Szent István University

Study about the professional and training needs of the HUN HYPOS project's target groups in the area of hybrid power systems

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1. General introduction

Barriers to use renewables and hybrid technologies, and extend their scope of usage come mainly from those difficulties, that every technology has to face, once introduced on the market. One of the main factors here is the knowledge and trust of potential users, which is the biggest barrier of all, and the most difficult to work out. The user is influenced by the knowledge one has about the technology, and his/her own approach and arguments to use it: how convenient, trustful and lack of difficulties it is. A very important role is here the state and civil society playing, by raising awareness, and giving advice to newcomers, new users without prior knowledge.

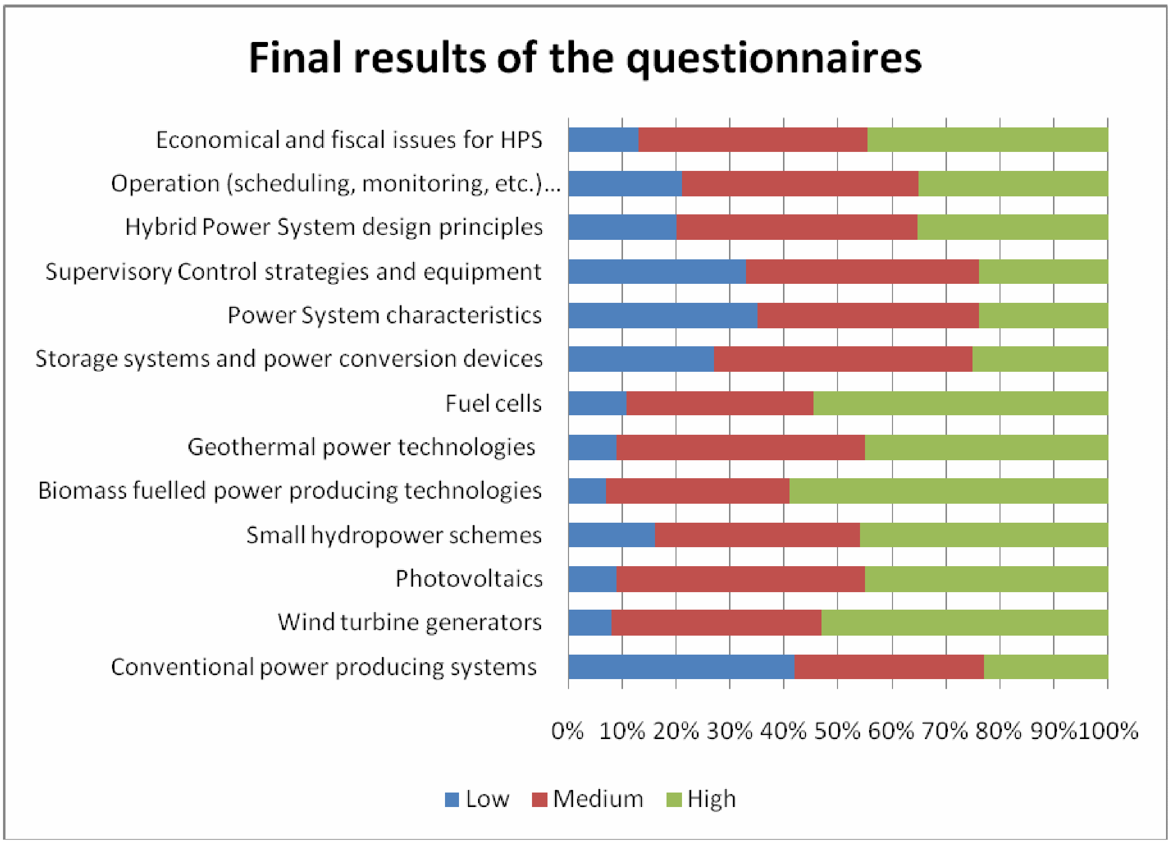
To inform the public, municipalities are the best suited to deal with the awareness raising. On this level existst namely such apparate, institution, that deals with every single public service, and can support new technologies through the operation of these devisions. The biggest tool is here the system of professional referents, their training, who can enter this arena by unified capacity building, information giving to persuade the public about the goods of the innovations. Also is the role of municipialities to get to know the EU and national tendering opportunities, and make public to gain tha biggest available share of the subsidies to go on into new areas like hybrid technologies. By vocational training, in the form of any learning method, the overall goal is to make referents capable to administer and operationalise renewables and alternative energy projects on the level of municipialities and regions. The spread of the renewables will for sure raise the demand towards these referents, whose vocational training needs can be later as permanent predicted.

Nowadays in Hungary there is „Renewable energy expert" vocational training course on the Debrecen University, and in Sopron on the West Hungary University's Forestry Engineering Faculty. The Szent Istvan University has traditions on this field too, having energy economy related courses. This field of profession is mainly taught on the Faculty for Environmental Engineering, and alternative energy related courses are taught on the Faculty of Mechanical Engineering. Another important step is the cooperation within the international, european renewable energy clusters. Such an opportunity is given in the framework of the CER2. The CER2 was introduced by the initiation of 7 countries' 14 partner companies and institutions – inbetween the Széchenyi István University too – with the objective to make renewables publicly well-known, and hopefully spread across the countries. The objective of the CER2 is to open new perspectives on the field of regional economics. The CER2 has the following objectives: organising vocational trainings, carrying out quality management duties, supports the setting up of companies, researching regional energy concepts, and building up regional groups and expert networks. The programme helps to share experiences and getting in touch with experts from the field of renewables, also there is education of alternative energy experts on the priority fields, the programme has identified before:

- **biomass use**
- **thermical usage of photovoltaics**
- **solar energy use in passive house architecture and eco-buildings**
- **photovoltaics (PV)**
- **heat-pump energy usage**

As a sectoral and vocational development goal, the alternative energy field was clearly identified by having priorities in the biomass emergy usage, solar energy usage, and heat-pump energy utilization. This gives the picture about the alternative energy conditions, that in our country – mainly on the short term – are educational and vocational training priorities.

In case to identify the frameworks, and groups of knowledge and information in educational and vocational thematics, the single alternate energy educational fields must be deeper analised.



Inputs, feedbacks and datas from questionnaires

The questionnaires were distributed on paper and email to people, and 104 questionnaires were received from respondents and evaluated given now as basis for feedback on the content of the HUN HYPOS material. Personal datas were supplied by less than half of respondents.

General questions' evaluation show, that 86 % have not participated in a training on hybrid power systems. Respondents had the following breakdown in numbers in terms of schooling: students 42, B.Sc level 19., M.Sc level - 32, Ph.D.level – 11 respondents. Some have indicated to be a designer - 24, or a planner – 35 but many, mainly the (45) rest indicated to be none of these or left the questions blank, that means the necessary need of educating people about the precise understanding of the new field: hybrid power systems or combined, alternative energy systems. 77% told he or she would consider the course to be useful for later carrier, which is a promising figure, although as previously understood, many people need still a clarifications on what hybrid power systems mean.

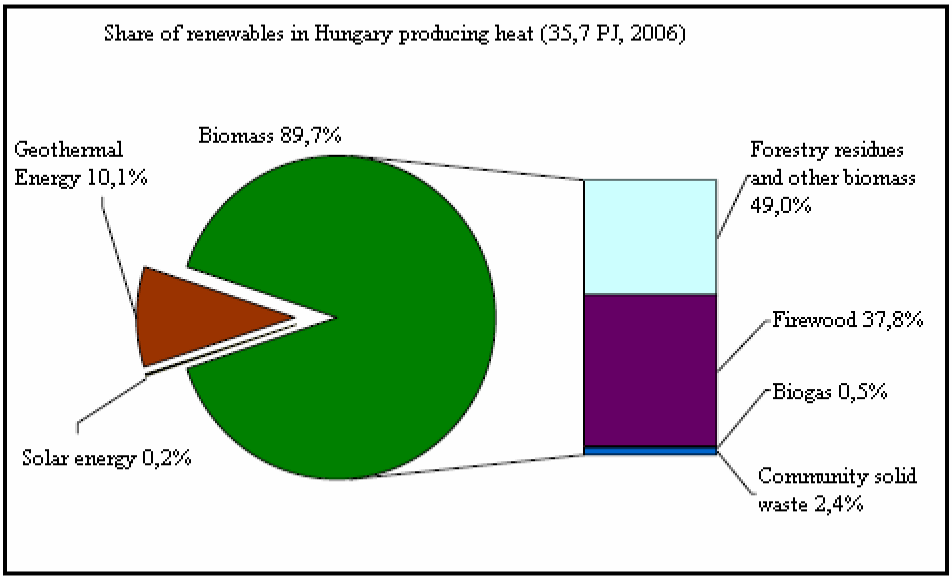
The target groups were characterised as we can see at the end of this study according to the Hungarian system of vocational trainings, or similar topic courses in higher education or beyond, at the beginning of professional carrier, therefore potential applicants for a future course of designers or planners were targeted and met. Clarification on Hybrid power systems are a clear need for both target groups, other identical special needs were not recognised by the questionnaires, rather a feedback of the different areas were made clear, as we indicate at the beginning of this study.

The study material of the HYPOS DILETR project will be adopted for the Hungarian circumstances, where a lot of already charachterised up-date needs were stated. At the same time one important complex issue should be incorporated in the whole material, which is the sustainabilitiy, and sustainable growth, natural resource use, energy resource use and planning, that have the 3 axes, the society, economy and the environment involved. Without these elements, the study material would not have the same outcome, as it is expected in recent times, where sustainability, climate change and energy production, security and other issues are of high importance.

Alternate energy conditions overview in Hungary to identify the vocational training priorities and information content levels

In this part we have a look at the single domestic renewables and identify their importance in educational politics. We research the domestic conditions of the single energy carriers, the potentials of them, conditions of production and raw materials, usage pathways and those environmental conditions, that can be a barrier to their usage. The overview is based on the study, „Strategy of developing the renewables usage in Hungary in 2007”.

As a starting point we can have a look at the following diagramm, which contributes to the CER2 programme too.



Biomass for energetic use

The biomass is a collective noun, it means the products, wastes and byproducts (both plant and animal origin) from the agriculture, forestry and their connecting industrial activities, and also the biodegradable part of the industrial and community waste. The given raw material for energy use can be solid (eg: biobrikett, pellet), liquid (eg. bioethanol, biodiesel), and also gas aggregate. In Hungary we call biomass the sewage sludge, that arises from the waste water treatment plants, and is used to generate energy, and also the waste burning, which are not sustainable energy sources, but the handling of community waste provides the opportunity for energy use.

The biomass for energetic use is very diverse, one can use it to produce heat, or electricity and can be used as fuel too. Most of the given biomass is at the same time serving as feedstock for food production or used for agricultural goals, the energy use is very low thorough whole Europe, but is growing part of biomass use. According to EU studies, the biomass for energy use will grow 2,5 times its value from 2003 to 2010, approximately on 200 Mtoe, if the EU will use close to all of its potential.

Domestic analysis show, that in Hungary, the biggest and most easy to extend energy basis is the biomass. The on purpose production of energy plants is not yet very significant, but biomass resources can be extended easily with energy plant production. Also big potential is in the biomass kindly byproducts, residues, and waste for energy use (the so called secondary and terciery biomasses), because all technologies resulting in waste utilization (eg. biogas) keep having a growing role. Therefore in education materials these systems' complex knowledge is necessary to gain experience and proper know-how for agricultural biomass systems. The agricultural basis therefore is one of the main educational element to teach the energetic biomass systems.

Th biomass for energetic use is highly important question for the agriculture, because the intervention rules and also the WTO rounds support and push to a lower domestic and EU wide food production in agriculture productions. Some of the estimations show, that even 20%, approximately 800-1000 thousands hectares land of Hungary can be touched, and so 80-120 thousands jobs can be affected. **The energy use of plant production, the biomass use as a renewable energy can provide a solution to the problem, through this can that be maintained, that producers can carry on their agricultural activity,** and that the grains produced can be without significant central budget support be marketable.

The biomass for energy use is although nowadays still in its childhood, when looking at the technology levels. The very efficient burning facilities are many times given, but adaptation to local conditions is needed, continuous feedstock supply is needed, solutions for transportation and storage and the view of combined use with other renewable energies (eg. Biosolar plants). The biomass production comes with certain damage to the environment, like reduced biodiversity, growing waste output, growing pollution of the soil and water. Analysis for the whole lifecycle of the biomass energy source tells, that the environmental impact arises mainly (80%) during feedstock production. The unfavourable environmental impact can be reduced by native domestic species for bioenergy use, that is less dangerous for the fauna, and has a longer cutting round. In this way environmental points can be closely integrated into the strategy of plant production for energy use.

The arboreal and non-arboreal plants for biomass use in the future can give the most of the renewable electricity. The favourable features: technical parameters, an easy to rule and adjust feature, additional conditions (creating jobs, rural development) of the technologies, and the favourable agricultural situation in Hungary is supporting this use. The technology to proceed the arboreal plants is already given, developments and research must at the same time help the conditions to improve the more varied us of energy plots for burning. The technology of non-arboreal plants for energy use is not yet a mainstream technology, on the long it can have a very serious research potential.

Biogas

To produce biogas, almost all organic materials are suitable, eg. manure, human fecalia, byproducts and waste of the food processing industry, all green plant residues, household waste, sewage sludge from community waste water treatment etc. Biogas plant are therefore very suitable for the most organic materials, to produce really valuable energy feedstock, tranform them, dispose them, when producing energy at the same time. In the biogas plants such energy plants can be transformed into electricity and heat energy, that for some reason cannot be used for food processing or feed production in some fields of agriculture, by this fact, the biogas technology is supporting employment on the countryside and reserving the country lifestyle. The agricultural education and the biogas aimed organic feedstock processing needs complementary knwoledge to one on the other, which professional requirements should be also met in educational programmes already under planning.

The biogas is a very broad range to use energy resource. It is suitable to switch on it from natural gas, to be used to produce electricity and heat energy and also usable for engines as fuel. The natural gas quality cleaned biogas, the biomethane can be put into the national grid of natural gas, where experimental plants already exist in Germany and Austria. The barriers to putting biomethane into the grid was removed by the modification of the Natural Gas Act 2005, but the real technical details and experimental input should be still cleared. To spread the biomethane use for wider public is not possible at the time in Hungary, because the small consumers natural gas price is subsidiesed, and much lower, than the Western-European price of the gas, so the agricultural plants, trying to produce biomass based biomethane are not yet economical. As the plant size shrinks, the production costs rise, therefore mainly th ebig cooperatives, and theit produced biomethane can be an alternative to the natural gas. To produce biomethane, the necessary agricultural and food processing industry’s feedstock are given, with suitable regulation environment, at least, looking realistic, 1% of the natural gas consumption could be set off. Tor un efficient and economically viable biomethane systems, the knowledge of the regulation environment and adaptation of it is crucial and necessary.

Recently in Hungary, biogas is used to produce heat and electricity on 20-25 places. Most of these are based on waste water plants. In 2003 has the plant in Nyírbátor started its operation with full capacity that is a big biogasplant in European context too, based on animal husbandry and agriculture waste electricity-production. Favourable subsidy conditions can improve the number of plants, solving the problem of manure and food processing residues, wastes and byproducts.

This direction is also represented in the regulations and Directive, that prohibited the flow of manure water into the sweet water flows to prohibit agriculture origined nitrate pollution in the water, animal husbandries should have met these requirements until 2005. In 2008 in Pálhalma was the biggest European biogas plant put into operation, which serves as the modell for food production and energy production. The experts, engineers working there received vocational and special training for the technology in Germany. The system is operated by a technological software, that is supplied and operated by the technology provider too.

After cleaning the biogas into biomethane by removing CO2 for example, the biomethane is also favourable to use to fuel cars with it. In Switzerland and Sweden, not only cars are run on biomethane, but also busses and trains. In Sweden the gas need of the gas fuelled cars are 50% covered by biomethane. The quality of the biomethane should reach a certain treshold, a standard to be enabled to fuel it into engines. It is not by mistake, that Sweden is the only country, where quality requirements are placed for the fuel use of biomethane. In Hungary the MSZ ISO 13686 is regulating the quality requirements of the natural gas, without more precise regulation, this is also used to comply the biomethane with the requirements. The uncertainties of the regulations does not help the biomethane yet in Hungary to become an economical energy product.

Biofuels – ethanol

Liquid biofuels have two important groups: plant based alcohols (bioethanol) and plant oil based (biodiesel). The feedstock to produce bioethanol can be the sugarbeet, sugarcane, because of their high sugar content, or such plant, that can be transformed into sugar, eg. starch containing corn, wheat, potatoes etc. or cellulouz containing tree, grassarts, grain residues, straw. Bioethanol production can be therefore based on a very wide scale raw material base, and provides an opportunity for the recent agricultural byproducts and wastes to be used efficiently. Hungary is mainly suitable to produce first generation ethanol from corn, wheat, sweet-potatoe and sugarbeet. But the coming future is the second generation, cellulouz based bioethanol. This technology is under experimental development, to go more mainstream, we can expect from 2012 onto 2015 or beyond. Hungary is very favourable to produce feedstock for bioethanol. Yearly there are in average 6-7 million tones of corn, which less and less is given away as feedstock for animal husbandry, but at the same time the export and industrial use is growing. The corn will significantly have an oversupply in the future, since domestic demand drops continouosly. The corn based ethanol can reach almost 700-800 thousands tonnes yearly, that is far more, than the demand of Hungarian engine fuel producers and retailers until 2010. Recently there is growing interest from investors to build bioethanol plants, therefore one of the priorities of the educational material should focus on the bioethanol production, and connecting professional fields.

Windenergy

Wind turbines transform the energy of the wind into electricity. The windpower plants can be connected to the electricity grid, but smalle wind turbines can solve single households electricity needs too. The windpower industry is worldwide dynamicly developing, competitive industrial sector, the built in capacities continue to grow. Due to technological developments, the capacity of wind turbines in the last 25 years has growed from 50KW to 5 MW, the production costs have dropped more than 50% in 15 years. The windenergy in Europe, in the 90s have already taken over the first place inbetween renewables to lead the share, therefore the windturbine production, and its industry became a very strong and most dinamicly evolving sector. Further results are the drop in production costs, and the effect on creating new jobs for Europe (production, launch, trade). In Europe the built in wind energy capacity grew 16 times in 10 years, almost on 50000 MW in 2008. Today the wind energy is providing Europe with 5-6% of its renewable energy needs, and we can expect it to grow.

In Hungary, the first windpower plant was built, and operates since December 2000, in 2007 the built in capacity reached the 60 MW. It is expected to rise to 330 MW until 2010, this capacity threshold was permitted until 2006 by the Hungarian Energy Authority. The favourable regulation made a huge overapplication, and a total of more than 1500 MW windenergy plant request has arrived to the office, that shows, windpower is a good investment. On the long run, by expecting the natural gas' price to rise, even with smaller subsidy or no subsidy, these investments will be beneficiary too. From the perspective of electricity production, wind energy plants are easy and fast to build installations, and expect from the investment cost, operational costs are pretty low. By these investments, theoretically the renewables share could be very fast developing. Disadvantage of their is although, that the domestic windenergy plants have an average of an 20% usage, therefore the energy production/capacity rate is too low. This gives the frame for the windenergy to supply for renewable electricity too. Because of the nature of windenergy, the changing energy production, the connection possibility to the electricity grid is higly depending on the management and abilities of the Hungarian electricity system. In the Hungarian system, where the production capacities are mainly from nuclear and fossil power plants, serious difficulties arise from the wind energy capacity, and wind energy reserve allocation and also with some quality parameter issues of the electricity grid. Recognising this, the Hungarian Energy Authority, building on international regulation experiences, on the technical situation of the domestic electricity net, asking experts from the Mavír, has concluded to limit the potential of built in wind energy into the grid to the treshold of the 330 MW. In case this limit wasnt to be changed to upper limits, the systemregulation problems should be solved. Recently it seems, there were solutions for this problem, and there is an opportunity to raise the limit to 410 MW.

Important is at the same time to see, that it isn’t a unic Hungarian problem. In Europe there are deep researches running to identify the impacts of wind energy on electricity management and regulations. Many international experience shows higher built in windenergy capacities into the electricity system. Danemark for example is first in wind energy utilization, that is working on a voluntary agreement with the electricity industry. It is based on the following: there are long term price guarantees to buy the electricity from wind energy, the connection fee is payed by the windenergy plants, and the electricity net maintainance fee is by the electricity industry. The predictibility, sound planning is also easiear, as the energetic meteorological weather forecast, as such providing better information on energy production from wind energy plants was invented.

From national economy point of view, the electricity production by wind energy plants alone has less so much additioanal values, as other renewables: employment effect is rather small, high only when the turbine production is within the country. But the advantage of them is that the emissions related environmental effects are not present by theor usage.

Every 100 MW windpower energy provides a

• 1 PJ/year burning feedstock savings in the electricity production, and

• 50 kt/year CO_2 emission reductions.

For minimising all other negative effects of the windpower plants, eg. noise, effect on animals, view of the countryside, the Ministry of Environment and Water has published guidelines, and approaches to windpower plant building concernin enviromental, spatial planning, view and natural points. The more the society is aware of these conditions, the more negative impact they have against the building, because windpower is not an organis element of the countryside.

Geothermal energy

In the EU 25 countries in 2007, the geothermal energy share within renewables was 5-6%. From the EU, Italy is the leader in producing electricity and heat by geothermal energy, and beyond the EU, Iceland has a bigger usage of geothermals.

Hungary has very good conditions for geothermal energy utilization. The geothermical gradient is 1,5 higher than the world average: the heat performance coming from under the soil is in average 90 mW/m2, until in rest of Europe this value is only 60 mW/m2. According to this data, the stones and the geothermal water within them is in 1km deep already 60ºC, and in 2km already 110ºC. The geothermical gradient is the biggest in South Transdanubium, and in the Great Hungarian Plane; in the Small Hungarian Plane, and at the hills the gradient is smaller, than the country average. The main usage directions in Hungary from geothermal energy are the direct heat usage and balneology (medicinal springs, medicinal waters in medicine bathes). Today in Hungary there are more than 900 thermal sources (at the exit more warmer than 30ºC springs and sources), 31% of which is balneologic use, one-fourth of them are for drinking water use, and almost half of them go for direct heat utilization. The produced geothermical water's heat content is used to heat agriculture glasshouses, builsings, swimming pools, usage warm water or sometimes for district heating.

In Hungary there is no geothermal energy based electricity production, only 2 of the EU 25 has such usage direction (Italy and Portugal). In Zala County, it is under preparation to install a 1 MW geothermal power plant, and the MOL (Hungarian Oil Company) is researching the establishment of a 2-5 MW experimental power plant, and the conditions.

The electricity use of geothermal energy is mainly barried by the relative low temperature of the thermal sources (the tipical temperature range of known geothermal waters are 40-95ºC), where the efficiency of energy production can be very low. Accoording to recent experts knowledges and statements, there are 8 scenes in Hungary, that provide theoretically opportunity to produce electricity and heat at the same time, with a total of 80 MW potential electricity capacity. From these ones, only the one at Fábiánsebestyén has a capacity of more than 64 MW, all the other are small, 1-5 MW suitable. The practical realization is also more difficult because of the environmental regulations (fluidum must be pumped back to the earth, salt produced must be treated), for which the recent projects, and their realization are at risk, on the long run only part of them can be maintained. Concluding the following: until the domestic geothermal waters are hard to use for electricity production by expenxive heat switch technologies, the decentralized heat production, and district heating production would be theoretically possible. Basic conditions of this to realize is, the subsidy for renewable heat production for the big investment projects, just as the green or renewables electricity is subsidized, and the natural gas consumption's subsidy content should be removed slowly too.

The environmental conditions, the salt quantity, and the pump-back requirements, and also the consumption demands in different geographical regions, the Hungarian geothermal waters can be used on a sustainable way only until 30 PJ/year heatcontent of geothermal energy, that means approx. 125 Mm3/year water exception from the earth, and from wich only 3,6 PJ would be the real heat usage. Despite of the very favourable conditions, the recent years' subsidy systems, and the preference of green electricity guaranteed buy in, did not change really the potential of geothermal energy fields and reserves usage. Besides the direct use the special art of geothermal energy use (for thermal water, and earthheat) is the heat-pump, by which one can heat, cool or produce usage warmwater. The installation takes the heat from a lower temperature agent – by using electricity -, and puts it into a higher temperature one. The heat-pumps are the most efficient, when the heat source has a possible high temperature, that should be levelled to the possible lowest level, therefore wastewater, bathes and other waterflows could be very good heat flows. By using the heatpump one could apply it to the low temperature central heatings, the so called surface-heating systems (big surface of radiator heating, floor-, wall- and ceiling heating). For application of these usage directions, bigger systems under reconstruction or new planned buildings are suitable.

In Hungary, the heatpumps are just in their infant stadium to grow, but mainstream spread of the technology is not to be expected. The high installation costs are just one factor, the system of the domestic powerplants and the electricity-natural gas price rates are determining these conditions. Due to that, in Hungary the potential energy switch is still very low. Different from the Hungarian situation is in Sweden, where the electricity almost exclusively is, approximately 50-50%, from hydro and nuclear powerplants produced. By heating purposes the electricity is playing a crucial role. Because of these circumstances, the heatpump has a different energetic-economical view, and competitiveness. The extended professional knowledge about geothermical energy usage could very much help the recent potential capacities of Hungary to be use efficiently, therefore in the educational material the technological and economical conditions of the geothermal must be developed.

Solar energy

The solar energy is the most obviously utilizable, clear, limitless energy source. The solar energy is adaptable directly or indirectly, the absorbed radiant energy can be transformed into electric energy with solar cells or to heat energy with solar collectors. The future of utilization of solar energy is very inspiring. In the last decade the prize of a common solar energy modul is reduced from 10 euro/W to 3 euro/W, and with an average growth of 35% per year, the utilization of solar energy is one of the most developed industry sector. Germany is the marketleader in solar energy, where the solar energy industry is a 5 billion Euro business with 50.000 employees due to the favourable regulation background and overtooked the previous leaders, the USA and Japan. In consideration of solar energy utilization Hungary’s nature facilities are very prosperous, the number of sunny hours are 1900-2200/year. It is more higher than in Austria or in Germany but the exploitation is much more lower than in these countries. The survey of Hungarian Scientific Academy says that the theoretical potential is 1838PJ, but the present utilization is 0,1 PJ, which is just a fragment of the practical potential (4-10PJ).

The most popular section to use solar energy is the so-called solar traps (closed, glassed space, where the sunlight is catched), the solar collectors, which help to heat, to cool the houses and in addition the water heating. The most popular service is the water heating supply for institutions and citizens. Good efficiency, creditable technologies are avaiable also from local market and from abroad. Yearly 50-70% water heating demand of a blockhouse is coverable with a 4-6 m2 solar collector. In 1999 a governmental ordinance said that till 2010 it must be implement 20.000 roofs with solar collectors, but the present situation is much more worse, in 2007 only 1000 housekeepers were adaptable to sponsorships and subsidies. The total amount of solar collector surface is about 100.000 m2, which was established by Ministry of Transport, Telecommunication and Energy during a long term, energy saving programs, supports. On the contrary with Austria, where the total amount of solar collector surface is about 3.000.000 m2, because the Austrian government backs up the using of renewable energy with favourable support systems. The 2002/91/EK guideline gives orders to the newly built, 100m2< houses to study the possibility of renewable energy implementations, to help the progression of decentralized heating systems together with distance heating applications and understand the economic background of these progresses. Catching the solar energy with solar cells in a photovoltaic way is not so implemented in voltage supply, the most inland use with eligible storage is appropriate to autonomic electricity inventory. High prices of solar cell systems cut off the increase of applications; the present compensation is about 50 years, so the inland potential will be remaining till the prices do not decrease significantly. Accepting the solar energy systems on the countryside (the farms embody the rural life form) it is a huge potential to local people to drop off the payment for electricity, because the prices of solar systems will be definitely subsidiesd. On the contrary, the inland circumstances could be well exploited with solar collector heating system, supporting the heat water production and decentralized heat combination. This will not change till the governmental support systems prefer the natural gas, disadvantaging the renewable energy sources.

Hydro energy

The hydro energy is the second most used renewable energy inception after biomass, with about 30% of total alternative energy source, but unfortunately its influence goes down in the last years. It happens due to West European water management, which overuse the hydro energy potential. In Hungary the managed 31 hydro energy power plants have 55 MW total energy efficiency, electricity yielding achieve about 190 GW/year, covered less than 0.5% of the Hungarian total used electricity. Only 4 significant power plants cover the 90% of the total amount, named: Kiskörei, Tiszalöki, Kesznyéteni and Ikervári power plants. The theoretical productivity of the small watercourses is about 40 MW/year and the assumed energy quantity is about 240GW/year. However the used water energy amount is about 10 MW/year which means about 60 MW/year electricity support. Hungary’s hydro energy strengths are not so high, in European comparison, Hungary is one of the weakest country. Due to the high specific costs is not to be expected new constructions of power plants.

Conclusions

Concluding, Hungarian natural attributes are very favourable for biomass utilization, geothermical energy and solar energy fields, which could be followed by the wind and hydro energy. Identifying the barriers and opportunities on all fields, we can conclude, that both the national and EU expectations to raise the share of renewables are only viable by growing the biomass based energy production and utilizitation, even if other renewables are used to their limits. For this goal, all of the biomass product ways should be carfeully studied, and utilized. Highly important is the both environmentally, energetically and rural economically beneficiary, very promising technology and energy source, the biogas. The biogas os the only technology, where organis waste is disposed, and at the same time useful energy arises. By using the windenergy, there are also limitless opportunities, but for the current situation everything depends on the managing features and governance of electricity-regulation system.

Biomass, solar anergy, and geothermal energy can be best used, takin ginto account the domestic attributes for heat generation very competitive to supply warm water for institutions and the public and also for complementary heating purposes. The condition here is however, that the regulation should not result in an unfavourable realteive prices for the bad of the heatmarket and being beneficiary for the natural gas use and renewable electricity production

Teaching the alternate energy production systems, and identifying the content elements, the niveau and structure of knowledge needed to compile with the requirements, the single fields of professions’ economical and market potencials should be taken into account, and the know-how adapted to these local and regional attributes. **On the field of education and teaching, the biomass energetic use and utilizaton programm should be the most developed and emphasised**, and because of having strong interrelations with agriculture, bringing it close to the target groups knowledge, and extending based on their prior education. Highly relevant is furthermore the complex professional knowledge transfer by overviewing whole range of product verticums and product cycles.

Same importance has the geothermal system planning in the future, but the professional arrear is pretty huge, lack of knowledge on the market is big. Higher education, and vocational trainings don't involve this field, therefore the basic level knwoledge transfer and related management issues, and know-how can be a first, and short term realistic educational goal.

The spread of solar energy in the public sector can be the highest volume, by these trainings and vocational educations the public can focus on leraning basic environmental and economical interrelations, and also awareness rising on the issue.

Hydro energy and wind energy utilization and planning has already may experiences, that are present on the domestic market, therefore the connected education and trainings are present in the educational systems. But at the same time, the national economical importance and expected small growth means a more moderate knowledge demand from the target groups, a basic alternative energy knowledge on these fields in the near future.

Overview of vocational trainings and their interactions within the recent higher education's system

In the coming paragraph, those special educational courses and forms were collected, that could be identified as entrance level for **system designer** and **system planner** target groups.

Making an overview of the domestic educational systems' mechanisms, we can conclude, that the **system designer** or technology planner level related PC know-how and identified basic skill needs can be connected to the higher education's vocational systems. Therefore the HPS technology designer educational level can be equalled with those higher education levels and forms, target group are those professionals and students of the professional engineering courses, and fields of professions could be also attracted as follows: agriculture, waste management, economica és mechanical sciences, also absolved university degree experts can join this target group.

The **system planner level expects the candidate of the education level to understand all alternative energy systems, and their range of product-cycles, howevere requires no technology knowledge**, therefore beyond the first target group, experts from Colleges and Universities, having absolved these can be attracted and chosen. Concrete target groups arise because of the speciality of the study material, that participated in postgraduate vocational courses. Prioritiesed could be the maintainance economics, logistics manager, finance manager, regional economics experts, municipialities experts, politicians, public utility companies, because they can immediately use the knowledge they gain from the project.

SYSTEM DESIGNER HPS E-LEARNING EDUCATION IS ADVISED TO THE FOLLOWING COURSES:
All of the courses are OKJ (National Qualification Log) vocational trainings:
Waste-management technician (OKJ)
Pannon University
Theme: technology
Type: FSZ
Form: postgraduate vocational course
Necessary prequalification: high school certificate
Qualification offered: Certificate
Length: 4 semesters

Mechanical industry engineer assistant (OKJ)
Pannon University
Theme: mechanical
Type: FSZ
Form: postgraduate vocational course
Necessary prequalification: high school certificate
Qualification offered: OKJ Certificat
Length: 4 semesters

Logistics technical manager (OKJ)
Eszterházy Károly College
Theme: logistics
Type: FSZ
Form: postgraduate vocational course
Necessary prequalification: high school certificate
Qualification offered: OKJ certificate
Length: 4 semesters

Food Industry Manager (OKJ)
Eszterházy Károly College
Theme: natural science
Type: FSZ
Form: postgraduate vocational course
Necessary prequalification: high school certificate
Qualification offered: OKJ Certificate

Length: 4 semesters

Economics Manager Assistant (OKJ)
Gábor Dénes College
Theme: IT
Type: FSZ
Form: postgraduate vocational course
Necessary prequalification: high school certificate
Qualification offered: OKJ certificate
Length: 4 semesters

Technical informatics engineer assistant (OKJ)
Pannon University AdultVocational Center
Theme: IT
Type: FSZ
Form: postgraduate vocational course
Necessary prequalification: high school certificate
Qualification offered: OKJ Certificate
Length: 4 semesters

Agriculture manager assistant (OKJ)
Károly Róbert College
Theme: manager
Type: FSZ
Form: postgraduate vocational course
Necessary prequalification: high school certificate
Qualification offered: University level certificate
Length: daytime-corresponding 4 semesters

SYSTEM PLANNER, HPS EDUCATION CAN BE SUGGESTED TO THOSE EXPERTS, HAVING ALREADY A UNIVERSITY DEGREE, WHO BEYOND THESE PROFESSIONAL POSTGRADUATE COURSES, POSTGRADUATE ENGINEERING COURSES, PARALELL WITH THESE, CAN START THE E-LEARNINGES HUN-HYPOS:

Information economics management professional postgraduate course(OKJ)
Szent István University
Theme: economical
Type: professional postgraduate course
Form: professional postgraduate course
Necessary prequalification: university level
Qualification offered: Certificate
Length: 4 semesters
Fee: 105.000HUF

Financial and entrepreunial professional postgraduate course (OKJ)
Szent István University
Theme: economical
Type: professional postgraduate course
Form: professional postgraduate course

Necessary prequalification: university level
Qualification offered: Certificate
Length: 4 semesters
Fee: 105.000 HUF

Regional Economics Expert Professional Postgraduate Course (OKJ)
Szent István University
Theme: economical
Type: professional postgraduate course
Form: professional postgraduate course
Necessary prequalification: university level
Qualification offered: Certificate
Length: 4 semesters
Fee: 105.000 HUF

Environmental Professional Engineer (OKJ)
Szent István University
Theme: environmental protection
Type: for graduates
Form: Daytime for graduates
Necessary prequalification: university level
Qualification offered: Diploma
Length: approx. 2 years
Fee: 0 HUF

Facility **Economics Manager Course** (OKJ)
WIFI HUNGÁRIA Education and Vocational Training Institute
Theme: manager
Type: Conferences and trainings
Form: professional postgraduate course
Necessary prequalification: high school certificate
Qualification offered: Certificate
Length: 210 study hours
Fee: 850.000 HUF

NEEDS STUDY RESULTS BY SUBCHAPTERS IN THE HUN HYPOS PROJECT

I. Hybrid Power System (HPS) component parts

a. Conventional power producing systems

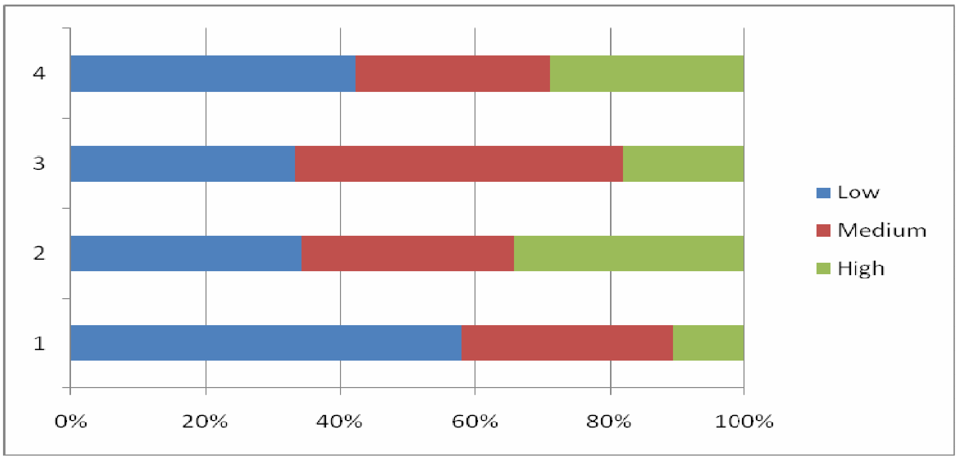
- AC and DC diesel generators design characteristics
- Gas-turbine generators design characteristics
- Conventional generators full and partial load operation performance
- Conventional generators fuel consumption curves

Other conventional generators related issues of interest:...

Results: (*Low Moderate High)*

Percentage of answers on the topic and **number of answers on the topic**

58%	32%	11%	60	33	11
34%	32%	34%	36	33	36
33%	49%	18%	35	51	19
42%	29%	29%	44	30	30



b. Wind turbine generators

- Wind energy potential calculation (for an area)
- Wind turbine types and characteristics
- Wind turbine power curve generation and adjustment
- Estimation of the energy produced by a wind turbine
- Multiple wind turbines and power smoothing

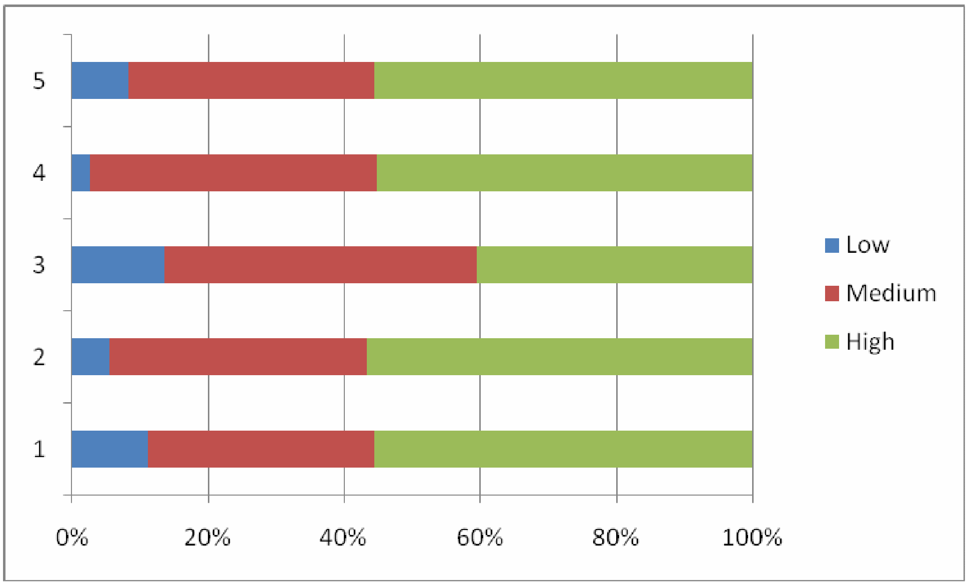
Other Wind Energy Exploitation Systems related issues of interest:.....................................

Results: (*Low Moderate High)*

Percentage of answers on the topic and **number of answers on the topic**

11%	33%	56%	12	35	58
5%	38%	57%	6	39	59
14%	46%	41%	14	48	42
3%	42%	55%	3	44	57

8%	36%	56%		9	38	58



c. Photovoltaics

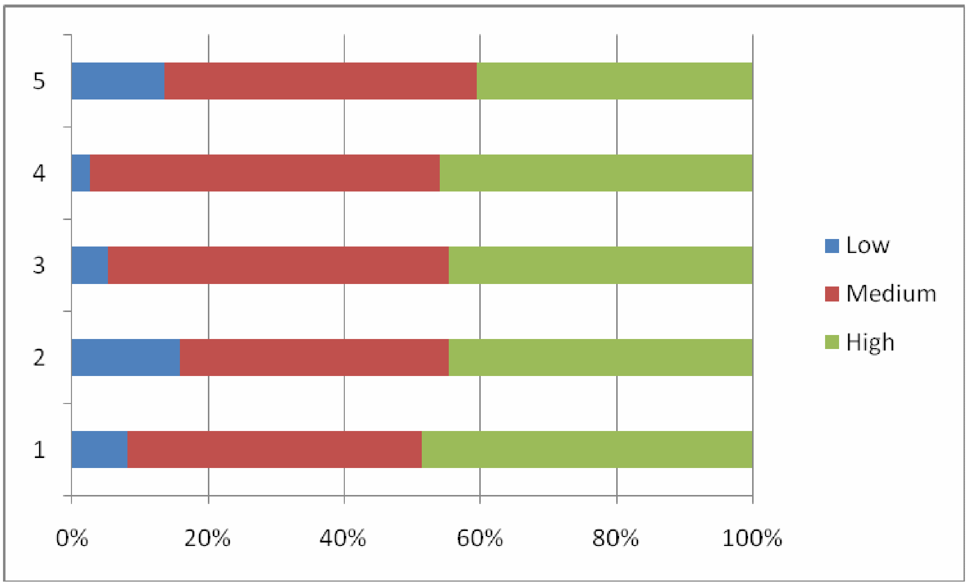
- Solar Resource characterisation (irradiance, insolation,…)
- Photovoltaic cells operation characteristics (I-V curves, etc.)
- Factors affecting the performance of photovoltaic cells
- Performance of multiple panels in photovoltaic arrays
- Photovoltaics / battery integration

Other Photovoltaic Systems related issues of interest:...

Results: (*Low Moderate High)*

Percentage of answers on the topic and **number of answers on the topic**

8%	43%	49%		8	45	51
16%	39%	45%		16	41	47
5%	50%	45%		5	52	47
3%	51%	46%		3	53	48
14%	46%	41%		14	48	42



d. Small hydropower schemes

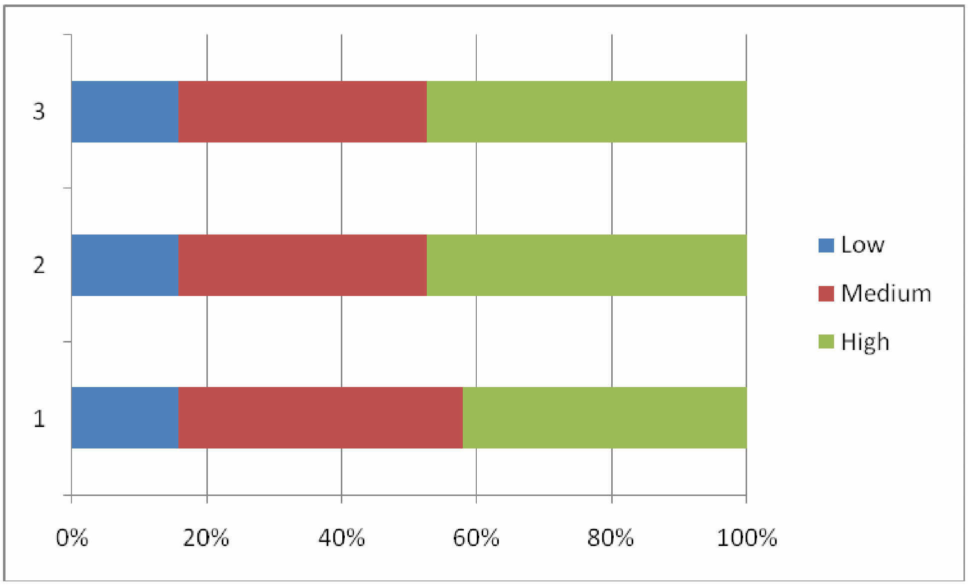
- Calculation of the exploitable potential
- Water-turbine types and their operational characteristics
- Turbine selection and sizing

Other Small Hydropower Stations related issues of interest:..

Results: (*Low Moderate High)*

Percentage of answers on the topic and **number of answers on the topic**

16%	42%	42%	16	44	44
16%	37%	47%	16	38	49
16%	37%	47%	16	38	49



e. Biomass fuelled power producing technologies

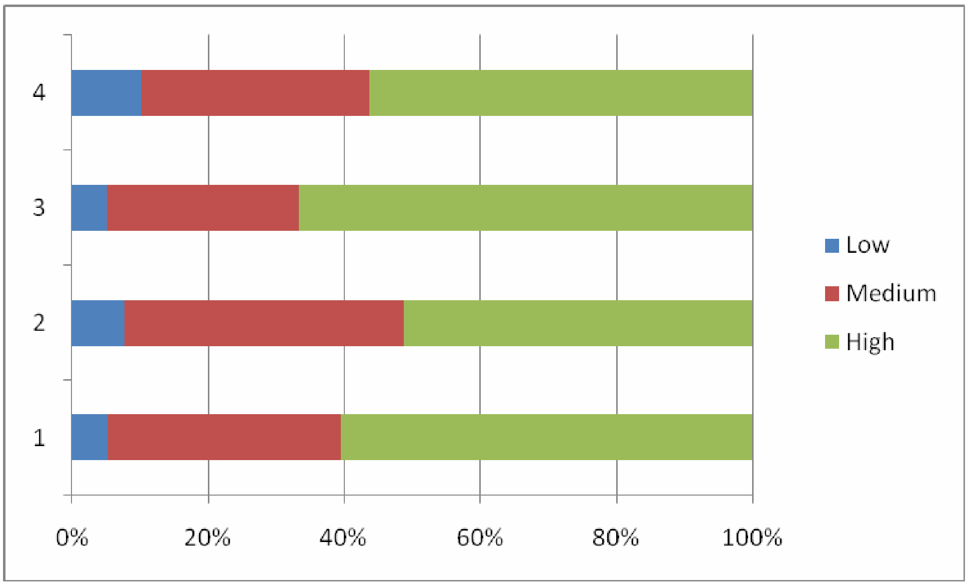
- Characteristics of various biomass fuels
- Operational features of solid biomass fuel burners
- Factors affecting the efficiency of a biomass fuelled system
- Biomass gasification/pyrolysis for power production characteristics

Other Biomass fuelled power producing technologies related issues of interest:........................

Results: (*Low Moderate High)*

Percentage of answers on the topic and **number of answers on the topic**

5%	34%	61%	5	36	63
8%	41%	51%	8	43	53
5%	28%	67%	5	29	69
10%	33%	56%	11	35	59



f. Geothermal power technologies

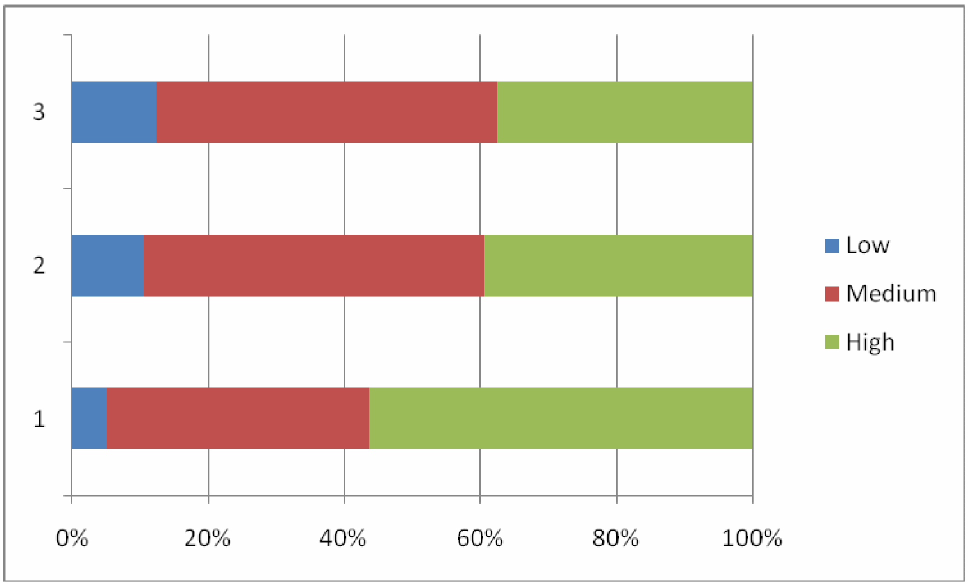
- Classification of geothermal zones – applications per type of field
- Flash steam power plant characteristics
- Binary cycle power plant characteristics

Other Geothermal power technologies related issues of interest:...

Results: (*Low Moderate High)*

Percentage of answers on the topic and **number of answers on the topic**

5%	38%	56%	5	40	59
11%	50%	39%	11	52	41
13%	50%	38%	13	52	39



g. Fuel cells

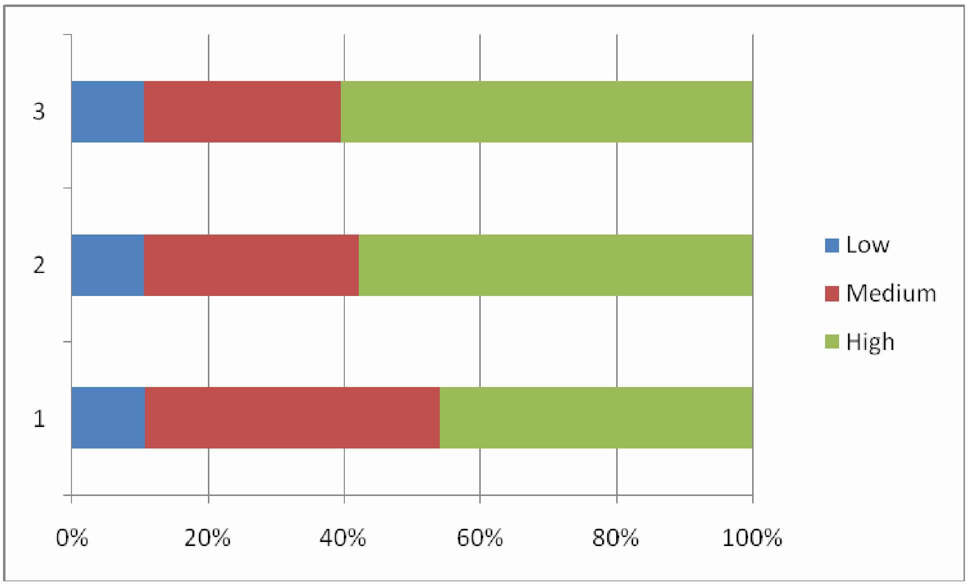
- Operational principles of fuel cells
- Types of fuels used in fuel cells
- Fuel cells benefit, applications and limitations

Other RES and "New" Energy Technologies related issues of interest:................................

Results: (*Low Moderate High)*

Percentage of answers on the topic and **number of answers on the topic**

11%	43%	46%	11	45	48
11%	32%	58%	11	33	60
11%	29%	61%	11	30	63



II. Power Storage, conversion and distribution with HPS

a. Storage systems and power conversion devices

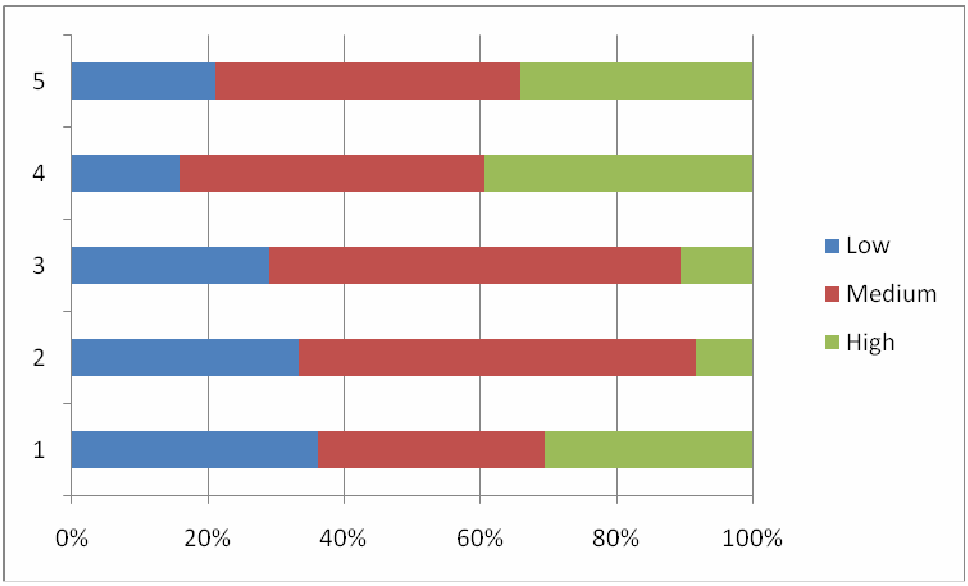
- Technologies for DC-AC transformation (rectifiers/inverters)
- Rotary converters characteristics
- Synchronous condensers operation principles
- Electrical an/or mechanical energy storage techniques
- Battery cell types and characteristics

Other Transformation and Storage of Electric Energy related issues of interest:..................

Results: (*Low Moderate High)*

Percentage of answers on the topic and **number of answers on the topic**

36%	33%	31%	38	35	32
33%	58%	8%	35	61	9
29%	61%	11%	30	63	11
16%	45%	39%	16	47	41
21%	45%	34%	22	47	36



b. Power System characteristics

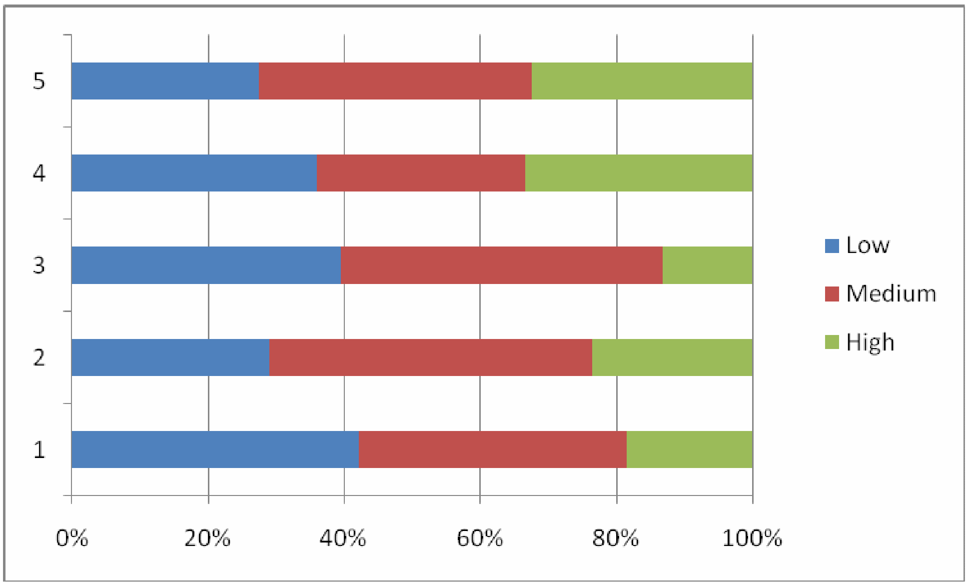
- Distribution of energy to storage and from diesels
- Distribution of energy to secondary and dump loads
- Bus system operation
- Power transfer between buses
- Transfer system loses

Other Power System characteristics related issues of interest:...

Results: (*Low Moderate High)*

Percentage of answers on the topic and **number of answers on the topic**

42%	39%	18%	44	41	19
29%	47%	24%	30	49	25
39%	47%	13%	41	49	14
36%	31%	33%	37	32	35
28%	40%	33%	29	42	34



c. Supervisory Control strategies and equipment

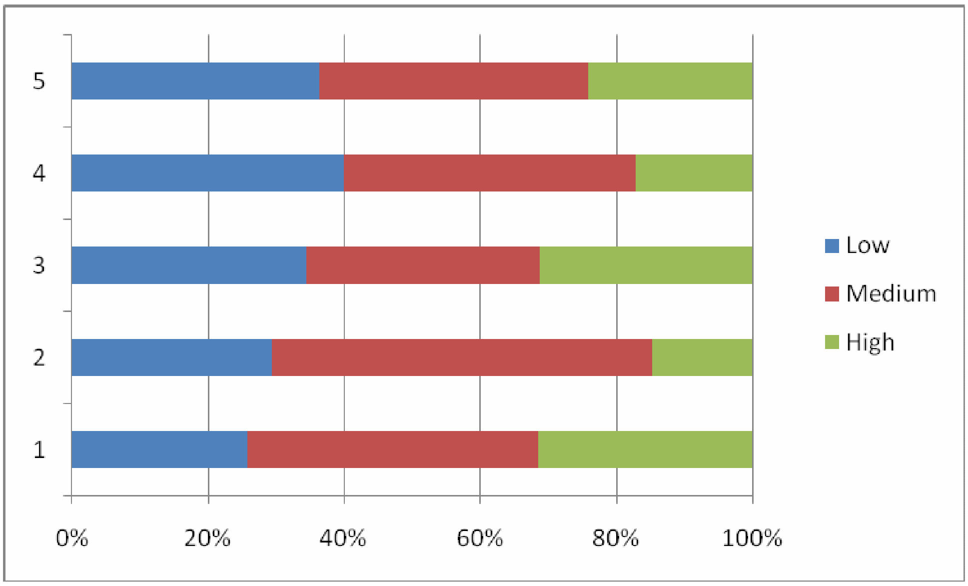
- Characteristics and difficulties of HPS operation
- Dynamic behaviour of HPS
- Power quality for HPS
- Scheduling and dispatching of conventional generators
- Supervisory controllers' characteristics

Other Control Strategies and Equipment used related issues of interest.................................

Results: (*Low Moderate High)*

Percentage of answers on the topic and **number of answers on the topic**

26%	43%	31%	27	45	33
29%	56%	15%	31	58	15
34%	34%	31%	36	36	33
40%	43%	17%	42	45	18
36%	39%	24%	38	41	25



III. Hybrid Power System Design and Operation

a. Hybrid Power System design principles

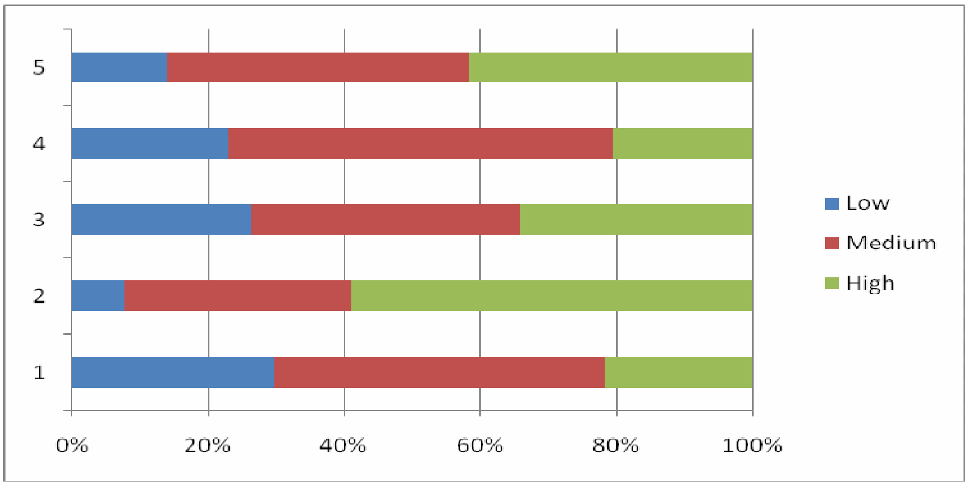
- Conventional generators selection
- Specification of RES and/or New technologies penetration level
- Sizing of various generators
- Identification of primary, deferrable and optional loads
- Identification of dump and unmet loads

Other Designing of HPS related issues of interest:..

Results: (*Low Moderate High)*

Percentage of answers on the topic and **number of answers on the topic**

30%	49%	22%	31	51	22
8%	33%	59%	8	35	61
26%	39%	34%	27	41	36
23%	56%	21%	24	59	21
14%	44%	42%	14	46	43



b. Operation (scheduling, monitoring, etc.) strategies for Hybrid Power Systems

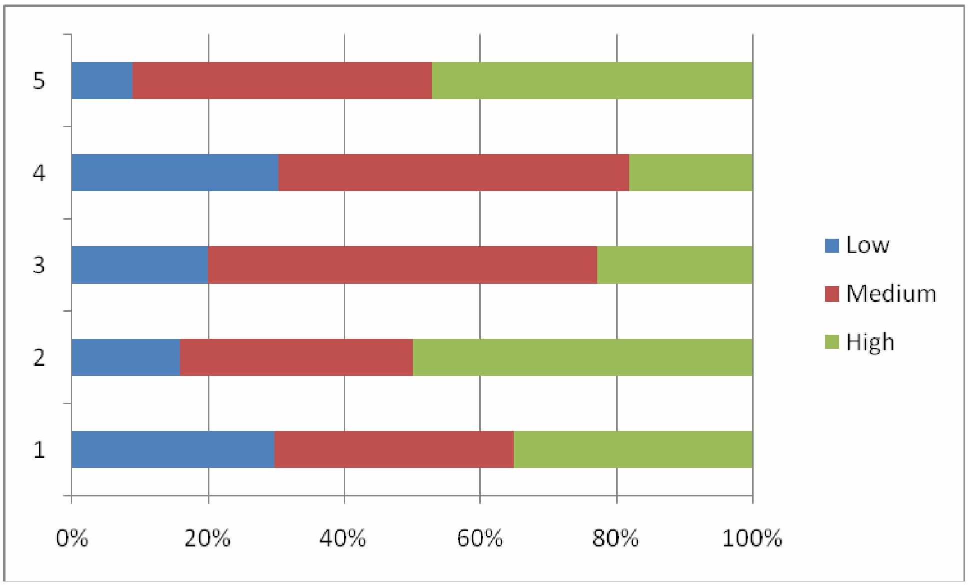
- Evaluation of the data collected by the monitoring system
- Use of the collected data for scheduling
- Spinning reserve, load management, and minimum run time technique
- Hyteresis method
- Storage management

Other Operation of HPS related issues of interest:..

Results: (*Low Moderate High)*

Percentage of answers on the topic and **number of answers on the topic**

30%	35%	35%	31	37	37
16%	34%	50%	16	36	52
20%	57%	23%	21	59	24
30%	52%	18%	32	54	19
9%	44%	47%	9	46	49



IV. Economical and fiscal issues for HPS

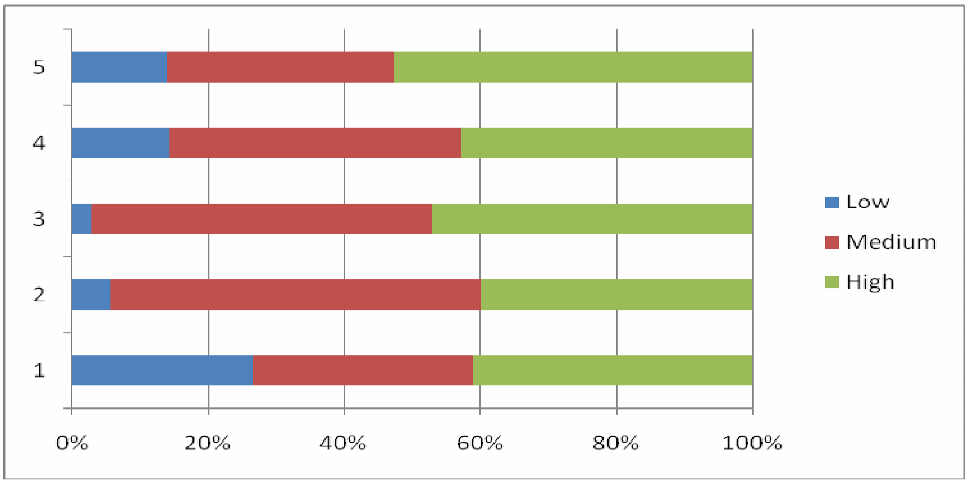
- Local/national priorities for HPS
- Current legal frame and permits required for electricity production
- Calculation of the economics of Hybrid Power Systems
- Economics of retrofit systems
- Financing capabilities for Hybrid Power Systems

Other Electricity Production from HPS Economical and fiscal issues of interest:..................

Results: (*Low Moderate High)*

Percentage of answers on the topic and **number of answers on the topic**

26%	32%	41%	28	34	43
6%	54%	40%	6	56	42
3%	50%	47%	3	52	49
14%	43%	43%	15	45	45
14%	33%	53%	14	35	55



TOTAL RESULTS

	Low	Medium	High
Conventional power producing systems	42%	35%	23%
Wind turbine generators	8%	39%	53%
Photovoltaics	9%	46%	45%
Small hydropower schemes	16%	38%	46%
Biomass fuelled power producing technologies	7%	34%	59%
Geothermal power technologies	9%	46%	45%
Fuel cells	11%	35%	55%
Storage systems and power conversion devices	27%	48%	25%
Power System characteristics	35%	41%	24%
Supervisory Control strategies and equipment	33%	43%	24%
Hybrid Power System design principles	20%	44%	35%
Operation (scheduling, monitoring, etc.) strategies for Hybrid Power Systems	21%	44%	35%
Economical and fiscal issues for HPS	13%	43%	45%