

## **Slutrapport**

# **Webbaserat magisterprogram i energiteknik**

**Nätuniversitetet # 5222313**

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### **SUMMARY**

A Master/Magister program in sustainable energy engineering was planned and developed as part of the project “Webbaserat magisterprogram i energiteknik”, sponsored by NSHU. The program had substantial discussions during the preparation phase and substantial progress was made towards a common strategy from the six partner universities (Umeå, Gävle, Linköping, Uppsala, Karlstad, KTH) who decided to participate in the endeavour. The program was first launched in 2007 with 18 initial students. It was re-launched in 2008 with 15 students and is now in the application phase for the fall 2009 intake.

The present report covers the final part of the project from the point of view of NSHU, but the educational efforts, and the cooperation between most of the partners, will continue into the fall 2009 intake at least, with own funding from the partner universities. The continuation of the project for 2010 onwards will be re-evaluated in the autumn 2009 based on decisions by the Swedish government regarding eventual tuition fees for non-European students.

This final report covers the background to the application, the development phase and gives some conclusions of what went well and where the major challenges were.

The project has been used as example for a national cooperation in the energy education at a few workshops and keynote speeches at conferences over the last two years.

### **SAMMANFATTNING**

Ett Master/Magister program i "Sustainable energy engineering" har blivit planerat och utvecklat som del av projektet "Webbbaserat magisterprogram i energiteknik", med NSHU som huvudfinansiär. Under utvecklingsfasen drevs mycket detaljerade diskussioner med ett antal universitet i Sverige som hade intresse för energiutbildning. Efter en viss tid konvergerade programmet mot en gemensam strategi mellan sex universitet (Umeå, Gävle, Linköping, Uppsala, Karlstad, KTH). "Energy on Line" utbildningsprogrammet lanserades första gången inför det akademiska läsåret 2007/08 med initialt 18 studenter. Inför läsåret 2008/09 accepterades 15 studenter. Programmet är nu i ansökningsfasen för läsåret 2009/10.

Rapporten avslutar NSHUs del I projektet, men utbildningsprogrammet kommer att fortlöpa och utvecklas under det kommande läsåret. Den framtida utvecklingen kommer dock att avgöras under hösten 2009 i samband med att den svenska regeringen klarlägger planerna avseende en framtida avgiftsbelagd högskoleutbildning i Sverige.

Slutrapporten sammanfattar bakgrunden till projektet, och det föreslagna utbildningsprogrammet "Energy on Line", utvecklingsfasen och de hittills uppnådda resultaten. Rapporten ger även en sammanfattning avseende de "utmaningar" som kom fram under projektets gång, och en indikation avseende hur dessa löstes på pragmatiska sätt.

Projektet har under de senaste 2 åren använts som exempel på hur samverkan kan genomföras inom energiutbildningen i ett nationellt perspektiv i Sverige.

## **BACKGROUND**

Energy and climate is very high on the political agenda today. There is a large need for innovative energy transformation models and components, and the possibility for saving of all kind of energy resources must be developed. In many of the "mature economies" like Unites States and Western Europe several power plants start to get old and need to be replaced within the next decades. In "emerging economies" there is a need for a large boom in installing new capacity for electricity, heat and cooling, as well as transportation fuel. One of the large challenges will be how energy saving measures can be introduced into "emerging economies" at the same time as the social welfare and the economy can grow in these countries with the present large increase in population.

There will thus be a large need for engineers with a good and solid background in energy technology, and especially related to sustainable energy. This need will exist throughout the world. It is also recognized that most future students in engineering will be in the part of the world where there are a limited number of experienced teachers available. Presently this is the case for many countries in Asia whereas Latin America and Africa will also need to develop their energy systems in appropriate sustainable ways. Finally, there will also be a significant need for energy engineering competence increase inside "mature economies" like Sweden, both as related to the replacement of existing installed capacity in power plants but more

specifically towards the sustainability aspects and new technologies that both present and coming engineers must accumulate in the life-long learning perspective. Also in this case it is clear that the students eager to assimilate new knowledge in the field will be dispersed over the country, working in various energy plants and communities all over Sweden, whereas the teachers are mainly concentrated in the urban areas.

There is thus a significant need for the development of “remote energy education”. At the time of the proposal for the present project it was recognized that only one completely webbased Master degree specialized in energy technology could be found in the world-wide perspective. This was at that time given in a small scale by KTH in Sweden. It was thus recognized that there would be a significant potential for further educational programs in the energy area. Furthermore, it was recognized that there were (and still are) different competencies in the energy field spread out in different universities throughout Sweden. It was then logical to see if it would be possible to arrange some kind of web-based common energy Master program, with special competencies from different universities, in Sweden. The “market” for the education was thought of as both Sweden and the world. Thus the idea of a common “Energy on Line” Master program between different universities in Sweden was born.

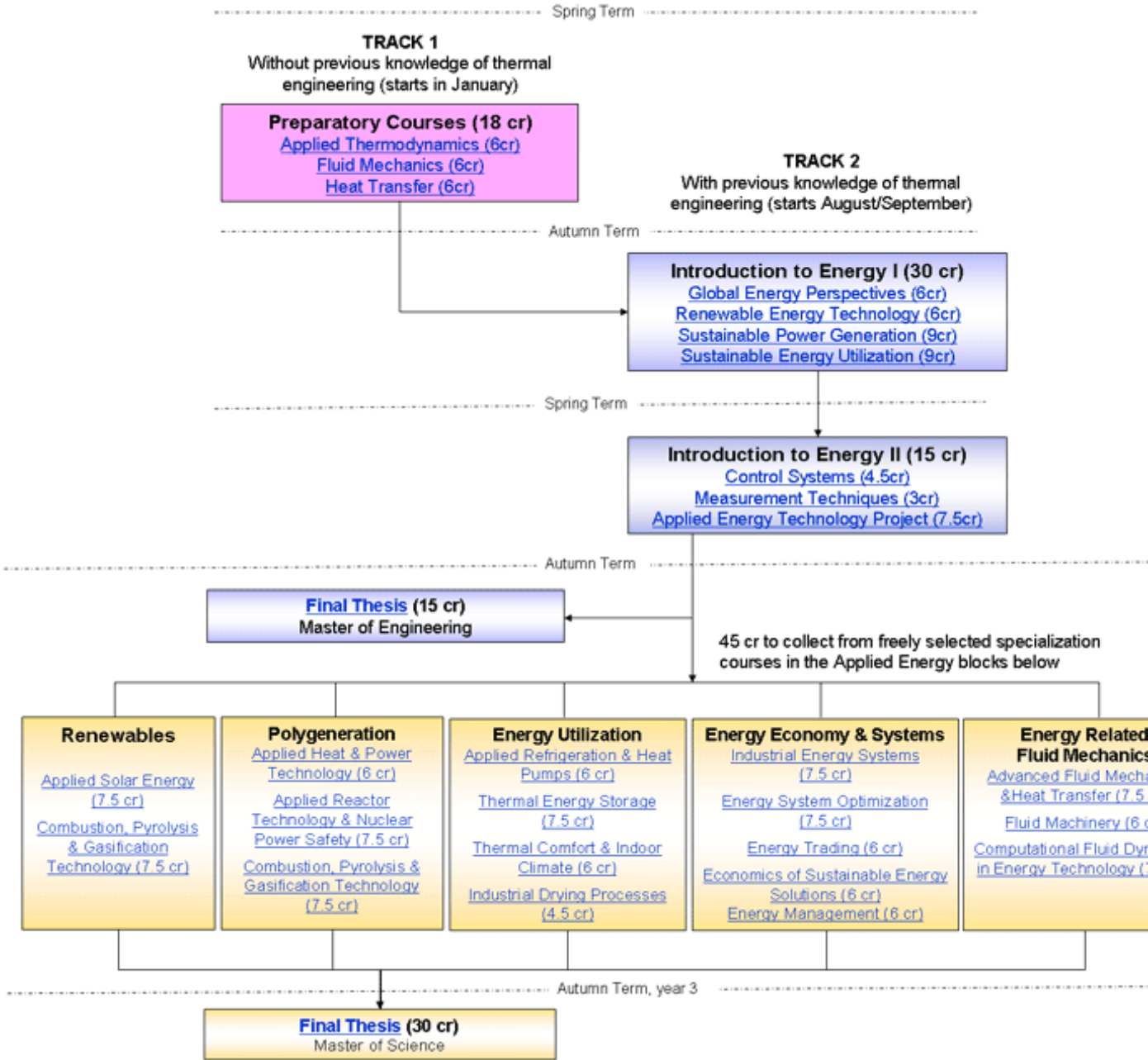
## **PROGRESS, RESULT & ACHIEVEMENTS**

Before the official start of the project it was investigated if the combination “energy and electricity” could be performed. There were serious and far-reaching discussions on this topic. It was however not possible to reach a coherent view of a complete such program, mainly as the background a student needs to study the energy part on the chemical/mechanical side is fairly different from the background needed for the electrical side. It was thus concluded that it would be better to separate the original thought into two separate programs. The present proposal did thus proceed with mainly the mechanical/chemical direction of the energy system.

Another aspect considered before the official start of the project was which universities would be interested to participate. It was concluded that none of the “large” institutes of technology in Sweden, apart from KTH, were interested to participate, whereas a few “general” universities were interested. After a while a group of Uppsala, Linköping, Umeå, Gävle, Karlstad and KTH was formed to develop and run the program.

Initially it was intended that a Master Degree in “Energy on Line” would be created at each one of the participating universities and that they would independently hand out the degrees (of course with the distinction if a “Master” or a “Magister” degree should be established depending on the exam rights the corresponding university has). However, this was not possible based on the fact that several of the partners did not accept such a Master program. The general reasoning behind this was in principle that there are so many Master programs already and it is not possible to establish new ones without a track record and/or taking away another existing program. After significant discussions it was decided that Umeå University would establish the program as a degree program and that the students who performed the final MSc thesis project in Umeå would receive an “Energy on Line Master Degree”. At the other universities the students would receive a general degree of the kind these

universities already have established. As Gävle and Karlstad can not hand out Master degrees, a clear option was established in which the students could also receive “Magister” degrees. The final program was thus very flexible in the sense that students can take courses at various universities and get these recognized at the other universities, and that they have the option to receive either a “Magister” or a “Master” degree. The outline of the complete program is described in Fig 1.



**Fig 1:** Description of the full Master and Magister Energy on Line program (for more information, please see [www.energy-online.org](http://www.energy-online.org)).

As can be seen the program also leaves an option for preparatory courses (see “Track 1” in the upper left corner) so that students who do not have the necessary

background in fluid mechanics, thermodynamics and heat transfer may have the possibility to prepare themselves during a spring semester and then start the program in the autumn semester, as for most degree programs in Sweden.

It is important to note that all the courses (with a few exceptions) offered inside the program already existed at the partner universities. This was a pre-requisite for starting the whole program as it was considered it would take several years to reach a critical momentum to be able to offer financially sustainable courses if these would have to be specifically tailored for the “Energy on Line” program. Although it was considered that there would be several students interested in the program it was not believed that there would be enough students finishing the courses on a full-time basis such that it would be possible to have specially developed courses. Furthermore, as the goal of the whole degree program was to collaborate between different universities there was a need (and significant wish) to offer courses of approaching content. Thus the number of students in each individual course would per definition be low during a certain number of years in the beginning.

Although the courses already existed, or were planned to exist, there were however several courses that needed to be specifically tailored towards the “Energy on Line” program. This was performed partly based on the development funding from NSHU and partly with funding from the partner universities.

The different courses were offered in different ways. These ways are mainly based on the experience the course responsible/examiner has previously had with “distance education”. Some courses were offered as only remote in the sense that the students received “a book to read” and then had some exercises to perform. Others were arranged such that all the lectures were given via an internet communication system, with interactive exercises and some pre-filmed lab and calculation exercises. Some courses were based fully on continuous examination whereas some were based on traditional “writing examinations in a classroom”. For both the lecturing as well as the examination mode there were several intermediate alternatives for some courses. In general it can be concluded that the examination mode has not had any significant influence on the achievements.

There has been an extremely good, positive and productive collaboration inside the “Energy on Line Program Committee”. Most partners have regularly participated in the meetings. During the semesters there have been a fixed bi-weekly internet meeting (using the tool CENTRA [which also has been used for all the lectures given by KTH inside “Energy on Line”]), and there have been, when so needed, “physical face-to-face meetings”. It has been concluded that most issues have been solved in the regular internet meetings and there has not been any need for a “physical face-to-face meeting” during the last year. This is probably based on the good working relationship that was developed during the preparation of the programs, and specifically to the considerable interest all the teachers representing the various universities in the “Energy on Line Program Committee” have had towards this kind of education. Although some persons in the Program Committee have been exchanged during the two last years the productive internet meetings have been able to continue.

The “Energy on Line” Magister/Master degree program is now offered the third time (with application date on Jan 15, 2009). The first year there was no marketing at all, and individual students who had applied for the KTH Distant Energy Program (to be performed group-wise) were re-directed to the “Energy on Line”. Some students also found the site on the internet directly. The second year there was a basic marketing and a substantial number of students applied, but only about 15 students were admitted by the Umeå Admission Office. The courses offered by KTH (and also a few other universities) were not included in the search database “studera.nu” and thus it was not clear exactly how students should apply. It is estimated that an even larger number of students would have applied if this would have been the case. There were many complaints from prospective students to the “Energy on Line Program Director” that the application process did not work, that they did not get proper feedback from “studera.nu” and the Umeå Admission Office etc. The “Energy on Line Program Committee” can not judge the validity in these complaints, but was clear that the “studera.nu” did not function very well in the end of 2007 and beginning of 2008.

For the third batch (for the application date Jan 15, 2009) all participating universities have performed marketing through their normal channels (more or less large, depending on the individual partner). As the application process is now central in the whole of Sweden, and as a little more than two weeks remain before the application dead-line, it is not presently possible to estimate how many students will apply.

It can however be concluded that the results from the degree program “Energy on Line” have not corresponded to the full intentions. The courses have been offered in the intended way, and several students have applied. There are presently about 20 students in the Energy on Line program. However, most seem to conclude after (or even during) the first semester that they can not spend enough time on full-time studies. The first course seems to go well and in many cases also a second course. However, thereafter it seems as if the burden to study on-line seems to be increasing and/or the motivation declining. With the too limited data the “Energy on Line Program Committee” has presently (it is only 1.5 years since the first students were admitted) it is not possible to draw any major conclusions regarding exactly why the students “drop out”. And it should also be stated that although most students show a low activity many of them has not indicated a complete “drop out”, but rather an indication “still interested but presently there are too many other commitments”. This is of course in line with experience from other on-line courses, and it probably becomes even more accentuated in the case of a complete 2 year (in the case of full-time studies) degree program. Of course it should be mentioned that the autumn 2007 was the first intake and thus no-one of the students should be more than 75% into the Master program, or should just have been allowed to start the “Magister thesis” by now. A short follow up (not complete as the results from the exams in the autumn period 2008 are not all yet fully available) indicates that:

- 10 students have fully finished the “Global Energy Perspective” course in Uppsala (=1<sup>st</sup> course in the program),
- 7 students have fully finished the “Renewable Energy Technology” course at KTH (and 5 more have done some, but not all, assignments) (=2<sup>nd</sup> course in the program)
- 3 students have finished the Sustainable Power Generation course at KTH (and 8 more have done some of the assignments) (=3<sup>rd</sup> course in the program)

- 4 students have completely finished the “Sustainable Energy Utilization” course at KTH (=4<sup>th</sup> course in the program)
- 3 students have finished the “Control system” course in Umeå (=5<sup>th</sup> course in the program)
- 2 students have fully finished all the courses so far. One is presently aiming for the “Magister degree” in Gävle, whereas the other presently takes the final courses for being allowed to start either the “Master degree” or the “Magister degree” (the student has not yet decided which).

Although the number of students who have passed a significant number of courses in the program so far is low, it can be concluded that there is still a large potential, especially considering that the first intake was autumn 2007 and thus no students should really have finished the complete program by now, as well as the problems encountered with “studera.nu” in the winter 2007/08. Some of the positive aspects to be mentioned:

- The “Energy on Line” program was developed and successfully launched.
- The ideas developed inside the project have been the basis for other educational initiatives (by at least one of the partners) towards EU-funded educational projects
- Some courses have been developed into more interactivity and “blended learning” than was originally the case
- The partner universities made significant progress in working together and making compromises regarding course offers etc. These will be very valuable in the future
- 2 students are close to the degree.
- About 10 more have made substantial progress but have not been able to follow up on the full-time speed in the program. Contacts are kept with them to finish the remaining parts and follow up the remaining courses at a slower speed.
- The “Energy on Line” program has been fully included in “studera.nu” from the end of December 2008, with admission in Gävle.

However, based on the low turn-out in the accepted number of students so far, Karlstad University has decided to opt out and not participate in the future efforts. KTH, Umeå, Uppsala, Gävle and Linköping are still committed to deliver the courses, and hand out the various degrees the students can obtain at the respective universities.

## **CHALLENGES**

There were several challenges throughout the project, out of which the following are worth mentioning:

- It was originally thought that it would be “an easy task” to arrange for a common Master/Magister Program called “Energy on Line” at each one of the participating universities. The reason for this was that the Rektors for each one of the universities had already given their “OK” to the program in an acceptance letter to NSHU. However, the administrative procedures became very tedious and although the faculties at the universities were in principle favourable towards the collaboration it was not possible to get a common “Energy on Line” Master program accepted. This challenge was solved in a pragmatic way such

- that the program was installed in Umeå (and later Gävle) and the other universities gave degrees with other names. These administrative procedures were one of the main obstacles in launching the program.
- There were also a substantial number of small problems that had to be solved in good spirit, including such issues to make sure that the students did not have to pay the “student union fees” more than at one university. All these issues were solved, although after significant administrative time by bought teachers and administrators.
  - Establishment of a common “course package”: Each one of the universities had their own specialities. There had to be made certain compromises related to which courses should be given at each university. This was solved in good constructive ways by the Program Committee.
  - Certain courses showed a significant amount of overlap. As far as feasible these “double courses” were avoided and a compromise related to which partner should give a specific course was reached.
  - The fact that “studera.nu” came into place at the time of second launch created some initial problems and delays during the 2008 application process.
  - The marketing was not done properly by the “Energy on Line Program Committee”. Even as the “whole world” was considered as market there was a specific marketing through Ny Teknik, Learning Centers etc in Sweden. However, it does not seem as if this reached the intended population. As the program was not officially launched at the respective partner universities the promotion was unfortunately not done through the partners regular channels the two first years. The program is now part of “studera.nu” and has been subject to a direct marketing campaign from the Energy Department at KTH, but it is however not clear to the “EoL Program Committee” how this will work, and/or how a better direct marketing should be made in the future.
  - One of the aims was to attract students “in remote areas” in Sweden. In the 2007 and 2008 intakes there were 5 resp 6 students (out of 18 resp 15) from Sweden. However the two students from the 2007 intake who has progressed best are not from Sweden, but from USA and Canada.
  - One of the major challenges is to keep track of the students’ progress. In fact, as the students registered for specific courses at different universities they do not show up in a single database. A manual “student follow up” has thus been made over the two years the program has run. This is possible as long as there have been a very low number of students, but it has been a very tedious process taking a lot of teacher time (each individual assignment in each course has been followed up for each individual student at the students’ own pace). If the program will continue there is a need to set up an automatic “tracking system”. This is especially so as almost all of the students in the “EoL” program have full-time employments, study in isolation and thus it is very easy to “lag behind”. The “EoL Program Committee” needs thus to be very “pro-active” to try to identify students who might need some extra help.

## **ACKNOWLEDGEMENT**

The partner universities, and especially the “Energy on Line Program Committee”, express the sincere thanks to NSHU for the encouragement of the project as well as



the financial support. It is clear that the "EoL" Master/Magister program would not have been developed without this support.