

Evaluation of Research in Power and Electrical Engineering

Institutes evaluated:

Tallinn Technical University

Faculty of Power Engineering:

- Department of Electrical Power Engineering,
- Department of Electrical Drives and Power Electronics
- Department of Fundamentals of Electrical Engineering and Electrical Machines

Faculty of Information Technology:

- Department of Radio and Communication Engineering
- Department of Electronics

Faculty of Mechanical Engineering

- Department of Thermal Engineering

Estonian Energy Institute

- Laboratory of Energy Economy and Planning
- Laboratory of Alternative Energy Research

Estonian Agricultural University

Agricultural Engineering Institute

Evaluation dates

September 29-October 6, 2002

Expert Team:

Prof. Erkki Lakervi
(Team Chairman)

Helsinki University of Technology

Power Systems Laboratory

P.O.Box 3000

FIN-02015 HUT, Finland

Tel: + 358 9 451 4790

E-mail: Erkki.Lakervi@hut.fi

Indrek Aarna, Ph.D

Eesti Energia AS

New Business Development Manager

Laki 24

12915 Tallinn

Tel: + 372 7152 301

E-mail: indrek.aarna@energia.ee

Prof. Sandor Halasz

Budapest University of Technology and
Economics

Department of Electrical Machines
and Drives

Egry J. u. 18

Budapest XI, H-1111, Hungary

Tel: + 36 1 463 3605

E-mail: shalasz@eik.bme.hu

EVALUATION OF RESEARCH INSTITUTES IN POWER AND ELECTRICAL ENGINEERING IN ESTONIA

Part I General Overview

Introduction

At the request of the Estonian Higher Education Accreditation Centre, Tallinn (EHEAC), an evaluation team (hereafter named the “Evaluators”) visited institutes in Estonia carrying out research activities in power and electrical engineering. The evaluating team consisted of Prof. Erkki Lakervi (Helsinki University of Technology, Finland), Prof. Sandor Halasz (Budapest University of Technology and Economics, Hungary) and Dr. Indrek Aarna (Eesti Energia AS, Estonia).

The institutions to be evaluated were:

- 1) Department of Electrical Power Engineering of Tallinn Technical University (Head: Prof. Mati Valdma);
- 2) Department of Electrical Drives and Power Electronics of Tallinn Technical University (Head: Prof. Juhan Laugis);
- 3) Department of Fundamentals of Electrical Engineering and Electrical Machines of Tallinn Technical University (Head: Prof. Jaan Järvik);
- 4) Department of Electronics of Tallinn Technical University (Head: Prof. Toomas Rang);
- 5) Department of Radio and Communication Engineering of Tallinn Technical University (Head: Prof. Andres Taklaja);
- 6) Department of Thermal Engineering of Tallinn Technical University (Head: Prof. Aadu Paist);
- 7) Estonian Energy Institute at Tallinn Technical University (Laboratory of Alternative Energy Research and Laboratory of Energy Economy and Planning) (Head: Ülo Rudi, Ph.D);
- 8) Agricultural Engineering Institute of Estonian Agricultural University (Head: Tõnis Peets, Ph.D)

The evaluators were provided in advance with self-assessment reports from each of these eight institutions, prepared by the members of these groups.

After a brief orientation meeting at EHEAC, the evaluators visited the different departments and institutes in Tartu and Tallinn during four days (two days in Tartu and Tallinn). Only one hour per department was allowed for visiting departments at Faculty of Electrical Power Engineering and at Faculty of Information Technology. This was far too short when the target is to evaluate research and in most departments also Dr-programs. At these meetings staff members of the various laboratories presented their work. During these presentations as well as during the subsequent discussions additional information about the research activities was provided. This included additional documents such as copies of published papers.

Approach to the evaluation

The evaluators were asked to

- 1) Judge the activities of research and development in the units evaluated and the research topics implemented by them to ensure the governmental funding for internationally recognised research and development. The Team was asked to concentrate on research units (university departments, laboratories) with specific comments to sub-units, groups if necessary.
- 2) Identify deficiencies in the activities of research and development units.
- 3) Give recommendations on the development concerning research and development and research areas to the state of Estonia.

The Team received the following materials: A working schedule, principles and criteria for evaluation of the research units, evaluation guidelines for the ranking of research units, and self-evaluation reports created by the research units themselves.

Each research group was evaluated using the following criteria to be rated on a scale from unsatisfactory to excellent:

1. The novelty of the results of research and development;
2. The quality of research and development;
3. The strategy and perspective of research;
4. The competence of research groups and their capability for development;
5. The success in applying for funds and grants;
6. The national and international co-operation;
7. The implementation opportunities for the research results and their importance for the Estonian society;
8. The correspondence of research and development to the international level.

In their work the evaluators followed the guidelines established by the EHEAC for research evaluation. This means that separate ratings are given for *quality of research* and for *overall capability* of the research groups. The ratings are based on the rating system provided in the said guidelines.

The other target was to evaluate the level of the graduate study programs, which are shown in separate reports.

Part II

General Comments

Based on the information collected from the various institutions some general comments can be given:

1. The level of research is varying considerably in different institutes. There were clear differences between the institutions because of the wide area of activities performed by evaluated institutions.
2. The age of the academic staff is very high – in some institutes the average age is close to 60 years.
3. The number of doctoral students is relatively low. During the last five years many doctoral students interrupted their studies and only few doctoral studies were successfully completed.
4. The institutions need more financial and physical resources in order to improve the research program. The research equipment and laboratory facilities in most of the departments are in a need of modernization. Research equipment is outdated, which seriously affect the quality of work and the kind of work that can be done. Computing facilities are gradually improving, they are of variable level, depending on the institution.
5. Salary of academic staff is too low to attract young and talented students to continue their career at universities.
6. The number of papers published in highly ranked international journals is limited.
7. Institutes have taken a direction towards participation in high level international conferences instead of preparing high level papers for international journals. The chosen strategy allows them to get more contacts with elite specialists in their fields. However, to become an international level research institution it is prerequisite that papers are regularly published in prestigious international journals. Publications and memberships are also important for being admitted to planning and review teams of international scientific organizations.
8. The accessibility of highly valued books, journals and reports has increased in the libraries of universities during the last years, however, this is still not enough to allow to perform research at international level.
9. There are some research areas that are covered by more than two institutes. For example, the wind energy related activities are carried out by four departments/institutes (by Department of Thermal Engineering, Department of Electrical Power Engineering, Estonian Energy Institute and Agricultural Engineering Institute). Even though some institutes cover different aspects of the problem, the concentration or joined efforts of the subject to one or two institutes would be suggested because of more rational use of resources. There is a need for coordination of the problem at the level of Ministry of Education if departments are unable to agree themselves. The formation of national programmes or national knowledge centers is highly recommended.

10. More attention should be paid to innovativity both in research and Dr-program targets.

Part III

Evaluation of institutes and research groups

1) Department of Electrical Power Engineering, Faculty of Power Engineering, TTU

Head of the Department: Prof. Mati Valdma

Theme: 0140225s98 “Optimal control, management and planning of energy system operation, market and development”. Principal investigator: Prof. Mati Valdma

The main objective of the theme is elaboration of mathematical models and methods for optimisation of electrical power stations, networks and systems operation and planning considering random factors and incompleteness of the information in the electricity market conditions. As a result the production, transmission and delivery of electrical power should become considerably more efficient.

Main collaborators are: prof. Olev Liik, prof. Mati Meldorf, assoc. prof. Tiit Metusala, assoc. prof. Rein Oidram, assoc. prof. Peeter Raesaar, assoc. prof. Heiki Tammoja, assoc. prof. Eeli Tiigimägi, assoc. prof. Ülo Treufeldt, assoc. prof. Juhan Valtin, sen. researcher Matti Keel.

1998-2002 were received 2 ESF research grants and filled appr 30 applied and development projects.

General comments

The department is the only academic unit in Estonia in the field of power systems and high voltage engineering. It has a long tradition and excellent knowledge in optimisation of electric energy systems. This capacity has also been used in changing conditions and most bigger research projects are still in this area. Also other fields must and have been studied for ensuring a research related teaching in the whole area of responsibility.

- The age of academic staff is high. Younger researchers must be employed for ensuring a favourable continuation. The small number of Dr-students makes this problem severe. Fortunately the number of M.Sc- and especially B.Sc-students is much higher.
- The number of publications is reasonable but considerably more papers should be offered to international scientific journals.
- The Department has fairly good incomes from contracts which shows that the R&D projects are useful for industry.
- The staff has close relations to older professors and some essential research organisations in Baltic States and Finland and in some extent to other Nordic countries. Contacts to international R&D forums like IEEE and CIGRE should be improved.
- It is important to upkeep the excellence in topics related to optimisation methods but new concentrations of research must be searched and started as well.
- The number of staff in the Department is 11.

2) Department of Electrical Drives and Power Electronics, Faculty of Power Engineering, TTU

Head of the Department: Prof. Juhan Laugis

The main purpose of the basic research is to perform high-level research in the field of electrical engineering in the areas as follows:

- Energy saving electrical drives
- Power electronic converters
- Diagnostics of electrical drives and converters
- Electrical transport systems
- Industry automation

The main basic research program of the Department has been *“Research, design and application of energy saving electrical drives in the Estonian power system, industry and transport”* (1997-2001). Co-ordinator: prof. Juhan Laugis

Members of the working group: Prof. Tõnu Lehtla, Ph.D., Jaan Tomson, Ph.D., Rain Lahtmets, Ph.D., Elmo Pettai, Ph.D., Arvo Oorn, Ph.D., Raivo Teemets, Ph.D., Jüri Joller, D.Sc., Raik Jansikene, M.Sc., Margus Leoste, M.Sc., Liisa Liivik, M.Sc., Argo Rosin, M.Sc., Madis Lehtla, M.Sc., Dmitri Vinnikov, M.Sc., Vitali Boiko, M.Sc.

The programme covers research of energy consumption of electrical drives applied in Estonia and their modernization . Design and implementation of power semiconductor transducer of a tram's electrical drive based on special IGBT transistors, which allowed for reduction of tram's energy consumption of 48%, were the major results. Two new trams were tested in 2001. An analysis of the drives of electrical trains based on the results of diagnostics was made for the company *Eesti Elektriraudtee AS (Estonian Electrical Railway Ltd.)*.

In connection with the reconstruction of electrical transport in Estonia, in 2002, studies of energy storage of electrical drives will continue. New storage units of electrical energy (ultracapacitors) and application of energy transducers allow for substantial enhancement of exploitation of industrial machinery and means of transport.

During 1996-2002 were received 4 ESF and Technology Agency grants and 16 Applied Research Projects (co-ordinator J. Laugis). The total budget is close to 14 MEEK.

General comments

The Department is in a good situation since it has a lot of grants which cover some important and interesting research and development possibilities at the good international level. At the same time these grants give the opportunities for modernization of the laboratories and computer technique, as well for participation of the staff in international conferences. It should be mentioned that Department is very active in the preparation of the new Estonian standards. The skills of the emeritus professor are here well utilized.

- The research activity has a lot of practical applications. The several grants was obtained from Estonian companies, which indicates the close co-operation of the Department with industry.
- The publication activity of the Department is at fairly high level. A considerable part of publication is performed on reputed international conferences.

- The Department has strong co-operation with universities and enterprises abroad, at first in Germany. As a result each year some students can be sent for a few months to different learning and practical courses in Germany.
- The number of staff in the Department is 17

In spite of additional resources from the grants the technical level of the laboratories must be increased and the new equipment must be bought. Probably, the transition to the new building – which will take place in September of 2003 – will improve the developments of the laboratories. Therefore, it is very important for the University to finish the new building in the shortest time possible and faculty members efficiently contribute its planning.

3) Department of Fundamentals of Electrical Engineering and Electrical Machines, TTU

Head of the Department: Prof. Jaan Järvik

Main fields of research activities:

- Development of the theory for eliminating higher harmonics in deeply saturated ferromagnetic devices.
- Development of principally new type of resonant converters based on alternation of parallel and series resonance (PSA-converters).
- Switch mode converters with sine-shape network current using the principle of lossless gyrators.

The main basic research program of the Department has been *“Research and development of adaptive to load resonant converters” and “Development of general theory of non-active energy conversion for electrical converters and synthesis of electromagnetically compatible power electronic equipment “*. Co-ordinator: Prof. Jaan Järvik

The goal of studies was to develop possible solutions for the problems with higher harmonics and reactive power compensation by studying the process of exchanging reactive energy in the converters and based upon these results to develop new converters with high power factor.

Other investigators: Kuno Janson, D.Sc., Evald Külm, Ph.D., Tiiu Sakkos, Ph.D., Vello Sarv, D.Sc., Toomas Vinnal, M.Sc., Viktor Bolgov, M.Sc., Jevgeni Shklovski, M.Sc.

During 1995-2002 were received 7 ESF grants (coordinators: J.Järvik, V.Sarv, K. Janson, V.Bolgov) and a lot of Applied Research Projects, the total budget was close to 1.5 MEEK.

General comments

The Department contributes to other study programs and teachers of Electrical Engineering and Electrical Machine’s courses for the needs of the University. During 1999-2002 three M.Sc and one Ph.D thesies were awarded.

- The Department has dealt with resonant converters and saturated reactors for a long time and has the practical applications in both the areas.
- The new research area is switch mode converters, the results of this development appears in this year.

- The number of Applied Research Projects is relatively high and the budget for several projects is quite big in size.
- The publication activity of the Department is high and a relatively high number of papers was published at internationally reputed conferences.
- The Department has several international patents.
- The number of staff in the Department is 14.

4) Department of Electronics Engineering (Electrical Engineering), Faculty of Information Technology, TTU

Head of the Department: Prof. Toomas Rang

The research work carried out at the Department of Electronics shaped up in the beginning of the 1990-s. The research areas are the following:

- 1) theoretical and experimental study of new semiconductor materials;
- 2) application of the new materials for development of improved electronic components;
- 3) development of selective measurement instruments and systems based on synchronous signal processing;
- 4) application of lock-in measurement technology in technical test and diagnostics.

In 1998 all these research directions joined the one common target financed project of the Department of Electronics No. 0140236s98 "*Microtechnology based electronic components/systems and intelligent measuring instruments*" (1998-2000). The aim was to integrate the existing scientific potential for creating and development of the informationally and electrically compatible electronic systems to solve various tasks from power systems to tiny implantable microsystems for medical diagnosing and treatment, e.g. cardiac monitors and pacemakers.

Project 0141754s 01 (2001-2005). Surveillance and data acquisition systems: electronic components and circuits, technology; models, algorithms, simulation and system integration. Principal investigator: Prof. M. Min. Funding: 1870 kEEK in 2001 to 2002

This target financed state budget project is a continuation of the research described above. The basic studies are aimed mostly to investigation of electrical and thermal properties of new semiconductor materials (GaAs, SiC). Development of microsystems is directed towards implementation in biomedical engineering, especially in implantable cardiac monitors and pacemakers. The systems integration methods have been developed for designing of coastal surveillance and marine navigation systems in Estonia.

General comments

The department is now evaluated only from the viewpoint of "2.12 Electrotechnics". This evaluation will unfortunately suffer from the fact that the background of evaluators is in electric power and energy engineering, which are quite far from the main scope of this department.

The Department is well situated in a renovated building and has fairly modern well equipped laboratories.

- The research budget of the Department is relatively high, therefore a good level of the research possibilities and laboratories is provided.
- The Department activity in M.Sc and Ph.D education is the one of the highest in TTU.
- The Department publication activity is high both in the local and the international journals.
- International cooperation is wide, especially with Nordic countries.
- The number of staff in the Department is 17.

5) Department of Radio and Communication Engineering (Electrical Engineering), Faculty of Information Technology, TTU

Head of the Department: Prof. Andres Taklaja

*Target-funded: 0140245s98 "Research in Telecommunication Technology" (1998-2002).
Principal investigator: Prof Ants Meister*

The main objective of investigations consist of signal classification and data transmission algorithms development and evaluation with applications in mobile communication networks and other fields, study of complex signals for estimation of distance, angle and velocity of an object, analysis of acousto-dynamic parameters in sonar technology, study of wideband and microwave equipment for telecommunication technology

Other investigators: A. Raja, I. Arro, A. Taklaja, V. Heinrichsen,

General comments

The department is now evaluated only from the viewpoint of "2.12 Electrotechnics". This evaluation will unfortunately suffer from the fact that the background of evaluators is in electric power and energy engineering, which are quite far from the main scope of this department.

- The Department is the only academic unit in Estonian in the field of radio and communication engineering. It has a long tradition and profound knowledge in signal processing in information systems. At present developments for applying sonars in sea measurements is vital. Cooperation with operators and manufacturers in telecommunication field exist increasingly.
- The academic age of academic staff is high but fortunately lower than in most other departments. The number of Dr- and M.Sc-theses has been low during the past few years but is increasing.
- The number of publications is low. This can be partly understood by the still large share of research dealing with military applications.
- The department has received much more contact money during the past two years than before which shows that the studies are important for the industry. In this modern field of engineering there is potential to further increase contract financing.
- In some topics the laboratories are well equipped while many other areas are studying with older equipment.
- The number of staff in the Department is 23.

6) Thermal Engineering Department, Faculty of Mechanical Engineering, TTU

Head of the Department: Prof. Aadu Paist

Thermal engineering research at the Thermal Engineering Department (TED) at TTU is performed under the direction of Prof. Aadu Paist. The research at TED has concentrated historically on combustion of oil shale and solid fuels in large power plants. The TED has a very long tradition in the above mentioned area and has been the world leader in the subject. Department is especially strong in applied research. R&D activities of Thermal Engineering Department are generally following the basic needs and development trends of Estonian energy sector.

Altogether there are working 31 researchers at TED. Researchers at TED have published annually on average 40 papers from which about 20 have been pre-reviewed articles.

The three main investigation areas are given below:

1. **Thermal power engineering on the basis of Estonian oil shale** (principal investigators – Prof. Arvo Ots and Prof. Andres Siirde)
2. **Energy management and utilization of domestic energy resources** (principal investigator – Prof. Aadu Paist)
3. **Thermal physics: heat and mass transfer** (principal investigator – Prof. Toomas Tiikma)

In the period under surveillance (1997-2001) the following target-oriented subjects were studied:

01402225s98 **Sustainable utilization of Estonian energy resources –the ways and means (1997-2001)**. Principal investigator: Prof. Arvo Ots

Development and upgrading of Estonian oil shale power energy; domestic biofuels wider utilization for the heat production; wind energy development; optimization of regional heat supply systems and energy conservation; energy production related environmental problems.

Main investigators: Prof. T. Tiikma, Ph.D, Prof. A.Paist, Ph.D., I.Klevtsov, D.Sc., A.Prikk, Ph.D., J.Laid, Ph.D., T.Pihu, Ph.D., O.Mäeküla, Ph.D., A.Ots, Ph.D., A.Veski, Ph.D., V.Selg, T.Parve, M.Sc.

0140219s97 **SO₂ emission reduction in oil shale pulverized firing** (1997-1999). Principal investigator: Prof. Arvo Ots, Managing director Jüri Loosaar. The theme is fulfilled in co-operation with the Department of Basic and Applied Chemistry (principal investigator – Rein Kuusik, sen. researcher, Ph.D)

The study was focused on finding out ways for sulphur dioxide emission reduction by optimizing boiler operation parameters in oil shale pulverized combustion. The effect should be achieved through better utilization of oil shale mineral matter alkaline components for the neutralization of SO₂ during thermo-chemical mechanical processes taking part in boiler gas passes.

Main investigators: A.Prikk, Ph.D., T.Parve, M.Sc., Ü.Kask

0141756s01 **Renewable energy sources of Estonia and wider utilization of them in energy (2001-2005)**; Principal investigator: Prof. Aadu Paist.

Renewable energy sources, especially biofuels wider utilization related theoretical and technological problems. Biofuel combustion facilities designing and testing, adapting and upgrading of technological solutions for Estonian conditions.

0141422s00 **Technological reduction of acidic atmospheric emissions in oil shale combustion for power energy** (2000-2004); Principal investigators: Arvi Prikk, Ph.D. The theme is fulfilled in co-operation with the Department of Basic and Applied Chemistry (principal investigator – Rein Kuusik, Ph.D)

Control of oil shale power plant acidic atmospheric emissions, ash removing system upgrade possibilities and ash field's environmental impact reduction. Acidic pollutants (CO₂, HCl, SO₂) formation and release under CFBC conditions.

General comments

Laboratory equipment in the Department is relatively old, but the teachers make the most of what is available. Some new instruments have been obtained over the last years.

- The age of the academic staff has been constant over the last years (average age in 2002 is 49), which indicates that institute has been able to attract some younger researchers.
- Department currently has 10 and 8 Ph.D and M.Sc students, respectively. The number of graduate students is relatively high compared to other institutions. Many of the graduate students are working at the department as part-time or full-time researchers. The problem has been the low number of successfully completed graduate studies (there has been no graduates from the Ph.D program).
- The number of publications is slightly higher than average of Estonian research institutions. Whereas the number of publications and citations of Dr. Arno Prikk and Prof. Arvo Ots is exceptionally high. The number of papers published in highly ranked international journals is relatively low, however.
- Institute has participated in some international projects, which have allowed them to renovate their laboratories and buy new laboratory equipment.
- TED has a very limited library in-house and has to rely on library services of TTU, which is located at the other end of town.
- TED has very good relations with private companies and has been able to get up to 70% of research money from contracts.
- Estonia has a unique position in oil shale related research. If the country decides to utilize its oil shale for a long time then it would be essential to improve the oil shale combustion related laboratory facilities. This is a major challenge for this laboratory also in the future.
- Department has put recently a lot of effort to accredit their testing laboratories, which have been very successful.
- The number of staff in the Department is 31.

7) Estonian Energy Research Institute at TTU

Head of the Institute: Dr. Ülo Rudi

Estonian Energy Research Institute has a long history in energy field related research activities. However, the staff at the institute has diminished considerably from the level of 340 in 1990 to 44 in 2001. Research in the Estonian Energy Research Institute has historically covered a very wide area of topics, whereas a lot of deep basic research in energy topics has

been performed in the institute at national and USSR level. Today, research projects deal primarily with renewable energy utilization, oil shale combustion and energy planning.

Institute has 4 laboratories from which only the following 2 were evaluated during the current evaluation:

Laboratory of Energy Economy and Planning. Head: Villu Vares, Ph.D.

Laboratory of Alternative Energy Research. Head: D.Sc. Teolan Tomson

The main target-oriented subject of the Laboratory of Energy Economy and Planning is the following:

0140223Bs98: *Analysis and planning methods for energy and fuel supply in Estonia under conditions of eurointegration (1998-1999).* Principal investigator Villu Vares, Ph.D.

The other research topics are given below:

Analysis and planning methods of the energy sector in the background system of changing conditions (2000-2001)

Investigation and improvement of process having influence on the efficiency of energy equipment for the reduction of environmental pollution load and GHG (1997)

The main target-oriented subject of the Laboratory of Alternative Energy Research is the following:

0070052s98 *Specification of local renewable energy recourses, development of solar energy utilisation technology and investigation of the problem of nuclear energy consumption.* Principal investigator Teolan Thomson, D.Sc.

General comments

Institute needs to use financial and physical resources more rationally when joining the educational and research system of TTU. Institute owns real estate in many places around Tallinn, which all are not necessarily needed for research. So, a more rational use of real estate should be considered. In order to improve the research, institute has to be fully integrated into the departments of TTU. Laboratory equipment is relatively old but the researchers make the most of what is available. The institute does not have its own library, but the library of Tallinn Technical University can be used by researchers.

- The average age of the research staff has increased over the last years and has reached a level of 54 years. The number of young researchers is very small, but hopefully the integration with TTU will improve the situation. There is still an urgent need to attract younger researchers to the field.
- The number of publications is higher than average in Estonia. However, the number of papers published in highly reputed international journals is low.
- Institute has been active in participating in different EU programmes and organizing international seminars.
- Meeting with the staff showed the problems in collaboration both within the institute and with other institutes of Tallinn Technical University.
- The process of integration with TTU will increase the possibilities of current staff to obtain scientific degrees. Institute has currently 2 doctoral degree and 4 master's degree students, who are working for the institute, but are on the list doctoral students of other departments.
- The number of staff in the Department is 44.

8) Agricultural Engineering Institute of Estonian Agricultural University

Head of the Department: Prof. Kuno Jürjenson

Research in an agricultural university is naturally mainly directed to agricultural applications. Thus it cannot be expected that so much deep basic research in energy topics could be met there. In any research, however, an important meter for original results is the forum and number of scientific publications.

Most research projects deal with heat processes in buildings. This is a relevant research area and results can be applied in practice. It also supports teaching. Essential topics for evaluation are how much scientific results have been obtained and should a wider field of interest have been covered from applications point of view.

The main target-oriented subject is following:

0170122s98 **“Agricultural machinery, building and renewable energy research and effective technologies development”** (1998-2002). Principal investigator Prof. Matti Liiske.

The Institute of Agricultural Energy Engineering is performing research under the subtheme: **Renewable Energetics and Heat Processes of Agricultural Buildings.**

The other research topics are given below:

The Heating and Ventilation Research and the Indoor Climate Modelling for Different Types of Buildings. Supervisor: Prof. Matti Liiske. Participants: V. Palge, E. Kokin, T. Peets, S. Peets, P. Leipalu, V. Põder

Renewable energy Sources in Rural Districts. Supervisor: Prof. Kuno Jürjenson. Participants: V. Palge, J. Lepa, M. Hovi, T. Tamm, U. Jõudu.

Energy Distribution Problems and Electrical Equipments Usage on Rural Level. Supervisor: Tõnis Peets. Participants: J. Lepa, E. Kokin, A. Normak, K. Jürjenson. M. Liiske etc

Electrical Machines, Equipment and Control Usage in the Rural Conditions. Supervisor: T. Peets. Participants: K. Jürjenson, J. Lepa, M. Liiske, T. Luiga, A. Lüiste.

General comments

Research might be intensified by converting some work load from teaching to research if formal regulations might allow this. Laboratory equipment is relatively old but the teachers make the most of what is available. The libraries need particularly improvements and scientific journals need to be bought and accessibility improved to elevate conditions for postgraduates and faculty research.

- The age of the academic staff has been constant over the last years, which indicates that institute has been able to attract some younger researchers.

- The number of publications is relatively small. The productivity of papers published in highly reputed international journals is especially low.
- Current graduate students who at the same time are working full-time at the Department are good in utilization of information technology in their research and teaching. The research in the area of modelling of different processes in the energy field is a strong plus for the future prospective of the Department.
- The activities in the area of renewable energy are not of the highest priority. Renewable energy problems are often linked to agricultural and rural problems, which might therefore have higher importance in the research activities of the institute.
- Graduate students have passed many international doctoral courses and have had possibilities to carry out research at other universities abroad.
- There is a very weak cooperation in the area of research with agricultural companies, because the Estonian agricultural sector has diminished considerably over the years. However, the involvement of private sector and municipalities in supporting research activities would ease the financial problems that the institute is facing.
- Mutual cooperation between the institutes of TTU and EAU is existing, but stronger cooperation is needed in the research area to optimize the utilization of research money in the energy sector.
- The number of staff in the Department is 9.

Part IV

Summary of evaluation

Below are given the grades for different research institutions in the energy field. Evaluation team has given the grades based on general overview and future perspective of the institutions. Productivity has been rated based on the number of publications and contracts.

Summary of ratings of different institutions

	Research activities	Overall capability
Tallinn Technical University		
<i>Faculty of Power Engineering</i>		
Department of Electrical Power Engineering	G	G
Department of Electrical Drives and Power Electronics	E/G	E/G
Department of Fundamentals of Electrical Engineering and Electrical Machines	G	G
<i>Faculty of Information Technology</i>		
Department of Electronics	E/G	G
Department of Radio and Communication Engineering	G	G
<i>Faculty of Mechanical Engineering</i>		
Thermal Engineering Department ¹	E/G	G
<i>Estonian Energy Institute</i> ²	G/S	G/S
Estonian Agricultural University		
Agricultural Engineering Institute	S	G

E: Excellent; E/G: Excellent to Good; G: Good; G/S: Good to Satisfactory;
S: Satisfactory

¹ There are different research areas performed at the Thermal Engineering Department, but the level of research is very similar in different areas.

² Different laboratories at the Estonian Energy Institute are at slightly different level.

Research and development fields for Estonian Energetics Industry

Estonian energy sector is quite unique because of the high reliance on oil shale produced electricity. Oil shale can be also found in many other places in the World, however, it is nowhere explored as extensively as in Estonia. Therefore, Estonian researchers have a very unique know-how in the field that should be supported also in the future. Already today many countries are looking for alternatives that would replace oil in the near future. One of the possible alternatives is oil shale with enormous resources. Therefore, the know-how that Estonian researchers can gain now might become even more valuable in the future. R&D priorities in the oil shale sector should focus on solving environmental problems in utilization of oil shale.

Energy efficiency is another important issue where much should be done in Estonia. Research contributing e.g. co-generation and efficient processes in utilising electricity should be emphasised and encouraged.

Power transmission and distribution networks and natural gas pipelines as well have operated reasonably due to decreased loads during the past decade. Growth in economy will increase loads and put new requirements to energy systems. Research contributing economic and advanced revisions and updating of energy distribution systems should be emphasised and encouraged.

World energy industry is moving towards wider utilization of renewable energy sources. Estonia has a very high potential in wind and biomass resources, which are not fully explored yet. Even though this research area is very competitive, still there are also many opportunities there.

Also manufacturing industry in various fields of energy, electric and electronic engineering needs attention and thus more research supporting its development.

Thus perhaps electronics, power electronics and thermal engineering have a biggest potential for contributing Estonian development.

Still some more practical suggestions and comments:

More active participation in European programs, conferences and associations (IEA, EPE, CIGRE, IEEE etc.).

Close cooperation in the field of Electrical Engineering between Tallinn Technical University and the other Estonian Universities. Tallinn Technical University should more support other Universities in the preparing and teaching of Electrical Engineering courses, mainly on M.Sc. and Ph.D. levels. Close cooperation the Universities with both the Estonian and the foreign companies. Active participation in the research and development projects of these companies.

Part V

Recommendations

- It is recommended that the basic infrastructure and the research equipment of the laboratories be upgraded to international standards. It is however recognized that funds are limited. The upgrading should, therefore, be done in a selective manner, based on priorities and on performance of institutions.
- Considering the limited resources it is obvious that too much overlap in areas of expertise should be avoided. Hence, it is recommended that research in one area should be performed in a minimal number of institutions or co-operative task-oriented national research projects should be established.
- It is recommended that urgent action should be taken to attract young researchers and more state orders given to master and doctoral studies.