 of 19 March 2013

Detailed procedures for executing the evaluation

1. The evaluation is carried out to provide information to the research community, research and development institutions, research funding organisations, research policy planners and society at large regarding research in energetics and the level, productiveness and influence of research fields related to research in energetics. The results of the evaluation serve as an input for preparing research policy decisions and measures pertaining to research in energetics and related fields, further development of the field, preparation of development plans and introduction of necessary changes.

2. The members of the evaluation panel carrying out the evaluation shall, before assuming their positions, sign a declaration of independence and confidentiality in the form approved by the authority organising the evaluation, and also undertake, after the end of the evaluation process, not to use or disclose to third parties any public or non-public information, such as data, documents and other information they learned or to which they were referred to in the course of the evaluation.

3. For carrying out the evaluation, the institutions participating in the evaluation shall submit, through the corresponding environment of the Estonian Research Information System, by 01 July 2013:

    - a self-evaluation report (including general information of the institution, overview of research and development activities, self-evaluation, overview of cooperation and activities aimed at the public) in the form published by the institution carrying out the evaluation;

    - data which serve as a basis for the evaluation (including personnel, research results, doctorate studies, infrastructure, research projects and financing).

4. The evaluation panel has the right:

    - to receive additional information necessary for the evaluation from participants in the evaluation, from the authority organising the evaluation, and the committee preparing the evaluation, formed on the basis of the Minister of Education and Research directive No. 32 of 14 January 2013, “Formation of committee for preparing 2013 targeted evaluation of research in energetics” (hereinafter Steering Group);

    - to visit the institutions participating in the evaluation for the purpose of obtaining additional information necessary for evaluation, the institutions participating in the evaluation, providing at least 10 working days advance notice.

5. The evaluation panel shall analyse, based on the information specified in clause 3 and 4 of this directive annex, the quality of research studies, the research environment and the influence of the research and development activities related to the research in energetics in society and their timeliness and organisational structure of the institutions participating in the evaluation.

6. The evaluation panel may, as a working format, use meetings or, by decision of the evaluation panel other formats, and to involve if necessary experts who possess the information necessary for carrying out the evaluation.

7. The evaluation panel shall, as a result of the analysis specified in clause 5 of this directive annex, compile a report in which the panel shall:

   7.1. to evaluate the quality of the research in energetics in Estonia compared to the international level, including:

   - identification of the strengths and weaknesses of the research and development activities in the field in institutions being evaluated and in Estonia generally;
   - assessment of the output of the performed research;
   - assessment of the collaboration with key academic partners at home and abroad;

   7.2. to give an assessment of the organisation of research in the institutions being evaluated, including:

   - assessment of the general organisation of research in the institutions and links between research and national/institutional strategies and development plans;
   - assessment of the general organisation of research in Estonia and links between research and national strategies and development plans;
   - assessment of the condition and relevance of the infrastructure to guarantee sustainable development of research;

   7.3. to give an assessment of the quality and relevance of doctoral studies in the area of research in energetics (if relevant), including:

   - assessment of the quality and quantity of the doctoral studies compared to the international level and based on the need to ensure the sustainability of research;
   - assessment of links between doctoral studies and research;
   - assessment of links between doctoral studies and societal needs;
   - assessment of the supervision of doctoral studies and effectiveness of studies.

7.4. to give an assessment of the significance and influence of research in energetics on Estonian society, including:

   - assessment of links between research and needs of industry and different policies;

   - assessment of the collaboration with key stakeholders in Estonian society.

7.5. to give recommendations and make proposals with regard to further development and financing of research and development activities in the field of research in energetics and for carrying out necessary changes in Estonia, including suggestions and recommendations:

   - for the further development of research policy in Estonia;

   - for the further development of research in energetics in institutions being evaluated;

   - to ensure the further sustainable development of research in energetics.

8. The evaluation panel shall submit the evaluation report and other materials compiled during the activity of the evaluation panel to the authority organising the evaluation by 1 December 2013.

9. The authority organising the evaluation shall forward the report to the Steering Group for an opinion. The Steering Group shall submit the opinion on the evaluation report to the authority organising the evaluation within 10 working days.

10. The authority organising the evaluation shall forward the evaluation report along with the opinion of the Steering Group to the Ministry of Education and Research and to the Ministry of Economic Affairs and Communication within 5 working days. The authority organising the evaluation shall organise public presentation of the evaluation report in cooperation with the Ministry of Education and Research and with the Ministry of Economic Affairs and Communication.

/*Signature*/
Taivo Raud
Vice head of department of research policy
in the capacity of department head

2. Members of the Evaluation Panel

Professor Ulrich Stimming, chairman of the panel
Professor Ulrich Stimming is currently Scientific Advisor and Principal Investigator in TUM CREATE, a Research project on electromobility of the Technical University Munich (TUM) in Singapore; until the end of 2012 he was also the Chief Executive Officer of TUM CREATE.
He is a Fellow of the Institute of Advanced Study of TUM. He was a Professor of Physics, chair E19, Interfaces and Energy Conversion, and of Chemistry at the Technical University of Munich, Germany and member of the Board of directors of the Bavarian Center of Applied Energy Research, ZAE Bayern.
He has received his Ph.D. in Physical Chemistry in 1979 from the Free University of Berlin; previously, he has held faculty positions at Columbia University in New York, U.S.A. and at the University of Bonn, Germany. He was also a director at the Research Centrer of Jülich where he set up a broad range fuel cell research program.
His research interests are mainly focused on the topics energy conversion and storage and the solid-liquid interface physics covering fundamental research on a molecular basis.
Prof. Stimming is Editor-in-chief of the journal "Fuel Cells-from Fundamentals to Systems" since 2001 published by Wiley-VCH. He received several international awards for his accomplishments.
Currently, he is holding Visiting Professorships at the University of Yamanashi, Japan, Nanyang Technological University, Singapore and Shanghai Jiao Tong University, Shanghai, China.
Prof. Stimming members various national and international academic advisory committees and serves in evaluation panels of the European Research Council (ERC).

Professor George Tsatsaronis
Prof. George Tsatsaronis is the BEWAG Professor of Energy Engineering and Protection of the Environment at the Technical University of Berlin since 1994. He received his PhD from the RWTH Aachen in 1977. Between 1986 and 1994 he was professor of Mechanical Engineering at Tennessee Technological University, USA.
He has over thirty-eight years of experience and related educational background in the fields of combustion technology, thermoeconomics, development, design, simulation and analysis of energy conversion processes, optimization of the design and operation of energy systems, and power plant technology.
He is a Life Fellow of the American Society of Mechanical Engineers (ASME) and member of the Executive Committee of the International Centre for Applied Thermodynamics.
Prof. Tsatsaronis has a Doctoris Honoris Causa from the Polytechnic University of Bucharest and is Honorary Professor at North China University of Electric Power.
He is honorary editor of the International Journal of Thermodynamics, International Centre for Thermodynamics and associate editor of the journals *Energy*; *Energy Conversion and Management;* and *International Journal of Energy Technology and Policy.*
Prof. Tsatsaronis has published one book, eight chapters in seven books, eight articles in encyclopedias, two dissertations, over 100 journal papers, over 180 conference proceedings papers, 25 technical reports, and has made over 300 presentations at national and international meetings and seminars. He is the co-editor of 22 bound volumes.

Dr Wojciech M. Budzianowski

Dr Wojciech M. Budzianowski is an assistant professor at the Wrocław University of Technology, Wrocław, Poland from where he received his PhD in engineering in 1998.

His research is focused on low-carbon energy and bio-energy. His current activities include the following fields: fuels, renewable energy, interactions between climate and energy, CO_2 capture, energy policy & economics, mechanical engineering, energy engineering, energy systems, applied mathematics and environmental energy.

He has published more than 50 scientific journal articles and book chapters, 1 book and 2 patents. His publications have received more than 400 citations and his h-index is 13 (Web of Science, 2013).

He is a section editor of Journal of Power Technologies and an editorial-board member of several international journals such as International Journal of Global Warming (Inderscience, impact factor 0.646), International Journal of Sustainable Energy (Taylor & Francis, SJR 0.464), International Journal of Low-Carbon Technologies (Oxford University Press, SJR 0.306), Open Fuels and Energy Science Journal (Bentham Science, SJR 0.280). He has served as the scientific-board member for several international conferences.

He has been evaluator for research projects and programs for European Commission (EC), European Research Council Executive Agency (ERCEA) and for several national agencies (Greece, Latvia, Estonia, Poland).

Professor Brian Norton

Professor Brian Norton has been President of Dublin Institute of Technology (DIT) since September 2003. He has a PhD degree in Applied Energy from Cranfield University and DSc from the University of Nottingham. From 1996 he had been Dean of Engineering and Built Environment at University of Ulster where he had been Professor of Built-Environmental Engineering since 1989.

Professor Norton has chaired the World Renewable Energy Network, the BSI Technical Committee on Solar Heating, the Eco-Energy Trust and, still chairs Action Renewables. He has served on a joint committee of the UK research councils and on the Engineering Sciences Committee of the Royal Irish Academy. He is a member of the Council of the Irish Academy of Engineering and served on the RCUK international panel that reviewed energy research in the UK in 2011. He is Vice-President of the European Sustainable Energy innovation Alliance.

He is the author or co-author of over 420 papers principally in solar energy research including 170 in major international learned journals. He has supervised nearly 40 doctorates. He serves as Associate Editor of “Solar Energy” and been awarded over €10 million in research grants.

Prof Norton has been awarded the Gold Medal of the Amir of Bahrain for “outstanding research achievement in solar thermal applications”, the Napier Shaw Medal of the Chartered Institute of Building Services Engineers and the Roscoe Award of the Institute of Energy. In 2003 he became a Fellow of the Irish Academy of Engineering. He is an Honorary Professor of the both University of Ulster and the Harbin Institute of Technology, China and an Adjunct Professor at University of Houston, USA. He is a member of the Institutional Evaluation Panel of the European University Association.

Professor Esa Vakkilainen

Esa Vakkilainen is a professor of sustainable energy systems and Vice Dean of Faculty of Technology in Lappeenranta University of Technology. He received his PhD in energy technology in 1993 in Lappeenranta University of Technology.

His research interests include biomass utilization (combustion, gasification), biofuels production (torrefaction, pyrolysis), steam boilers (design, operation) and energy efficiency (energy generation prices, pumping).

Prof Vakkilainen has more than 20 years of experience in energy business sector. He is reviewer of several scientific journals and has organised various international conferences. He has supervised 5 PhD and 125 MSc thesis.

Prof Vakkilainen has published around 150 publications in the fields of energy efficiency, environment, biomass combustion and gasification, boilers, ash behaviour and small scale energy production.

3. Self-assessment Form

Self-assessment Form
Evaluation of Research in Energetics in Estonia (2008–2012)
Submission Form

GENERAL REMARKS

All data in this self-assessment form should represent research in energetics (excluding in question G3) and should cover only R&D activities and R&D personnel (teaching staff and doctoral students are not included).

GENERAL INFORMATION
Institution (entity):
Address:
Phone:
Internet home page:

Contact person for the Evaluation:
Phone:
Email:

G.1. Percentage that research in energetics represents in the research carried out in the institution

(Calculations should base on proportions of research financing. The fields of research in energetics are defined in question G.2. In your institution there may be many other fields of science represented, but we ask you to give the percentage that research in energetics stands for).

Percentage that research in energetics represents in the research carried out in the institution	… %

In the following questions, you are asked to concentrate only in this portion of research.

G.2. Institution’s research profile within research in energetics (give estimate of the percentage)

(Calculations should base on proportions of research financing. The percentages should add up to 100.)

Research field	**(%)**
Energy resources and power generation (wind, solar, biofuels, hydro, oil shale, fossil fuels)	
Electricity generation, conversion, system operation, transmission and distribution (power plants, smart energy networks, power electronics)	
Materials for power generation and energy storages (ultracaps, PV, electrochemical batteries, fuel cells)	
Thermal engineering and energy efficient buildings	
Energy policy, economy and security (environment, energy markets)	
Total	**100%**

G.3. Other relevant fields connected to institution’s research profile

(The interaction between research in energetics and other fields are studied. Three levels are given:
1 - normal collaboration with joint publications;
2 - common scientific projects i.e. consortia;
3 - integration through scientists working in the group.

Mark with x the columns 1, 2 or 3. More than one column can be marked in the same row).

Research field	**1**	**2**	**3**
A			
B			
…			

Comments. Max 1 page.

(Any comments about general information what could be useful for evaluators for better understanding of current situation of institution)

1. THE INSTITUTION’S SELF-ASSESSMENT

(Self-assessment is an important part of the evaluation. Please answer carefully.)

1.1. Describe the development of/changes in the institution’s scientific expertise, funding, facilities, organization during 2008-2012

(max 5 pages)

1.2. The institution’s research strategy

(Relation to the institution’s appropriate strategies, priority areas in research, development measures; max 3 pages.

Describe the institution’s research strategy for the next few years, the key research objectives and means to achieve these objectives.

- *What is the role of basic and applied research?*
- *Is there need for new knowledge, facilities, is the present level of funding sufficient for attaining the objectives laid down?*
- *Do the strategies of the institution support each other?*

1. 3. The societal impact of the institution’s activities

(max 2 pages. Describe here how the institution’s research activities and cooperation with other actors in society have promoted the activities of other societal actors, e.g. public sector, industry or SMEs, professional unions, technology competence centres etc).

1.4. Assess the academic and societal need for doctoral training within the institution and the institution’s role in doctoral training (if relevant)

(max 1 page)

1.5. Assess the strengths, weaknesses, *opportunities and threats* of the research in institution

(max 3 page)

Comments. Max 1 page.

(Any comments about self-assessment what could be useful for evaluators for better understanding of current situation of institution.)

2. NATIONAL AND INTERNATIONAL COLLABORATION

2.1. Most important national collaboration (max 10)

(List the most important national collaboration partners of the institution (max 10). Collaborator refers to a person or a research team with whom the cooperation has generated one of the outcomes indicated in item ETIS data "Outcomes of R&D activities". Types of collaboration include e.g. joint projects, organizing common scientific events (conference), researcher mobility.)

Organization	Type of collaboration	Year

2.2. Most important visits abroad by institution's staff (max 10) (minimum duration of visit: three weeks)

(List the most important visits of each year by country in the alphabetical order (max 10). In item "Purpose of the visit" indicate clearly the objective of the visit.)

Name	Target organization	Country	Purpose of the visit	Duration (weeks)	Year

2.3. Visits of the foreign researchers to the institution (max 10) (minimum duration of visit: three weeks)

(List the visits of each year in the alphabetical order (max 10). In item "Purpose of the visit" indicate clearly the objective of the visit.

Name	Home organization	Country	Purpose of the visit	Duration (weeks)	Year

2.4. Short but particularly important visits of the foreign researchers (max 5)

(List the short but important visits of each year in the alphabetical order (max 5). In item "Purpose of the visit" indicate clearly the objective of the visit.)

Name	Home organization	Country	Purpose of the visit	Year

2.5. Most important foreign academic collaborators (max 10)

(List the most important foreign academic collaboration partners of the institution (max 10). Academic collaborators include universities and public research institutes. Types of collaboration include e.g. joint projects, organizing common scientific event (conference), researcher mobility. In outcome section describe e.g. key joint publications, researcher training, adoption and use of new technologies or new approaches etc.)

Name and organization	Type of collaboration	Country	Year	Outcome

2.6. Most important non-academic collaboration and societal impact (max 10)

(List here the most important domestic and foreign non-academic collaboration, e.g. industry contacts, collaboration with different professional unions.

Name and organization	Type of collaboration	Country	Year

Comments. Max 1 page.

(Any comments about collaboration what could be useful for evaluators for better understanding of current situation of institution.)

3. OTHER SCIENTIFIC AND SOCIETAL ACTIVITIES

3.1. Invited presentations in international scientific conferences (max 10)

(Most important invited international plenary talks, and other invited talks (max 10).)

Name	Topic of presentation	Name and time of the conference

3.2. Invited presentations and organized domestic conferences (max 10)

(Most important organized domestic conferences and invited domestic plenary talks (max 10).)

Organized conferences

Name and time of the conference	Main topic of the conference	Main target audience

Invited domestic plenary talks

Name	Topic of presentation	Name and time of the conference

3.3. Memberships in editorial boards of international scientific journals (max 10)

(Give only the most important memberships (max 10).)

Name	Journal	Period

3.4. Memberships in committees and in (advisory) boards of business companies or other similar tasks of no primarily academic nature (max 10)

(Give only the most important memberships (max 10).)

Name	Company/ organization	Tasks	Period

3.5. Organized societal (educational) activities (max 10)

(List here the most important societal and/or educational activities, e.g. TV or radio shows, regular seminars, regular collaboration with different professional unions.

Name	Activity	Period

Comments. Max 1 page.

(Any comments about other activities what could be useful for evaluators for better understanding of current situation of institution.)

4. Data provided by the Estonian Research Information System ETIS

- **R&D activities:**
  - List and description (incl. project number, title, description, project leader, senior personnel, duration, financing) of R&D projects;
  - Summarized data tables.

- **R&D infrastructure:**
  - Number and total area of labs and other research related rooms and facilities;
  - List of most important equipment, apparatuses and instruments (up to 30 and advisably with minimum cost 10 000 euros).

- **Personnel:**
  - Names, positions and CV-s;
  - Summarized data tables by positions held;
  - Age structure table;
  - Defense of doctoral dissertations;
  - Implementation of doctoral studies;
  - Awards and recognitions.

- **Outcomes of R&D activities:**
  - List and description of publications by classification;
  - List and description of other R&D based activities;
  - List of most important publications (up to 30) with full text;
  - Number and description of patents, patent applications and plant variety right certificates.

All data are from period 2008–2012.
All sections have options for making comments.

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Eesti Teadusagentuur
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