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INNOVATION IN ENERGY SUPPLY

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The paper introduces the specialities of innovation in energy supply. The innovation is distributed into three parts: 1) technology innovation, 2) power system cybernetic innovation, 3) business innovation. The principles of acceleration and prognostication of innovation are considered in the paper too.

Introduction

The term **innovation** means using new ideas in certain activities to obtain certain goals.

The notion of innovation is very general. The peoples use the innovative or creative approach everywhere though not always. The innovative actions may have many concrete objectives but a general goal is progress. Innovation is the main engine of the progress [1]. The directions and the speed of progress depend of innovation. About great importance of innovation speaks the fact that year 2009 is deemed to be a year of creativity and innovation in EU.

Innovation in energy supply means using new ideas in energy supply. This contains the treating and producing of energy resources, the generation, transmission, distribution and consumption of electrical and thermal energy.

Power engineering is a very important, complicated and expensive area, where the acceleration of innovation may give a great effect.

The paper introduces the specialities of innovation in energy supply and possibilities to accelerate innovation in power engineering.

Main directions of innovation in power engineering

The main directions of innovation in the power engineering are:

1. technological innovation;

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2. cybernetic innovation;
3. business innovation.

Technological innovation

The technological innovation means the developing and using of new technologies, materials and equipments in the mines, power plants, energy networks and energy appliances. It bases on the physical and technical researches as in the fundamental sciences, so in the applied sciences areas.

The technology is developed for increasing safety, reliability, security, quality, efficiency, for decreasing costs and for improving many other indicators. At the same time it is tried to change the power engineering more environmental friendly.

The main directions of technological innovation in the energy supply area are [2]:

- creation of controllable nuclear fusion reactors;
- development of nuclear fission reactors;
- development of new combustion technologies and boilers;
- development of combined cycles power plants;
- improvement the controllability of power plants and electrical networks;
- creation of energy storage units;
- application of renewable energy sources etc.

The main technological problems for Estonian energy supply are:

- complex development of oil shale energetics;
- development of new combustion technologies and boilers for oil shale power plants;
- use of overcritical steam parameters in oil shale power plants;
- high-voltage insulation problems and others.

Cybernetic innovation

The cybernetic innovation includes the theories, models and methods of optimal control, operation, development planning and analysis of power plants, networks and systems. This area is always very important in increasing the efficiency, reliability, security and quality of energy supply and also in diminishing the environmental losses. The optimization of power systems may decrease fuel costs and environmental losses up to 10%.

Busyness innovation

The busyness innovation consists of the management problems of energy companies and of energy markets problems. The busyness area is based on the energy policy, energy laws and state’s energy strategy. It is always very important.

Supporting and accelerating of innovation

Among the energy supporting actions, the most important ones are:

1. promotion and popularization of power engineering education;
2. financing and signification of scientific researches in the field of energy engineering;
3. information the publicity about new directions in energy development where Societies of engineers have a key role.

Fundamentally, innovation means selecting a new way, expressed as changes in the way of thinking, in ideas, economy, business, technology, organisation, social sphere, society, etc. and resulting in positive changes [3]. Positive changes at various levels and in various activities improve the capabilities of the society and ensure a sustainable development.

Innovation has the following expected results:

1. An individual person will have a wider view on the world, more knowledge, skills and abilities.
   Indicators:
   - the work contribution and work efficiency of the person are higher;
   - the value of the labour force is higher;
   - the life-long learning system functions.
2. Business association will have a more competitive product or service in the market [4].
   Indicators:
   - product development and technology development have the first priority;
   - the product or service conforms to the needs of the market;
   - the additional value created in the company increases.
3. The state will have an increase in the economic and social welfare and a sustainable development [4].
   Indicators:
   - more active investments from abroad;
   - valuing the role of research; the full linkage of research, development and business (R&D&B) is functioning;
   - the support structures for research, development and business are functioning.

In a crisis it is more important than ever to make economy more research-based and to change the perceived values of the society. The functioning of the innovation system of the state ensures a sustainable country [4].

The following factors are important:

1. the members of the society must be informed and there must be a participatory democracy in action;
2. the education and vocational qualification system must conform to the needs of the labour market;
3. innovation must function at all levels;
4. a united national strategy must exist and function.

Developing the capacity for innovation is not so much a technological or financial matter, but an issue of culture [5].

An energy strategy significantly influencing the sustainability of the country must be based on research, societal consensus, international co-operation and analysis. All this requires stability, setting long-term goals and having a consensus in the society.

In addition to the economic functions, the complex of fuel and energy industry has also social, regional and ethical functions.

In order to develop different directions of this complex, one needs the availability of people with world-class knowledge. Both human resources and material resources should be gathered into research centres in the field of energy. The developments produced by these research institutions are necessary for determining a scientifically justified energy strategy.

Taking into account the actual competence and the market demand in Estonia today, it can be said that the main question of the energy field is the issue of shale [7].

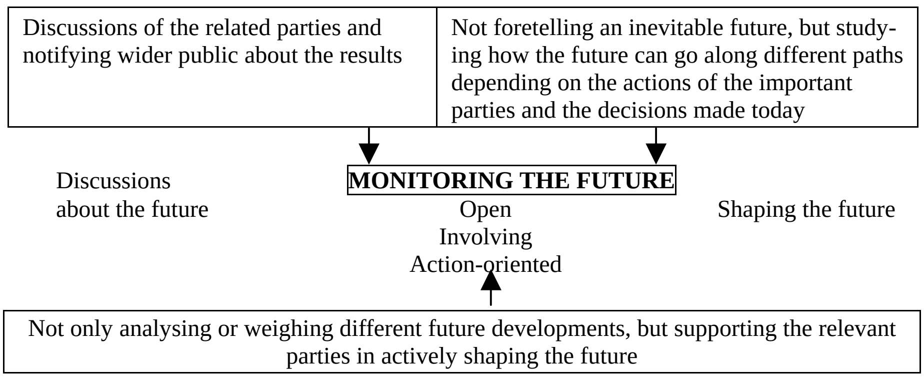
The following is important in order to have a varied structure of energy production and to ensure energy sparing:

1. ensuring energy sparing in the entire energy circuit;
2. establishing gas turbines in order to optimize reliability of the electricity system;
3. developing technologies of combined heat and electricity production;
4. developing renewable energy technologies and integrating them into the overall energy system;
5. further developing shale industry.

We have achieved significant technological innovations regarding both shale mining and shale combustion in the fluidized-bed layer. The new combustion technology increased the efficiency of electricity production and reduced the atmosphere pollution.

In order to plan the development strategy of energy industry, one needs a unified, complex scientific view on society [2].

Algorithm for preparing the prognosis for the future is shown in Fig. 1.



Source: European Commission

Fig. 1. Algorithm of prognosis.

Planning of innovation

In planning the innovation process, it is of primary importance to have the research potential available and to involve it in the planning process.

The goals of R&D work are as follows:

1. increasing the innovation capacity of Estonia in the field of research and development;
2. transferring key technologies into other areas of the economy, primarily industries and vital areas.

After the system has been established, specific development projects for energy production technologies can be planned.

Energy production industry is a servicing sector; its development trends can be planned ahead, taking into account certain existing patterns. The developments of the energy technologies across different levels of the field are planned on the basis of the development directions of the society (Fig. 2).

Information about external environment	**Current state**	**Future trends and objectives**	**Future development areas**
	– statistics; –universities, research centres; – companies; – main activities;	– trends; – technology roadmaps; – technology pyramids; – life cycles; –competition, customers;	– reduction of energy consumption; – new energy sources and technologies;

Process of preliminary studies	
	1. Scope of survey (definition and fine-tuning the scope of the development strategy project roles and resources) 2. Analysis and evaluation of the current state based on Estonian basic data 3. University and research centre face-to-face interviews (20–30 persons) 4. Company face-to-face interviews (separately to energy producers, distributors and users, 20–30 persons) 5. International benchmarking and objective current state analysis (Boston) 7. Commitment and fine-tuning workshop(s): presentation of the development strategy project results; commitment; strategic decisions; future development states and main actions; 8. Mutually agreed conclusions, main findings and answers to key questions 9. Detailed action plans (key state holders) 10. Implementation 11. Follow up

Information about internal environment	**Current state**	**Future trends and objectives**	**Future development areas**
	– statistics; –universities, research centres; – companies; – main activities;	– resources and competences; – technologies; – networking and partnerships;	– to be determined in the project

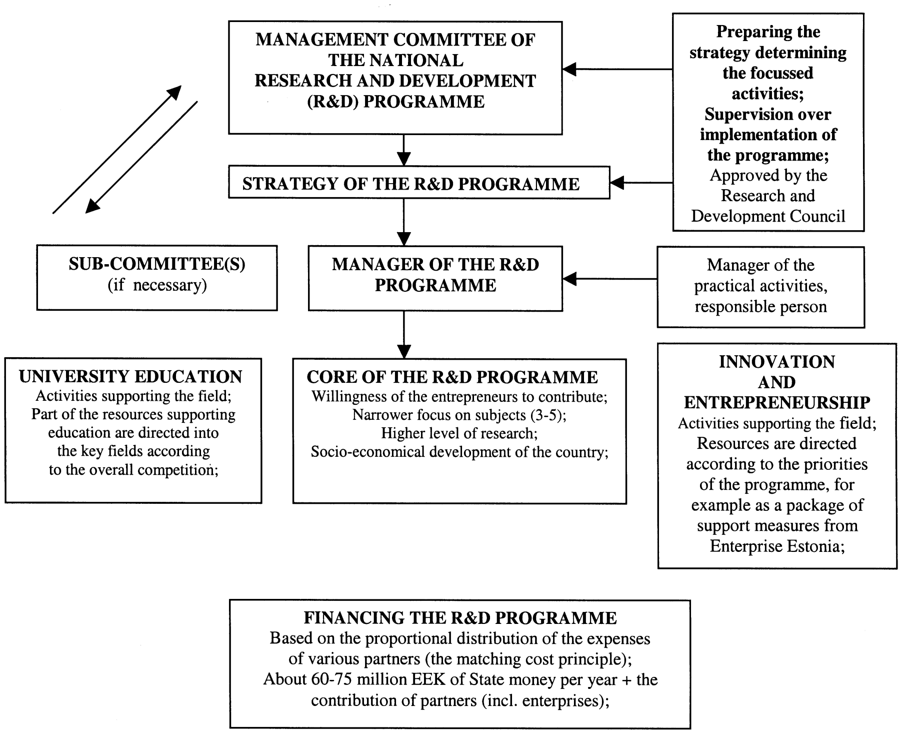
Source: * Ministry of Economy and Communications, 2007

Fig. 2. Field levels of energy production technologies.

Overall goals of the Energy Technology Programme (ETP):

1. optimum use of the resources directed into this field;
2. improving the co-operation within a sector, between the state and the sectors, and between different sectors;
3. developing human resources and research potential;
4. supporting R&D and innovation in the field; supporting technology transfer.

Relations of the Energy Technology Programme (ETP) to the R&D complex of the entire country and the National Innovation System (RIS) are presented in Fig. 3.



Source: Ministry of Economy and Communications, 2007

Fig. 3. Relations of the Energy Technology Programme to the R&D and the National Innovation System.

Reorganising economy to be knowledge-based is an activity that has to be supported by energy industry. Historically there have been different reasons for establishing ways of thinking, and also different consequences. Transition from skill-based economy to knowledge-based economy takes place in several development steps (Fig. 4).

1970–1980 Skills-based economy “OLD ECONOMY” Preserving existing industries	1980–1990 Competence-based economy “TRANSITION-TIME ECONOMY” Adjusting to industrial changes	1990–2000+ Knowledge-based economy “NEW ECONOMY” Establishing knowledge-based industries
FOCUS “Ability to do” Less attention towards “understanding” and personal competencies (attitudes)	FOCUS Wide-scale comprehensive competencies Increasingly more attention towards integrating techno-logical, social and personal competencies and attitudes	FOCUS Integrating formal and informal (practice-based) knowledge and know-how Including dimensions related to business activities, techno-logies, social / organisational aspects and self-management
SKILLS, KNOWLEDGE, ATTITUDE SKILLED WORKER	**SKILLS,** KNOWLEDGE, **ATTITUDE** COMPETENT WORKER	**SKILLS, KNOWLEDGE, ATTITUDE** KNOWLEDGEABLE WORKER

1970 1980 1990 Year

Source: Nyhan 2002

Fig. 4. Transition from skill-based economy to knowledge-based economy.

Conclusions

Innovation factors in the field of energy

Prerequisites:

1. gathering the existing knowledge and material resources into a unified research and development institution of energy industry;
2. ensuring continuity in energy-related education; transferring the experience of researchers;
3. co-operation between entrepreneurs, researchers and developers.

Innovation results:

1. mapping the resources;
2. connecting the possible solutions to the attitudes of the society and to the overall trend;
3. establishing a sustainable energy industry conforming to the expectations of the society.

All this requires a smooth co-operation between the public sector, entrepreneurs and the third sector.

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