Sustainable Energy Systems Curriculum

An Interactive Qualifying Project
submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfilment of the requirements for the
degree of Bachelor of Science

by
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Abstract

In 2012, the Lucerne School of Engineering and Architecture launched a bachelor degree in Business Engineering with specialization in Sustainable Energy Systems (BE SES). The program is designed to supply well-trained graduates to meet the demand for business engineers in growing energy-related fields. The goal of our project was to compare the BE SES curriculum at the Lucerne School of Engineering and Architecture to similar programs at other universities around the world, and evaluate student and faculty satisfaction, employer expectations, and marketing strategies. We found that the program is very well situated to meet the demands of students and potential employers, but we make several recommendations to ensure continued success of the program in the future.

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Executive Summary

The Business Engineering Sustainable Energy Systems program (BE SES) at the Lucerne School of Engineering and Architecture is currently in its fourth semester. As the program is addressing one of the key global challenges during its acceleration phase – characterized by rapid changes in perception and new innovations, it is important to continuously benchmark the curriculum to ensure that it optimally preparing students to become leaders and innovators in the field of sustainable energy. The goal of our project was to compare the BE SES curriculum at the Lucerne School of Engineering and Architecture to similar programs at other universities around the world, and evaluate student and faculty satisfaction, employer expectations, and marketing strategies. Based on our findings, we provide a list of recommendations to aid in the refinement/timely adjustments of the BE SES program curriculum.

The project team:

- evaluated the BE SES program in comparison to other educational institutions' offerings (*External Review*);
- evaluated student and faculty outlook on current sustainable energy curriculum (*Internal Review*);
- evaluated employer perspectives on the program and their expectations of graduating students (*Employer Review*); and,
- assessed the marketing and communication strategies used by the BE SES program and other similar programs (*Marketing and Communication Review*).

For the *external review* we assessed the online materials posted by sustainable engineering programs around the world and followed up with a questionnaire survey and telephone interviews of selected programs. For the *internal review*, we distributed surveys to all 43 students currently enrolled in the BE SES program and followed up with in-depth interviews of 11 students and the affiliated faculty. For the *employer review*, we identified 244 contacts of potential employers, surveyed a total of 24 of them, and interviewed 6 of them for more in-depth information. We also surveyed 48 students who attend colleges and universities in the United States in order to learn what marketing and communication tools are commonly used by these schools.

Conclusions & Recommendations

Conclusion 1: The base of program is very well conceived and organized requiring only minor changes. Based on our review of the curriculum and surveying of the students we

found that a module that gets students excited about sustainability, and teaches them where the basics can be applied, is necessary in the first year. Students expressed interest in energy storage, which is a topic offered in other similar programs. Their interests were not limited to those technologies found in Switzerland, in part because over a third of the students surveyed have international backgrounds. Expanding the program may require little effort since BE SES students expressed interest in modules already offered for other majors at HSLU. They have indicated that they would like to have them offered in English. Students have also shown interest in being informed when/if changes and updates occur within the program. Overall, we uncovered no major flaws with the program and only have relatively minor recommendations for how to improve the program moving forward. (*Internal Review*)

The areas of sustainability that are currently most important to companies are energy efficiency, carbon management, wind, thermal, biomass, and storage. The survey results received from the employers suggest that these topics are currently the most important, and as such should be the primary focus of the BE SES education. (*Employer Review*)

Based on these findings and conclusions, we make the following recommendations:

A module that is an overview of renewable technologies should be added or incorporated into existing module(s). It should be available in the first or second semester. This topic would be best instructed by two professors, one who approaches the problem technically, and one who approaches it from a social perspective. Further, breaking this class into half lecture and half guided research project work would introduce students early on to group projects. (*Internal Review*)

An energy storage module should be added and made available to students from the third semester onwards. This topic is offered at other universities with similar programs, employers find it important, and it was found to be of high interest to the students we surveyed in the BE SES program. (*Internal Review*)

More modules of related topics from existing classes at HSLU should also be made available in English. This should take place when possible and if enough interest exists. As the BE SES program progresses and grows, these English versions can be adapted specifically to fit into BE SES needs. (*Internal Review*)

As the BE SES program grows, so too should education in areas of sustainability previously unaddressed. In order to have a truly international program there needs to be a focus on all major types of sustainable energy worldwide. This should be a focus as the program expands. (*Internal Review*)

Once a semester, a meeting of all BE SES students and professors should be scheduled. This would be scheduled in order to give updates, important information, and advice for what students should be looking forward to each semester. These meetings will also allow students to ask questions regarding the upcoming semester, which would be answered for the entire group. (*Internal Review*)

Conclusion 2: HSLU compares favorably with many other programs around the world. It is a new program that shows great promise in competing with other, similar, programs offered around the world. The material that is covered within its modules provides valuable knowledge for the students to take into the field and apply to future projects. As this program grows and develops, it has the potential to establish itself as a leader in the field. However it could improve by incorporating wind energy and transportation/mobility to stand out in the world. (*External Review*)

Based on these findings and conclusion, we make the following recommendations:

Add/modify modules to cover more electricity generation sources. Based upon what other programs are offering, and the international focus of the program, more electricity generation sources should be covered to, at a minimum, give student's background information on a variety of electricity sources. This will help them excel in an ever changing and evolving world. (*External Review*)

Add a module in transportation and mobility. Few of the programs that were reviewed from around the world cover the topics of transportation and/or mobility. These are crucial topics in our increasingly connected world economy and personal lives. The addition of this module would be a great advantage to HSLU as very few other programs offer modules in this field. (*External Review*)

Conclusion 3: HSLU is one of the few English programs offered in non-English speaking countries, and employers find English to be an asset. According to the survey results, the majority of companies in Switzerland that show interest in hiring students from the BE SES program do not require any language other than English. In addition, employers have stated that they are most interested in employees that speak English. (*Employer Review*)

Accordingly, we recommend HSLU **advertise the fact that the program is taught in English as reason for potential employers to hire the students.** If this program is

advertised to employers as an English speaking engineering program, they would become more interested in hiring the students.

Conclusion 4: Companies are interested in working with the HSLU on student projects, in hiring interns, and in hiring the students for a variety of positions. Many of the companies surveyed expressed interest in working with the BE SES students on their senior year projects so long as the project would be relevant to the company's focus. Also, it has been found that some employers prefer to hire more experienced workers rather than recent graduates. Employers are also interested in hiring interns. Employers said students from this program have skills that would make them valuable as project managers, group leaders, consultants, technical consultants, sustainability researchers, and working in service innovation. In addition, most companies indicated that even if the students may not be able to get hired in these jobs right after graduation, they would at least be hired in second line positions to gradually work up to these jobs. (*Employer Review*)

Accordingly, we recommend that HSLU p **ursue projects and apprenticeships or work experience programs with employers.** The creation of joint projects with companies or other forms of extra work experience would add value to those employers who prefer new employees to have previous work experience. Utilizing the internships offered by many companies would also be useful.

Conclusion 5: The BE SES program addresses places that employers generally find new employees to be lacking. Employers stated that new employees tend to be lacking in communication skills, an understanding of market value, an understanding of basic statistics and Excel usage, and an understanding of how the hiring process works. The BE SES program offers courses in technical writing and in marketing, which cover two of these topics. (*Employer Review*)

Based on these findings and conclusions, we make the following recommendations:

Add statistics and Excel to the curriculum. The addition of an English version of the currently offered statistics course or the addition of statistics to an existing math course would improve the value of the students to the employers. (*Employer Review*)

Train the students to understand how hiring works from an employer's point of view. According to employers, the way that many students get hired is by knowing how to be politely persistent, knowing how the hiring system tends to work in most companies, and being able to sell what they have done to the company they would like to work for. If the

students were given basic training in how to get hired, it would improve their hiring rate after completing school. (*Employer Review*)

Conclusion 6: Both web tools and 'face-to-face' connections are important. Web tools are necessary in establishing indirect connections and providing exposure, but "Face-to-Face" methods establish the strongest connections. When students were asked what their greatest influence was in joining the program, the most common response was "face-to-face" interactions such as info sessions, campus visits, and exhibitions. The same applies to employers. Most employers do recruitment by being present on university campuses. Our research also indicates that social media sites can be useful tools for developing the program's network and introducing the program to the world. (*Marketing and Communication Review*)

Based on these findings and conclusions, we make the following recommendations:

Create a BE SES Linked-In page and suggest students create their own accounts. A program Linked-In page will provide students with a tool to expand their networks with employers. Additionally, Linked-In will provide a professional means of staying connected to alumni who may then be able to provide connections and job opportunities for graduates of the program. (*Marketing and Communication Review*)

Create a Facebook page for the program. Not only is this a new program that is still establishing itself globally, it is a program designed with an international focus. Facebook can provide a means of exposing the program to potential prospective students, and allow professors to post content that will be permanently viewable for students. (*Marketing and Communication Review*)

Conclusion 7: Hardly any international students had any 'face-to-face' interaction at all. Many international students learned about the school and program through family and friends who happened to live in Switzerland. (*Marketing and Communication Review*)

Accordingly, we recommend that HSLU c**ontinue to put much time and effort into active 'face-to-face' recruitment techniques and employer events.** These experiences are the greatest factors in a prospective student's decision to join the program. Reaching out to prospective international students must be stressed. In speaking with BE SES faculty, we learned that they are aware of this and are doing as much active recruiting as they can. Continue to put emphasis on these recruitment methods (*Marketing and Communication Review*)

Authorship

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Introduction	R.M.		M.D. N.G. R.L. R.M.
Literature Review: Sustainable Energy and the Swiss Energy Supply	N.G.		M.D. N.G. R.L. R.M.
Literature Review: Swiss Energy Strategy 2050	N.G.	M.D.	M.D. N.G. R.L. R.M.
Literature Review: Growth and Job Prospects in the Sustainable Energy Industry	N.G.		M.D. N.G. R.L. R.M.
Literature Review: Existing Sustainability Curricula/Study Programs	R.L.		M.D. N.G. R.L. R.M.
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Methods: Conclusion	R.M.	M.D. N.G. R.L.	M.D. N.G. R.L. R.M.
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1. Introduction

Switzerland is one of the world leaders in efforts to promote environmental sustainability. In 2013, Switzerland ranked number one in the world in both energy sustainability and environmental sustainability on the World Energy Council's Energy Sustainability Index (World Energy Council). This is largely due to the fact that energy and environmental sustainability is a priority in Switzerland. The Swiss currently have a plan called Energy 2050, which is a multi-decade-long campaign to completely eliminate the use of nuclear power, and replace it with more sustainable energy options. In the midst of this campaign, Switzerland anticipates that it will need more people trained in a wide range of areas within the sustainable energy sector in order for this plan to be successful. The field of sustainable energy systems is still in its infancy, yet it is a growing field that is constantly and rapidly changing. With any modern and developing field, there will be temporary difficulties in finding fully trained individuals for building, designing, maintaining, and operating the newest technologies and systems.

The Business Engineering department at Hochschule Luzern has developed a curriculum in order to match the ever-growing demand for business engineers that are competent in conceptualizing, developing, installing, and maintaining sustainable energy systems. The goal of this program is fill these positions with competent graduates who are well-versed in all areas of sustainability and are able to apply their knowledge to solve potential problems in the future. The curriculum for the bachelor program in BE SES offers classes in a wide variety of subjects, from electrical engineering to project management, accounting and marketing. During the three years of study, students are expected to use what they have learned from classroom instruction and practical project experience, to creatively solve problems associated with the development and implementation of sustainable energy systems.

At Hochschule Luzern, the newly developed curriculum is providing students with the knowledge to be leaders in this growing field in Switzerland and abroad. The university is beginning to be recognized as an innovator within this field and has the potential to develop a lasting impact in the field. It is among the first universities to train students specifically for careers in sustainable energy through a discrete specialist program rather than as an option within an existing program ("Switzerland's Universities of Applied Sciences"). Doing so will give graduates superior knowledge of and experience in the careers in which they plan to work.

The primary goal of this project was to evaluate the current program at Hochschule Luzern by studying both the current status of sustainability programs in Switzerland as well as similar programs around the world. From the evaluation, recommendations for additions or alterations within the program will be discussed. Additionally, surveys and interviews with employers, faculty, and students at Hochschule Luzern allowed us to compare the current program's elements to those expected of employers hiring in sustainability. Other operations within the program, such as the use of media for recruitment, communication, employment, and alumni relations were also studied through the student surveys as well as a survey to students at various other universities. All of these comparative studies were conducted to ensure that Hochschule Luzern's BE SES program is optimally equipping students for the task of advancing sustainable energy systems in Switzerland in the coming decades.

2. Literature Review

The primary goal of this project was to evaluate the current program at Hochschule Luzern by studying both the current status of sustainability in Switzerland as well as similar programs around the world. This is to ensure that Hochschule Luzern's BE SES program is equipping students for the task of advancing sustainable energy systems in Switzerland over the next few decades. In this review of literature we provide background knowledge on sustainable energy in general as well as its place in Swiss society and industry. We then move on to discuss a review of programs that are similar to the BE SES program, the BE SES program at Hochschule Luzern as viewed from available written information, and end with a discussion of marketing strategies in universities.

2.1 Sustainable Energy and the Swiss Energy Supply

Switzerland used approximately 69 Gwh of electricity in 2008. The consumption of this electricity has increased slightly in the past few years, but has remained relatively the same, see Figure 1. Most of the electricity generated in Switzerland is obtained from hydroelectric generation and nuclear power, see Figure 2 below.

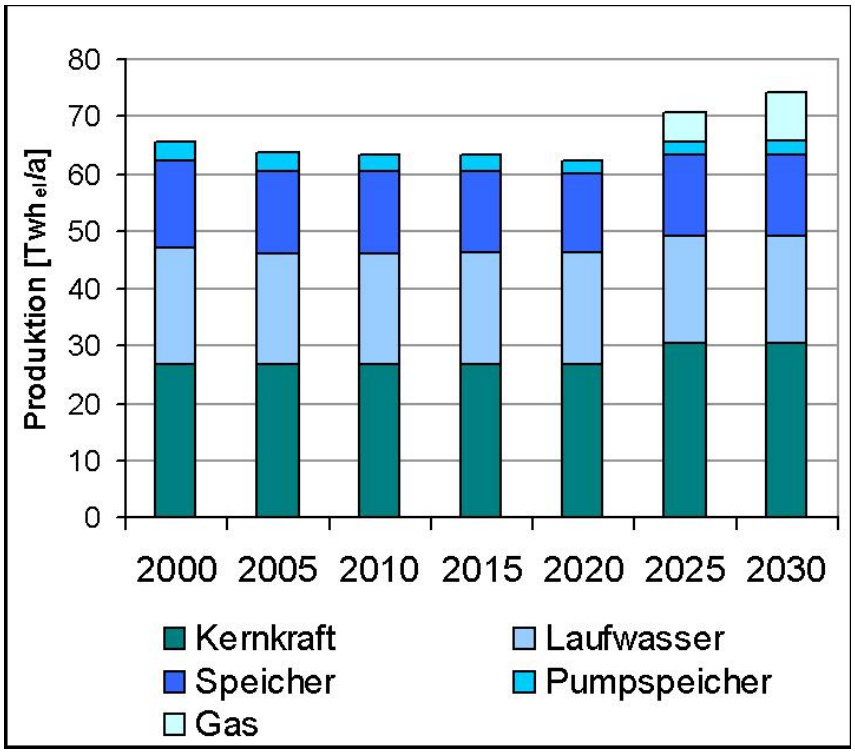

Figure 1: Swiss electricity production by year (Energy Science Center, 2001)

Key: Nuclear, Hydro, Reservoir, Pumped Storage, Gas (Left to Right, Top to Bottom)

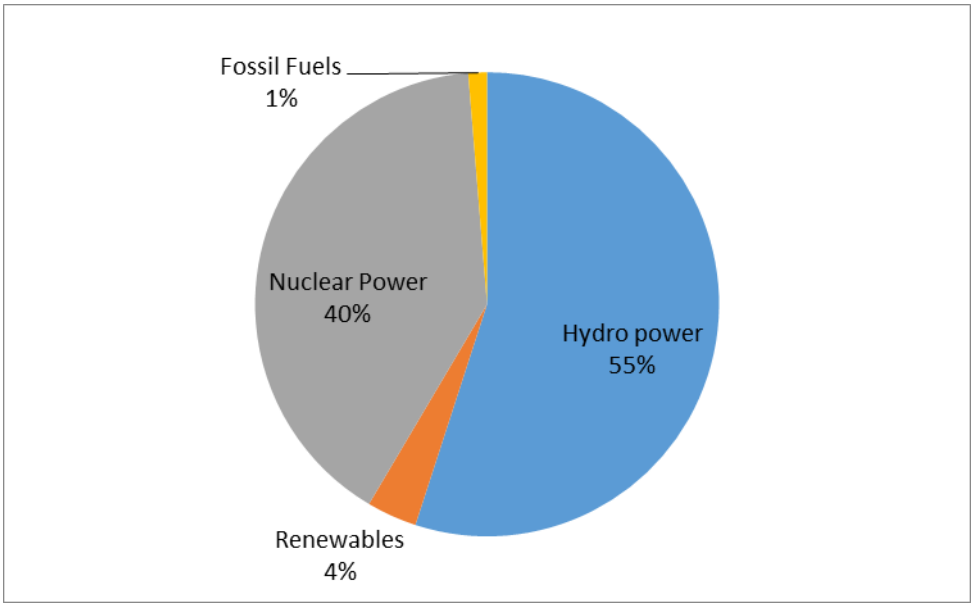

Figure 2: Swiss electricity production, 2008 (Cleantech, 2008)

Hydro-electric power is a popular form of electricity production in Switzerland. Much of Switzerland's electric energy production comes from hydroelectric power generation, and this production rate is expected to rise as nuclear power in Switzerland is phased out (Energy Strategy 2050). As of 2008, 55% of domestic electrical energy production was the result of hydro-electric generation. The Swiss hydro system is able to produce almost 15 GW of electricity (Designing a Sustainable Swiss Energy System). The hydroelectric production capabilities of Switzerland are starting to edge closer to capacity and thus electricity must be generated by other means before it becomes difficult to implement new hydroelectric plants. As shown in Figure 3, production of electricity has remained relatively stable over the past two decades.

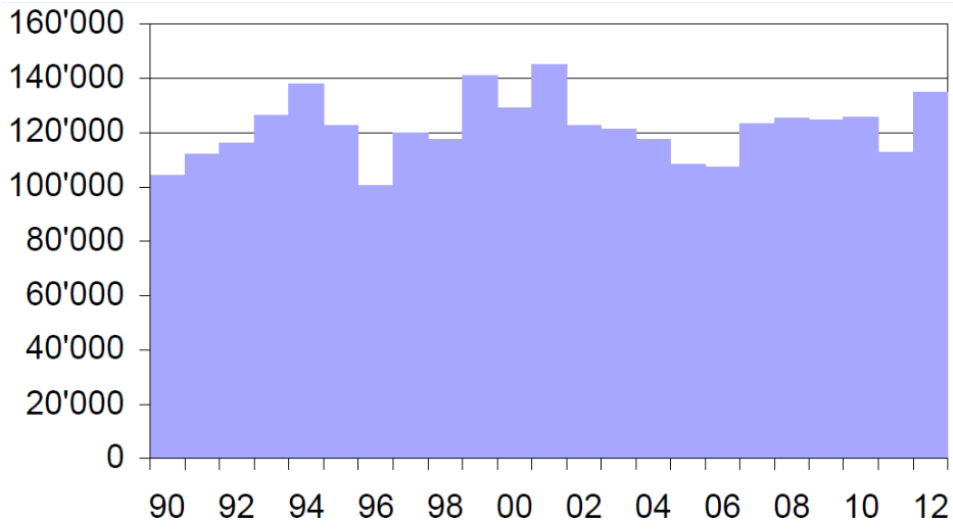

Figure 3: Energy Production from Hydroelectric Sources 1990-2012 (Swiss Federal Office Energy)

The five nuclear reactors currently in use in Switzerland produce 3.2 GW of power of more than 40% of Swiss electrical power, which means that Switzerland ranks 5th in the world in terms of nuclear dependency. Several of these reactors are scheduled to be decommissioned after they reach the end of their 50 year lifespan starting in 2019 with no plans to extend their lifespan or build new reactors (Designing a Sustainable Swiss Energy System). The Swiss 2050 plan calls to phase out the use of nuclear power altogether in favor of other energy sources such as hydropower, wind, solar, and biomass to generate their electricity.

Solar energy presents an easy means of producing clean power in rural and urban settings. Approximately 44.6 MW of electricity is generated from photovoltaic systems in Switzerland; with 1.2 MW being produced off the electric grid for private use (Designing a Sustainable Swiss Energy System).This number is increasing with every passing year as residents install more solar panels on their rooftops, as illustrated in Figure 4.

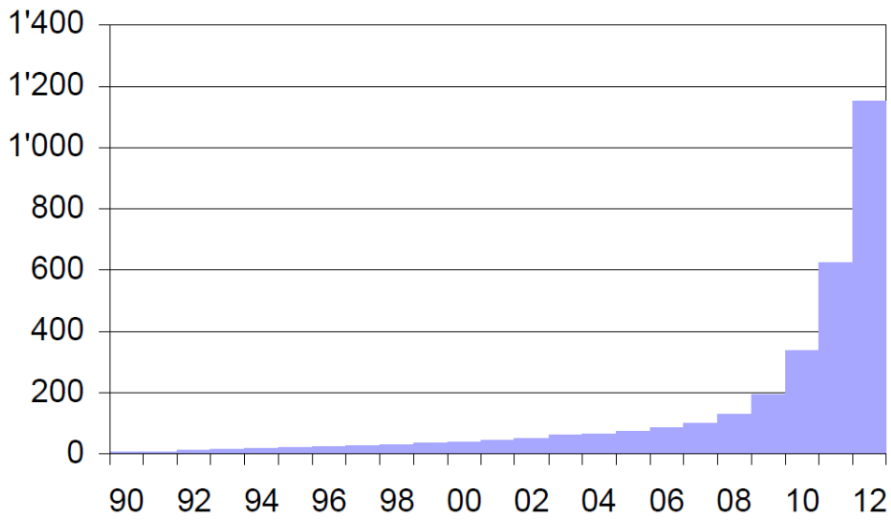

Figure 4: Energy Production from Solar Sources Since 1990

Wind energy is popular because it can produce a relatively constant supply of electricity depending upon location. Wind energy in Switzerland is its least used renewable energy, only comprising 13.6 MW of energy production; however several new installations are being constructed (Designing a Sustainable Swiss Energy System).

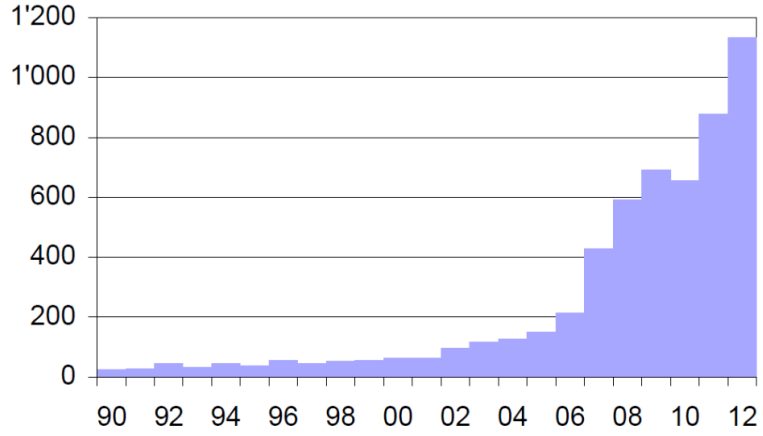

Figure 5: Energy Production from Biomass Sources Since 1990

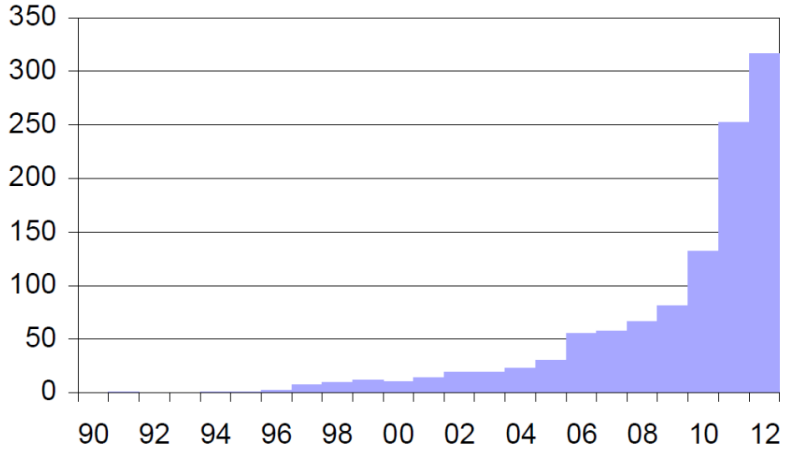

Figure 6: Energy Production from Wind Sources Since 1990

As shown in Figures 4-6, production of electricity from solar, biomass, and wind sources has increased appreciably, although these sources contribute relatively little as yet to total electricity production.. These sources of electricity are expected to grow substantially in the future as Switzerland moves toward a more sustainable future with the adoption of the Swiss Energy Strategy 2050.

2.2 Swiss Energy Strategy 2050

The future of Swiss electrical energy production lies in the "Energy Strategy 2050" developed by the Swiss government. This plan will expand the use of new renewable energy sources and increase the efficiency of existing energy production and energy consumption practices by promoting particular types of technology and, providing incentives for these changes. The first part of the plan involves the phasing out of nuclear power, in favor of "greener" energy sources such as wind, solar, and hydroelectric-power that will make up for the difference in generation capacity.

The second part entails reducing energy consumption by fifty percent by the year 2050; this involves increasing efficiency standards for all devices and systems that consume

electricity. The government plans to use various taxes to drive residential and business consumers to become more energy efficient and to adopt renewable energy options more widely and enthusiastically. The government also hopes that increasing the price of electricity will encourage further reductions in energy consumption of the Swiss ("Energy Strategy 2050").

2.3 Growth and Job Prospects in the Sustainable Energy Industry

As Switzerland switches to more renewable electricity sources and the adoption of energy conservation measures, it is expected that this will help enhance the prospects for the sustainable energy sector and with it increase demand for employees to fill jobs in the sustainable energy sector. The sustainable energy industry in Switzerland and worldwide is expected to grow in several different sectors directly: transmission additions, smart grid investments, demand response, and energy storage. Indirectly, the fields of manufacturing, installing, maintaining, and managing sustainable energy systems in the commercial, industrial, transportation, and residential sectors will increase as well. Demand for expertise in sustainable energy systems will permeate all sectors of these markets to varying degrees, thus the increase in jobs will likely be substantial.

According to three different projection models, transmission additions will add 300-600 billion dollars to the world economy every year between 2013 and 2030 (Figure 7). Smart-grid investments will yield between 300-430 billion dollars to the world economy every year in the same time frame. Power demand additions will yield about 50 billion dollars and storage of electricity will yield between 100 and 200 billion dollars added to the economy. Also included in these projections is that by the year 2030, 70% of all new power generation capabilities will occur from the expanding renewable energy sector and this will result in half of all power generation capacity will come from renewable sources (Global Renewable Energy Market Outlook).

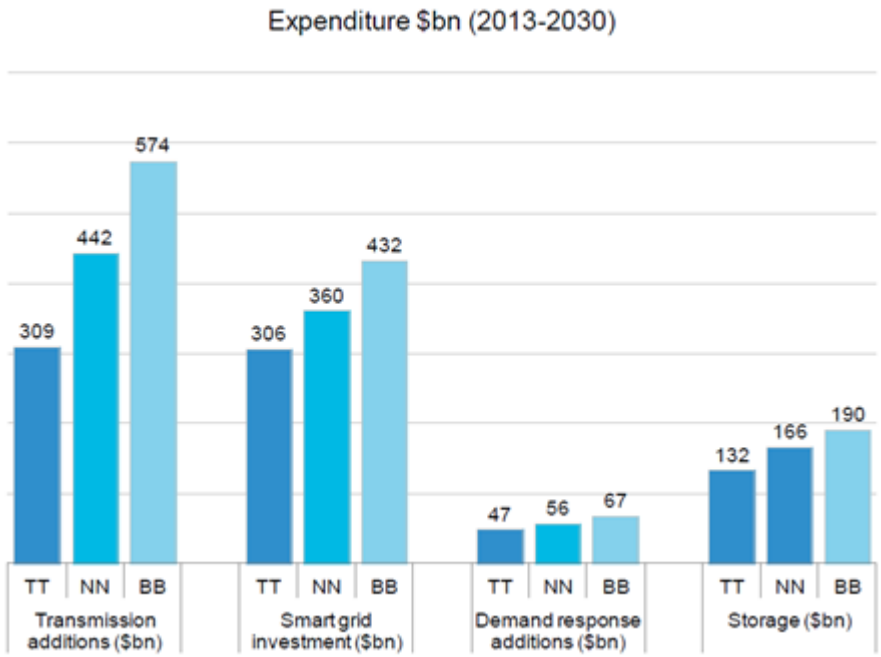

Figure 7: World Renewable Energy Expenditure
(Global Renewable Energy Market Outlook)

According to "Global Impact Consulting", the market for renewable energy in Switzerland was calculated to be in excess of $900 million in 2007 and the Swiss were expected to have to invest $20-30 Billion in power generation capabilities to meet the rising demand in the following 15-30 years. Since this time, the Energy Strategy 2050 was put in place. With its emphasis on sustainable energy, it is likely that the Swiss will need to invest even more heavily than predicted in 2007 and the need for people who are well-versed in the field of sustainable energy will be substantially higher. People will be needed with skills ranging from designing and implementing systems to people with the skills necessary to install and operate the systems being put in place (Renewable Energy >> Switzerland).

The Federal Council of Switzerland estimates that over CHF 200 billion, approximately $230 billion US, will need to be spent to meet the outcomes outlined in the Swiss Energy Strategy 2050. Of this, CHF 126 billion will need to be used to modernize the existing power generation systems to produce more power more efficiently, CHF 67 billion will be needed to construct new power stations, and CHF 18 billion will be required to restructure and expand the power transmission and distribution systems to be able to handle the new power generation systems and transmit power more efficiently across the country (Energy Infrastructure Financing in Switzerland, 2014). Thus, it is likely that large numbers

of workers proficient in the fields of sustainable energy systems will be needed to accomplish the goals set out in the Energy Strategy 2050.

Currently there are two big solar photovoltaic (PV) manufacturers in in Switzerland: Meyer Burger and Applied HCT Wafering Systems. Both suffer from competition with cheap production costs in China. A third PV manufacturer was sold to Tokyo Electron in 2012. Swiss Wafers is the only one that produces wafers and does not publish or disclose any of their production data to the public. There is a large support for the development of thin film solar cells, with private and government money being funneled into R&D programs. There are many other companies that are needed to support the implementation of PV systems. These companies' produce inverters, junction boxes/connectors, cables, support structures, and storage batteries. There is at least one company for each of these manufacturing areas present in Switzerland. Most of the PV installations are on the roofs of buildings, with ground installations being in the backyard of a house. Large "plants", plants consisting of vast areas of land dedicated to solar energy production, are not in place as they are in other countries. There are no precise labor figures for the employment directly tied to photovoltaic systems, although a national survey estimated approximately 8600 people are likely employed in the PV industry. This number is likely to increase with growing demand for PV systems in the future (National Survey Report of PV Power Applications in Switzerland). As it can be seen in the Figure 8 below, the Swiss solar market is growing exponentially with each year.

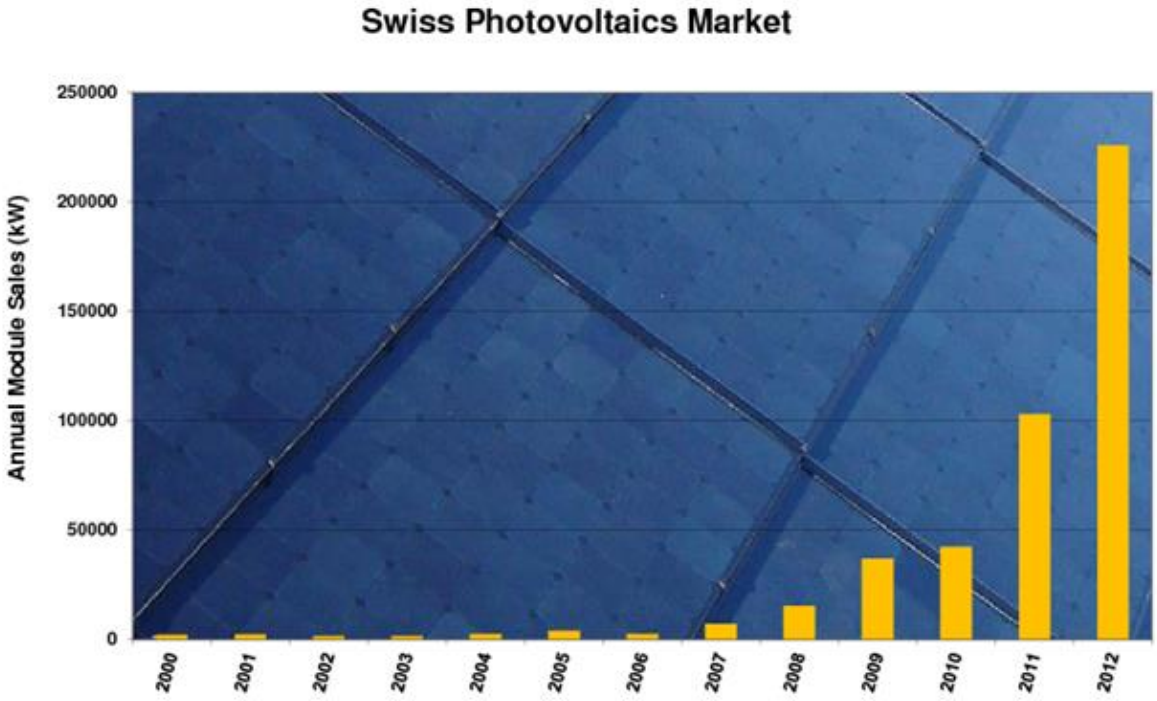

Figure 8: Swiss solar sales (Swiss Solar)

At the end of 2012, there were 32 large wind turbines producing 49 MW of electricity in Switzerland. The wind energy industry, as of 2010, employed 290 people. This does not include the number of people needed to construct the wind turbines from raw material to producing power. Since 2012, the wind industry has continued to expand, and so has the number of people employed in the wind energy field (IEA Wind). Wind energy is the least developed of the renewable energy systems in Switzerland, however possibly because wind farms and turbines are viewed as eyesores to many who seek to prevent wind power development.

SGS, Société Générale de Surveillance, is a large multinational company headquartered in Geneva, Switzerland. This company provides services to inspect, verify, test, and certify various products. They operate in various sectors; related to the sustainable energy sector. This is a large and well established company with over 80,000 employees worldwide. One of the many assessments that SGS completes is Wind Turbine Blade Testing. Thus it can be assumed from here there are many other employment opportunities for people with degrees relating to the sustainable energy field within this company alone (SGS). With this information in hand, it can then be assumed that there are many other companies around the world, and in Switzerland, that are looking to employ people trained in the fields of sustainable energy systems, especially given the field's rapid expansion that is expected to occur.

Switzerland produces some of the PV systems that are installed across the country. The hydro-electric generation systems installed across the country are starting to approach capacity with current technology. Both the PV and the hydro systems require trained technicians and managers to maintain, replace, and install new systems as they are needed. However the wind energy sector only has a small foothold in Switzerland and does not appear, as of now, to be expanding to become a large part of Swiss electricity production. It is expanding and will require skilled workers to install the new systems and maintain them throughout their lifespan. The electric transmission system is and will need to be upgraded to better supply electricity to the country and increase the efficiency of the system. This will be done by upgrading the systems components to newer, more efficient modules, implementing smart grid technology, and using new energy storage technology. This upgrade to the national grid will require workers and planners knowledgeable in sustainable energy systems to install and maintain the new systems. With the entire country moving toward sustainable energy

systems, trained and skilled people will be needed to fill specialized positions in the field of sustainable energy systems.

2.4 Existing Sustainable Energy Curricula/Study Programs

Across the world, population growth and economic development have resulted in the ever increasing consumption of natural resources and growing concern about the need for more sustainable economic systems. Cliff Davidson (2010) argues that too few universities have any sort of focus on sustainability, and that in order to avoid the depletion of our resources more schools must improve their existing curricula in order to cater to the rising demand for sustainable engineering.

Nevertheless, many universities around the world are developing bachelors and graduate programs in sustainable energy systems. Hochschule Luzern is part of this growing movement and recently established its own program focusing on the business aspects of sustainable energy in particular. The bachelor degree program on Business Engineering with a specialization in Sustainable Energy Systems (BE SES) was launched in 2012. The goal of the BE SES program is to "educate business engineers who fit the current and future needs of energy-related industry" (In English Business Engineering Sustainable Energy Systems). Hochschule Luzern is a university that prides itself in teaching both theory and practice. This is akin to other industry-related universities in Switzerland which integrate academic studies with hands-on practice. A detailed description of the Swiss school system can be found in Appendix A.

Many other colleges and universities around the world have begun to develop and offer courses, programs, and curricula in sustainability studies. This section first looks at different programs offered around the world, and then at the ways these programs are similar, and finally at the BE SES program offered at the Hochschule Luzern. The schools examined in this section are intended only as a taste of what else is offered, and a more in depth analysis of other programs can be found in the findings and results sections.

2.4.1 Australia

In Australia, there are at least six schools that offer full graduate degrees in Renewable Energy Engineering or Sustainable Architecture (Table 1), and at least three that offer undergraduate degrees. Australia has felt the need to teach more about sustainability and renewable energy in their engineering programs because of their over-dependence on coal, and growing concerns about global warming.

Universities	Degree Programs in Renewable Energy or Sustainable Architecture
Australian National University	BE in Sustainable Energy Systems
Curtin University of Technology	ME in Renewable Energy Systems
Monash University	Postgraduate Certificate in Photovoltaic Engineering
University of Melbourne	Graduate Diploma in Energy Studies Postgraduate Diploma in Energy Studies MSci in Energy Studies MApp Sci in Renewable Energy MEngSci in Renewable Energy
University of New South Wales	BE in Photovoltaics and Solar Energy Graduate Certificate in Photovoltaic Engineering Graduate Diploma in Photovoltaic Engineering MEngSci in Photovoltaics and Solar Energy
RMIT University	Graduate Certificate in Sustainable Energy Graduate Diploma in Sustainable Energy ME in Sustainable Energy
Murdoch University	BSc in Sustainable Energy Management BE in Renewable Energy Engineering Postgraduate Certificate in Energy Studies Postgraduate Diploma in Energy Studies MSc in Renewable Energy MSc in Environmental Architecture

Table 1: Degree Programs in Renewable Energy or Sustainable Architecture (Taleghani, Ansari, & Jennings, 2011)

The Australian programs have developed well-rounded approaches towards teaching sustainable energy in engineering, as they offer courses both in the technical aspects of engineering sustainably, as well as the social aspects, such as explaining why sustainable engineering is important and how it affects the environment. In this section, we examine the programs offered by the Australian National University and Murdoch University as examples of the kinds of programs offered.

2.4.1.1 Australian National University

At the Australian National University, one can pursue an undergraduate degree in Sustainable Energy Systems. The curriculum for this includes courses related to architecture such as "Sustainable Systems: Urban" (Australian National University, 2014) as well as generic sustainable engineering courses such as "Engineering Sustainable Systems" and "Energy Resources and Renewable Technologies" (Australian National University, 2014). There are many other courses related to sustainable energy offered, both undergraduate and graduate, and many of the more specific courses, such as "Advanced Topics in Solar Energy Technologies", are only available at the graduate level, despite the lack of a graduate degree in sustainable energy, and are supplemental courses to other degrees (Australian National University, 2014).

2.4.1.2 Murdoch University

At Murdoch University, the various sustainability programs all take into account that the curricula need to have a balance between being broad and specific in order to insure that the students will be able to get jobs. They offer a broad range of courses covering topics including those in Figure 9.

The available courses cover these topics in varying detail from major to major, as they offer a variety of programs in sustainability. The university also offers courses in both theory and practice, so the students get good practical experience. This program embodies the previously described ideal way to teach sustainability, as it makes sure to teach towards getting the students jobs, and also towards making sure the students have the practical experience that they will need (Murdoch University, 2014).

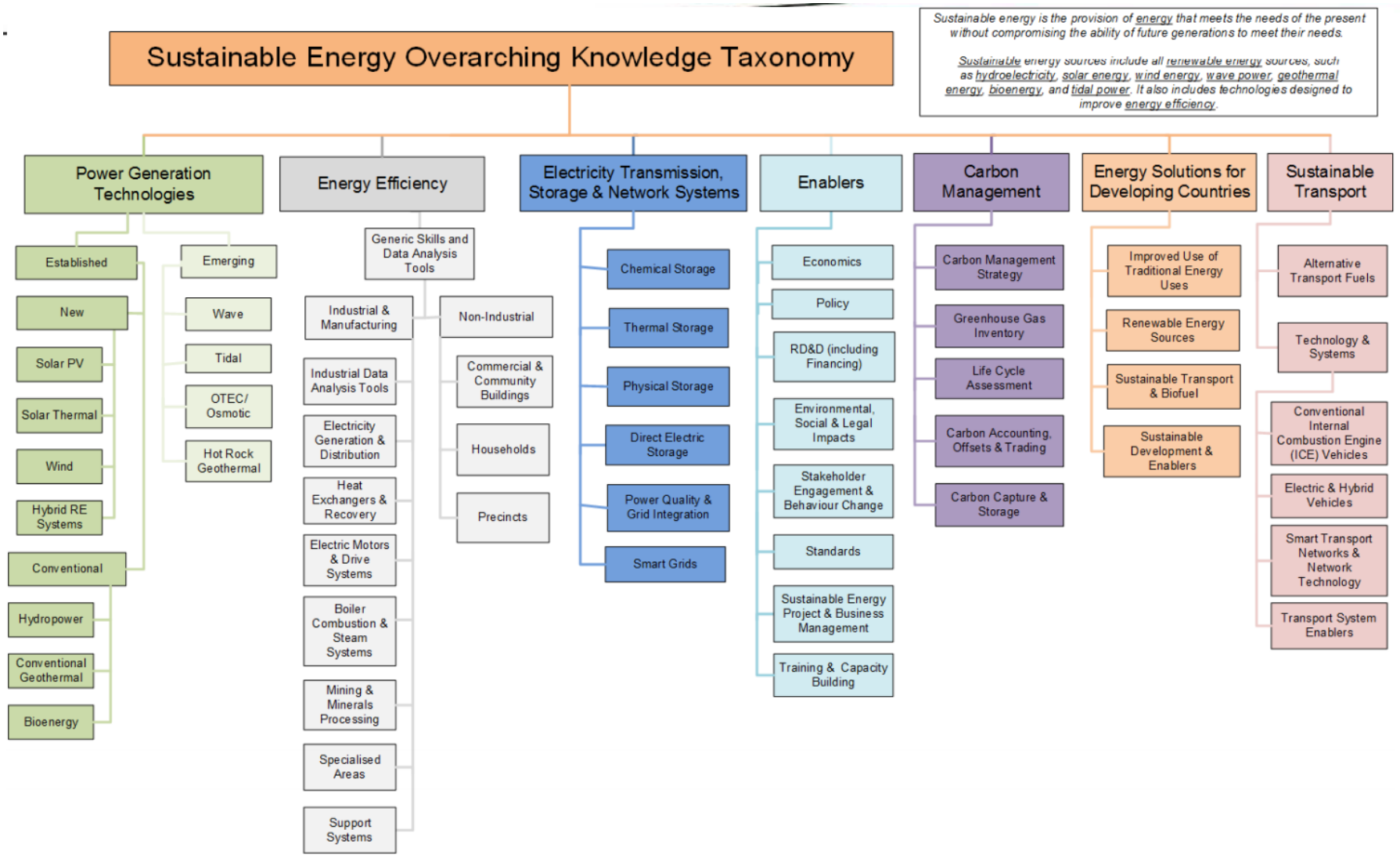

Figure 9: Sustainable Energy Overarching Knowledge Taxonomy

(Murdoch University n.d.)

The available courses cover these topics in detail varying from major to major, as they offer a variety of programs in sustainability. The university also offers courses in both theory and practice, so the students get good practical experience. This program embodies the previously described ideal way to teach sustainability, as it makes sure to teach towards getting the students jobs, and also towards making sure the students have the practical experience that they'll need. (Murdoch University)

2.4.2 United States of America

In Oregon, the Oregon Department of Transportation (ODOT), has developed a sustainability plan to help the state of Oregon become more sustainable and environmentally conscious. The plan focuses specifically on seven different parts of sustainability, including health and safety, social responsibility, environmental stewardship/workforce well-being and development, land use and infrastructure, energy/fuel use and climate change, material resource flows, and economic health (Sustainability Program ODOT Sustainability Plan). In response to this push from the government to create a more sustainable state, the Oregon Institute of Technology, a longtime advocate of sustainable energy, began offering an undergraduate degree in Renewable Energy Systems (later changed to Renewable Energy Engineering) in 2005. Table 2 details the courses available to students in the program.

This course overview shows that the program begins by teaching the basics, moves on to applying more advanced sustainability concepts, and ends with a comprehensive project in which the student demonstrates their knowledge of the field. This curriculum also follows the balance of theory and practice approach, as many of the courses come with labs to give practical experience in the topic. It also fits very well into the multidisciplinary approach, as it offers courses from many different related fields, including math, engineering, physics, and sustainability. (Renewable Energy Engineering Degree Programs, 2014)

Proposed Courses by Year for Renewable Energy Engineering Offered by the Oregon Institute of Technology		
Freshman	General Chemistry	Argumentative Writing
	General Chemistry Lab	Electrochemistry for RE
	Intro to Engineering 1+2	Advanced Engineering Programming
	Differential Calculus	Vector Calculus 1
	English Composition	Public Speaking
	Integral Calculus	Technical Report Writing
Sophomore	Circuits 1,2,3	A History of Energy
	Applied Differential Equations 1	OR History of Electrical Grid
	General Physics with Calculus	Electrical Power
	Principles Of Economics, Microeconomics	Statistical Methods 1
	OR Macroeconomics	OR Probability and Statistics
	Statics	
Junior	Electronics 1	Materials for RE Applications
	Linear Algebra	OR Solid-State Electrical Devices
	Fluid Mech 1	Power Electronics
	OR Engineering Mechanics: Fluids	Heat Transfer 1
	Control Systems Design	Fuel Cells
	Thermodynamics	Small Group + Team Communication
	Advanced Technical Writing	
Senior	Senior Project	Photovoltaic Systems
	Senior Sequence	Energy Systems Instrumentation
	Electric Power Conversion Systems	

Table 2: Proposed courses for students to take at Oregon Tech

2.4.3 Greece

At the University of Thessaly in Greece, the already existing Civil Engineering program has been augmented with sustainable energy courses to create a sustainable Civil Engineering curriculum. The push to incorporate sustainability into other engineering programs was already being seen in Greece in the 1990s, and in 2002, the University decided that it needed to update its programs to be more environmentally conscious. This curriculum uses the approach described in the above section on how to approach teaching sustainable energy where the curriculum combines both teaching the technical details as well as the social details. Some of the courses offered include Environmental Impact Assessment, in which the students learn about why it is important to assess environmental impacts and how to do so effectively, and Environmental Design of Civil Engineering Technical Works: Environmental Legislation, in which the students learn about key environmental issues and about different measures that can be taken to reduce the risk of causing more of these issues. There are many technical courses on civil engineering as well, but the courses dedicated to sustainability are kept separate. This curriculum also appears to follow the other approach, that of practice based learning, as in some of the courses the "students are applying theory to a practical "real-life" case study." (Manoliadis, 2009) Overall this curriculum goes about its course structure in the right way,

incorporating aspects of different well received methods of designing a sustainable energy engineering curriculum. (Manoliadis, 2009)

2.4.4 Design of Sustainable Energy and Related Curricula

In designing a sustainable energy curriculum, faculty and administrators must balance several key attributes in order to adequately meet the needs of the students. Firstly, sustainability studies are by nature multi-disciplinary, as they include both knowledge of the environment and current energy policies in addition to whichever sort of engineering the program aims to teach sustainability relating to it. The difficult part about a multidisciplinary curriculum is that it needs to cover enough material from each discipline that the student has a good understanding of each, while not focusing too much on any one discipline (Tomkinson, Tomkinson, Dobson, Engel 2008). In sustainability studies, as with any other multi-disciplinary program, maintaining this balance is paramount. In addition, according to Professor M. Gennert, designer of the multidisciplinary robotics curriculum at WPI (M. Gennert, personal communication, March 2, 2014), it is important to keep a good balance among the supporting curricula so that the curriculum does not become weighted too heavily towards one supporting curriculum and neglect another.

According to Odysseus Manoliadis (2009), "sustainable development education within an engineering context is about giving engineers an understanding of the issues involved as well as raising their awareness of how to work and act sustainably." This means that a curriculum in sustainable engineering needs to encompass both teaching the students how to go about solving sustainable engineering problems, as well as teaching them why it is important. In other words, the curriculum must contain technical classes and more social science based classes. Manoliadis also suggests that using web-based learning tools, such as web-based simulation software, may be effective since they allow students to test out their theories and get immediate feedback. This enables self-paced and maybe faster learning, as the students are essentially able to teach themselves.

2.4.5 HSLU - BE SES

The Business Engineering department at Hochschule Luzern has developed Business Engineering Sustainable Energy Systems (BE SES), the first of its kind, to offer classes in a wide variety of subjects from electrical engineering to project management, accounting and marketing. During an intended three years of study, students use what they learn from classroom instruction and practical project experiences, to develop solutions to problems associated with the development and implementation of sustainable energy systems.

The program is entirely conducted in English in order to provide the most beneficial training for the engineering profession. Additionally, this allows for a wide range of students from across the globe to participate in this program.

During their three years, students complete classes in four modules which include both compulsory and elective classes. The Core Modules make up around half of the required credits. Project Modules are where students work in many different hands on situations for experience with real-life problems. Related Modules provide areas students can concentrate on more specific areas of interest. In addition, Minor Modules allow for non-major specific learning of societal, cultural, and ethical subjects ("Welcome - Hochschule Luzern," 2014). Appendix B shows the existing classes for this program that are all instructed in English as well as indicates which of those are compulsory and which are electives.

Following graduation, these students can expect to fill a wide range of jobs in areas such as energy related project management, consulting in companies on energy policies, and policy development on energy and sustainability. The overall curriculum has been developed to educate business engineers that are competent and able to enter the workforce in fields of advising, conceptualizing, developing, installing, and maintaining sustainable energy systems.

2.5 Marketing and Communications

In order for the BE SES program to be successful, it must effectively communicate with potential students and convince them that this program is worth their time and suits their interests. It also must communicate effectively with potential employers who may eventually hire these students, as well as alumni of the program who may provide connections and support. One way to do this is through social media. Much of the literature discussed below describes marketing in relation to a school as a whole, mainly because few individual programs market themselves in such a way or to such an extent. It remains an open question whether marketing through social media provides a competitive advantage, however.

2.5.1 Social Media in Recent Years

The BE SES program has emerged at an ideal time because it is currently very easy and highly effective to spread information and ideas through social media. The virtual world of social media is vast. It includes news and information sharing sites such as Facebook, Twitter, and MySpace; photo sharing sites such as Instagram and Pinterest; more practical professional networking sites such as LinkedIn and Xing; and video sharing sites such as

YouTube and Vimeo; among others. The reason why social media is so effective at spreading information is because so many people are using it to stay connected. According to a 2012 article written by Grant Greenwood, an admissions counselor at Hardin-Simmons University, 82 percent of teenagers between 14 and 17 years of age and 83 percent of adults between 18 and 29 use at least one social networking site (SNS). Within those numbers, 52 percent of Facebook users and 33 percent of Twitter users use SNSs daily (Greenwood 2012). A 2010 study from the University of Wisconsin found that the average Facebook user has 130 friends and 160 million "objects" to interact with, which include specialized pages, groups, and events (Pikalek 2010), and those number have surely increased since then. To give another perspective of how many people are using social media today, a 2012 article from *Life Science Journal* states that if Facebook users were a country it would be the third largest in the world by population, behind China and India (Saravanakumar 2012). The world is incredibly connected, and this has made it extremely easy not just to communicate with other people, but to promote products, information, and ideas.

2.5.2 Social Media as a Marketing Tool

People are not only very connected to other people, but they are also 'socially' connected to things, companies, products, ideas, music, art, and more. Most pertinent to this study are people's connections with schools of higher education. This level of connectedness makes it relatively easy for a school to get its name out to control and promote its identity online. Perhaps the most important reason for this is recruitment; drawing in a prospective student who without online media may have never known anything about the school.

Prior to this social media revolution, schools relied mostly on advertisements through television, radio, newspapers, and magazines, as well as direct mail to students and organizations, such as high schools. Now many schools are investing a lot of time and effort in social media marketing and building a presence on the web. One of the ways schools are establishing their social media presence is by linking to media within their website. According to a 2012 study performed by the *Journal of College Admission*, 92 percent of colleges link at least one social networking site (SNS) within their official website with an average of 3.7 SNSs per site (Greenwood 2012). Among SNS users in college, 98.9 percent were linked to Facebook, 95.7 percent were linked to Twitter, and 85.9 percent were linked to YouTube. Other top SNSs include iTunes, Flicker, LinkedIn, and Foursquare. Clearly establishing a presence on social networking sites has become common practice for most colleges. Greenwood argues that not only is it common practice, but schools that do not

utilize these tools are “lagging behind their competitors” (Greenwood 2012). Greenwood indicates that schools without direct links to SNSs on their home page may lose an opportunity to connect with prospective students and may be “forfeiting a competitive edge” (Greenwood 2012).

Facebook, Twitter, YouTube and the other media mentioned are not the only tools schools are using for online marketing. In the 2007 study by the New England Board of Higher Education, David Gastwirth explains how blogs, interactive websites, and chat sessions help to contribute to increased student applications and reduced recruitment-related expenses (Gastwirth 2007). Since this article was written, other tools, such as Instagram, Pinterest, and WhatsApp have been added to the mix.

In an article in *Life Science Journal*, Saravanakumar (2012) suggests that a company, or in this case a university, that does not take advantage of the tools available on the web it may not reach its full potential. “Without a correct plan and social media strategy (companies) have no chance to stand out in the rapidly changing digital freedom.” (Saravanakumar 2012). If a university program does not effectively reach its target audiences, it could be in danger of failing to stand out among other programs that do this more effectively.

Social media is becoming a crucial component in promoting oneself, whether it is a large company, small business, charity organization, school, or even an individual person. In a sense, every person or organization has enormous control over how they are perceived by the world. Furthermore, those who do actually utilize these channels to their fullest potential have a strong competitive advantage. In a lecture at HSLU business school (May 17, 2011), Dorie Clark, a marketing strategy consultant, discussed how beneficial social media can be in promoting yourself and enhancing your professional career. Clark emphasized the concept “personal branding” which is the practice of marketing oneself as if one is a product being sold. She claims that everyone has a perception of you, and when approached strategically you can shape those perceptions in any way you choose. The tools that will help shape those perceptions are personalized websites, blogs, Twitter, Facebook, and LinkedIn. All of these tools help to shape one’s identity as perceived by the rest of the world, as well as provide direct contact to the rest of the world as well.

2.5.3 Negatives of Social Media

While social networking sites may help to get a prospective student interested about a school, one study revealed that social media may not have the influence expected.

Constantinides and Stagno (2011) examined social media as tools for marketing schools of higher education. Their survey revealed that the channels that students found most useful when applying to schools were not the social networking sites, but rather the more traditional ones. The preferred sources of information were campus visits, official university internet site, brochures, family/friends/acquaintances, and high school resources. Additionally another part of the study explored the impact of social media on a student's study choice. Surprisingly, students who were connected with social media ranked social media last in a list of informative channels that influenced their choice of study. The author attributes this lack of influence, however, to the limited content provided online and low engagement with social networking tools on the program level rather than any inherent failure of the medium of SNS per se (Constantinides and Stagno 2012).

Although social media offer many benefits to institutions of higher education, there are also drawbacks. Sara Lipka (2009) stresses that social media is a place of "perpetual motion and little control" so it is difficult for institutions to stay current and in control of their messages. Staying current and maintaining control has become increasingly difficult for institution since this article was written in 2009 because there has been a proliferation of social networking sites and tools.

Message control is a significant and growing problem for institutions like universities. The rapid spread of positive information about a school can be very beneficial, because it helps to promote the school and display it in a good light. By contrast, the rapid spread of negative information can be damaging to a university's reputation, recruitment, and fundraising efforts.

In contrast with Dorie Clark, Lipka argues that social media gives the *users* more control of your image online rather than you having supreme control. Lipka sites Brad J. Ward, co-founder of BlueFuego which is a Web-based marketing firm, who says, "You don't own the conversation anymore." He means that you, and in this case the school, have little or no control over what is said about you on the web.

Lipka (2009) explains that although it may be tempting to try to use many of the existing social media tools at the same time, this may not be the best approach. She recommends that a user, whether an individual or an institution, should become very good at one or two tools and really put a lot of time and effort into them. If an individual or institution tries to work on too many social media sites at once, with insufficient resources, it is likely that none of the social networking sites will be as informative, content-rich and current as is desirable. At the same time, a school must maintain a good main website as well. Meyer and

Jones cite a study by Noel-Levitz (2007) which found that 92 percent of prospective students said they would be "disappointed with a school or remove it from further consideration if they didn't find information they needed on the school's Website" (Meyer and Jones).

Like Constantinides and Stagno (2012), Meyer and Jones noted the surprising ineffectiveness of social media tools. Only 24 percent of students in a 2009 study were more interested in a school after looking at their social media sites as opposed to 88 percent who said the same about campus visits (Lipka 2009).

2.6 Conclusion

Based on our review of the literature, it is clear that there is a need for a Business Engineering Sustainable Energy Systems curriculum in Switzerland since sustainability is a major focus and jobs in this area are expected to increase substantially in the future in Switzerland and elsewhere. As a program in an emerging field, it is important that the HSLU program try to remain ahead of its competitors by developing a well-structured curriculum and effective marketing and promotion strategy, and ensure that its graduates are ready to meet current and future industry needs. Moving forward, in the next section we explain how we gathered data on the current and future expectations of students, faculty, and employers regarding the program, as well as options for improved marketing and promotion of the BE SES program.

3. Methods

The goal of our project was to evaluate the current curriculum of BE SES at Hochschule Luzern compared to similar programs around the world and employer expectations of graduates from this kind of a program. Additionally, we evaluated the recruitment strategies utilized by the BE SES program compared to the programs previously mentioned. Furthermore, we looked into effective ways to connect with employers and alumni from this program, as well as alternative ways for students and professors to communicate other than email. The project had four main objectives:.

- Objective 1: evaluated the BE SES program in comparison to other educational institutions' offerings (*External Review*);
- Objective 2: evaluated student and faculty outlook on current sustainable energy curriculum (*Internal Review*);
- Objective 3: evaluated employer perspectives on the program and their expectations of graduating students (*Employer Review*); and,
- Objective 4: assessed the marketing and communication strategies used by the BE SES program and other similar programs (*Marketing and Communication Review*).

Much of the information gathered in each of these reviews was acquired through surveys and interviews. Four different surveys were distributed to four main groups, BE SES students, representatives from similar programs, potential employers, and students who a spectrum of colleges in the USA. All of these surveys except for the one to US students were followed up with interviews.

3.1 Objective 1: External Review

We conducted a comprehensive assessment of the leading programs in sustainable energy studies offered at selected universities around the world. Comparing the structure, content, and purpose of the different curriculums with those developed at Hochschule Luzern.

We reviewed the curriculums at 46 institutions (Appendix C). We chose these institutions because they offer majors in the fields of sustainability and sustainable energy and have posted extensive information about their curriculums on their websites. Many of these programs are relatively new and are still developing, so we were careful to note the dates that the program started. The information from which we compared the programs that were collated is course information related. We reviewed online class listings and any

associated supporting documents and external reviews of the programs that were available. We compared not only formal classes offered, but also practical experiences that were part of each program. We compared the curriculum in terms of several categories, including the types of renewable energy covered, concentrations, business/engineering/technician level, environmental/social implications, background knowledge, projects, and field experience.

The next step in this process was the assessing of the current curriculum and programs offered by Hochschule Luzern, which involved analyzing information available on the internet; viewing the school as a potential student or employer would in order to maintain the same perspective when assessing each institutions. This includes the website for Hochschule Luzern, as well as published pamphlets that are available on the web, and any other published content relating to Hochschule Luzern. This information will then be compared against the other educational institutions that are being assessed.

Some of the questions that were asked of each institution are mentioned in Appendix D. These questions were directed toward key professors within the program. Interviews of professors took place in the form of in person, phone, and email conversations depending upon the most convenient method for the person being interviewed. Consent for the interview was ascertained when setting up the interview, and confidentiality of the interviewer will be maintained unless specific permission is given otherwise. Interview scripts were developed with the consultations of this projects sponsors and advisors. The results were compared by creating a spreadsheet of key information to help the analysis.

When performing the review of all the institutions, we looked for specific features within their curriculums. These include aspects of renewable energy covered in courses (i.e. solar, hydro, architecture, heating and cooling systems, thermal). We were able to determine the features of each curriculum from the following questions: Is background knowledge needed to understand how renewable energy systems function? Are designing principles such as applied electrical mechanical engineering covered? Are there business classes that focus on ethical and environmental responsibility? How do they integrate business and renewable energy development while not compromising the environment or similar? These features along with others determined by interviewing potential employers and with the program developers at Hochschule Luzern will be highlighted in the external review. The full survey that was sent to the institutions can be found in Appendix D.

After this external review was completed, a document was constructed that would highlight the features that Hochschule Luzern offers to its students in education, competitiveness, and job placement as seen from an outside perspective and in comparison to

other institutions that will be reviewed using the same method. This document provides necessary information for Hochschule Luzern to better showcase themselves to prospective students by showing what other institutions offer as well as show what various other programs are offering around the world so as to help Hochschule Luzern advance their program. As well as benchmark the program against the other programs offered at other institutions to calibrate the material that the modules teach students, leading to the graduates of the program being more prepared to start their careers. This would also increase the programs competitiveness on an international scale.

3.2 Objective 2: Internal Review

We conducted an internal review of the existing program to determine the opinions of participating students and professors in or closely related to this program. This review was a partial continuation from the external review for Hochschule Luzern and provided an in depth view following the surveys and interviews with current students as well as interviews with Dr. Uwe Schulz and Dr. Shaun West. Using the knowledge acquired from the external review, we determined areas of most interest for sustainability programs and conducted in-person interviews of faculty members and an internet based survey of students using Surveymonkey in order to gage the perceived effectiveness of the program at Lucerne against a set of goals for the program pre-established in the external review. The internal review identified areas in which the program is performing very well as well as identified areas where additional or altered instruction may be most helpful.

3.2.1 Faculty Interviews

In person interviews with the two primary faculty, Dr. Uwe Schultz and Dr. Shaun West, who teach within the BE SES program were conducted. These interviews were done in person by the group and followed a general interview structure and question set in order to obtain the similar types of usable information from each interviewee. Any additional information a professor could share was welcomed and encouraged to add dimension and direction to our research.

We began with interviewing Uwe Schulz, the creator of this program, we had the greatest interested in information on the intended direction and origin of the program. We interviewed both professors on the, purpose, current performance, and future directions of the program. Several other professors from Hochschule Luzern also teach courses within this

program within their areas of knowledge, but the courses are simply English versions of classes offered in German through other majors so just class content was given consideration.

The professors interviewed were encouraged to give feedback on how structured the courses are and if the topics can be covered thoroughly within the time allotted. The professors were asked about their views on the importance of the content of what they teach, performance of the students, and future directions in which they would like to see the program go. Additionally, we asked if they can generalize any feedback from current and past students on the classes they have instructed.

3.2.2 Student Interviews

The intent of the interviews with students was to acquire information on their personal interests with the program. Understanding if a student is seeing value in his/her education as well as their personal feelings of preparedness for future employment will comprise a large part of this area of research. Students expect to receive an education and training in skills that will make them competitive in the job market. As such they should expect to leave the program feeling confident and competent.

Student information was primarily gathered using an online survey system, Survey Monkey, and distributed through the Hochschule Luzern email system with the email addresses of the students in the program provided by Dr. Shaun West. This was done to reach every student enrolled within this program, keep responses anonymous, and allow students to be completely honest. Questions ask about their studies at the school, why they chose Hochschule Luzern over other schools, and about their personal satisfaction with individual sections of the program. The survey was developed closely with Dr. Shaun West and Dr.Uwe Schulz in order to obtain all possible pieces of information that are of great interest and with guidance from our WPI advisors in making the most of the survey. These questions extended to include if the students feel they are being educated in the chosen topics well enough to feel confident using what they have learned on the job. A combination of multiple choice and open ended questions were asked to obtain this information and can be seen in Appendix E. Additional explanation for each question was able to be given in optional text boxes within the survey. Students were able to comment on how coherent the program is as a whole and if they feel important questions in their field of interest are being fully addressed.

The survey was first sent out on the 21st of March 2014 and after a total of 30 out of 43 possible results were collected from 19 students in the 2nd semester and 11 in the 4th, we

reviewed the bar graphs of the multiple choice questions and divided the open ended responses into groups to determine specific trends within the data.

In person interviews were also conducted with 10 students willing to give additional insight on their experiences in the program. Similar topics to those in the survey were asked, but with the objective of learning more about the reason(s) for choosing each answer. These were conducted at Hochschule Luzern and kept the identities of participating students anonymous.

In order to determine the initial effectiveness of the student survey, a pretest was sent to twelve randomly selected Hochschule Luzern students in the BE SES program. The responses were reviewed and after determining the survey functioned as desired, it was sent out to the whole BE SES program.

3.2.3 Review of Program Structure and Courses

In the interest of assigning numbers to the curriculum focus beyond student and faculty interviews, an evaluation of the breakdown of offered modules in the BE SES program was completed. It was done to reinforce and clarify our findings in the interviews and verify that our interview findings were not skewed. Additionally it allowed us to make direct graphical comparisons to results obtained in the employer survey.

This was done using available physical materials from the BE SES program that are also available online. Each of the core modules, project modules, and related modules were categorized into the top results from the employer survey on what major their employees came from, or the modules were put aside to see if there was any larger group they all fit into. Ultimately these were not looked into further as they lacked commonalities of interest. Engineering modules were categorized further and when various topics were not specific to a category, they were placed in a General Engineering section. This is to note that students are being educated in the engineering field, but not in any specific direction from these courses. After making the separations, the number of credits in each category were noted and graphed for easy comparison against the findings from the employer survey.

3.3 Objective 3: Employers Review

In order to determine what potential employers would be looking for in graduates from the program, we surveyed the opinions of employers in the field of renewable energy and sustainable engineering regarding the role that Hochschule Luzern program could play in meeting employer demand for skilled labor. We also interviewed as many as time allowed, and then analyzed the acquired information to see what results overlapped from employer to

employer. In order to properly survey employers, we first identified as many companies involved in renewable energy or sustainable engineering that are located in Switzerland as possible. In order to do this, websites listing many of these companies were used, such as posharp.com (POSHARP). In addition, the heads of the program were asked to provide lists of any companies they knew might be interested in hiring graduates from the program and ended up providing many business cards from potential employers. The contact information for these people was then compiled in preparation to send a survey to them, which was then sent to a selected group of the contacts as chosen by Dr. Shaun West, our sponsor. This survey asked questions that could be used to group the companies by type such as asking about the size of the company and what the majority of employees majored in. In addition, a short description of the BE SES program was provided in the survey, followed by questions for determining if the company was interested in hiring people from this program as well as what they would expect of its graduates. The surveys also asked for any other contacts that the person could point us to. They were sent to each contact in a semi-personalized email, and if the website for the company provided an email to send questions to instead of contacts, the survey was sent to that email. The full version of the survey is included in Appendix F.

Once these surveys came back in, they were analyzed in the following way. First, the results of the questions about what the employers want to see were used to group the companies into different categories of what they want and what type of company they are. For example, companies who tended to hire employees from similar fields were grouped together. In addition, the companies were grouped by their responses to the questions about the size and other factors of their company, and any correlation between the two groupings were documented. Following this grouping of the companies, interviews were requested from anyone that said they would be willing to be interviewed. They were from at least one company from each grouping made in the previous analysis. When possible, in-person interviews were preferred, but phone interviews were used when necessary. Each interviewee had their wishes regarding anonymity and confidentiality respected, as well as their preference in how the interview was recorded, if at all. These interviews consisted of more in depth questions asking for elaboration about what they would expect from graduates from the program. A full list of interview questions and interviewees is included in Appendix F.

Once these interviews were completed, the final step was to analyze the data. This was done in a couple of parts, with the first being a comparison of how the different segments related to each other and if the companies within the same segments had similar views or not. The second analysis went hand in hand with the internal review of the BE SES program, and

compared what employers want to what is being taught in the program. A couple of smaller analyses were made as well, including a summary of how the segmentation worked out, as well as a summary of what the overall picture is in terms of what companies want from graduates of the program.

3.4 Objective 4: Analysis of Marketing and Communications

In collaboration with our sponsors Dr. Uwe Schulz and Dr. Shaun West, we determined that it is necessary to benchmark the marketing and communication operations of the BE SES program to ensure that they optimally suit the program's needs. We determined that there were four main stakeholders whom the program must communicate well with: potential students, current students, employers, and alumni. Each of these stakeholders were then linked to four operations within the BE SES program that we chose to benchmark, which are recruitment, student-professor-communication, employer relations, and alumni relations.

3.4.1 Surveys and Interviews

Information regarding recruitment was gathered primarily from two surveys. The first survey was to every student in the BE SES program. The survey was emailed directly to every student in the program. Of the 43 total students in the program, 30 responded to the survey. The second survey, called *Collegiate Marketing and Communication Survey*, was sent to a more general population and was distributed very differently. We wanted to get feedback from a population of students who all attend different colleges and universities. The most effective and easiest way to do this was to utilize social media and post the survey as a Facebook status. This allowed for voluntary response from anyone who read the status.

A few test surveys were sent to five "friends" to ensure that the responses answered our questions appropriately and that the logic of the survey made sense. One problem that arose while preparing for posting the survey was that most of our friends attended WPI. This was an issue because too many responses from WPI students would severely skew our data, since we were looking for marketing trends among different schools. We therefore had to filter who could view the survey within Facebook so that only non-WPI people who fall between junior year of high school and 5 years out of college could view the survey. We ended with a total of 48 responses to this survey.

We also conducted 11 interviews which gave us more insight into how students learned about the program. Of these 11 interviewees, 6 were international students, which was very helpful for supporting our findings regarding differences between marketing to Swiss students in contrast to international students.

3.4.2 Description of Analyses

As previously mentioned, four separate analyses were performed, each drawing information different surveys and interviews.

The first analysis from this section was a benchmarking of BE SES marketing methods for recruitment. In this analysis, information gathered in the BE SES student survey was compared to data from the collegiate marketing and communications survey. These findings were then reinforced by our student interviews.

The second analysis was of the current student-professor communication methods within the BE SES program. Once again, results from the BE SES student survey were compared to what was found to be common practice in the collegiate marketing and communications survey. The results were once again confirmed and elaborated in interviews with students.

The third analysis was of BE SES employer relations. In this section, data from the employer survey regarding employer-program relations was compared to what was found to be common practice in the marketing and communications survey.

The fourth and final analysis was of BE SES's future alumni relations. Data from the external school survey was compared to data from the marketing and communications survey, both of which provided some insight into what is common practice for schools and programs as far as alumni relations.

3.5 Conclusion

By conducting these four reviews we acquired knowledge that enabled us to propose several possible changes to advance the BE SES program at Hochschule Luzern. We evaluated the effectiveness at every stage in a BE SES student's journey into the workforce. The first is their application into the program: Are qualified students around the world well informed about the program? The second is their immersion into the BE SES curriculum: is what they are studying effective and relative to similar programs and employer expectations? The third is working for an energy-related company: are graduates prepared for both employer's expectations and possible changes to the field? Based on the information that we gathered, we developed a set of conclusions and recommendations that the program may choose to use regarding the structure of the curriculum, preparing students for energy-related jobs, and marketing strategies.

4. Findings, Conclusions, Recommendations

Using findings we acquired from extensive background research, four surveys, and subsequent follow-up interviews, we were able to establish a series of conclusions and recommendations for the program to consider. Like the methods section above, this section is segmented in congruence with our objectives and work streams. It starts with the *External Review* and is followed by the *Internal Review*, the *Employer Review*, and the *Marketing and Communication Review*. Each review's detailed and specific findings, conclusions, and recommendations are presented within each of these subsections, and are then summarized at the end.

4.1 External Review:

In our external review, we examined 54 programs offered by 45 universities around the world (see list in Appendix C). These programs were compared against each other on a variety of criteria, based on information gathered from institutional websites as well as a brief online survey that was completed by 5 institutions online and another 5 from phone surveys (see copy of survey in Appendix D). We collected basic background information on the program, the types of energy sources covered in the curriculum and other important characteristics.

4.1.1 Findings

4.1.1.1 Geographical Distribution:

The programs reviewed are spread across the globe. Most of these programs are found in Europe (22 programs, including European countries outside the European Union) and North America (15 programs), with only 2 from Oceania and 1 in the Middle East. This sample was developed to cover programs across the world; this list is not exhaustive and may over represent programs in the developed world. Alternatively, this may reflect that such programs truly are more prevalent in the more affluent parts of the globe with mature economies.

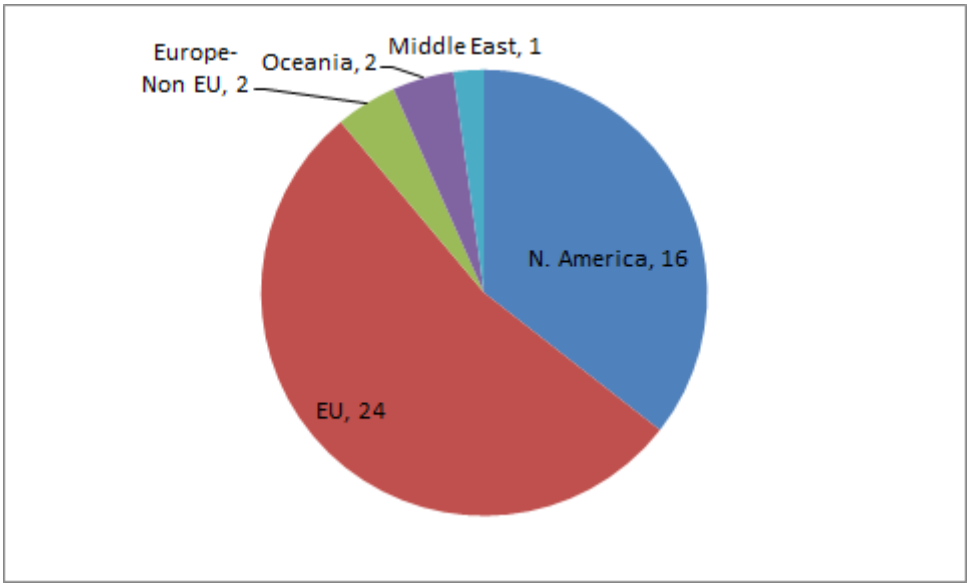

Figure 10: Geographic Distribution of Degree Programs (n=54)

4.1.1.2 Type of Degree Program:

Within the sample of 54 programs, 31 (57%) offer a BS, 22 (41%) offer an MS, and 1 offers only a 2 week program (Figure 7). There is a distinct split between programs that focus on policy versus those that offer business/engineering degrees. The programs that focus on policy tend to have more general programmatic titles with words like environmental science, environmental sustainability, environmental engineering, and their curricula focus on "surveys" of environmental issues ranging from ecological to energy to resource use. Eliminating the 13 policy programs from consideration leaves us with a set of 41 programs with a focus on business/management that more closely resembles that of the BE SES program offered at HSLU.

The more technical degree programs require the students in the program to take engineering courses ranging from mechanical, electrical, and renewable energy engineering. These courses and modules teach engineering fundamentals integral to the electricity generation processes that are being studied. Without these engineering fundamentals, the students would not be able to fully comprehend the technology they would be using and its limitations, as well as being able to exploit certain aspects of the technology to create a better, more reliable and efficient system.

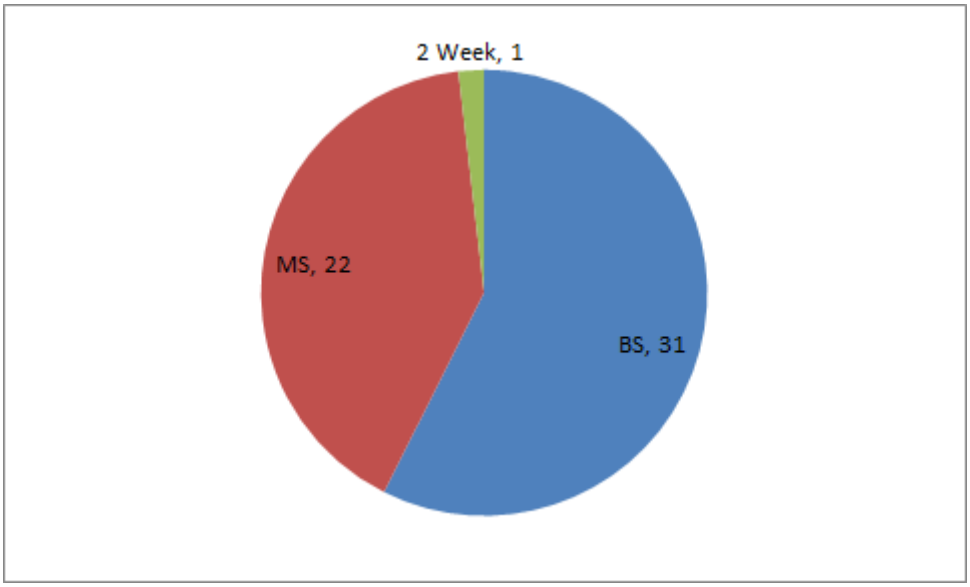

Figure 11: Distribution of Degree Type

4.1.1.3 Age of Program:

Age of a program could be important factor in students being interested in a specific program. The more developed a program, it is likely that it is known in industry, that it has a pre-set path for those entering to program to graduation, and possibly onto industry as well. With a new program, there is usually more fluidity within the program, meaning that it is likely to change its dimensions. However, with a new program there are some risks to the first few years of students. The program could possibly be shut down in its infancy if it does not receive enough interest and there may not be a clear path to complete the program even if the institution lays out the entire framework. Unfortunately, few programs responded to our survey, leaving us with only a few programs of which to make comparisons.

The first group of students participating in the program offered at HSLU are currently in their second year, of a total of 3 to complete their Bachelor's degree in BE SES. Several other programs have also started recently: Aalborrg University's "Energy Engineering" started in 2007, Oregon Institute of Technology started its "Renewable Energy Engineering program in 2005. Both of these programs are Bachelor's degrees. One of the older programs offered is from Reading University. They have offered a Master's degree in Renewable Energy Technology and Sustainability since 1984. We suspect that many of these programs are quite new and their growth and development may have been encouraged by increasing concerns about resource depletion, fossil fuel use, especially climate change.

4.1.1.4 Energy Sources:

Much of the environmental and sustainability field focuses on the development of renewable or sustainable energy sources given concerns about fossil fuel use and climate change in particular. In the words of Kenneth Deffeyes, "In a sense, the fossil fuels are a onetime gift that lifted us up from subsistence agriculture and eventually should lead us to a future based on renewable resources (Hubbert's Peak: The Impending World Oil Shortage, 2001)." This focus is evident in our assessment of the course offerings of the surveyed programs.

Of the programs surveyed, 23 offered classes covering wind energy technology, 24 covered solar PV, 15 covered biomass, and 11 covered hydroelectric generation technology (Figure 12). Nine of the programs that we surveyed, covered solar PV, hydroelectric, and biomass generation of electricity. These three represent the most commonly taught electricity generation technologies of the programs surveyed. However, other electricity sources should to be taught, even if a general overview is performed of how the technology functions. This would give the students the ability to work with a greater range of technologies, and integrate them into one functioning system. Sources such as tidal, geothermal, ocean thermal energy conversion (OTEC) and others would likely prove valuable to be familiar with the technology.

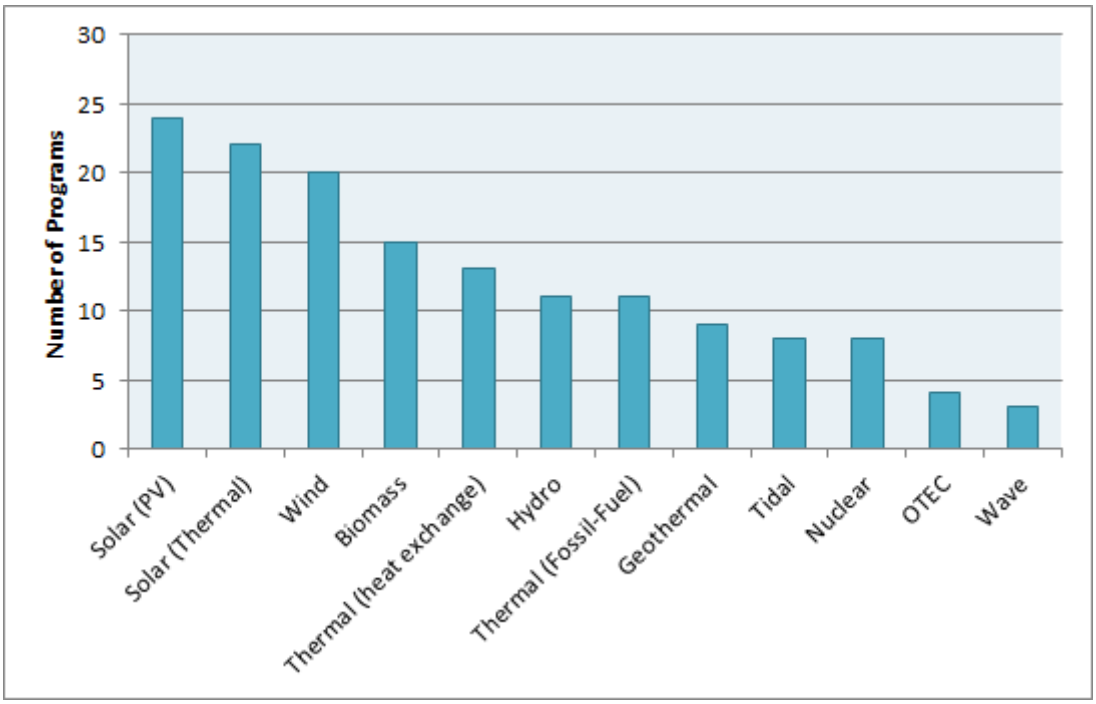

Figure 12: Number of Programs that Covered Each Electricity Source

4.1.1.5 Energy Technologies and Topics:

Of the different energy technologies that are discussed in the various programs that we reviewed, energy efficiency and the electric grid stand out and are taught in 16 of the 54 programs (Figure 13). The Oregon Institute of Technologies along with HSLU and Aalborrg University teach this topic. In addition, the topics of the electric grid and carbon management were covered by the 16 and 14 programs respectively. However, it needs to be noted that different institutions use different terms and the topics covered in particular classes and curricula are not always clearly evident.

Transportation, mobility, and climate change topics are covered by only a few programs (as shown in Figure 13). HSLU already has a module on climate change, but adding a module about the use of alternative methods of transport of goods and people, increased efficiency of transportand mobility, and better transport and mobility systems as a whole would help HSLU stand out among its competitors.

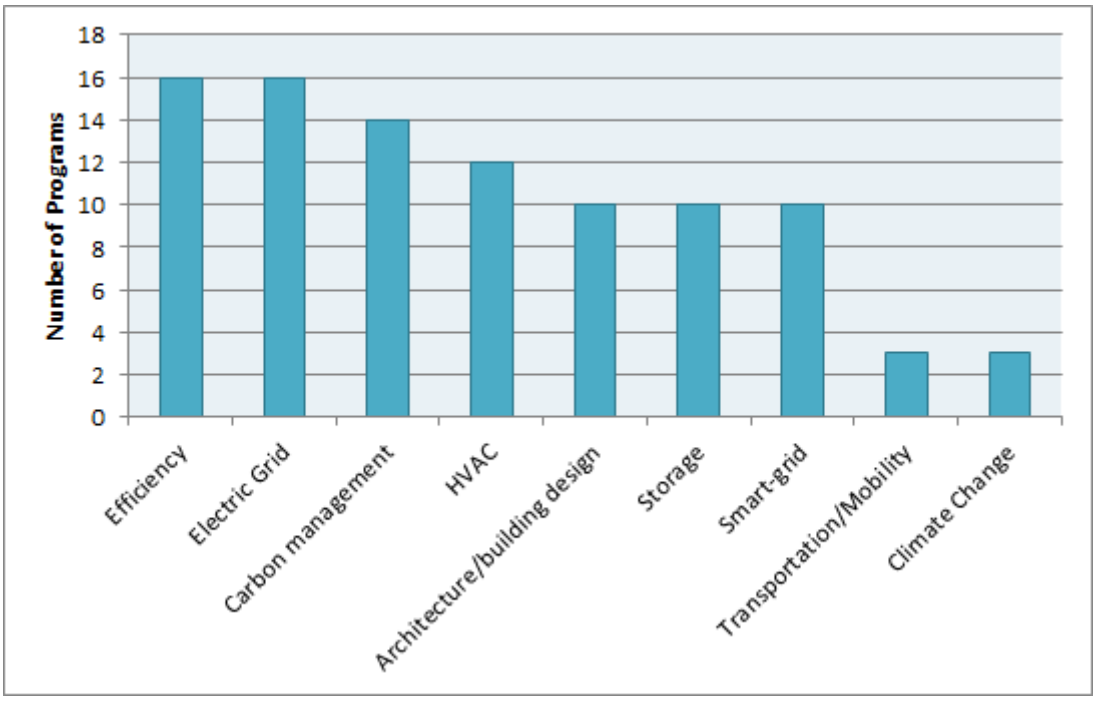

Figure 13: Number of Programs that Covered Each Energy Topic

4.1.1.6 Language of Modules:

Most of the programs we reviewed were taught completely (42 programs) or partly (3 programs) in English (Figure 10). This is not surprising, since 36 of the programs review are offered in the UK, the United States of America, and Australia. That programs are offered in English in other countries emphasizes that English is the international language of business and engineering.

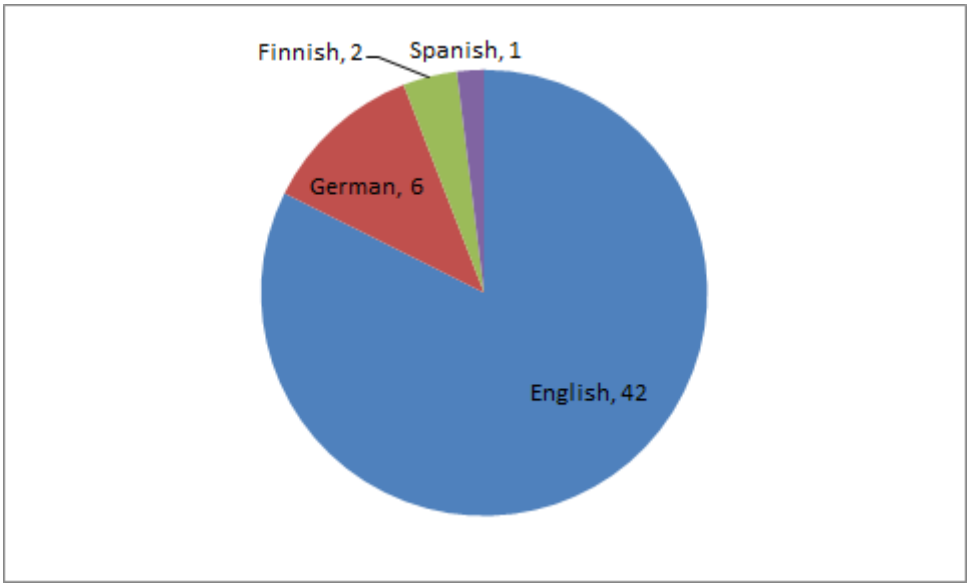

Figure 14: Language distribution of programs (n=51)

4.1.1.7 Business Aspects of the Programs:

Some engineers may never have learned how to effectively run and manage a project in a business environment where time and money are driving factors, but understanding how business is conducted is necessary to be fully functional member of a project team. Relatively few institutions, however, offer business training for engineering students, so HSLU will standout, along with institutions such as Kyamk: University of Applied Science, De Montford University, Reading University, and Oregon Institute of Technology, that offer classes in project management, ethics and finance/accounting.

4.1.1.8 Environmental Aspects:

Many of the programs emphasize the environmental implications of energy and materials consumption, which is to be expected in programs on sustainability. The program at HSLU does the same. It is very important students participating in the program understand the greater applications and consequences of their actions and designs. Since the purpose of these degree programs is to train students to create a more environmentally friendly, sustainable society, they need to possess a good grounding in environmental science.

4.1.1.9 Observations about Web Pages:

In reviewing the programs offered at many other institutions, there are vast differences in the information that some schools provide about the programs offered. Cincinnati State University, Lucerne University of Applied Science and Arts, and Oregon Institute of Technology are good examples of programs that provide prospective students and

employers of graduates with information to make informed decisions about whether or not to attend the program or hire a graduate of the program.

Basic program information was difficult to locate on the websites of 35 universities in our sample of 45 and 33 failed even to provide contact details for further information. This makes it difficult for prospective students to find the information they need or even where to go if they have questions about a program.

An informative and easy to navigate program page is necessary to convey important information about the program to prospective students and prospective employers of graduates. The more information, and the easier the information is to access, the better and more informed decisions can be make about hiring graduates and applying to an institution of study. From observing many different program pages, most tend to be formatted in a way such that specific information about the program in question is hard if not impossible to find without making a special request for the information from the school.

Sixteen of the 54 programs reviewed, failed to provide any information online about their programs other than a title and/or a very rough description. Three of the institutions with the biggest issues related to their websites are the programs at the University of Tehran, Hochschule Fur Technik Rapperswil, and Furman University. These schools offer very little information about their programs online to prospective students and employers of graduates of the program. By contrast, the Lucerne University of Applied Sciences and Arts (HSLU) does a fairly good job of conveying the information that students and employers need to make informed decisions. The program has a dedicated page linked in with the main school website and a published PDF pamphlet that contains detailed information about the program, as well as descriptions of each individual class offered within the program.

4.1.2 Conclusion:

The approach that the Lucerne University of Applied Science and Arts takes in its Business Engineering Sustainable Energy Systems is sound when benchmarked with other institutions, which sponsor similar programs focusing on business and energy with a theme of sustainability. The way that the engineering modules and business modules are blended into one program is unique. This program presents itself as one of the most clearly defined programs that was reviewed for the purpose of this project. The course listings were laid out in an easy to understand pamphlet that is easily accessible in a PDF document on the program specific webpage. These courses cover the main areas of study that other institutions cover in their programs around the world, giving the program at HSLU credibility in the development

of this program. The material of the program that is covered in the modules shows that the graduates will be familiar with elements of electrical engineering, mechanical engineering, thermodynamics, management of projects, and international business practices. Energy topics learned by the students in this program will enable them to effectively transition into the workforce. This degree program is attractive to those that want to be in an energy related industry that is working towards making a more sustainable world in relation to energy production and utilization.

4.1.3 Recommendations:

4.1.3.1 Electricity Generation Sources Module(s)

An optional or required class/module that covers all the different electricity generation sources that are available: wind, solar (PV and Thermal), hydroelectric, wave, tidal, geothermal, biomass, OTEC, and possibly nuclear. With this background knowledge, graduates will be able to adapt quickly if they are presented with a project that requires an electricity generation source that is outside of their main knowledge base. This would allow them to be familiar with the electricity generation technology in question, and not have to start from scratch or have to play the catch-up game to become familiar with the technology that they are tasked with working and implementing.

4.1.3.2 In Depth Exposure to Other Electricity Sources

One aspect that we recommend to be added to the program is to provide one specific elective module for an in depth exposure to a specific electricity source other than biomass, solar, and hydroelectric. This program would have a competitive advantage if it were to train and teach other electricity generation sources that are up-and-coming in the world as well as those that are of high interest to students, discussed in internal review. Such sources include wind, tidal, and OTEC. These electricity generation technologies may not directly pertain to Switzerland but they would be appealing to students looking toward the future and the international community of students desiring a jump-start on the renewable energy industry.

4.1.3.3 Addition of Module in Transportation/Mobility

The addition of a module in transportation/mobility would be helpful in the expansion of the program. This would expose the program to more people from around the globe, creating a larger interest in the program from international students, as very few programs

offer education in this area. This module is not absolutely necessary as of yet, but would help to expand the scope of the program in the future.

4.1.3.4 Program Webpage

For now, the program specific webpage has the content that necessary to provide potential students and employers. However, the grammar and wording of some information needs to be fixed for a better appearance and for conveying the correct information. An aspect that should be added in the future as students join the workforce, also observed when researching programs similar to BE SES at other institutions, is the potential careers of graduates and success stories of graduates of the program.

4.1.3.5 Program Expansion & Specialization

As this program develops further, more concentrations in different energy sources and technologies should be added to the curriculum. This would allow students specialize if they wished to do so, an enable them to more effectively work with and implement technology of a specific field.

4.2 Internal Review

The internal review included an assessment of the course offerings and credits, interviews with staff and faculty, and a surveys and interviews with students. Surveys were sent to all 43 students in the program, and we received 30 completed questionnaires and conducted 10 follow-up interviews.

4.2.1 Curriculum

4.2.1.1 Curriculum Credits and Focus

In our Review of the BE SES curriculum, we reviewed the various course descriptions available both online and in print. We segmented by module content and counted by credits in each topic area. We used categories to match those used in surveying employers to make it easier to compare what the program offers with employer expectations. Only core, project, and related modules were examined and when they did not fit well into one of the predetermined categories, they were not counted in the distribution.

The program was expressly designed to be a mix of business and engineering, with a greater emphasis on engineering, which is clearly shown in Figure 15. The employer survey (Section 4.3.1) found that employers believe this balance is generally appropriate. As shown

in Figure 16, the proportion of mechanical, and electrical engineering, and other engineering topics matches the emphases preferred by employers (see Employer Survey in Section 4.3.1.4).

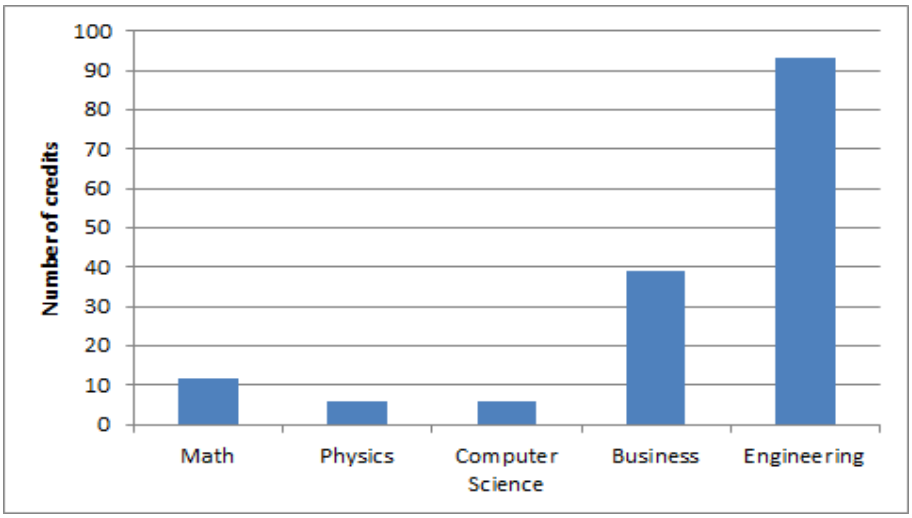

Figure 15: Partial credits offered through the BE SES program

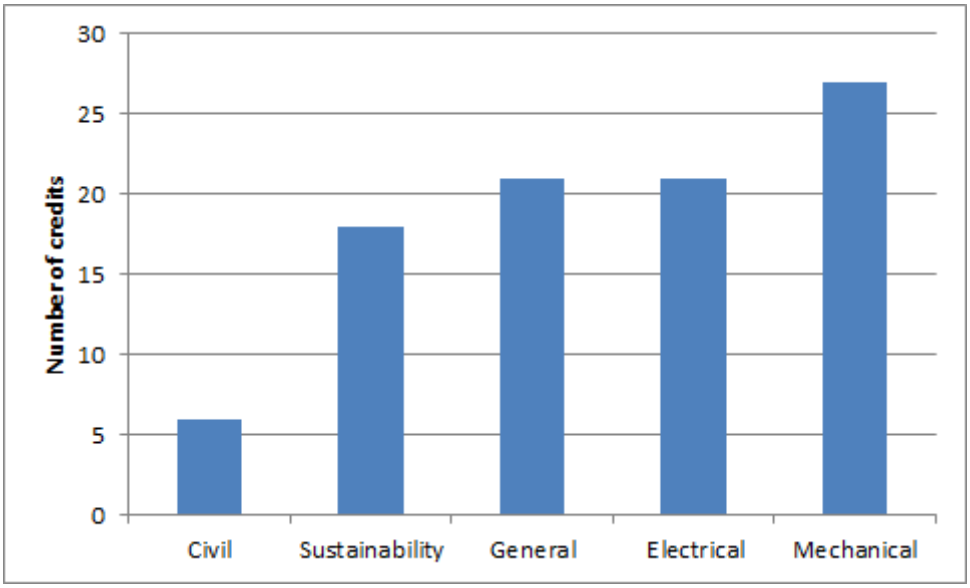

Figure 16: Credits offered for engineering typed through the BE SES program

4.2.1.2 Topics of Most Interest to Students

Energy efficiency, energy storage, project management, and solar are all topics of high interest to students as shown in Figure 17. HSLU offers course on all but energy storage at present. In student interviews, two interviewees expressed their interest in learning more on the subject and would like to see an energy storage module available from the 3rd semester incorporated into the curriculum.

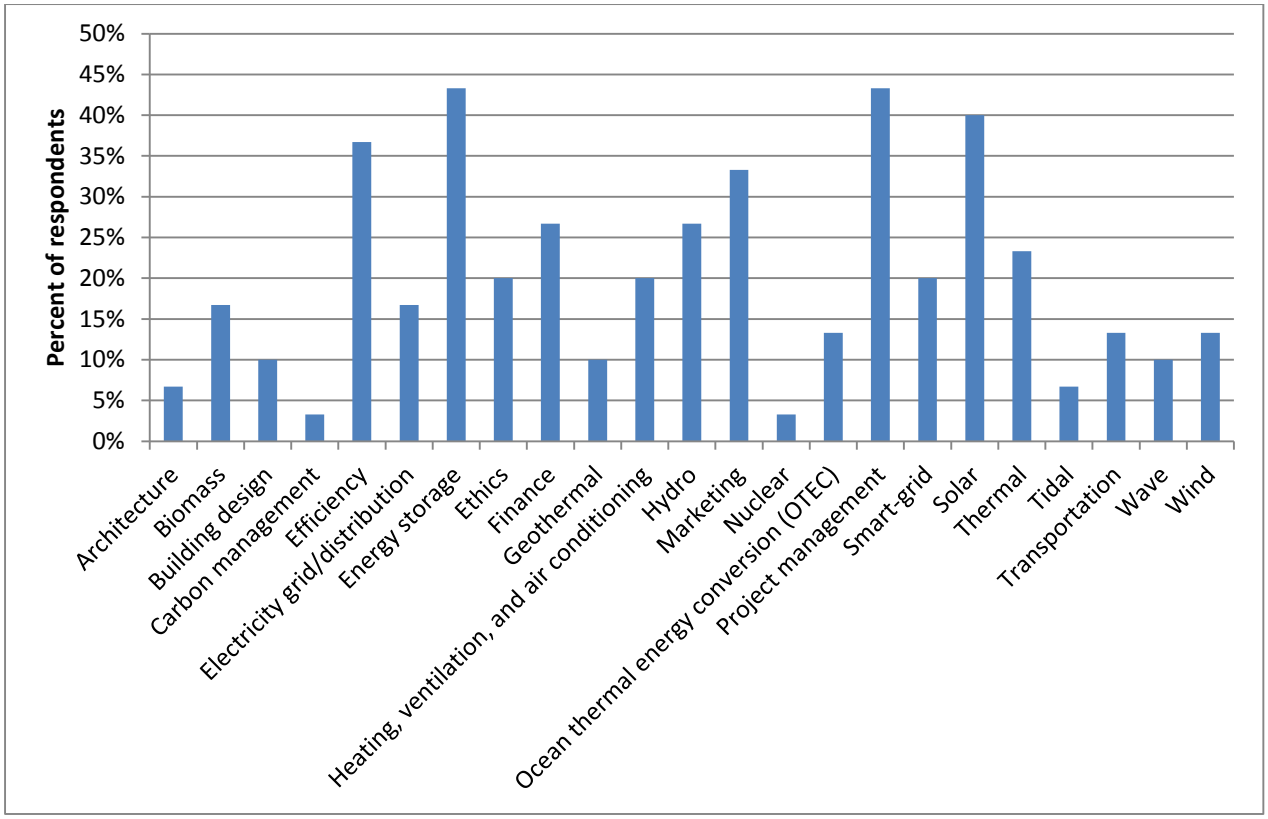

Figure 17: Topics of most interest to students currently in the BE SES program.

4.2.1.3 Limited Sustainability Classes Before Third Year

The current curriculum has a very limited number of modules on sustainability in the first two years of the program. Many students indicated that they disliked the current emphasis on basic knowledge in the first two years while numerous courses on sustainability are not offered until the third year. Several students said they would prefer to have an overview module on sustainability that would give them a more broad understanding of what types of sustainable energy systems are in use today in their first year. This course would be able to provide context for their studies that eventually add into upper level sustainable topics in their third year.

4.2.1.4 Modules of Most Interest to Students

To determine where the students see value in the program, they were asked in the survey to select the top three modules they have found most valuable. Of the top five modules selected, three of which were categorized as engineering courses and two as business courses as seen in Figure 18. This balance of interest between engineering and business interests suggests that the curriculum matches the personal preferences of the students.

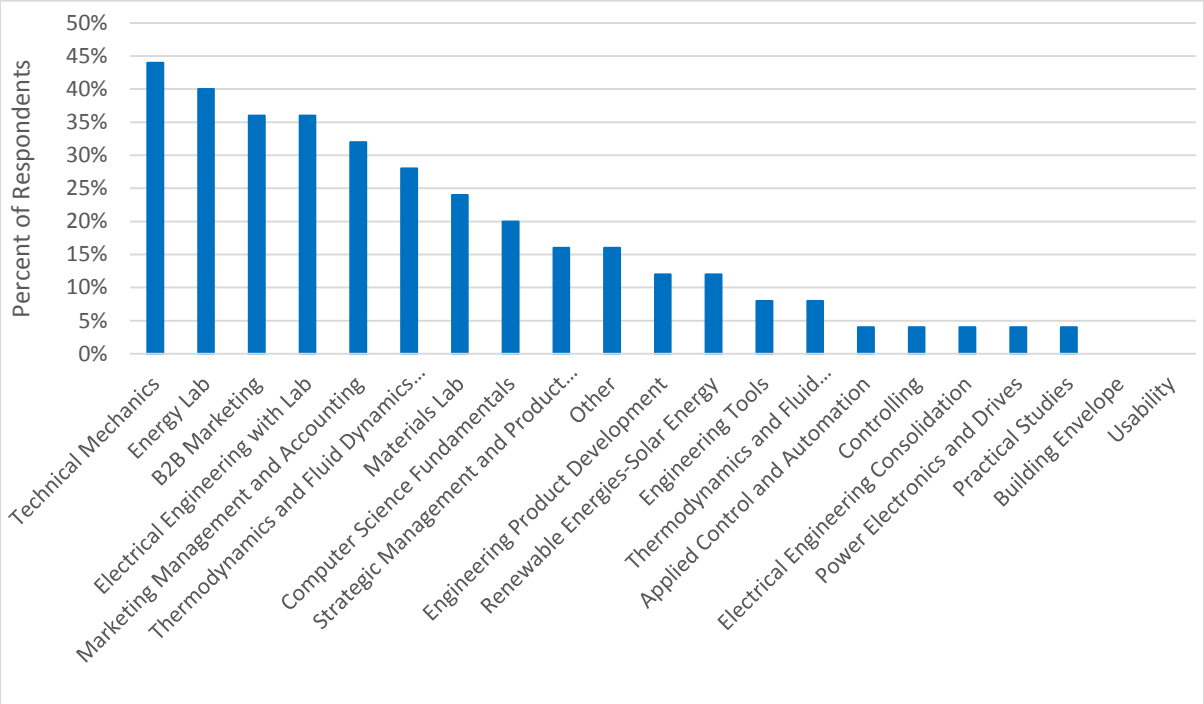

Figure 18: Modules found to be of most value by the students surveyed.

4.2.1.5 International Focus at the Current Time

In discussing the ideals for the BE SES program with Dr. Uwe Schultz and Dr. Shaun West, it is clear that an international focus for the program was intentional and desired. Of the students surveyed, 11 of the 30 were in countries other than Switzerland when applying to the program and half of the students who chose to answer where they see themselves working after graduation chose a country other than Switzerland.

Reviewing the modules specific to different forms of sustainable energy, a focus on Swiss topics is noticeable. This however leaves several areas in sustainability partially uncovered by the curriculum, specifically those of international importance. One international student in particular commented that they were unclear if they would graduate and know enough about all of the different aspects of the sustainable energy field to allow them to seek employment anywhere the world. As they have not taken all of the classes yet, these were not well grounded concerns, but rather speculations.

4.2.1.6 Short Term Expansion of Existing Classes

In student interviews, several students have expresses interest in other modules offered at HSLU is the various other programs. These are modules are ones that relate to their specific interests, but may not be a focus of the BE SES program. International students in

particular mentioned how they feel limited by what classes they can take because they cannot possibly take German courses with the language barrier.

4.2.1.7 Energy Lab

When asked about a least favorite module in interviews, or something they would like to see changed about the program, Energy Lab was mentioned at least four of ten times. These students were consistently unhappy with specific aspects of the module itself, but did not suggest that it be removed from the curriculum. A lack of previous knowledge coming into the module made studies difficult for students and had they taken physics before, their understanding may have been much clearer. Students were also were unhappy with how little their lab work counted towards their final grade and how much of exams did.

4.2.1.8 Swissness

In interviewing international students, one recurring comment for favorite modules was Swissness. One student in particular explained that they liked this class for both the interesting content and a great professor. It was something that greatly helped them at the school. Although this module may not have applied directly to their technical studies, it was still found to be of great value to students.

4.2.1.9 Conclusions

From the credit distribution of the BE SES program, we can conclude that the proportion of various classes offered is optimal or near optimal for what current employers are searching for. Topics of most interest to students are all covered well with the existing program except for energy storage. There is no need to reduce the number of business courses in favor of more engineering courses. Energy lab is a topic still valued by students, but restructuring the module can give students a better experience. And no matter how crowded or intensive the BE SES curriculum may become, Swissness should continue to be an important and required module for international students.

The offering introductory level courses on sustainability would allow students to gain a basic understanding of the field while providing context for their future studies. In order to be a completely international program in both student body and curriculum, topics of sustainable energy not only related to Switzerland must be offered in some way. Allowing students to take a number of classes directly related to the areas in which they hope to see themselves working is more appealing to students. Selected modules already instructed in German at HSLU that could be given additionally in English are of interest to students in the BE SES program.

4.2.2 Curriculum Recommendations

After conducting student surveys and interviews as well as going through the literature available for an internal review, the following are recommendations made for the BE SES program. Among these suggestions are both short term and long term actions that will add value to the program and the educational experience it is capable of providing.

4.2.2.1 Sustainability Class

Following student interviews, we recommend that the BE SES program incorporate into existing module(s) an overview of renewable technologies and their respective uses in the first and/or second semester of the curriculum. This would be to get students excited about sustainability and understand where their hard work of learning basics can be applied. This module should be a compulsory module and be emphasized as the student's introduction to the sustainability field.

One option is to have the module instructed by two or more professors offering both a technical and social side to the problems presented. A professor of engineering would be able to clearly explain how various sustainable processes are carried out and the technical requirements for operation throughout the world. A second professor well versed in topics relating to social and environmental issues could complement the topics by discussing the benefits and drawbacks beyond the technical aspects. This would add another dimension beyond engineering to student thoughts early on.

Further, breaking this class into half lecture and half guided research project work would introduce students early on to group projects. After having learned about many types of sustainable energy resources in the first half of the module, students may be formed into teams based on their interests and research a single topic of interest much more in depth. Frequent meetings with one or both of the professors to review best practices in research and writing can allow for individual attention for each student and group. The research could culminate in a final written report of the group's findings as well as a short presentation on the topic.

Worcester Polytechnic Institute (WPI) in the United States has started within the past few years to offer a similar grouping of courses called "Great Problems Seminars (GPS)" that follow a similar structure and span a wide range of topics.

Adaption of the module Context 1 that already is in the BE SES program can serve this purpose. The project portion that already exists could be chosen with a sustainable focus in an area not covered in depth in the rest of the program to expand the knowledge base and worldly views of students.

4.2.2.2 Module Topics

As the BE SES program grows, so too should education in areas of sustainability previously unaddressed. Starting with areas directly relevant to Switzerland works well for getting the program going, however in order to have a truly international program there needs to be a focus on all major types of sustainable energy worldwide. A recommendation for when the program is in the position to add new modules is that the modules begin to expand the program's reach to include all major types of sustainable energies. International students who intend to return to their previous country and/or students looking to work in different countries following graduation will both want and need to know about these various topics. Modules of this type can be provided to supplement a student's existing course work.

4.2.2.3 Energy Storage Module

The addition of an energy storage module to the BE SES program should be made. This topic is offered at other universities with similar programs and was found to be of high interest to the current BE SES students. It would satisfy student desires as well as keep the program current and competitive with other universities. This module should be made available to students from the third semester onwards.

4.2.2.4 English Offerings

In order to expand the program in the near future, more modules of related topics from existing classes offered at HSLU should also be made available in English. This should take place when possible and enough interest exists.

As the BE SES program progresses and grows, these English versions can be adapted specifically to fit into BE SES needs. This would involve removing content that is unnecessary for a BE SES student to know or information that is repeated in other modules. In its place, information on sustainable energy systems related topics can be substituted.

4.2.2.5 Energy Lab

In order to improve student experiences with the Energy Lab module, a few alterations should be considered. The content of the physics courses and Energy Lab should be reviewed together to see where overlap of concepts may occur. The very basics of the electricity concepts should be given to students in the beginning with the goal of building a strong knowledge base to work off of. The modules that follow should allow students to go into more depth with a better understanding. In the case that Energy lab is given before physics, as was the experience with the students interviewed, we recommend that only content necessary to complete and understand the labs is given. Following physics modules could then pick up where Energy Lab left off.

4.2.3 Student Interaction

4.2.3.1 Student Updates

Students do not feel well informed about their futures in the program. They understand who they need to ask when they have questions; however they rarely do so until necessary. Limited material beyond course descriptions and a general program appear to be easily found online or in print. The program is continuing to change and the students see a need for regular updates on the various changes.

4.2.3.2 Module Descriptions

Working on categorizing the Core, Project, and Related modules offered in the BE SES program, there was difficulty determining what a class offered from the course descriptions available. The class content was very general. In interviews, students in their second semester were unclear what modules they were looking forward to because they could not tell what a class offered. At least two students in their fourth semester said that their expectations for modules usually are very different from what is actually course content.

4.2.3.3 Conclusions

Students would like to be informed or readily have information available to them in each year and semester of the program. Knowing who they should contact for information is not enough because they may not contact anyone until a major question arises. Course descriptions would be more helpful if they explained more module goals for topics to be learned. Clear objectives of courses help students understand what they should be looking for in a module.

4.2.4 Student Interaction Recommendations

4.2.4.1 Student Updates

Once a semester, a meeting of all BE SES students and professors should be scheduled. This would be to give updates, important information, advice for what students should be looking into next, and allow for student questions involving the program to be answered for the entire group. These meetings would be kept somewhat informal and provide for additional discussion before and after the event between students and the professors.

The goal of these meetings is to keep students informed and comfortable with their progress through the BE SES program. Common concerns of students can be restated with

the respective recommendations as it is likely more students have the same questions or concerns, but are not asking them.

These meetings can also serve as a way for faculty to get feedback about the program by talking with students in small groups about their perceptions. Students standing with their peers discussing a topic they may be more willing to discuss a topic knowing that they are not alone in their opinions.

4.2.4.2 Module Descriptions

As a help to current students, potential students, and potential employers, it would be beneficial to make module descriptions more extensive and descriptive. Now that many of these modules have been instructed before, it may now be relevant to change or elaborate on the published description.

This would aid students trying to decide what courses to enroll in. It could also provide a better understanding to students looking at the program who want to see what is really offered in the BE SES program.

In addition to revised and lengthened module descriptions, including a description as to how a module is relevant to the major of sustainable energy systems would be helpful. It informs students why they are taking a module and the overarching themes they should be taking away from it. For professors teaching a course, they can see how best to relate topics back to sustainability.

4.3 Employer Review:

In order to determine how the students in the BE SES program stand in terms of employability, we surveyed 24 potential employers from 23 different companies to determine employer expectations of new employees in terms of qualifications, skills and training. Some of these 23 are small branches of large companies, but due to geographic and focus differences they were treated as separate entities. We surveyed a broad cross-section of companies ranging in size from 1 employee to 145,000 employees. These companies were primarily located in Switzerland (15), with others being located in the United Kingdom (5), and China (3). In addition, we conducted in-depth follow-up interviews with six of the survey respondents from six different companies. All provided useful insight into what the company would be looking for in a student from the BE SES program

4.3.1 Findings

4.3.1.1 Language Barrier

One of the primary concerns of the creators of the program was that there would be too many companies that required their employees to speak a language other than English, as this program is taught entirely in English. Of the 23 companies surveyed, 17 (74%) either only required English or had no language requirement. These responses represented all sizes of companies in the simple. Only 4 (17%) required German, 1 required Chinese, and 1 was a single person company who had not decided yet.

4.3.1.2 Future Hiring of Full Time Employees and Interns

Of the surveyed companies, 16 (69.5%) expressed interest in hiring new full time employees in the next three years, while the rest either did not know or did not intend to. In addition, 15 (65%) stated interest in hiring interns, with 10 companies offering 6 month internships and 5 offering 2 month internships. The remaining companies that offered internships did not know how long their offered internships were meant to be.

4.3.1.3 Interest in BE SES Program and Related Student Projects

Of the 19 companies that answered the question regarding their interest in hiring graduates from the BE SES program, 14 (74%) expressed some degree of interest. The companies that expressed interest were asked to rate their interest on a scale from 1 to 3, with 1 being somewhat interested and 3 being very interested. Of these companies, the average interest was a 1.78, putting the total interest between somewhat interested and moderately interested, lying closer to moderately interested. Table 3 presents a list of companies that showed interest in the program, and their contact information can be found in Appendix J.

Company	Location	Number of Employees
ABB Turbo Systems AG	Baden, Switzerland	145000
Anthills	Bern, Switzerland	1
Deritend Group Limited, The	United Kingdom	240
Frost & Sullivan	United Kingdom	2000
GDF Suez	Zug, Switzerland	43
Holcim Group	Zurich, Switzerland	70000
ITZ Innovations Transfer Zentralschweiz (requires German)	Horw, Switzerland	5
Noventum	United Kingdom	10
Phonak	Stafa, Switzerland	10000
Roland Berger (requires German)	Zurich, Switzerland	70
Siemens	United Kingdom	18000
SoftInWay Switzerland GmbH	Zug, Switzerland	50
Sulzer Pumps	Winterthur, Switzerland	17000

Table 3: Employers Interested in Hiring Graduates of Program

The five companies that expressed a lack of interest in hiring students from the program gave three primary reasons. One was that the company does not have sufficient funds to expand at this time, which is mostly true of the smaller companies. The second reason was that the company does not hire graduates straight out of college, and prefers instead to hire people with more 'real world' experience. The last reason given was that the company needs engineers with a narrower range of focus, rather than the more general training of the BE SES program.

Of the 18 companies that answered the question regarding their interest in working with a group of students on a relevant project, 9 (50%) stated that they were interested, 1 stated that they had no interest, and the rest said that they did not know at this time. Many of the companies who said yes or did not know also stated that it would depend heavily on how relevant the project was to their interests. The one company that expressed no interest indicated that collaboration with students on a project would have limited value. A list of the interested companies can be seen in Table 4, and their contact information can be found in Appendix J.

Company	Location	Number of Employees
ABB Turbo Systems AG	Baden, Switzerland	145000
Anthills	Bern, Switzerland	1
Deritend Group Limited, The	United Kingdom	240
Holcim	Zurich, Switzerland	70000
ITZ Innovations Transfer Zentralschweiz	Horw, Switzerland	5
Noventum	United Kingdom	10
Phonak	Stafa, Switzerland	10000
Roland Berger Strategy Consultants	Zurich, Switzerland	70
Sulzer	Winterthur, Switzerland	17000

Table 4: Employers Interested in Performing Projects with Students in Program

4.3.1.4 Common Hiring Practices

Figure 15 shows the percentage of companies out of 23 respondents who selected the discipline as important to their company. From this, it is clear that the top three disciplines that the companies want to hire from are mechanical engineering, business, and electrical engineering.

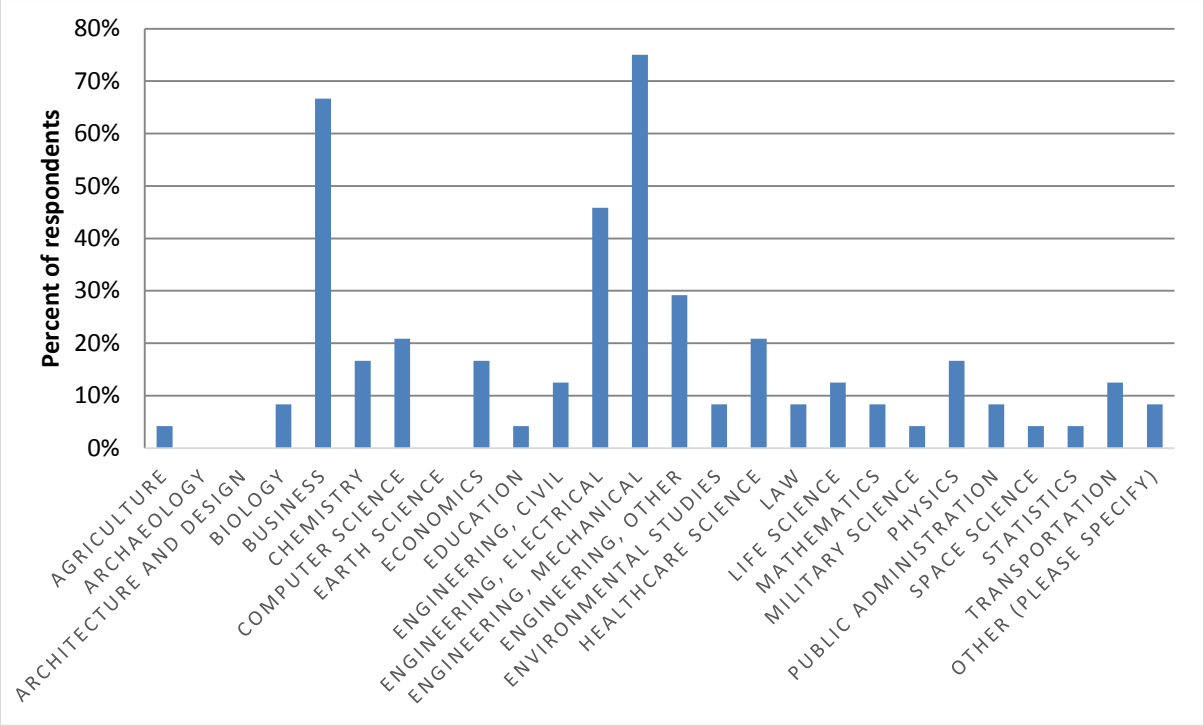

Figure 19: Commonly Hired Disciplines (n=23)

4.3.1.5 Relevant Topics in Sustainability

Figure 16 shows the percentage of companies that indicated what topics are important to their company. Evidently, 44% of companies would like incoming employees to know about energy efficiency, followed by carbon management, and then a tie for third place between wind, thermal, biomass, and storage.

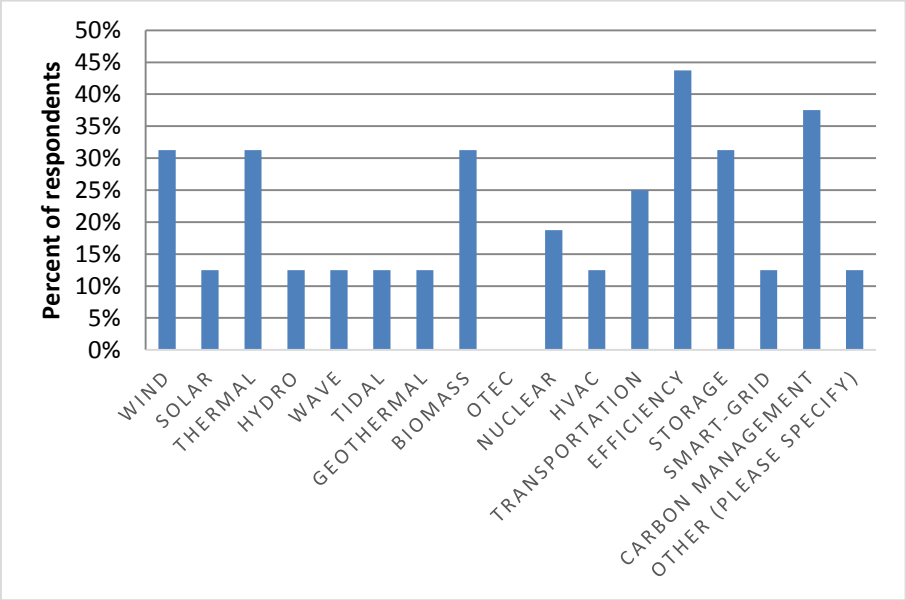

Figure 20: Popular Sustainability Topics (n=16)

4.3.1.6 Broad vs Narrow Knowledge

When asked if they prefer broad or narrow knowledge, 8 of the 18 companies that responded (44.4%) said they prefer broad knowledge, 6 (33.3%) said they would like somewhere in between, and 4 (22.2%) said they prefer narrow knowledge. There was no correlation between this preference and the size of the company or the commonly hired disciplines. Most of the companies looking to hire people for more engineering type practices were the ones looking for narrow knowledge.

4.3.1.7 Interview Insights

The interviews provided valuable insight into the opinions of different potential employers and what they would like to see from new employees. Some of the key computer programs that they said they like to see are the Microsoft Office products, and some of the engineering firms said they would like to see some sort of CAD program. In terms of coursework, some of the places that new employees are sometimes lacking include stress, dynamics, statics, economics, and statistics.

In addition, many engineering employees tend to be lacking in communication skills, both written and oral. Many employees also don't have as much practical project experience when they start the job as some employers would like, or a good enough understanding of market value, statistics, or economics.

The interviewees also provided insight into what non-academic skills they like to see in new employees. Accordingly, the best employees should have drive, a good attitude, and an inquisitive personality and they should be fast learners, self-sufficient, and quick thinking. In terms of how to stand out from other students applying to similar jobs, the interviewees tended towards suggesting the students highlight their lab experience and technical backgrounds.

The overall response from employers when asked if they believed these students could get hired was also positive, saying that the students would be best suited for jobs as production engineers, sales managers, project managers, group leaders, consultants, technical advisors, sustainability researchers, and workers in service innovation. As one interview stated, however, it is unlikely the students will be able to obtain a high level position to start out, and would have to work their way up to being a higher level project manager or the like. One interviewee also mentioned that in order to get a job, the students will have to keep an open mind about which sustainability topic they want to work with, as some topics don't have many job opportunities.

4.3.2 Conclusions and Recommendations

4.3.2.1 Companies are Interested in the Students

The most important conclusion that can be drawn from the findings is that the students are employable. As indicated from these results, the three main parts that determine if the company would potentially hire one of the students are that the company does not require employees to speak any language other than English, the company anticipates hiring new employees in the next few years, and that the company has expressed interest in the students from the BE SES program. In addition, around 70% of companies meet each of the three criteria, so it is relatively safe to assume that there are more companies willing to hire the students that had not been surveyed. Most of the companies that were not interested stated that their reasoning was that graduates fresh out of college do not have enough practical work experience.

We also found that the jobs the companies believed the students would be best suited for are jobs as production engineers, sales managers, project managers, group leaders, consultants, technical advisors, sustainability researchers, and workers in service innovation. Many companies also expressed interest in hiring interns as well.

In addition to being interested in hiring these students as new employees in the future, many companies also showed significant interest in working with the students on a project, so long as it sufficiently relates to their focus.

According to some of the employers that did not express interest in hiring graduates from the BE SES program, their primary reasoning was that students fresh out of college do not have enough practical work experience to be valuable enough for them to hire. In order to add value, we recommend that projects, apprenticeships, or work experience programs be pursued so that the students can gain the additional work experience they would need to get hired by these companies right after they graduate. As stated in the findings, many of the companies stated that they offer internships, which could be a good place to start.

From the findings we have determined that most employers only require their employees to speak English, and also that employers believe that knowing English is especially important in engineering because of its international nature. Thus, we also recommend that the program advertises to potential employers that the program is taught in English in order to garner more interest for the program from these employers.

4.3.2.2 The BE SES Program Offers Extra Value to Employers

When surveying and interviewing companies, there were a lot of places that employers found their employees to generally be lacking. However, the BE SES program addresses most of these, resulting in students that are more valuable to employers than those from other programs. For instance, a major place that engineers tend to be lacking is in communication skills, including both oral and written. The technical writing course offered within the BE SES program teaches the students how to communicate better than most engineers, giving them a leg up in the hiring process. In addition, many incoming employees lack an understanding of the importance of market value, but the business side of the BE SES program contains marketing classes, which ensures that these students will have that knowledge. Finally, many new employees fresh out of college do not have any practical lab or technical background. The BE SES program provides this as well, once again adding value to the employers that would potentially hire the students. There are also a couple other places that employers find their new employees to be lacking, and that is in understanding basic statistics and Excel, as well as knowing how to apply for a job effectively.

We recommend that statistics and Excel both be added to the curriculum. The addition of an English version of the currently offered statistics course or the addition of statistics to an existing math course would improve the value of the students to the employers.

We also recommend that some sort of course or seminar in how to get hired for a job should be offered to the students. According to employers, the way that many students get hired is by knowing how to be politely persistent, knowing how the hiring system tends to work in most companies, and being able to sell what they have done to the company they would like to work for. If the students were given basic training in how to get hired, it would improve their hiring rate after school. These skills could include how to make a CV stand out, how to sell themselves during an interview, as well as how to show companies that they are what the company needs. A possible implementation of this could be some sort of career development center or brochures explaining how to write a proper CV, complete with examples.

4.3.2.3 Sustainability Topics that Companies Want

The survey results received from the employers suggest that these topics are currently the most important, and as such the incoming employees should have some knowledge of them. These topics include efficiency, carbon management, wind, thermal, biomass, and storage.

From this, we would recommend that the BE SES program offer a course in sustainable storage in order to be teaching all of the companies' desired topics.

4.3.2.4 Which Types of Employers are Most Interested in BE SES

While it is useful to know that employers are interested in hiring students from the program, it is even more useful to know what types of employers show the most interest so that it is easier to predict other potentially interested employers. Using the survey data, we found, as expected, that companies that tend to hire both engineers and business people were far more interested in the program than those who either only hired one of the other. Size did not play a deciding role in which companies were interested in the program. In terms of the companies who offer services versus those who offer products versus those who offer both, the data is unaffected, meaning that the offering of products or services does not play a part in whether a company would be interested in hiring from the BE SES program. Location, however, does play a part in the interest of the employer. None of the companies located in China were interested, while 3 out of 5 from the United Kingdom were interested, and 10 out of 15 from Switzerland were interested. For the companies in Switzerland, distance from Lucerne did not make a difference, as there were far away companies that showed interest as well as close ones, and the same for the companies that showed disinterest. This suggests that the students should apply primarily to companies in Switzerland, but may have luck in the United Kingdom as well.

These data leads us to recommend that the program should continue international outreach to employers, primarily with English-speaking countries such as the United Kingdom. Possible other countries could be Australia, the United States, and any other English-speaking country with potential employers. In addition, the companies in Switzerland should continue to be viewed as potential employers, due to the large amount of interest from the Swiss companies.

4.4 Marketing and Communication Review

The following four sections discuss findings with regard to four main topic areas: (1) recruitment, (2) internal communication, (3) employer connections, and (4) alumni connections. We analyzed data drawn from the *Student Survey*, *Marketing and Communications Survey*, and *Employer Survey*.

4.4.1 Findings

Below are key findings with regards to the four sections of interest.

4.4.1.1 Recruitment

In this section we analyzed the data by first distinguishing Swiss student responses from international student responses. It was important for us to make this distinction because we could then determine what differences exist in terms of how students learn about this program. As shown in Figures 21 and 22, there was a significant skew in our survey results because the Swiss/International distribution for our survey respondents was much different than that of the actual distribution. In the survey, 11 of 30 students (37%) were international students, whereas in actuality 49% are international and 5% are dual citizens. It is important to keep this in mind when viewing the data; however the skew does not affect the overall data trends that are discussed in this section.

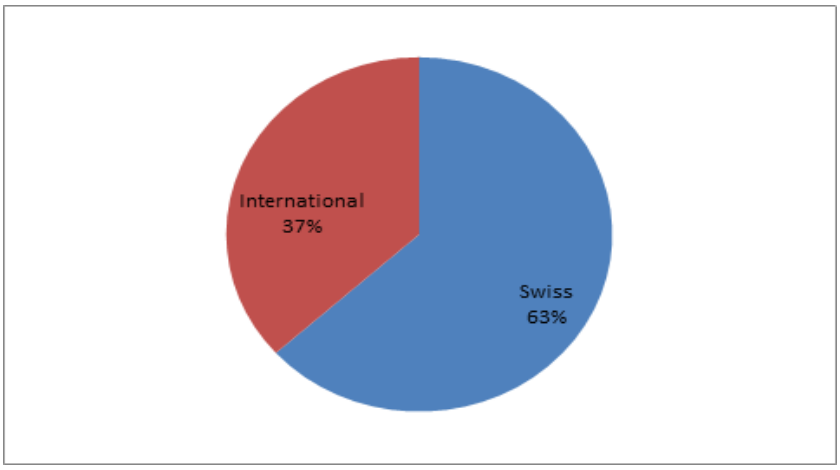

Figure 21: Distribution of Swiss and International Students (*BE SES Student Survey*)

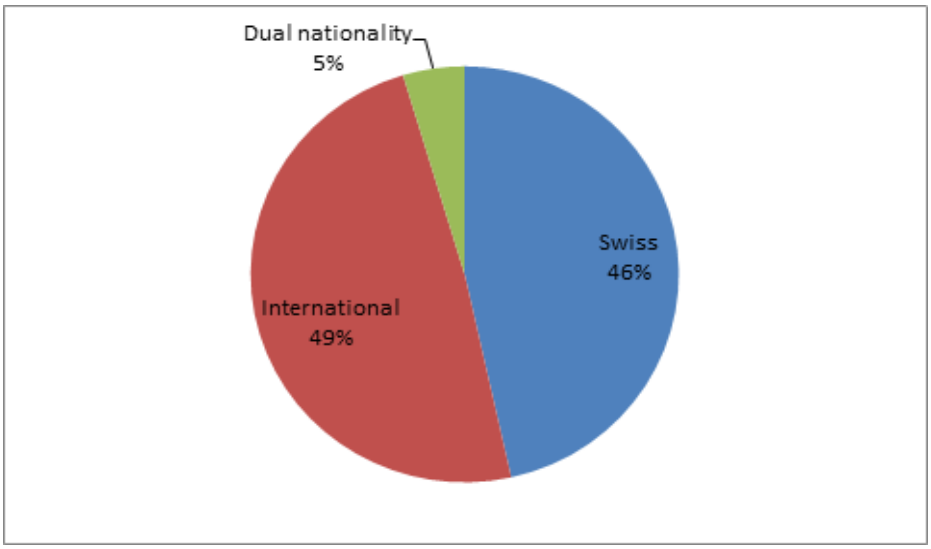

Figure 22: Actual Distribution of Swiss and International Students

This section provides four findings regarding the channels by which students in the BE SES program learned about HSLU and the program as well as their greatest influence in making their decision. For the purpose of our analysis, we distinguish between three types of information channels: web tools; 'face-to-face' interactions, and personal connections. Web tools include the HSLU website, Facebook™, Twitter™, YouTube™ and other social media. Web tools also refer to general searches for information on the web using search engines such as Google™. 'Face-to-Face' interactions refer to any interaction with the school, program, or representative that is conducted in person. This includes HSLU info evenings, campus visits, college fairs and exhibitions. Lastly, personal connection refers to a student's connection to the school or program though another person, usually through a friend, family member, college counselor or teacher.

The following results are based on the survey responses of 30 students in the BE SES program including 19 Swiss citizens, and 11 international students. This distinction is important because it shows differences in how Swiss students hear about the school and program in different ways than do international students, and this has implications for future marketing efforts.

Figure 23 shows how students learned about HSLU. Students were allowed to select multiple answers, and many selected choices in more than one category. For example, one student learned about HSLU through the school website and an information session. That student is therefore represented in both the 'HSLU Website' column and the 'Face-to-Face' column. As a result, each row represents the number of students who learned about the school in each category. The same can be said for almost every figure in this review.

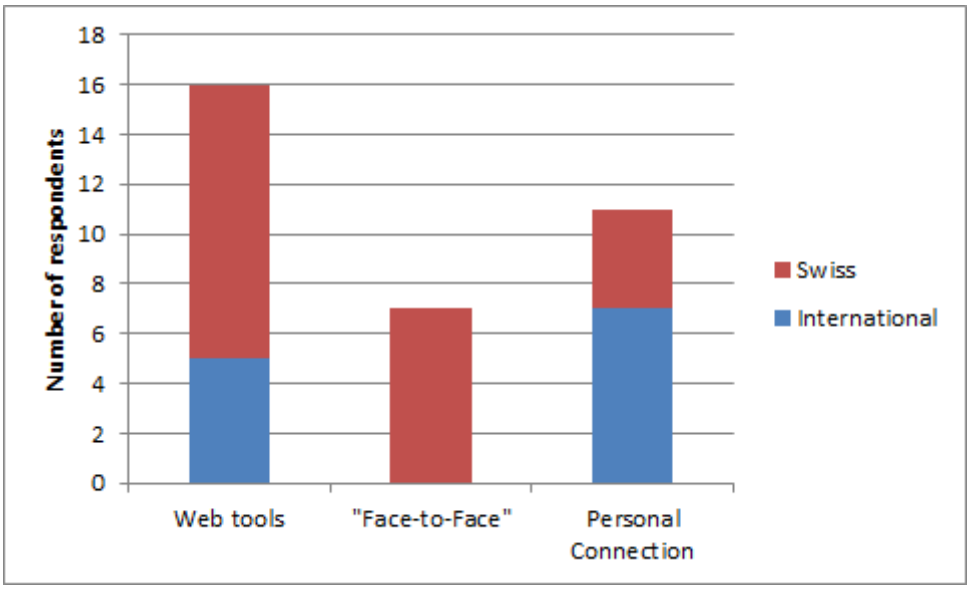

Figure 23: How BE SES Students Learned about HSLU (*BE SES Student Survey*)

Figure 23 shows that the HSLU website was the most frequently used channel to learn about HSLU and all 16 respondents indicated they accessed the HSLU website. Additionally, no student claimed to hear about the program through any form of social media. Five out of 16, (31.25%) of those respondents were international students. This is very close to the overall distribution of international students in the survey, which is 11 out of 30, or roughly 37%. This tells us that there is no difference between the frequency with which Swiss and international use the HSLU website.

Many students also claimed to hear about HSLU from personal connections. Most interestingly 7 out of the 12 students who heard about HSLU through a personal connection were international students. This indicates a clear distinction between Swiss and international students. Not surprisingly, only Swiss students heard about the school through 'face-to-face' contact. Figure 24 shows a similar distribution of data as Figure 23, only with regard to how student learned about the BE SES program specifically.

These data show a distinct difference between how students learn about HSLU and how they learn about the program. Figure 24 shows 15 students, or half of the respondents, learned about the program through 'face-to-face' interaction. Not surprisingly, 15 respondents were Swiss students and only one was an international student. More surprisingly, a majority of international respondents claimed they learned about the program through personal connections. There is clearly a difference between how Swiss and international students learn about the program and this has implications for future marketing efforts.

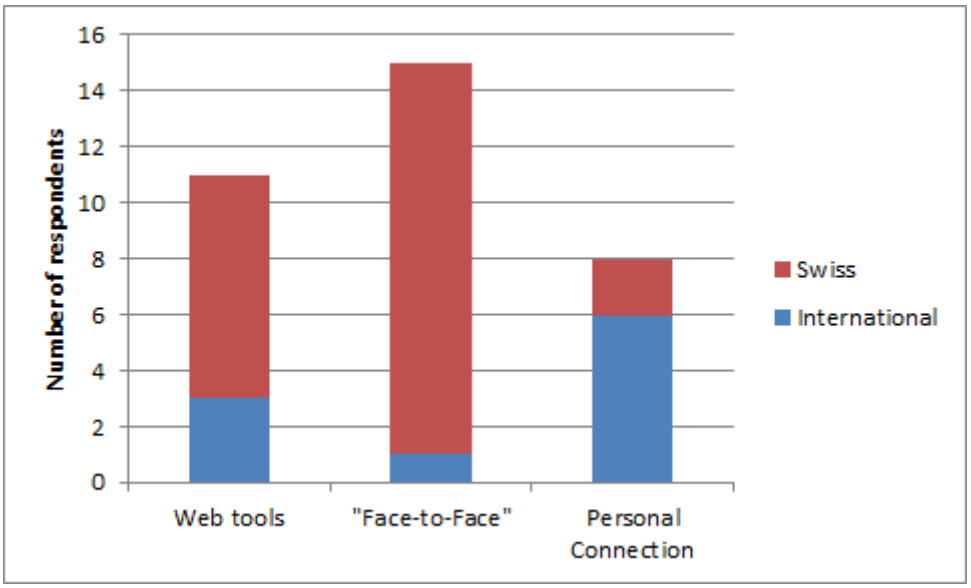

Figure 24: How students learned about BE SES (*BE SES Student Survey*)

Figure 25 shows what were the greatest influences that encouraged students to join the program, and it follows the same trend as Figure 24. 'Face-to-face' interactions were the greatest influence on Swiss students but the weakest influence on international students. Once again, many international students were most greatly influenced by personal connections.

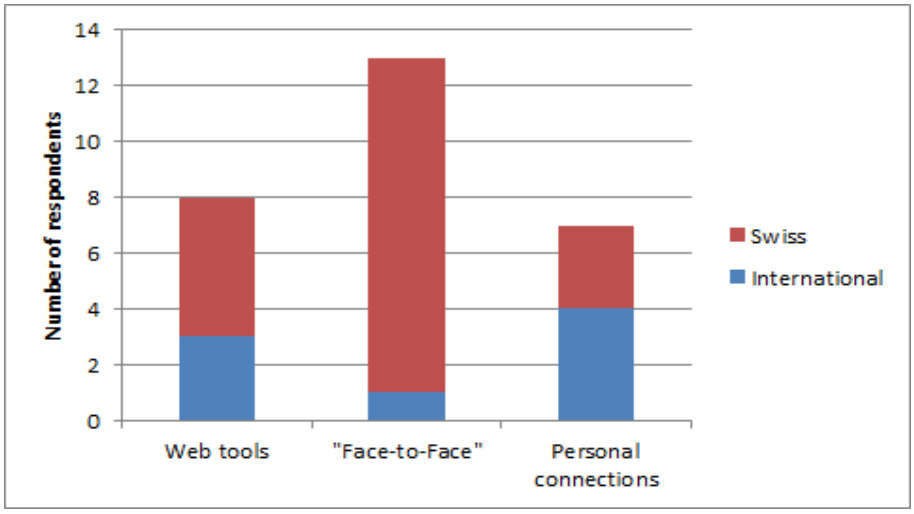

Figure 25: Greatest Influence for BE SES Students in Joining the Program (*BE SES Student Survey)*

The data represented in Figure 26 comes from the *Collegiate Marketing and Communications Survey* of 48 students in the United States. We asked to college students at various universities how they learned about their school and programs. Figure 26 shows the same general trend that was seen in Figures 24 and 25. 'Face-to-face' interaction was the most common way in which students learned about the school and program. Additionally, most students indicated that these interactions were the best tools for choosing a school or program. These data confirm the previous data from the internal HSLU *Student Survey.*

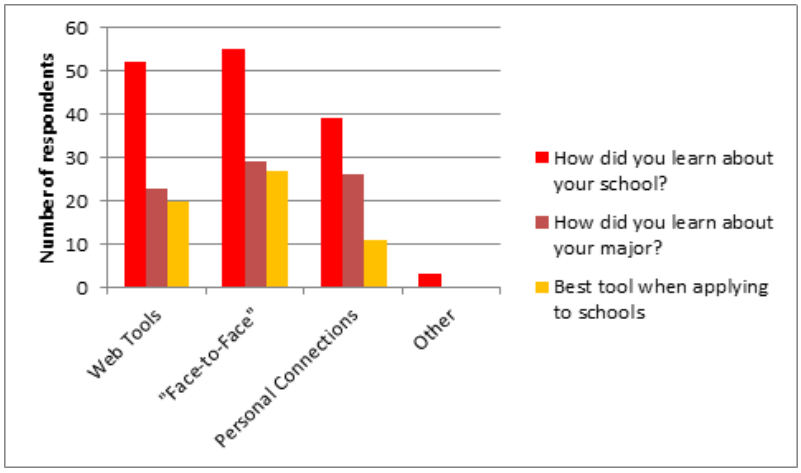

Figure 26: General recruitment data (*Marketing and Communication Survey*)

Figure 27 shows US student responses when asked what the best tools are for applying to schools. The most favored response was campus visit, followed by the school's website. Similar to the previous results mentioned, this shows a 'face-to-face' interaction (pink) as the most common tool that is used by prospective students. Secondly the most common web tool (green) is the school website, as it was for HSLU students in the internal *Student Survey*. Unlike the responses in the *Student Survey*, however, US students *Marketing Survey* had at least a few students who selected social media (Facebook, YouTube, Twitter) as the most useful tool when applying to schools. Furthermore, personal connections (blue) were somewhat of importance to US students, but less so than campus visits, school websites, and college search sites.

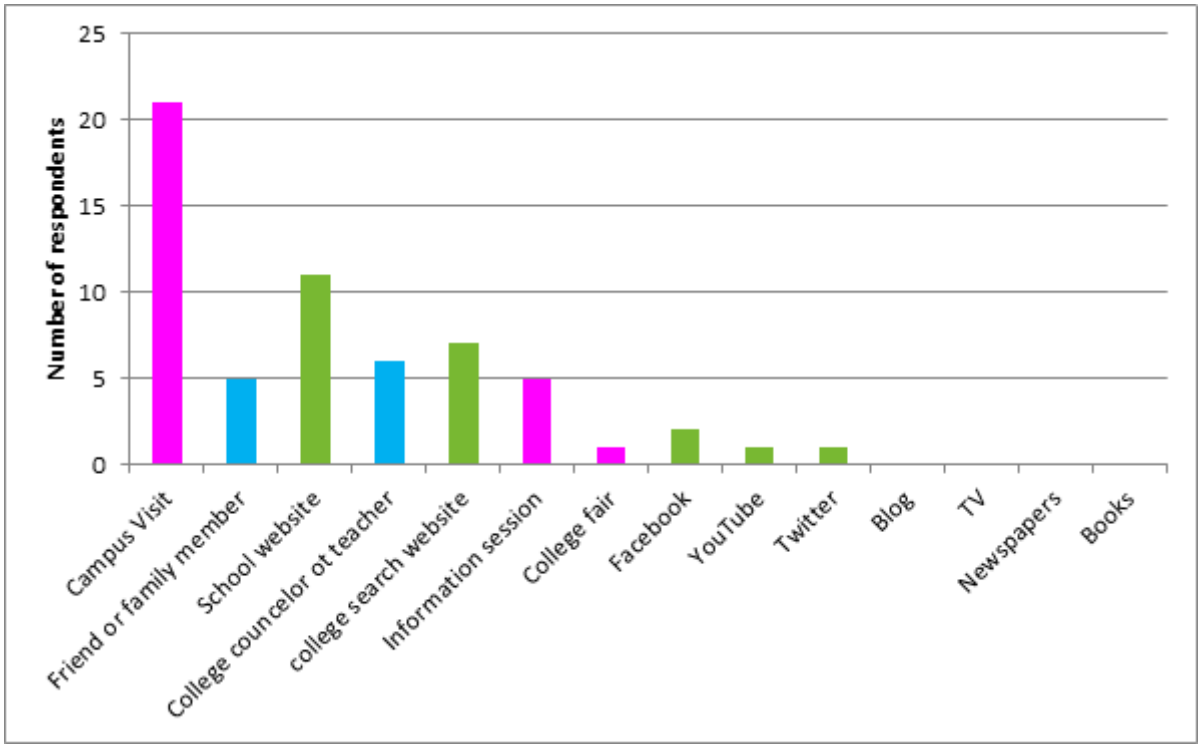

Figure 27: Best tool for applying to schools (*Marketing and Communication Survey*)

Figure 28 shows the channels BE SES students suggested the program should use to spread the word about BE SES. A majority (57.9%) of students suggested that the program should use Facebook to spread the word about the program. The second most selected tool was Linked-In at 21.1%. This shows that students do feel these social media can help the program expand its outreach. Significantly, two international students wrote in answers suggesting that the program attend university fairs around the world.

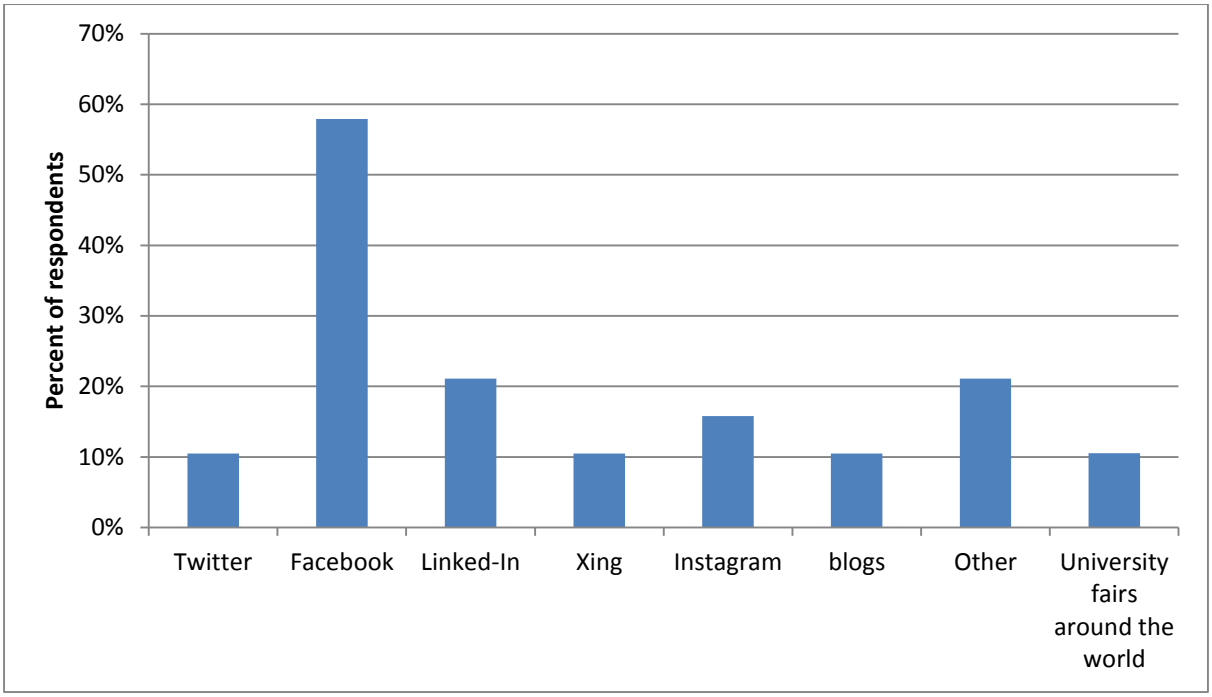

Figure 28: Student suggestions for recruitment channels (*BE SES Student Survey*)

4.4.1.2 Internal Communication

This section focuses on communication methods that are used within the BE SES program, specifically with student-professor communication. The purpose of this part of our study was to reveal what students thought of the current communication tools, ask what they suggest should be used, and compare that to common practice at other universities.

The BE SES program currently uses two channels for student-professor communication: Email and Ilias. Ilias is a learning management system (LMS) which is used for file sharing and online assignments. Ilias is comparable to Blackboard, which is utilized by many schools in the US.

The BE SES program was interested in knowing what kinds of tool it should utilize for internal communication, if any. This is an interesting topic for the program because currently if professors want their students to see an interesting article in sustainability it is sent via email. The program is concerned that getting this information via email will eventually be treated as spam, and therefore will not be viewed by students. Figure 29 shows the interest BE SES students had in receiving information regularly about sustainability in the news. A majority of students show interest, but there are a significant number who do not.

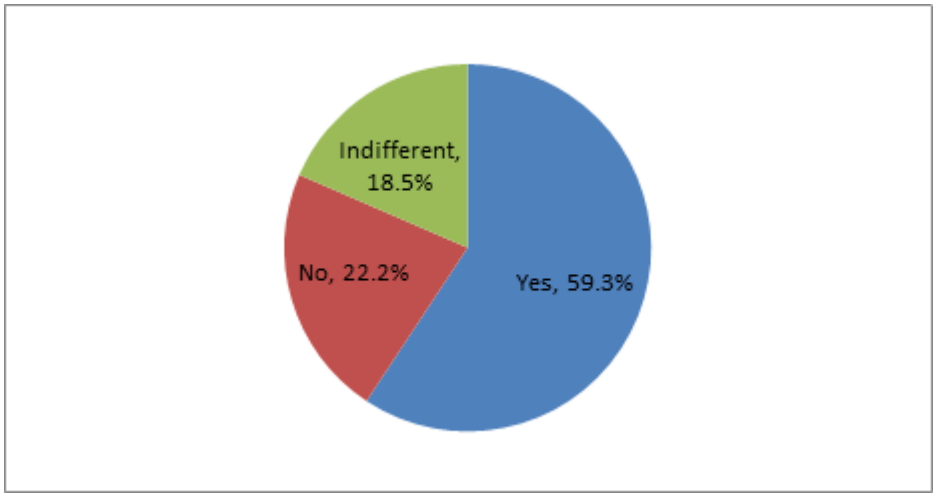

Figure 29: Student interest in receiving info regularly about sustainability (*BE SES Student Survey*)

As seen in Figure 30, of the students who expressed interest in receiving information regularly about sustainable energy in the news, most seemed content with receiving it via email. However, some students also suggested that the program use a blog or Facebook page as well. Twitter was suggested by one student.

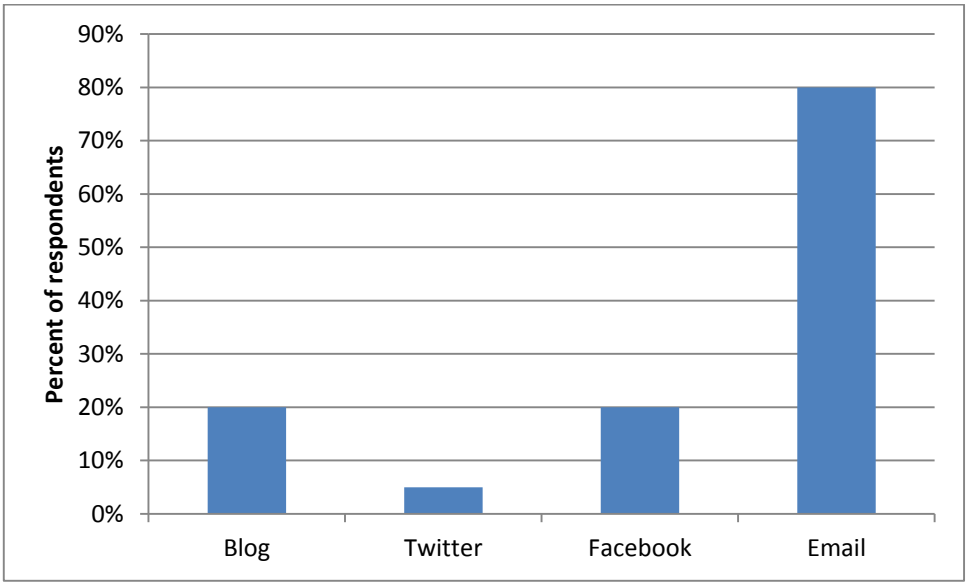

Figure 30: Students' Preferred Channels for Student/Professor Communication (*BE SES Student Survey*)

The data in Figure 31 comes from the *Marketing and Communications Survey* of US students. The results show that email and Blackboard are the most commonly used tools at US schools for student-professor communication. Since Blackboard and Ilias perform the same function, the results support the fact that what is currently available at HSLU is also common practice. Other tools such as Facebook, Twitter, and blogs are used by some, but remain relatively uncommon at present.

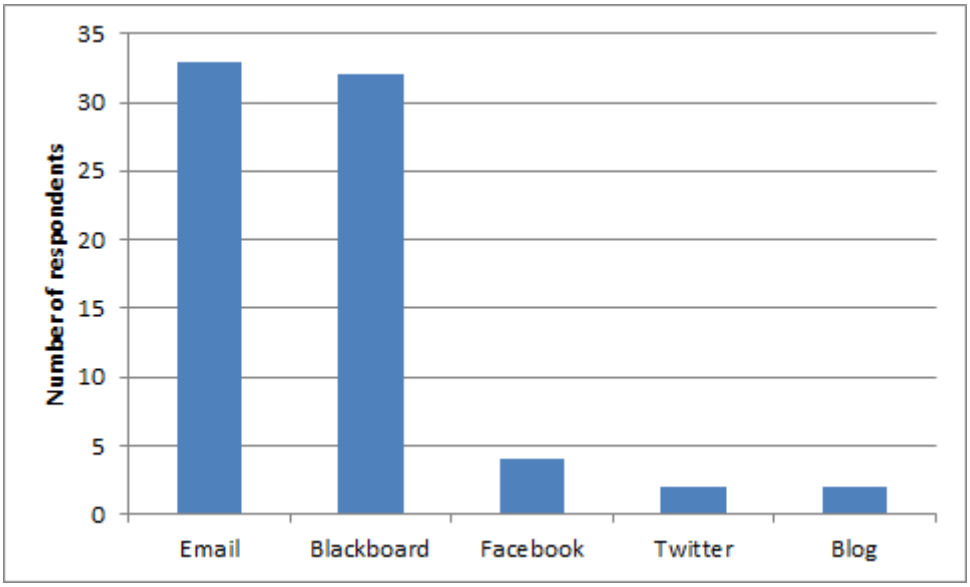

Figure 31: Student/Professor Interaction at US Colleges – (*Marketing and Communication Survey*)

4.4.1.3 Employer Connections

This section explores tools that are used to connect with employers. Data from this section were collected through the *Employer Survey* as well as the *Marketing and Communication Survey* to indicate what is common practice for employer connections among US universities. Much like the recruitment sections, results in this section were separated into three main sections: Web tools (green), 'face-to-face' recruitment (pink), and relationship based recruitment (blue).

'Web tools' includes Linked-In and other job-seeking websites. 'Face-to-face' recruitment includes career fairs, visits to universities, trade shows, and conferences. Lastly, relationship based recruitment includes personal contacts with universities and/or people within them, and special programs at schools.

Figure 32 shows how employers learn about programs they may be interested in. Of the 20 responses to this question, the most common of the three categories is 'face-to-face' recruitment, which tallied a total of 11 responses. Of these 11 employers who indicated that they learn about programs through 'face-to-face' interaction, 6 of those said that they attend career fairs.

Interestingly, the data in Figure 32 follows a similar trend to that of Figures 24 and 25, which pertained to recruitment channels. Both show a significant distinction between 'face-to-face' interactions and web tools, in which 'face-to-face' methods are more favorable.

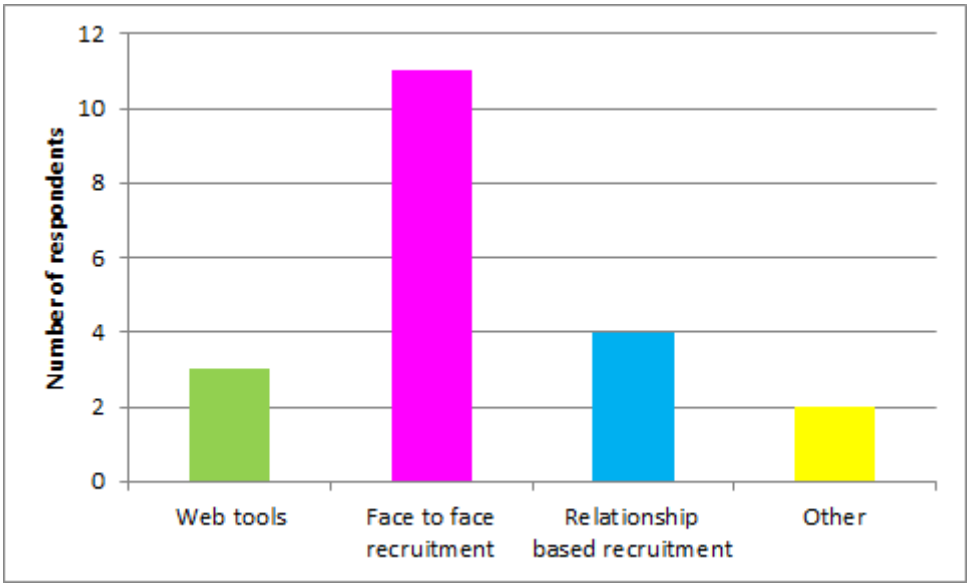

Figure 32: How employers learn about relevant programs (*Employer Survey*)

The data in Figure 33 comes from the *Marketing and Communication Survey*. In this survey, 48 students were allowed to select all of the channels that their school offers with regards to connecting students with employers. Figure 33 shows a detailed distribution of the data. It is clear that 'face-to-face' recruitment in the most practiced means of employer recruitment at universities from a student's perspective. The top four options are all 'face-to-face' methods. The most common is career fairs, which correlates with our findings in the *Employer Survey*.

Although 'face-to-face' methods are more prominent, students indicated that various web tools are also used. Linked-In, being the most professionally-driven social media tool was naturally the most prominent response. Additionally, students indicated that Facebook, Twitter, and YouTube are also used, but not as often. Other interesting responses by students included a co-op program, careerbuilder.com, and a STAR mentoring program.

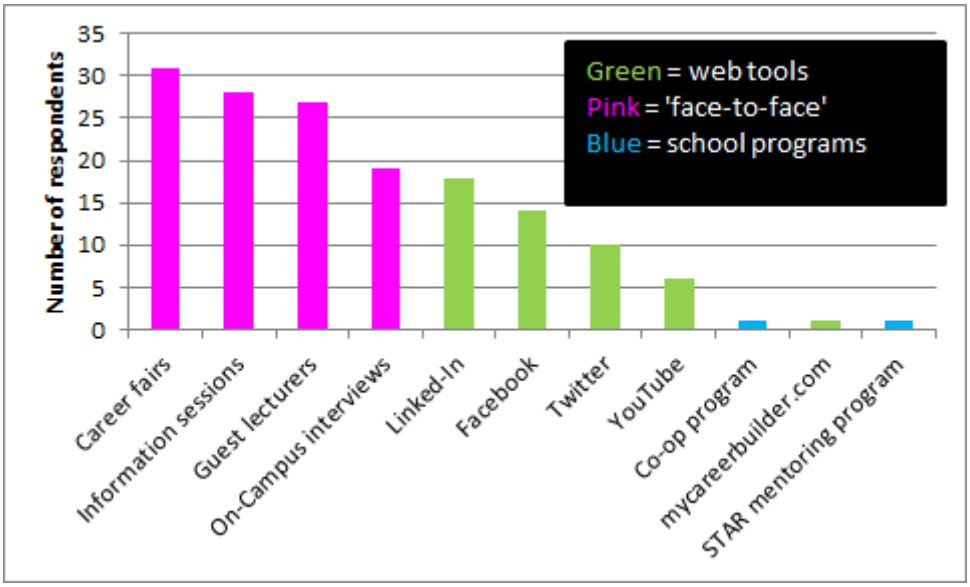

Figure 33: Employment connections at US schools (*Marketing and Communication Survey*)

4.4.1.4 Alumni Connections

The purpose of this section is to explore what common practices exist for connecting with alumni. The BE SES program currently does not have any alumni, so all of the data collected in this section came from the *Marketing and Communication Survey*. Congruent to the previous survey questions mentioned, this survey allowed students to select as many options as they wished.

Figure 34 shows undergraduates' knowledge of alumni relations channels. As is shown by the graph above, schools seem to connect with alumni in a wide variety of ways. The most common channels are email, alumni events, newsletters, and traditional mail. Interestingly, the top three channels are all of different categories. This indicates that schools try to connect with alumni in a variety of ways. Facebook is the most common form of social media with regards to alumni relations, though Twitter and Linked-In are also not uncommon.

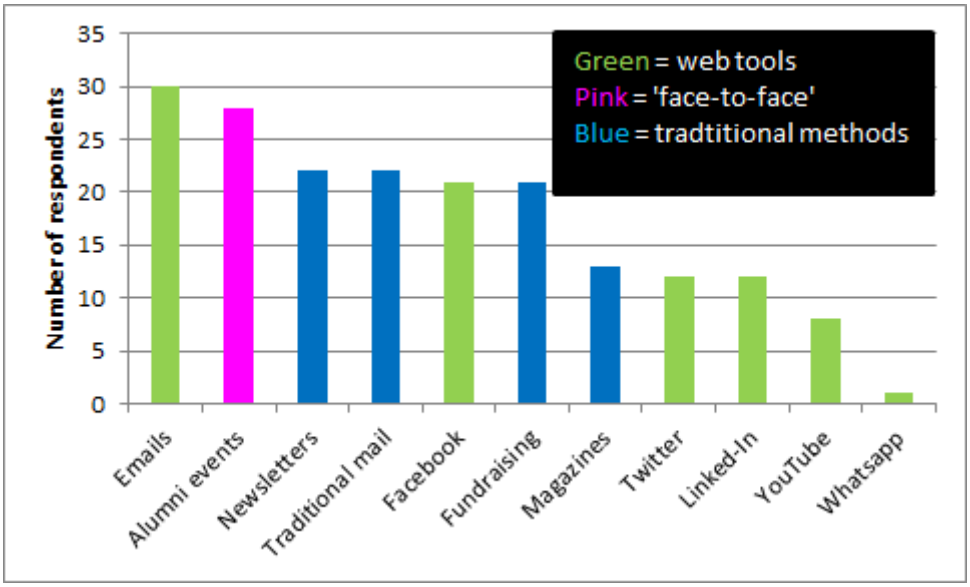

Figure 34: How schools connect with alumni Undergraduates (*Marketing and Communication Survey*)

A small sample of 4 alumni was asked what their school is currently doing to stay connected with them. Figure 35 shows the distribution of their responses. Despite a smaller sample size, the distribution follows that of Figure 34 very closely. Though the number of alumni asked is not significant, there is value in these results since alumni likely have a better knowledge of alumni relations than undergrads.

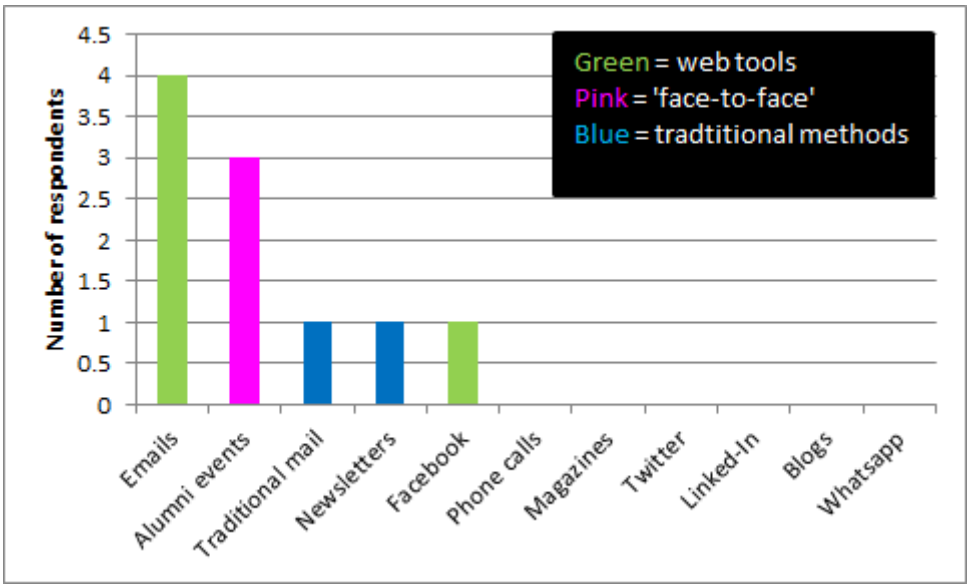

Figure 35: What Alumni Have Seen of School's Alumni Relations (*Marketing and Communication Survey*)

4.4.2 Conclusions and Recommendations

Below is a list of conclusions regarding marketing and communication strategies and how they relate to the BE SES program. Each conclusion is grouped and subsequently followed by a recommendation for the program to consider.

4.4.2.1 Face-to-Face Interactions

'Face-to-face' interactions are very important. When students were asked what their greatest influence was in joining the program, the most common responses were 'face-to-face' interactions such as info sessions, campus visits, and exhibitions (Figure 23). Students also found out about the program more through these interactions than through web tools or personal connections. Results from the *Marketing and Communication Survey* also show that students found visiting a campus was the most influential experience when choosing what school to attend (Figure 27).

The same principle can be applied to employers. Most employers do recruitment by being present on university campuses through career fairs and trade shows (Figure 32). Schools also rely on these methods to get their students in contact with employers, as shown in Figure 33.

4.4.2.2 International Interaction

Few international students had any 'face-to-face' interaction at all. Most international students learned about the school and program through family and friends who happened to live in Switzerland (Figures 23 and 24). One international student visited campus and attended an information evening. That same student revealed that doing this greatly influences his/her decision to join the program.

Based on conclusions 4.4.2.1 and 4.4.2.2, we recommend that BE SES faculty continue to put a lot of emphasis into active recruitment around the world whenever possible. We have been informed recently that faculty of the program have been in contact with several prospective students from around the world. This tells us that the program is currently doing what is necessary to recruit internationally, so this recommendation is merely to continue to build these strong connections with international students. Attend as many international university fairs as possible and stay in close contact with any students who show interest. Since this program prides itself on being an international program, it needs to rely less on international students having personal connections to Switzerland and more on its own recruitment efforts. Since 'face-to-face' interaction seems to be the most crucial factor in

a student's decision to join a program, and since international students are missing this interaction (Figure 25), it is essential that the BE SES program makes this a primary focus.

4.4.2.3 Internal Communication Tools

Email and Ilias are enough and mirror common practice. Based on survey results and interview feedback, most BE SES students seem fairly content with the current use of email as the primary means of student-professor communication (Figure 30). Additionally, the program seems to follow common practice in this regard considering most students in the US use email and Blackboard (which is similar to Ilias) to communicate with their professors (Figure 31). Some people are worried, however, that the use of email is not useful for posting interesting content for student's interest. They worry that many students treat it as spam, and it will therefore be lost in cyberspace.

4.4.2.4 Student-Employer Connections

Student connections with employers require networking and personal connections. Results from the *Employer Survey* and the *Marketing and Communications Survey* both indicate that students connect with employers best through 'face-to-face' interaction (Figure 32). The most common of which are career fairs. Employers also indicated that much of their recruitment has to do with pre-existing relationships with schools or programs. Schools also utilize 'face-to-face' connections such as career fairs, information sessions, guest lecturers, and on-campus interviews to connect with employers (Figure 33). It is therefore essential that programs network in industry as much as possible to provide these contacts to their students.

4.4.2.5 Alumni Connections

Schools stay connected with alumni in a wide variety of ways. Results from the *Marketing and Communication Survey* indicate that universities use a wide variety of channels to stay in contact with alumni. These include web tools such as email, Facebook, Linked-In, and Twitter; traditional tools such as newsletter, traditional mail, fundraising, and magazines; and alumni events (Figure 34).

4.4.2.6 Presence at HSLU

The program is not known by other students on this campus. One student indicated this in an interview. Because this interview was conducted near the due date of this report, we could not investigate it any further. However, we recommend looking into this further and find a way to correct it, since if this program wants to be a global presence, it must first be a presence on its own campus. (*Marketing and Communication Review*)

4.4.2.7 Social Media Need

It is more necessary for the BE SES program to utilize social media than other programs. Through online research, we found that it is quite rare for programs within schools to have their own social media sites. Usually they just use the entire school's sites when necessary. However, this program is in a completely unique situation. Programs usually don't need to rely on social media for recruitment because recruitment is not usually needed. Programs are usually able to pull students from the school's general student body who already have an interest in the field.

The BE SES program is very different. It is an internationally-based program that requires more active recruitment. It is taught in English in a country where the primary languages are German, French, and Italian, meaning pulling students out of the general student body is not likely. The program has the unique challenge of trying to reach out to prospective students around the world. Currently the program is doing a terrific job traveling the world and promoting the program at specific sites around Europe and Singapore. However, because this program can't physically be everywhere at once, it needs to spread the word in different ways.

The program can use these sites not as primary recruitment tools, but as complements to current efforts with 'face-to-face' recruitment. Tools such as Facebook and Linked-In can provide prospective students and employers with exposure to the program. People who would have never otherwise heard about it could then become part of the BE SES network. The literature we discuss in Section 2.5 describe the benefits of being connected via social media, especially since the use of these sites continues to grow. Strengthening the program's online network can open new doors for the program and allow it to reach people whom it may not have otherwise reached.

4.4.2.8 Linked-In

Based on conclusions 4.4.2.3-4.4.2.7, we recommend that the BE SES program create a Linked-In page and suggest students create their own accounts. Although our data does not indicate that Linked-In is essential, it is our belief that having a program Linked-In page, as well as students who are connected to the page, can only help build the program's network. The goal is to build strong connections with employers, and that starts with exposure. Linked-In can be the necessary means of exposing qualified graduates to employers. It can also be used for alumni relations. The benefits of a BE SES Linked-In page are:

- *BE SES faculty can help get students connected and strengthen their network with employers.* Students will have connections immediately by connecting with the BE SES staff. The more connections one acquires the stronger one's overall network. Each of the BE SES faculty members have hundreds of connections on Linked-In, many of which are with people in industry. Students can benefit greatly from this virtual proximity to potential employers.
- *Employers can see student skills, classes taken, and work experiences.* Linked-In can act as an active and fluid resume which employers can see at use as a recruitment tool.
- *Job search feature can help students find the jobs they want.* Students in this program have indicated through the survey and follow-up interviews that they have a wide range of interests. This program allows for a lot of freedom in regard to career path. Linked-In's job search feature allows students to search for a job that best suits them based on their personal interests. Since employers generally indicated in the *Employer Survey* that they would hire graduates from this program, the right job search tool is ideally all a BE SES graduate would need.
- *Employed alumni will provide connections for graduates looking for jobs.* Once this program has alumni out in industry, they can then use Linked-In to help current students strengthen their networks and find jobs.
- *Distribution of what kinds of jobs alumni are working.* It is unclear exactly what kinds of jobs graduates will be working in. However, once graduates who are connected to the program's Linked-In page get employed, they will be added to the BE SES database. Linked-In provides data on school pages that include distribution of alumni jobs. This is why it is important for the program to establish its own Linked-In page. The page can make current students aware of possible career options, provide success stories, and get them more connected as well.
- *A BE SES page can get the program more connected to employers, alumni, and current students.* This network already exists, and Linked-In can only help make it grow.

4.4.2.9 Facebook Page

We also recommend that the BE SES faculty create a Facebook page for the program. It is very common for universities to have their own Facebook pages, but rare for individual programs to have one. However, this program has a stronger need to have one than others. Not only is it a new program that is still establishing itself globally, it is also a program designed with an international focus. Facebook will not bring a student into the BE

SES program, but it may give a prospective student exposure and allow him/her to investigate further. The benefits of having a Facebook page are:

- *It can spread the word about the program quickly.* This will only happen if current BE SES students are involved. Current students must "Like" the BE SES page, and then further "like" items that are posted on that page and show up in their newsfeed. From there, friends of the students will then be able to see the content on the BE SES page. If they are looking forward to attending a school of higher education, the post may catch their attention and provoke them to do more research. Again, Facebook can help with exposure, but don't expect it to get students into the program immediately. Getting students connected on Facebook doesn't seem too difficult, considering a little under 60% of respondents in the *Student Survey* suggested using Facebook as a way to spread the word about the program (Figure 28).
- *Alumni can stay passively connected and informed without being spammed with emails*. The *Marketing and Communication Survey* indicates that email is currently the most common tool used to stay connected with alumni. One risk with email is that they may treat messages from their school as spam and never read them. However, Facebook is a more passive way of receiving information. It allows people to read if they feel like it. So long as what the BE SES program posts is interesting, and so long as alumni remain on Facebook, they may be alerted.
- *It is easy to maintain and keep updated.* Even if Facebook does not work immediately as a marketing tool, it is worth a try since it is so easy to maintain and update. All it takes is some interesting pictures of students working on projects, links to compelling and relevant articles on the web, and other important updates. A post every few days is enough to keep it current. Additionally, Facebook was the number one tool students suggested for helping to spread the word about the program. This means students are connected to Facebook, so it's worth the effort to try.
- *It may be an appropriate medium for professor-student communication.* Although students are generally content with the current use of email as a means of communication with their professors, some did suggest to use a tool in which content is permanently there and easy to retrieve. Email runs the risk of losing content either through deletion or by simply getting lost in cyberspace. Facebook, however, has a relatively new timeline feature that allows one to backtrack my month or year, and the content is never lost. This may be a better means of posting interesting content so

students can read it if they are interested, leave it alone if they are not, or go back to it if they change their mind or their professor asks them to.

- *It will make the program more well-known at HSLU*. One student in an interview mentioned that since this program is so new, it is not very well known by students in other programs at HSLU. Having a program Facebook page may help because this page and the HSLU Facebook page can "Like" each other, and therefore create a stronger connection on the web between the program and the university as a whole.

6. Overarching Conclusions

Overall, we conclude that the BE SES program is doing quite well. The program structure is effective and compares well to similar program at other universities around the world. Additionally, it stands out in Switzerland as its only engineering program that is taught entirely in English. Students are generally pleased with their studies and how the curriculum is laid out, though some did offer some suggestions to enhance the program. Our findings through surveys and interviews indicate that employers are in fact interested in students from this program. Finally, we conclude that marketing tools such as Linked-In and Facebook may be beneficial to the program, but overall the program is currently working towards active 'face-to-face' recruitment and employer interaction. No major changes are absolutely necessary; however we believe that this program has the potential to grow into a stronger global presence in sustainability curricula.

In this report we offer many recommendations for the program. We believe all can enhance the program, however we set some recommendations above the others. In terms of the structure of the program, we recommend that the program offers sustainability topics all three years. Since sustainability is the focus of the program, a student should not have to wait until their second year to get exposed to the topic, and their third year to dive deeper into the subject. We also recommend that the program adds modules on other forms of electricity generation and energy technologies, as well as statistics and Excel to the program. This became apparent in our comparison to similar programs in the External Review and our interactions with employers.

Finally, we recommend that the program continues its effort to establish strong connections with prospective students through exhibitions in as many countries as possible, as well as with employers by inviting them to on-campus events. In addition to this, however, we recommend that the program creates Linked-In and Facebook pages in order to strengthen the program's overall network. On a global scale, it is clear that this program is not yet well known in many countries. When used effectively, these two social media sites can be useful tools to expose the world to the program. Sustainability is a global issue. That is why through these channels prospective students, current students, employers, or alumni of this program may like to learn about how the Business Engineering Sustainable Energy System program at Hochschule Luzern is preparing its students to become leaders in a more sustainable world.

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8. Appendices

Appendix A: The Swiss Educational System

The Swiss school system, in a very broad sense, is designed similarly to that of the American school system. The progression for most Swiss students is preschool, primary school, lower secondary school, upper secondary school, and finally tertiary school. In the US, this progression is essentially parallel with the Swiss order but it uses different names (preschool, elementary school, middle school, high school, and college).

Lower and Upper Secondary Levels

The most prominent difference between the American and Swiss school systems is the Swiss system's emphasis on specialized education. At the lower secondary level, students are separated into one of two groups based on interests and learning styles. They either follow a path that is en route to eventually attending a University for more theoretical learning, or they pursue a vocational education. In Switzerland, the grouping occur at a very young age at the lower-secondary level of their education. (The Swiss Education System).

Once grouped, students then move onto the upper secondary level which ultimately prepares them for the tertiary level of either attending a university or the highest level vocational school. Within the upper secondary level, there are a variety of schools to choose from. These include Baccalaureate Schools and Upper Secondary Specialized Schools, which are meant for students who intend to attend universities, as well as schools of Vocational Education and Training (VET) where students attend vocational classes but also work as apprentices for companies in a specific field. The breakdown of the school system from preschool to upper secondary education is shown below.

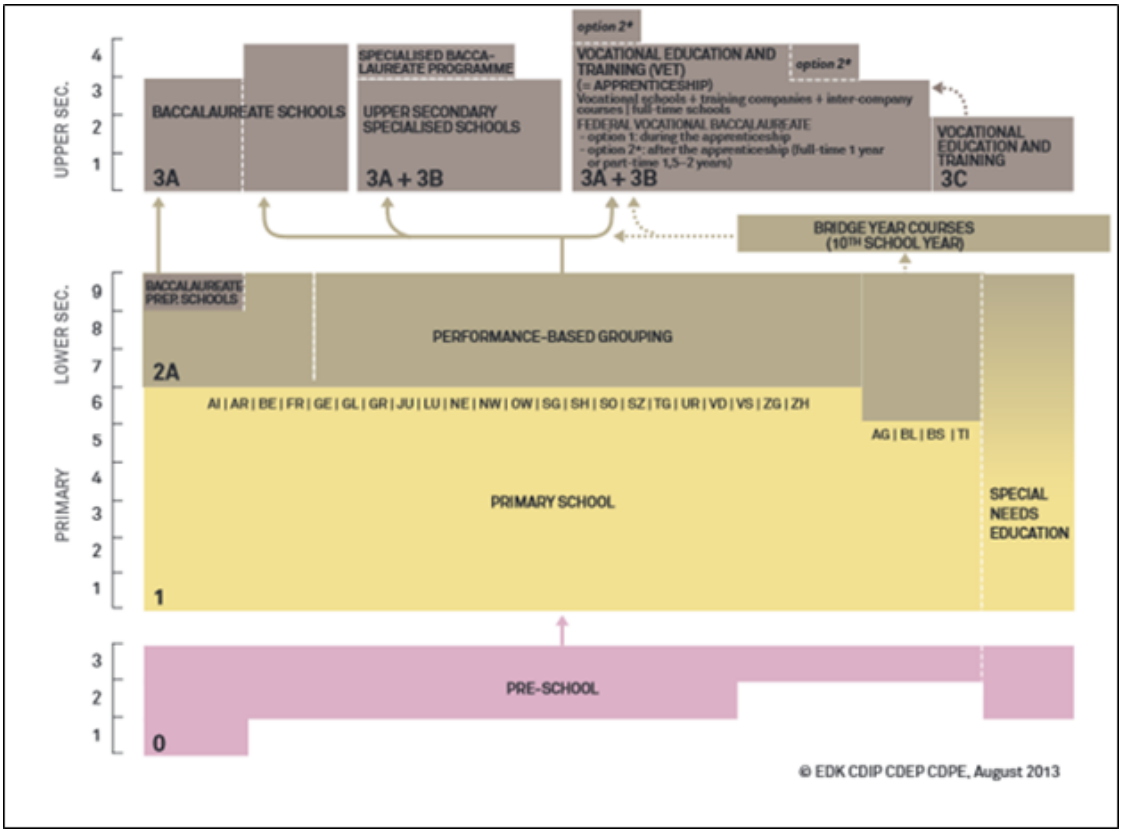


Figure: Swiss Education – Preschool to Upper Secondary School

(The Swiss Education System)

Tertiary Level

The Swiss tertiary level of education consists of two main sub-levels: Levels A and B. Level A is the university level as level B is the vocational level. According to a statistical report released by the Swiss Federal Department of Home Affairs (FDHA), roughly 21% of students attended level B schools in the 2011-2012 school year as the other 79% attended level A (Education Statistics 2012) . The division can be seen in Figure 5.

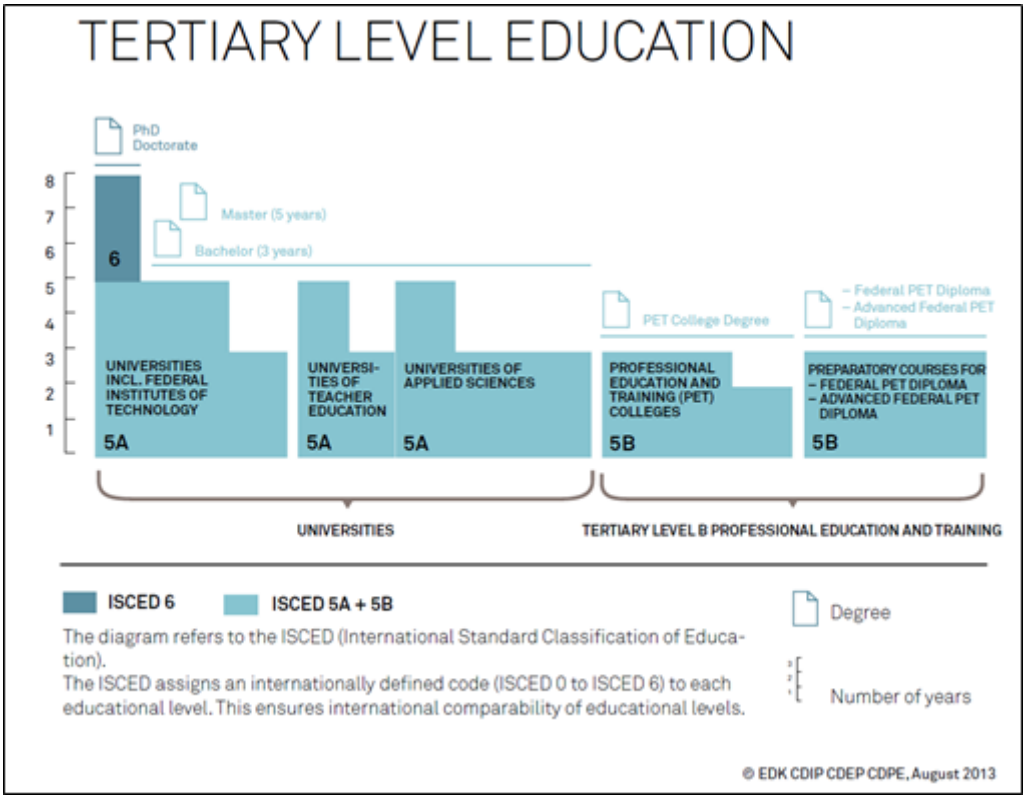


Figure: Swiss Education - Tertiary Level

These statistics, however, would not match those of the equivalent secondary schools. This is because the transition from the upper secondary level to the tertiary level allows for flexibility. If one attends a VET, he does not necessarily have to attend a level B school. He is allowed the option of attending a university due to the creation of the Universities of Applied Sciences (UAS) in the 1990s. This group of schools were made to act as a merge between level A and B schools where a student can experience the practice-oriented education of vocational school while also earning professional qualifications including Bachelors and Masters degrees. The UAS “offer practical university-level education and training and are in great demand with both students and employers”. ("Switzerland's Universities of Applied Sciences.") There are nine total UAS in Switzerland; two private and seven public. Below is a figure of these nine schools among others in relation to each other within Switzerland.

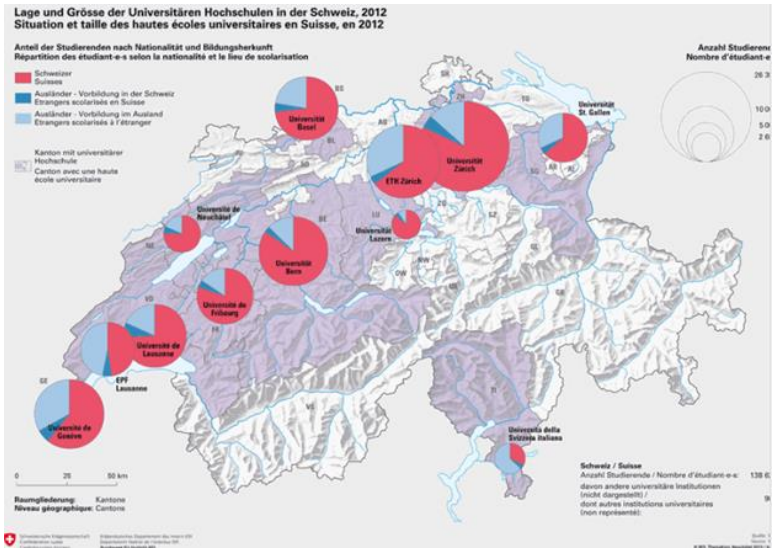


Figure: Map of Hochschulen

(Swiss Confederation)

The University that we are most interested in, Hochschule Luzern, is a public University of Applied Sciences. Other UAS include Berner Fachhochschule (BFH), Fachhochschule Nordwestschweiz (FHNW), Zürcher Fachhochschule (ZFH), and Fachhochschule Ostschweiz (FHO) ("Switzerland's Universities of Applied Sciences.").

Programs at Hochschule Luzern

All of the UAS offer more applied vocational training than the academic universities, and Hochschule Luzern is no exception. Hochschule Luzern offers both Bachelors and Masters programs in a wide variety of fields and disciplines. The bachelor's programs last between three and five years, and this depends on whether the student chooses to commit to the program full-time or part-time. Prerequisites for entry into this program are a vocational baccalaureate, Matura, or another similar upper secondary education degree. Hochschule Luzern offers bachelor's programs in architecture, structural engineering, business, administration, business engineering in sustainable energy systems, computer science, music, art, and many other disciplines. Students may apply for entry into Hochschule Luzern's Master's program on completion of the undergraduate program,. The Master's programs are categorized more generally into topics such as engineering, fine arts, design, banking and finance, and business administration among others. These programs are designed to combine practical methods with professional research. (Das Master Studium)

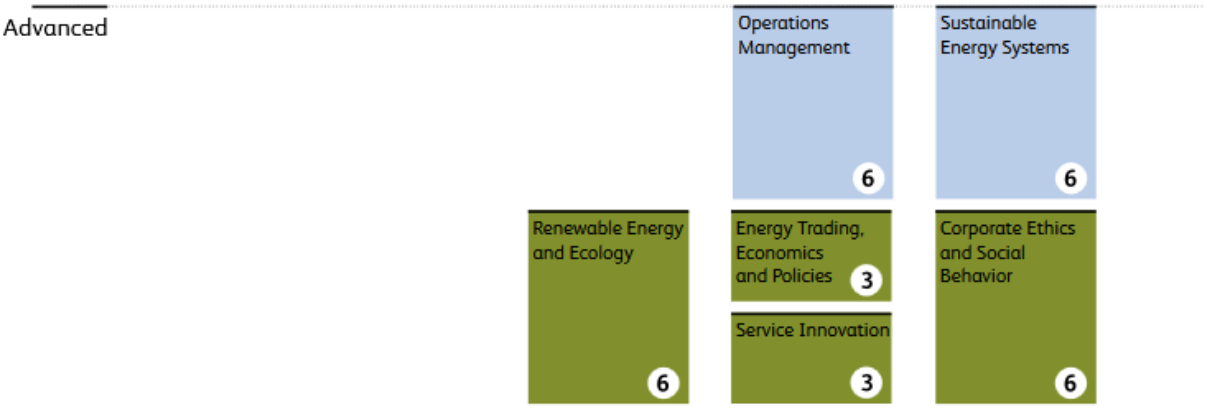
Appendix B: Modules Business Engineering Sustainable Energy Systems

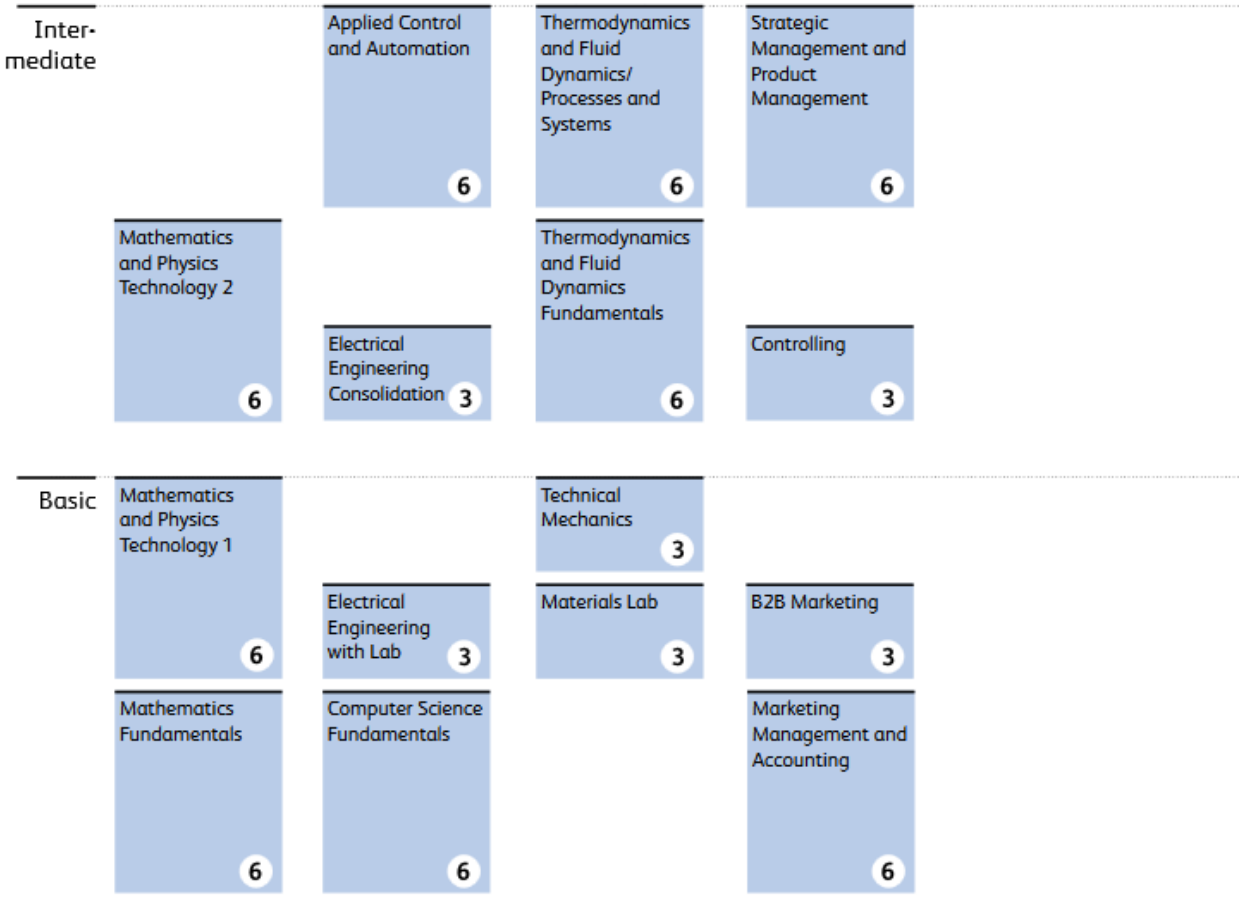
12/24

Modules Business Engineering Sustainable Energy Systems

Core modules

96 ECTS credits are to be earned





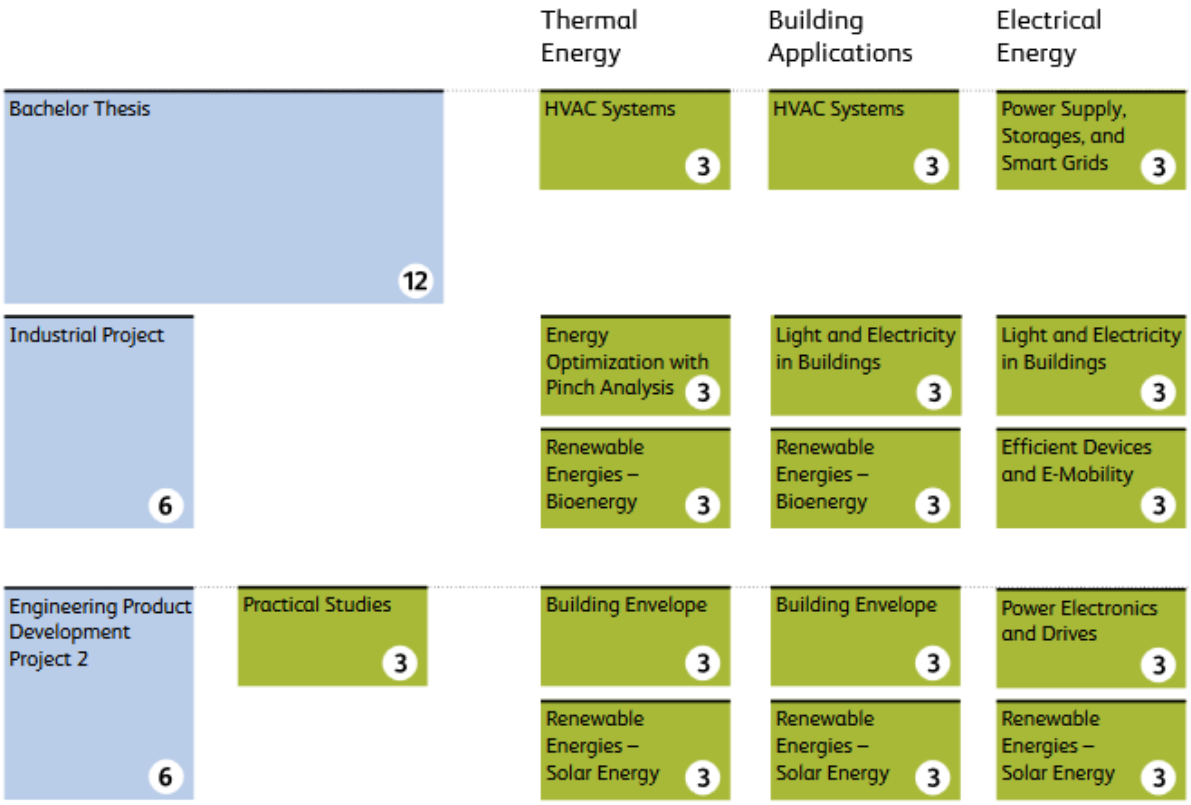
Compulsory modules
12 ECTS credits are compulsory, 6 ECTS credits are elective.

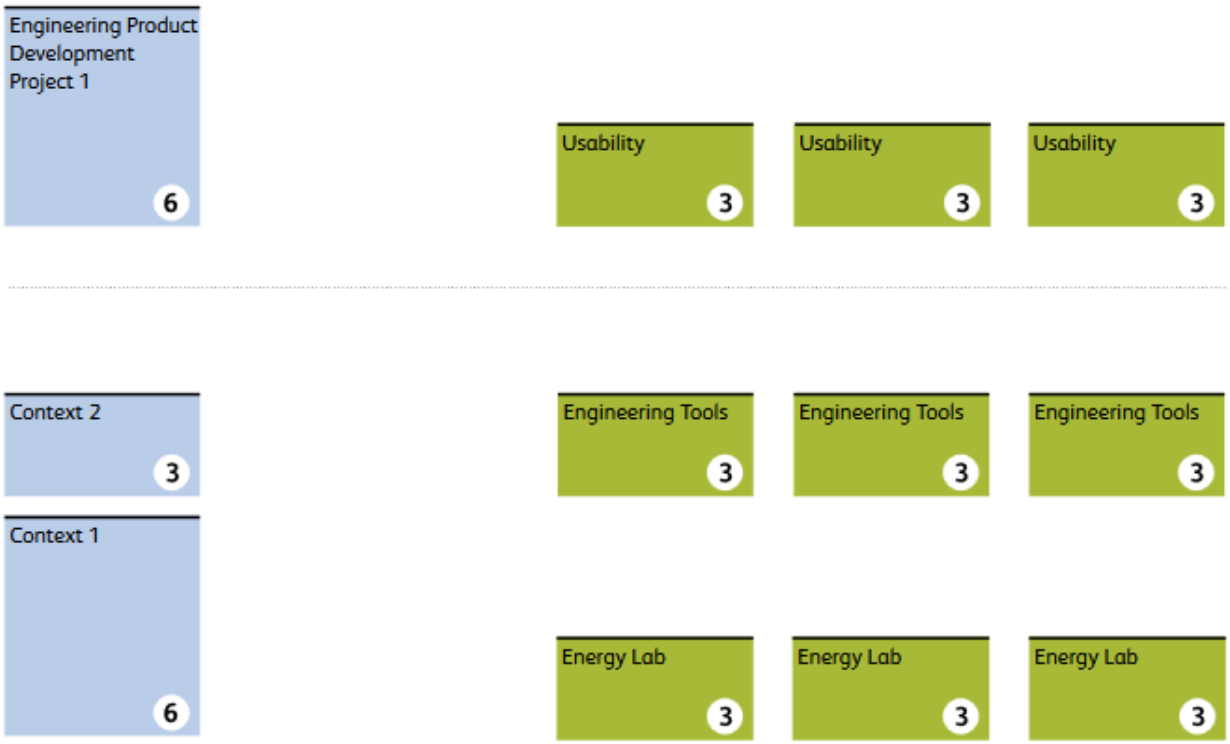
Lucerne School of Engineering and Architecture, Business Engineering 2014/2015

13/24

Project modules
39 ECTS credits are to be earned

Related modules
At least 15 ECTS credits are to be earned





Compulsory modules
Elective modules

Minor modules
A selection is shown on pages 18 and 19.

18/24

Minor modules

At least 15 ECTS credits are to be earned

Example of a selection of minor modules

Appendix C: List of Schools Reviewed

- Lucerne University of Applied Sciences and Arts
- Aachen University
- Aalborg University
- Arizona State University
- Australian National University
- Beuth Hochschule fur Technik Berlin
- Catawba University
- Center of Alternative Technology
- Clarkson University
- Columbia University
- Coventry University
- Cincinnati State University
- Cranfield University
- De Montfort University
- Drew University
- Furman University
- Heriot-Watt University
- Illinois State University
- Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM)
- Loughborough University
- Murdoch University
- Newcastle University
- Oldenburg University
- Oregon Institute of Technology
- Philadelphia University
- Plymouth University
- Reading University
- Robert Gordon University
- Royal Institute of Technology
- Stanford University
- State University of New York
- Technical University of Denmark
- Unity College
- University of Abertay
- University of Freiburg
- University of Tehran
- University of Kassel
- University of Leeds
- University of Nottingham
- University of Stirling
- Wilson College

Appendix D: HSLU Business Engineering Sustainable Energy Systems- Educational Survey

HSLU Business Engineering Sustainable Energy Systems - Educational

This survey was created to benchmark the BE SES program offered at Hochschule Luzern against other programs.

Please take a few minutes to answer these questions concerning your program. Feel free to leave any questions blank, but more detailed responses would be greatly appreciated. Please contact me at nkgoodale@wpi.edu if you have any questions or concerns.

You can view the program offered at HSLU at:
http://www.hslu.ch/technik-architektur/t-ausbildung/t-ausbildung_bachelor/t-bachelor_in_business_engineering_sustainable_energy_systems.htm

1. What year did the program start?

Year

2. How many students are currently enrolled in the program?

Approximately

3. What are the entry requirements for the program?

4. How many semesters does the program require to complete the program?

# of Semesters

5. What are the program themes?

- [ ] Technical
- [ ] Policy/Management
- [ ] Multidisciplinary
- [ ] Sustainability
- [ ] Project management
- [ ] Environmental considerations of projects
- [ ] Other (please specify)

HSLU Business Engineering Sustainable Energy Systems - Educational

6. Is there an international focus within the program?

- ◯ Yes
- ◯ No

If so, what international focus is there?

7. What basic courses do students take?

- ☐ Business ethics
- ☐ Environmental ethics
- ☐ Electrical engineering
- ☐ General ethics
- ☐ Mechanical engineering
- ☐ Material engineering
- ☐ Renewable engineering

Comments

HSLU Business Engineering Sustainable Energy Systems - Educational

8. What energy sources are discussed/covered in the program? Check all that apply.

- [ ] Biomass
- [ ] Geothermal
- [ ] Nuclear
- [ ] Ocean Thermal Energy Conversion
- [ ] Solar (PV)
- [ ] Solar (thermal)
- [ ] Thermal (fossil fuel)
- [ ] Tidal
- [ ] Wave
- [ ] Wind
- [ ] Other (please specify)

9. What energy topics are covered/discussed in the program?

- [ ] Architecture
- [ ] Building design
- [ ] Carbon management
- [ ] Climate change
- [ ] Efficiency
- [ ] Electricity grid/distribution
- [ ] Energy storage
- [ ] HVAC
- [ ] Smart-grid
- [ ] Transportation

Other (please specify)

10. What are the program specific modules that are required?

HSLU Business Engineering Sustainable Energy Systems - Educational

11. Are there any specialization modules that the students can take?

- ◯ No
- ◯ Yes (please specify)

12. Are there any courses that the program is on the leading edge/state of the art/renound?

- ◯ No
- ◯ Yes (please specify)

13. Are there any computer skills that students learn in the program?

- ☐ AutoCAD
- ☐ C/C#/C++
- ☐ GIS software
- ☐ Mat-Lab
- ☐ Microsoft Office
- ☐ Python
- ☐ Solidworks
- ☐ SPICE
- ☐ Other (please specify)

HSLU Business Engineering Sustainable Energy Systems - Educational

14. Does the program target any markets in particular?

- [ ] Manage energy related projects
- [ ] Advise companies on energy policy
- [ ] Counsel corporations/engineering offices on energy supply and use
- [ ] Participate in trading grey and renewable energy
- [ ] Building sustainable buildings
- [ ] Sustainable energy technologies
- [ ] Sustainable transportation systems
- [ ] Sustainable ecosystems
- [ ] Other (please specify)

15. What are the expected learning outcomes of the program?

16. Do you have any partner institutions?

- ◯ No
- ◯ Yes (please specify)

HSLU Business Engineering Sustainable Energy Systems - Educational

17. Overall, how do you professors communicate with their students?
ie: if class is canceled, class announcements

- [ ] Students person email
- [ ] Students school email
- [ ] Text message
- [ ] Facebook page
- [ ] Twitter page
- [ ] School provided website
- [ ] Personal website
- [ ] Note on class room door/blackboard/whiteboard
- [ ] Other (please specify)

18. How do you/the school keep in contact with alumni?

- [ ] Email
- [ ] Facebook
- [ ] Twitter
- [ ] Publications
- [ ] Other (please specify)

19. Is there any other information you feel is pertinent to an evaluation of schools in the area of sustainability and energy?

Appendix E: Student Survey

HSLU Business Engineering Sustainable Energy Systems - Student Survey

About you

This survey was created to evaluate the current state of the BE:SES program and offer possible suggestions to enhance the program.

Please take a few minutes to answer these questions. They are split up into 5 sections:
i. About you
ii. Applying for the program
iii. Program material
iv. Communication methods
v. Additional comments

All answers will be treated anonymously. If you have any questions please email rmmoran@wpi.edu.

Many thanks,

Students of Worcester Polytechnic Institute

1. Which semester of the program are you currently enrolled?

If other, please explain:

2. Which of these topics are you most interested in? Please choose 3.

- ☐ Architecture
- ☐ Biomass
- ☐ Building design
- ☐ Carbon management
- ☐ Efficiency
- ☐ Electricity grid/distribution
- ☐ Energy storage
- ☐ Ethics
- ☐ Finance
- ☐ Geothermal
- ☐ Heating, ventilation, and air conditioning
- ☐ Hydro
- ☐ Marketing
- ☐ Nuclear
- ☐ Ocean thermal energy conversion (OTEC)
- ☐ Project management
- ☐ Smart-grid
- ☐ Solar
- ☐ Thermal
- ☐ Tidal
- ☐ Transportation
- ☐ Wave
- ☐ Wind

If other, please specify:

HSLU Business Engineering Sustainable Energy Systems - Student Survey

3. What type of job do you see yourself working after completing this program?

If other, please specify:

4. In what country do you see yourself working in the future?

5. What country did you live in when you first applied to HSLU?

HSLU Business Engineering Sustainable Energy Systems - Student Survey

Applying for the program

This section includes questions pertaining to students applications into the program.

6. Check all that apply.

	How did you learn about HSLU?	How did you learn about the program?	What was your greatest influence in joining the program?
Campus visit	☐	☐	☐
HSLU website	☐	☐	☐
YouTube	☐	☐	☐
Facebook	☐	☐	☐
Twitter	☐	☐	☐
Friend or family member	☐	☐	☐
College counselor or teacher	☐	☐	☐
HSLU info evening	☐	☐	☐
Exhibition	☐	☐	☐
College fair	☐	☐	☐
Other	☐	☐	☐

Comments

7. What other tools do you think could be used to help spread the word about the program?

- ☐ Twitter
- ☐ Facebook
- ☐ Linked-In
- ☐ Xing
- ☐ Instagram
- ☐ blogs
- ☐ Other

If other, please specify:

HSLU Business Engineering Sustainable Energy Systems - Student Survey

8. How easy did you find the application process?

- ◯ Very difficult
- ◯ Difficult
- ◯ Easy
- ◯ Very easy

What made it easy/difficult?

9. If you had not enrolled in the program, where would you have gone?

If other, please specify:

HSLU Business Engineering Sustainable Energy Systems - Student Survey

Program material

This section contains questions pertaining to the modules you have taken, would like to take, as well as suggestions for different modules.

10. Which modules have you found most valuable so far? Please select three.

- [ ] Applied Control and Automation
- [ ] B2B Marketing
- [ ] Building Envelope
- [ ] Computer Science Fundamentals
- [ ] Controlling
- [ ] Electrical Engineering with Lab
- [ ] Electrical Engineering Consolidation
- [ ] Energy Lab
- [ ] Engineering Product Development
- [ ] Engineering Tools
- [ ] Marketing Management and Accounting
- [ ] Materials Lab
- [ ] Power Electronics and Drives
- [ ] Practical Studies
- [ ] Renewable Energies-Solar Energy
- [ ] Strategic Management and Product Management
- [ ] Technical Mechanics
- [ ] Thermodynamics and Fluid Dynamics Fundamentals
- [ ] Thermodynamics and Fluid Dynamics/Process and Systems
- [ ] Usability
- [ ] Other

If other please specify:

HSLU Business Engineering Sustainable Energy Systems - Student Survey

11. Which of these modules are you most looking forward to? Please select 3.

- [ ] Applied Control and Automation
- [ ] Building Envelope
- [ ] B2B Marketing
- [ ] Computer Science Fundamentals
- [ ] Controlling
- [ ] Corporate Ethics and Social Behavior
- [ ] Efficient Devices and E-Mobility
- [ ] Electrical Engineering COnsolidation
- [ ] Electrical Engineering Lab
- [ ] Energy Lab
- [ ] Energy Optimization with Pinch Analysis
- [ ] Energy Trading, Economics and Policies
- [ ] Engineering Product Development
- [ ] Engineering Tools
- [ ] HVAC Systems
- [ ] Industrial Project
- [ ] Light and Electricity in Buildings
- [ ] Power Electronics and Drives
- [ ] Power Supply, Storages, and Smart Grids
- [ ] Practical Studies
- [ ] Materials Lab
- [ ] Marketing and Management Accounting
- [ ] Operations Management
- [ ] Renewable Energy and Ecology
- [ ] Renewable Energies - Bioenergy
- [ ] Renewable Energies - Solar Energy
- [ ] Service Innovation
- [ ] Strategic Management and Product Management
- [ ] Sustainable Energy Systems
- [ ] Technical Mechanics
- [ ] Thermodynamics and Fluid Dynamics Fundamentals
- [ ] Thermodynamics and Fluid Dynamics/Processes and Systems
- [ ] Usability
- [ ] Other

If other, please specify:

12. Would you suggest adding any additional topics or elements to the program? Please select 1-3.

- [ ] Carbon Management
- [ ] Geothermal Energy
- [ ] Nuclear
- [ ] Ocean Thermal Energy Conversion (OTEC)
- [ ] Tidal Energy
- [ ] Transportation
- [ ] Wave Energy
- [ ] Other

If other, please specify:

HSLU Business Engineering Sustainable Energy Systems - Student Survey

13. Please Specify the School and/or Program.

School

Program

HSLU Business Engineering Sustainable Energy Systems - Student Survey

14. Specify the program.

HSLU Business Engineering Sustainable Energy Systems - Student Survey

Communication methods

This section is to gauge the interest of various communication tools that would be used by professors and students.

15. Would you be interested in receiving information regularly about sustainability in the news?

- ◯ Yes
- ◯ No
- ◯ Indifferent

16. If yes, by what means would you like to receive this information? Check all that apply.

- ☐ Blog
- ☐ Twitter
- ☐ Facebook
- ☐ Email
- ☐ Other

If other, please specify:

HSLU Business Engineering Sustainable Energy Systems - Student Survey

17. Do you have any other comments about your experience in the program so far?

18. Your input is greatly appreciated.

If your are willing to be interviewed about your personal experience in the program, please provide your name and email address below. Your responses within the interview will be kept confidential upon your request.

Thank you!

Name

Email address

Appendix F: Survey/Interview of Potential Employers

These are suggested types of questions for hiring managers at various energy related companies. The responses we receive may be used in our presentation and/or final report. Manager names and information will not at all be linked to their responses if they so choose.

Survey Request Email:

Dear [Contact Name]

This survey was created to evaluate of the employability of graduates of the Business Engineering Sustainable Energy Systems (BE SES) program offered at HSLU. It was created by students from Worcester Polytechnic Institute, and your responses would be very much appreciated. It should take 5 - 10 minutes to complete.

Here is the link to the survey:

[link]

This link is uniquely tied to this survey and your email address. Please do not forward this message. Thanks for your participation!

HSLU Business Engineering Sustainable Energy Systems - Employer

You and Your Company

This survey was created to evaluate of the employability of graduates of the Business Engineering Sustainable Energy Systems (BESES) program offered at HSLU.

The survey is split into 3 sections with a total of 19 questions:

1. You and your company
2. HSLU's program
3. Follow up contact information

Your answers to this survey are very much appreciated. Please feel free to contact me (Robyn Lindsay) with any questions or concerns at rolindsay@wpi.edu. Thank you.

This section asks general questions about you and your company.

1. Personal Info

First Name

Last Name

Email Address

Preferred Phone Number

2. Company Name

3. What is your role at this company?

Other/Comments (Please Elaborate)

4. Does your company require that employees speak a certain language?

Other/Comments

5. Approximately how many employees does your company have?

HSLU Business Engineering Sustainable Energy Systems - Employer

6. Does your company anticipate hiring any new employees within the next three years?

Comments

7. What discipline(s) do the employees at your company generally come from? Select up to five.

- Agriculture
- Archaeology
- Architecture and Design
- Biology
- Business
- Chemistry
- Computer Science
- Earth Science
- Economics
- Education
- Engineering, Civil
- Engineering, Electrical,
- Engineering, Mechanical
- Engineering, Other
- Environmental Studies
- Healthcare Science
- Law
- Life Science
- Mathematics
- Military Science
- Physics
- Public Administration
- Space Science
- Statistics
- Transportation
- Other (please specify)

Other/Comments

8. How does your company find out about relevant programs that will provide you with quality graduates?

Other/Comments

HSLU Business Engineering Sustainable Energy Systems - Employer

9. Does your company offer internships? If so, what is the duration of these internships?

- No Internships
- 2 Month
- 6 Month
- Other (please specify)

Other/Comments

HSLU Business Engineering Sustainable Energy Systems - Employer

BESES at HSLU

This section talks about the BESES program offered at HSLU.

10. Did you know that HSLU is currently offering a degree in Business Engineering Sustainable Energy Systems? If not, more information on the program can be found from following these links: Program Brochure, Program Website

- ○ Yes
- ○ No

Comments

11. Based on what this program offers, how interested would your company be in hiring a graduate from this program?

Not Interested	Some Interest	Interested	Very Interested
○	○	○	○

Comments

12. Knowledge of which topics relating to sustainable energy would you value most in a new employee from the BESES program? Choose three to five.

- ☐ Wind
- ☐ Solar
- ☐ Thermal
- ☐ Hydro
- ☐ Wave
- ☐ Tidal
- ☐ Geothermal
- ☐ Biomass
- ☐ OTEC
- ☐ Nuclear
- ☐ HVAC
- ☐ Transportation
- ☐ Efficiency
- ☐ Storage
- ☐ Smart-Grid
- ☐ Carbon Management
- ☐ Other (please specify)

Other/Comments

HSLU Business Engineering Sustainable Energy Systems - Employer

13. Do you think a new employee should have a broad knowledge of a lot of topics or a narrow knowledge of few topics?

○ Broad Knowledge ○ Inbetween ○ Narrow Knowledge

Comments

14. Do you think that project management is a good skill for new employees to have?

○ Yes ○ No ○ Don't Know

Comments

15. Would your company be interested in working with a group of students on a project?

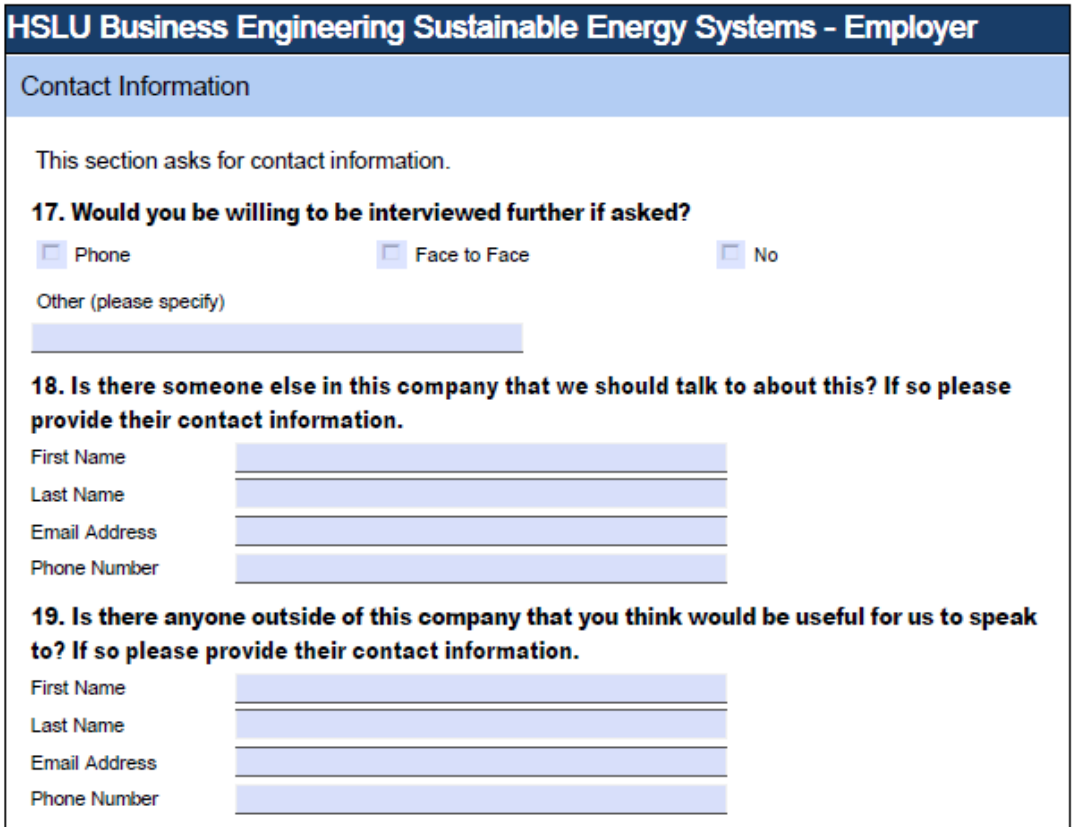
○ Yes ○ No ○ Don't Know

Comments

16. Are you aware that HSLU offers a speaker series on sustainability that is open to the public? Speaker Series

○ Yes ○ No

Comments



HSLU Business Engineering Sustainable Energy Systems - Employer

Contact Information

This section asks for contact information.

17. Would you be willing to be interviewed further if asked?

☐ Phone ☐ Face to Face ☐ No

Other (please specify)

18. Is there someone else in this company that we should talk to about this? If so please provide their contact information.

First Name
Last Name
Email Address
Phone Number

19. Is there anyone outside of this company that you think would be useful for us to speak to? If so please provide their contact information.

First Name
Last Name
Email Address
Phone Number

Interview Questions:

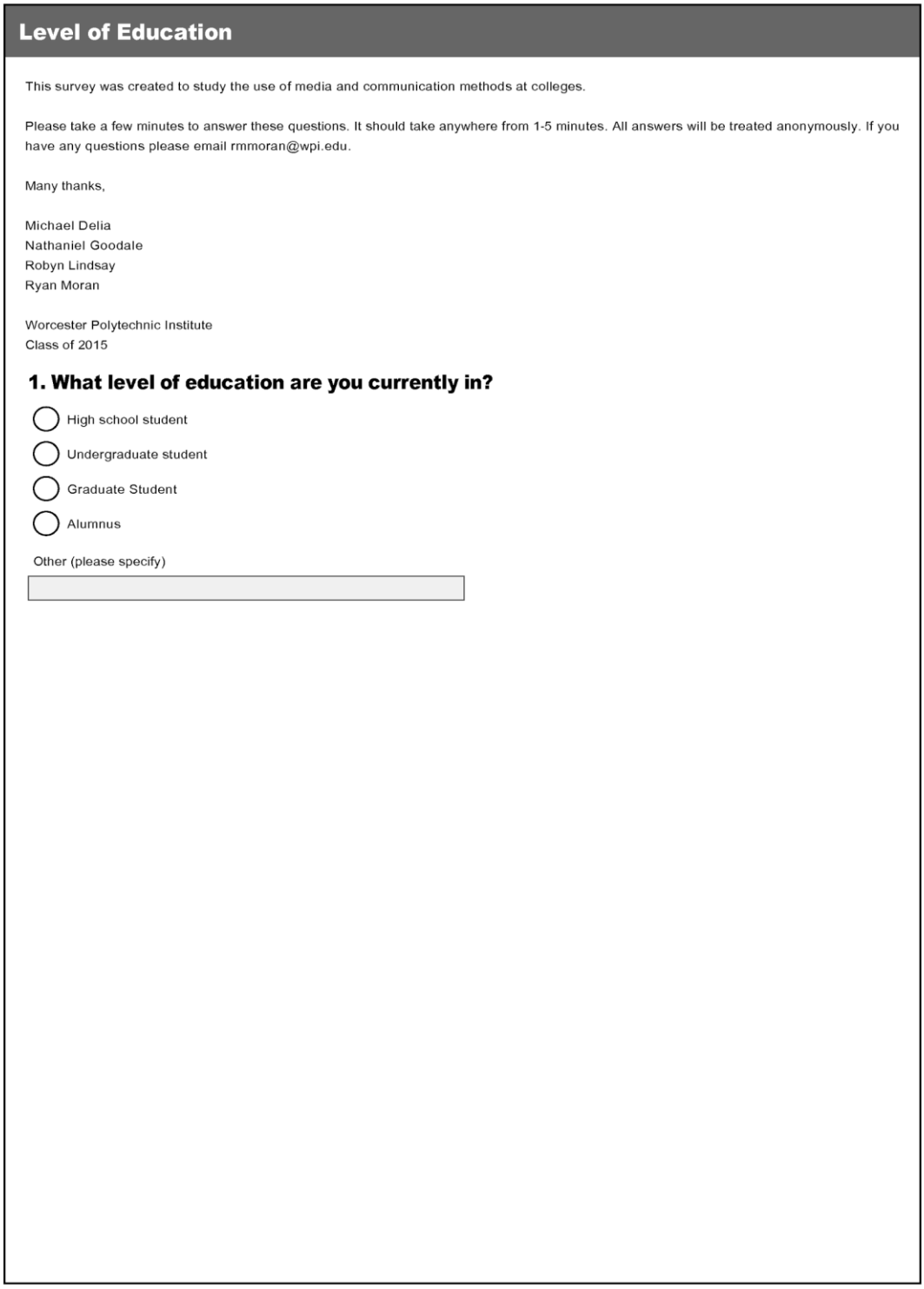
- What do you look for most in recent graduates looking for a job at your company?
- Is there anywhere that you feel job applicants in your field tend to be lacking?
- What do you value most in an application for a job at your company?
- What do you think is the most important for someone from this program to know?
- Do you generally prefer a graduate with a broader knowledge of your field or a specific focus?
- Does a lot of lab experience make an applicant more desirable?
- How do you think students from this program could make themselves stand out from others pursuing similar jobs and studying in similar programs?
- What sort of position would you see someone from this program holding at your company?

Interviewees:

Name	Company
Jim Siler	Sulzer Pumps
Daniel Portmann	ITZ Innovations Transfer Zentralschweiz
Geoff Hirst	Siemens (UK)
Andreas Graf	Anthills
Chuanfeng Lang	Siemens (China)
Amlan Saha	M.J. Bradley and Associates LLC

Appendix G: Marketing and Communication Survey

This survey was sent to 48 students who attend a variety of colleges in and universities in the United States.



Level of Education

This survey was created to study the use of media and communication methods at colleges.

Please take a few minutes to answer these questions. It should take anywhere from 1-5 minutes. All answers will be treated anonymously. If you have any questions please email rmmoran@wpi.edu.

Many thanks,

Michael Delia
Nathaniel Goodale
Robyn Lindsay
Ryan Moran

Worcester Polytechnic Institute
Class of 2015

1. What level of education are you currently in?

- ◯ High school student
- ◯ Undergraduate student
- ◯ Graduate Student
- ◯ Alumnus

Other (please specify)

Interests in schools

This section asks about your preliminary search for collegiate schools.

2. Have you started looking for information about colleges you may want to apply to? If yes, please indicate your top school so far.

- ◯ Yes
- ◯ No

Top School

3. Are there any particular majors that you have looked into at this school? If so, please specify.

- ☐ Agriculture
- ☐ Architecture and Planning
- ☐ Arts
- ☐ Biological Sciences
- ☐ Business
- ☐ Communications
- ☐ Computer and Information Sciences
- ☐ Education
- ☐ Engineering
- ☐ Environmental Sciences
- ☐ Health Care
- ☐ Languages and Literature
- ☐ Law
- ☐ Mathematics & Statistics
- ☐ Mechanics and Repair
- ☐ Military Science
- ☐ Philosophy and Religion
- ☐ Physical Sciences
- ☐ Protective Services
- ☐ Psychology & Counseling
- ☐ Recreation & Fitness
- ☐ Services
- ☐ Skilled Trades and Construction
- ☐ Social Sciences & Liberal Arts
- ☐ Social Services
- ☐ Transportation

Other (please specify)

4. Check all that apply.

	How did you learn about school of interest?	How did you learn about major of interest?	What is the best tool to use when applying to schools? (please check only 1)
Campus visit	☐	☐	☐
Google search	☐	☐	☐
School website	☐	☐	☐
YouTube	☐	☐	☐
Facebook	☐	☐	☐
Twitter	☐	☐	☐
Reddit	☐	☐	☐
Friend or family member	☐	☐	☐
College counselor or teacher	☐	☐	☐
Information session	☐	☐	☐
College fair	☐	☐	☐
Blog	☐	☐	☐
College search website	☐	☐	☐
Advertisement	☐	☐	☐
Other (Please comment)	☐	☐	☐

Comments

Applying for Undergrad

This section asks about your application process before college.

5. What college do/did you attend for undergrad?

6. What is/was your major?

- ◯ Agriculture
- ◯ Architecture and Planning
- ◯ Arts
- ◯ Biological Sciences
- ◯ Business
- ◯ Communications
- ◯ Computer and Information Sciences
- ◯ Education
- ◯ Engineering
- ◯ Environmental Sciences
- ◯ Health Care
- ◯ Languages and Literature
- ◯ Law
- ◯ Mathematics & Statistics
- ◯ Mechanics and Repair
- ◯ Military Science
- ◯ Philosophy and Religion
- ◯ Physical Sciences
- ◯ Protective Services
- ◯ Psychology & Counseling
- ◯ Recreation & Fitness
- ◯ Services
- ◯ Skilled Trades and Construction
- ◯ Social Sciences & Liberal Arts
- ◯ Social Services
- ◯ Transportation

Other (please specify)

7. Check all that apply.

	How did you learn about this school?	How did you learn about your major?	What is the best tool to use when applying to schools? (Please check only 1)
Campus visit	☐	☐	☐
School website	☐	☐	☐
YouTube	☐	☐	☐
Facebook	☐	☐	☐
Twitter	☐	☐	☐
Friend or family member	☐	☐	☐
College counselor or teacher	☐	☐	☐
Information session	☐	☐	☐
College fair	☐	☐	☐
Blog	☐	☐	☐
College search website	☐	☐	☐
Other (Please comment)	☐	☐	☐

Comments

Communication with Professors

This question inquires about student-teacher communication.

8. Typically, how often do/did you receive information or updates from your professors?

- ◯ Daily
- ◯ Weekly
- ◯ Monthly
- ◯ Per semester
- ◯ Never

Comments

9. What channels do/did your professors use to communicate with you outside of class? Check all that apply.

- ☐ Email
- ☐ Twitter
- ☐ Facebook
- ☐ Blog
- ☐ Blackboard (or another course management site)
- ☐ Other (Please comment)

Comments

Outside Connections

This section asks about the channels your school or program uses to connect with employers and alumni.

10. To the best of your knowledge, what kinds of tools does your school offer to strengthen connections with employers? Check all that apply.

- [ ] Guest lecturers
- [ ] Career fairs
- [ ] Twitter
- [ ] On-campus interviews
- [ ] Information sessions
- [ ] Facebook
- [ ] YouTube
- [ ] LinkedIn
- [ ] Whatsapp
- [ ] Other (Please comment)

Comments

11. To your knowledge, in what ways does your school stay connected with alumni. Please check all that apply.

- [ ] Traditional mail
- [ ] Emails
- [ ] Fundraising
- [ ] Magazines
- [ ] Newsletters
- [ ] Twitter
- [ ] Facebook
- [ ] YouTube
- [ ] LinkedIn
- [ ] Alumni events
- [ ] Whatsapp
- [ ] Other (Please comment)

Comments

Graduate School

This section asks about the graduate school application process.

12. Where do you attend graduate school?

13. What is your graduate area of study?

- ◯ Agriculture
- ◯ Architecture and Planning
- ◯ Arts
- ◯ Biological Sciences
- ◯ Business
- ◯ Communications
- ◯ Computer and Information Sciences
- ◯ Education
- ◯ Engineering
- ◯ Environmental Sciences
- ◯ Health Care
- ◯ Languages and Literature
- ◯ Law
- ◯ Mathematics & Statistics
- ◯ Mechanics and Repair
- ◯ Military Science
- ◯ Philosophy and Religion
- ◯ Physical Sciences
- ◯ Protective Services
- ◯ Psychology & Counseling
- ◯ Recreation & Fitness
- ◯ Services
- ◯ Skilled Trades and Construction
- ◯ Social Sciences & Liberal Arts
- ◯ Social Services
- ◯ Transportation

Other (please specify)

14. How did you learn about this graduate program?

- [ ] Same field as undergrad
- [ ] Campus visit
- [ ] School website
- [ ] YouTube
- [ ] Facebook
- [ ] Twitter
- [ ] Friend or family member
- [ ] College counselor or teacher
- [ ] Information session
- [ ] College fair
- [ ] Blog
- [ ] College search website
- [ ] Other (please comment)

Comments

Employment

This section inquires about your employment in relation to the school you came from.

15. Are you currently employed in your field of interest?

- ◯ Yes
- ◯ No

Comments

Employment

16. How much influence did the school's resources have in helping you get a job?

- ◯ Strong influence
- ◯ Some influence
- ◯ Very little influence
- ◯ No influence

Comments

17. By what means does your company connect with students?

- ☐ Email
- ☐ Phone calls
- ☐ Guest lecturers
- ☐ Career fairs
- ☐ Twitter
- ☐ Facebook
- ☐ YouTube
- ☐ LinkedIn
- ☐ Whatsapp
- ☐ Other (Please comment)

Comments

Graduate School

18. Did you attend graduate school?

- ◯ Yes
- ◯ No

Comments

Alumni Relations

his section inquires about alumni relations within your school.

19. In what ways does your school connect with you as an alumnus? If other, and/or you have other comments, please indicate below.

- [ ] Traditional mail
- [ ] Newsletters
- [ ] Magazines
- [ ] Alumni events
- [ ] Phone calls
- [ ] Emails
- [ ] Facebook
- [ ] Twitter
- [ ] Linked-In
- [ ] Blogs
- [ ] Whatsapp
- [ ] Other (please comment)

Comments

Comments

20. Do you have any additional comments about how your school communicates with prospective students, current students, employers, and/or alumni?

Thank you!

You're input is greatly appreciated.

Appendix H: Selected School Comparison Chart

Sustainable Programs Comparison Chart (2014)

														Focus				General										Energy Topi
University	Degree	Type	Country	City	Region	Program Web-Site	Contact Name	Contact Phone	Contact email	Open paragraph from the home page of brochures	Year created	Number of students	Language	Technical	Policy/Management	Multi-Disciplinary	Sustainability	Project management	Environmental considerations of projects	International focus	Engineering courses	Ethics	Finance/Accounting	Basic Electrical Engineering	Basic Mechanical Engineering	Renewable Energy Engineering	Wind	Solar (PV)
Lucerne University of Applied Sciences and Arts	Business Engineering: Sustainable Energy Systems	BS	Switzerland	Lucerne	Europe-non EU	http://www.hslu.ch/technik-architektur-ausbildung/t-ausbildung_bachelor/t_bachelor_in_business_engineering_sustainable_energy_systems.htm				Sustainability is central to the future plans of governments, companies and society alike. This is especially true when it comes to energy, the driver of growth for the past hundred years.	2012	~50	English	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Aalborg University	Energy Engineering	BS	Denmark	Aalborg	EU	http://www.studyguide.aau.dk/programmer/guest-exchange/57207/	Chair of Study Board, Associate Professor Birgitte Bak-Jensen	E: bbj@et.aau.dk P: +45 9940 9274		At Aalborg University, we offer a study programme in Energy targeted at the demands and challenges which the future poses. The programme is founded on research-based teaching and problem-based project-organised learning. As a guest student, you will contribute to maintaining and strengthening a healthy environment. The Department of Energy Technology conducts research on alternative and environmentally friendly energy sources as well as on savings on energy consumption and optimisation of energy systems in all aspects.	2007	200	English	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Cincinnati State University	Electro-Mechanical Engineering Technology Renewable Energy	BS	USA	Cincinnati, Ohio	North America	http://www.cincinnatistate.edu/real-world-academics/academics/center-for-innovative-technologies/copy22_of_bt_program_template/description-1		(513) 569-1500; http://www.cincinnatistate.edu/contact/email		The Renewable Energy major prepares graduates to address needs in several related and growing industries, including the manufacturing of photovoltaic electric panels, geothermal, solarthermal, wind turbines, and fuel cells; installing and servicing photovoltaic and wind turbine systems; and assisting energy efficiency companies and consultants. Understanding these new technologies requires most of the traditional foundations of electro-mechanical engineering technology studies.			English	Yes	Yes	Yes	Yes		Yes		Yes		Yes		Yes	Yes	Yes	Yes
Kyamk: University of Applied Sciences	Double Degree Programme in Energy Technology	BS	Finland	Kotka	EU	http://www.kyamk.fi/Applying/Double%20Degree%20Programmes/Energy%20Technology/	Mrs. Arja Sinkko;	+358 44 702 8219	arja.sinkko@kyamk.fi	Double degree programme is a part of full time degree programme in Energy Technology. Studies lead to a Bachelor's Degree of Engineering (BSc. Eng). This education gives competences in environmental friendly and economical energy production and in innovative energy technology and engineering. Modern learning methods support students' communication and co-operative teamwork skills.			Finnish with reqired English classes	Yes	Yes	Yes	No	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes
Murdoch University	Renewable Energy Engineering	BS	Australia	Murdoch	Oceania	http://www.murdoch.edu.au/Courses/Renewable-Energy-Engineering/			https://askmurdoch.custhelp.com/app/askmurdoch/ask/1300_MURDOCH	With this course you will focus on systems for electricity generation and learn about the availability and distribution of renewable energy resources, including solar radiation, wind, hydro, tidal, wave and biomass.			English	Yes	Yes	Yes	Yes	Yes	Yes		Yes		Yes		Yes	Yes	Yes	Yes
Oregon Institute of Technology	Renewable Energy Engineering	BS	USA	Wilsonville, OR	North America	http://www.oit.edu/academics/degrees/renewable-energy-engineering	Mateo aboy	503-821.1291	mateo.aboy@oit.edu	The promise of sustainable power depends on our ability to harness renewable resources like wind, sunlight, biofuels, geothermal heat and rivers. The technology needed to harness these natural energy resources is continually improving, but the demand for workers who can lead us toward a sustainable energy future has far exceeded the supply.	2007	170	English	Yes	Yes	No	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Technical University of Denmark	Electrical Energy Technology	BS	Denmark	Lyngby and Ballerup	EU	http://www.dtu.dk/english/Education/Bachelor-%28BEng-and-BSc%29/BEng/Electrical-Energy-Technology	Rasmus Post		rapo@dtu.dk	Major changes in energy systems worldwide are forecast for the coming decades. Sustainability is the key, and in the run-up to 2050 the entire Danish energy system is to undergo radical conversion to make the Denmark carbon neutral. The new system is to be based on energy sources including wind power, solar power, hydrogen and biomass, and will be centred on the national power grid. As a result, BEng graduates with extensive competencies in the fields of electrical energy systems and heavy current will be in great demand. On the Electrical Energy Technology programme, students can specialize in one of the two fields.				Yes	Yes	Yes	No	Yes	Yes		Yes	No	No	Yes		Yes	Yes	Yes	Yes

cs Covered by Program																					Required Courses		Highlighted Courses	Computer Programs Covered/Utilized					Target market		Marketing info....
Solar (Thermal)	Thermal (Fossil Fuel)	Thermal (heat exchange)	Hydro	Wave	Tidal	Geothermal	Biomass	OTEC	Power Plant	Nuclear	HVAC	Architecture/building design	Transportation	Efficiency	Storage	Electric Grid	Smart-grid	Carbon management	Climate Change	Core Modules (degree specific)	Specialization Elective Modules	i.e.: super cool wave.....	i.e.:Mat lab.....	Target markets	Industry contacts	Expected learning outcomes	Partner Institutions	Students	Employers	Social Media Used
Yes	Yes	Yes	Yes	No	No	No	Yes	No	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	CS fundamentals, EE with lab, Materials lab, Thermo dynamics, Energy and ecology, Marketing and accounting, control and automation, technical mechanics	Thermal energy, building applications, electrical energy	Industrial Project, Bachelor Thesis	ERP systems			manage energy projects, advise companies on energy, trade energy, purchase components considering the lifecycle, understand customer needs, communicate on all levels	Indian Institute of Technology, Universidad Monterey, Cal-Poly San Luis Obispo, Wentworth Institute of Technology, Beuth Hochschule für Technik Berlin	Swiss, Europe, International		
Yes	Yes	Yes	No	Yes	Yes	No	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	Future energy systems, efficient energy systems, modeling and analysis of simple electrical and thermal systems, control of energy conversion systems	Electrical energy engineering, thermal energy engineering, mechatronic control engineering		Matt-Lab	Sustainable energy technologies, sustainable transportation systems						
Yes	No	No	No	No	No	Yes	No	No	No	No	No	No	No	Yes	No	No	No	No	No						Duke Energy; Mazak Corp.; Melink Corp.; Procter & Gamble; RA Jones & Co.	Advise organizations on how to reduse energy consumption, serve as a technician or installer for wind, geothermal, solar thermal, PV, or fuel cell tech			Duke Energy; Mazak Corp.; Melink Corp.; Procter & Gamble; RA Jones & Co.	
Yes	Yes		Yes	No	No	Yes	No	No	Yes	No	No	No	No					Yes													
Yes			Yes	Yes	Yes	Yes	Yes				Yes	Yes		Yes																	
Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Communications, Math/Science, General Education, Electrical Engineering, General Engineering, Mechanical Engineering, plus some basic Renewable Energy Engineering courses.	3 Senior sequences: Power (System analysis, protection and control, integration of renewable energy) Green Building (HVAC, energy auditing and management, energy efficient building design) Geothermal (only Klamath Falls campus) (geothermal energy and ground source heat pumps, HP design, power plants)		AutoCAD, Mat-Lab, Mirosoft Office, SPICE, Labview	Sustainable energy technologies, building sustainable buildings, manage energy related projects		design system/component within realistic constraints, function in a multi-disiplinary team, understand professional and ethical responsibility, understand energy fundimentals, broad education to understand impact of engineering solutions	No			
No	No	No	No	No	No	No	No	No	Yes	No	No	No				Yes		No													

Appendix I: Student Survey Results

Note: not all responses follow across horizontally. This is to prevent any identifying answers from being traced back to students.	Discovering program	Country info	Experience (work)	Interests/looking forward to	Positives to curriculum	Suggested improvements	Favorite modules	Least favorite modules	Contact with professors/e mail availability	Social Media	Other comments
Interviewee #1	-lived in Lucerne, so school easy to find -didn't visit any other schools	Swiss	-apprentices hip (Mason) -vocational HS	-Project management -sustainability (from traveling the world) -international aspects	-offers all the basics (math sciences)	-have an overview course in sustainability -needs comparison of options -calculated investment of systems -link between classes	-Technical Mechanics --relavent subject --good teacher --learned new stuff --industrial standards -Materials lab --interesting subject new teacher	Thermofluid dynamics -difficult (30-50% drop rate) -hard teacher -why doesn't WI have to take it? -does not seem as relavent -shouldn't be mandatory	-email --thinks it is good ---all in one place --reliable --all relavent info	not noted	-structure of curriculum is ok
Interviewee #2	Brother, who lives in CH, introduced	Internatio nal	minimal	-Recycling -energy conservation -world economics	-enjoyed B2B marketing class and the case	Would like more electives to be offered in English for a better balance	-B2B marketing. Swissness was also liked	-not a fan of accountin g	-"Email is fine, it keeps things down to a single	not noted	-Energy Lab placement not optimal in curriculum. -Class okay

				-business of economics	studies because of the practical aspect. Swissness was a positive	throughout the years of study.			information stream"		
Interviewee #3	-Found through online search for "ME" English" "Europe" - looked at German universities as well	International	Minimal	(see favorite modules for same topics) EE topics in general	-An engineering focus can be seen clearly, but is okay with this because of personal intrests and prefferences.	-The electives for additional classes in the subject areas are good, but not helpful when only given in German. -Would like to see some in english as an option. -It would be interesting to see something offered on energy storage	-electrical engineering because of teacher -recycliny because of usefullness of content, - physics for interest of content, - really liked swissness because of professor and content.	-did not like accounting partially because of the instruction and partially because of the content	-Email checked 1 time per day unless expecting something in which case it may be as many as 5 times.	not noted	Concerned that in order to get even basic program information that the students need to ask for it. -Is something being looked over or left out then. -Unclear if program is truly preparing students for international employment as it seems big fields of energy are not going to be covered well.
Interviewee #4	Found through a friend at HSLU in a different program	International	Some, not relevent to major	-Looking forward to the industrial project and Ecology	-Amount of engineering content over business content	-Improvements in teaching ability in the english language would be of much more help when many of the students come from	-Liked Energy lab (although scheduled a bit early in the program), -Math &	-None noted, prefers engineering over business	-Email checked very often (on phone), prefference for limited "junkmail"	FB or instragram good tools. "Istragram is trending and catches attention a lot more	none noted

						backgrounds not of high english levels.	Physics because of the professor, -4th semester solar class because of importance of topics, -and Thermo (difficult, but good)		from professors	than just some text or web page." -Cool pics of the labs, projects, etc. -A quick way to get interest. (*could this be a type of student submitted picture type of thing?*)	
Interviewee #5	Info evening, had also looked into electrical engineering @ HSLU	Swiss	Had an apprenticeship	Intrest in solar and mechanical drives	Liked the english, business, and international aspects	-More available choices in the future. -Some sort of sustainability earlier.	Renewable energies- Solar and mechanical drives modules	-Human development because of professor. -Not a ton of interest in marketing classes overall	-Email check very often/linked to phone. -Communication should be kept simple and in one place.	feels name of school gets out enough for what the school is	-Looked into Rapperswill. -Liked BE SES English, business, and INTERNATIONAL aspects of the program at HSLU.
Interviewee #6	suggested by father from local information	International with Swiss contact	minimal	Thermo and Electrical drives	English, match to interest in ME	More labs wanted for hands on experience as well as the posibility to have dificult subjects slightly slower ex. physics.	-Liked Computer Science, -Math fundimentals, -B2B, -and Math and	-None noted	-Email checked very often (on phone)	FB and/or Twitter. Twitter seems more active on an international level.	Interest in exchange program and concerned how possible a 3 year degree would be.

							Physics Technology 1				
Interviewee# 7	Was in the process of looking at schools online. Had applied in Austrailia, London, Singapore, as well as BE SES	International	Worked in a school lab at a previous school	-Renuable energies - Bioenergy module, -Nanotechnology	Liked the computer science and contest #1 because of the subject matter.	Shorter classes - not able to stay focused completely for 4 hours at a time. -Review sessions run by a teaching assistant may be helpfull. -Offer courses with a connection to BE SES at the school in english.	-Computer Science, -Context 1	Energy lab	-Email checked extremely often. (on phone)	Little interest in social media use	Dificulty with some parts of the application process only in German?
Interviewee# 8	-Internet research at first, -initially looked at WI and was convinced at an info evening to do BE SES. -Only applied to HSLU	Swiss	Worked as a car mechanic before entering the program.	Greatest interests in renuables/sustainable practices. Storage of energy.	Really like the small classes and international mix. -Balance of engineering and business okay	-Energy/sustainability content earlier (possibly as easy as including partially in other classes or a seperate introductory class overall). -The flow of marketing studies is a bit too broken up with the times different classes are offered. -Too little program response as of lately, setting up a class	Thermofluids and mechanical systems	Computer science - because not enough is learned to do anything of value with what the class teaches. Additional classes would be needed to do productive things, yet they are not offered in	-checkes email "often enough" (has on phone). Twitter could be an option for non critical information and reminders of various events/dates.	no interest	-English was not much of a draw, but not a negative. -Does not think there are many companies who know that such a program even exists. -There isn't a good way to find out more about the program (for current students) beyond the basic info sheets other than bothering someone in the office.

						meeting with Prof Schulz helped, but should have come sooner.		this program.			
Interviewee# 9	Came to an info evening and heard about the program involving sustainability and in English.	Swiss	minimal	Interest in electric power production	- Engineering to business balance of the program is fairly good. -The technical side needs to be developed more.	Energy lab ont in the 1st semester and a 1st year intro/info module would be helpful.	neutral about many	-Usibility seemed to only be helpful for design work. -Applied control amd Automation needed to have more program background to make the most of the class. -Having more physics would have helped in Energy Lab	-email is checked every half hour to hour	-FB and twitter not really helpful and just for entertainment. -Only really good for getting some exposure, but content would be personally useless. -Events with a personal touch would be a much better use of time.	-Annoyed with copy of german model. -Would prefer dedicated modules and sees the program having a big opertunity to restructure before getting too set in its ways.
Interviewee# 10	School information event	Swiss	apprenticeship	Interest in electrical engineering and modules available	- Engineering focus a good thing for	-Restructure Energy Lab. -The BE SES program is not even well known	-Not much of real niterest so far. -Looking	-"Energy lab was just a waste of time".	-"Email is pretty good. I couldn't think of a better way without	Social media isn't really of interest	-"we need to get out of Mr. Schulz's little box" -It is hard to

					personal interests. - "If you look at the whole package, there is enough of interest"	at the school and thinks it should be more visable.	forward to better things to come.	-1st semester marketing did not seem well structured and rather messy.	being annoying". -Hard to talk with Uwe Schulz about real issues.		give Uwe Schulz feedback on "his baby". -Not all forms are in english. This is not something dificult to do, yet this program all in english should have already taken care of.

Appendix J: Interested Employer Contacts

Below is the contact information for the employers who expressed interest in either hiring students or working with students on a project. Note that the contact may need to supply the contact information for someone better to talk to about hirings or projects.

Company	Hiring/Projects	Contact Name	Contact Email	Contact Phone Number
ABB Turbo Systems AG	Both	Herbert Mueller	herbert.mueller@ch.abb.com	+41 58 585 18 38
Anthills	Both	Andreas Graf	andreas.graf@anthills.ch	79 775 20 91
Deritend Group Limited	Both	Richard Hale	rhale@deritend.co.uk	780 230 68 69
Frost & Sullivan	Hiring	Alina Bahkareva	alina.bakhareva@frost.com	+44 (0) 20 7915 7829
GDF Suez	Hiring	Virgilio Caramujo	virgilio.caramujo@ippdeeside.com	+44 (0) 1244 286026
Holcim Group	Both	Richard Stoffelen	richard.stoffelen@holcim.com	+41 58 858 86 82
ITZ Innovations Transfer Zentralschweiz	Both	Daniel Portmann	dp@itz.ch	041 349 50 67
Noventum	Both	Nick Frank	nick.frank@noventum.eu	+352 621 215 856
Phonak	Both	Martin Riedi	martin.riedi@phonak.com	58 928 46 10
Roland Berger	Both	Roland Berger Strategy Consultants	sven.siepen@rolandberger.com	433 368 671
Siemens	Hiring	Geoff Hirst	geoff.hirst@siemens.com	+44 (0) 161 446 5300
SoftinWay Switzerland GmbH	Hiring	Valentine Moroz	valentine@softinway.com	+41 78 868 6440
Sulzer	Both	Jim Siler	jim.siler@sulzer.com	+41 79 625 1982