S.21-93

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MEMORANDUM

ATTENTION	Senate	**DATE**	July 15, 2021
FROM	Catherine Dauvergne, Vice-President, Academic and Provost and Chair, SCUP	**PAGES**	1 of 1
RE:	Full Program Proposal for an Honours Program in Sustainable Energy Engineering (SCUP 21-25)		

At its July 14th, 2021 meeting, SCUP reviewed and approved the Full Program Proposal for a Bachelor of Applied Science in Sustainable Energy Engineering (Honours) in the School of Sustainable Energy Engineering within the Faculty of Applied Sciences.

Motion:
That Senate approve and recommend to the Board of Governors the Full Program Proposal for a Bachelor of Applied Science in Sustainable Energy Engineering (Honours) in the School of Sustainable Energy Engineering within the Faculty of Applied Sciences, effective Summer 2022.

C: M. Ahmadi

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MEMORANDUM

ATTENTION	Senate Committee on University Priorities	DATE	July 9, 2021
FROM	Elizabeth Elle, Vice-Chair Senate Committee on Undergraduate Studies	PAGES	1/1
RE:	Faculty of Applied Sciences (SCUS 21-54)		

Elizabeth Elle

Action undertaken by the Senate Committee on Undergraduate Studies at its meeting of July 8, 2021, gives rise to the following recommendation:

Motion

That SCUP approve and recommend to Senate the Full Program Proposal for the Bachelor of Applied Science in Sustainable Energy Engineering (Honours) in the School of Sustainable Energy Engineering within the Faculty of Applied Sciences.

The relevant documentation for review by SCUP is attached.

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MEMORANDUM

ATTENTION	Wade Parkhouse, Chair Senate Committee on Undergraduate Studies	**DATE**	June 25th, 2021
FROM	Edward Park, Associate Dean Faculty of Applied Sciences	**PAGES**	1/350
RE:	New Program		

The FAS Undergraduate Curriculum Committee in the Faculty of Applied Sciences has approved the following new program:

1. Sustainable Energy Engineering
    - Honours

Best regards,

Edward Park
Associate Dean, Faculty of Applied Sciences

SIMON FRASER UNIVERSITY
ENGAGING THE WORLD

Bachelor of Applied Science in Sustainable Energy Engineering (Honours)

Full Program Proposal

September 21, 2020

School of Sustainable Energy Engineering

1 Executive Summary

a) An overview of the institution's history, mission, and academic goals:

Please provide a brief summary (1-2 paragraphs) that links the proposed program to the SFU's vision and mission (use and add to the boilerplate institution detail below):

As Canada's engaged university, Simon Fraser University is defined by its dynamic integration of innovative education, cutting-edge research and far-reaching community engagement. SFU was founded in 1965 with a mission to bring an interdisciplinary approach to learning, embrace bold initiatives, and engage with communities near and far. Today SFU is consistently ranked amongst Canada's top comprehensive universities and is one of the world's leading teaching and research institutions.

In 2019 SFU launched a new program in Sustainable Energy Engineering (SEE) based in the new Sustainable Energy Engineering Building in Surrey, BC. The Honours program will provide a research option for students considering a Masters' degree and/or further study. The main objective is to give B.A.Sc. in SEE students an additional option in their final term to do a research project with SEE faculty.

b) Credential to be awarded:

Bachelor of Applied Science in Sustainable Energy Engineering (Honours)

c) Location of program:

SFU Surrey, SYRE (Engineering Building)– co-located with the School of Sustainable Energy Engineering and the campus where the B.A.Sc. in Sustainable Energy Engineering (SEE) is offered.

d) Faculty offering the proposed new program:

School of Sustainable Energy Engineering, Faculty of Applied Science

e) Anticipated program start date:

Fall 2022 would be the earliest start date, but this may shift depending on resources and other priorities.

f) Anticipated completion time:

The honours option would generally add one or two terms of study for students in their final year of the B.A.Sc. in SEE.

g) Summary of the proposed program

- **Aims, goals, and objectives:**

The program provides a research option for students considering a Masters' degree. The main objective is to give B.A.Sc. in SEE students an additional option in their final term to do a research project with SEE faculty.

- **Contribution to the mandate and strategic plan of the institution:**

The honours program will provide additional options for students in SEE and allow them to experience a research project before making the decision to continue into a Masters' degree or other research position. This contributes to both the strategic vision of 'engaging students' and the vision of 'engaging research'.

- **Linkages between program outcomes and curriculum design:**

The honours courses allow students to perform leading edge research and prepare an honours thesis in a very similar way as they would do for a Masters' degree. This will allow students to determine if they want to continue a research career path.

- **Potential areas/sectors of employment for graduates or opportunities for further study:**

The labour market demand was studied in depth for the B.A.Sc. in SEE. The Honours option will enhance students' ability to enroll in a Masters' program after completing their Bachelors degree and will allow them to explore if a research career is something they want to pursue. This may open up employment opportunities for students in more research focussed industries/areas.

As stated in the earlier full program proposal for the B.A.Sc. SEE:

> *The cleantech sector is a continuously growing area that will lead to significantly increased future career opportunities. Graduates of the Sustainable Energy Engineering program will acquire a diverse range of knowledge and skills that will enable them to pursue various career opportunities related to energy harvesting, conversion, distribution, and energy-efficient systems and machines. These opportunities range from entry-level to professional positions in a wide range of sectors, including wind, solar, geothermal, hydro-electric power, fuel cells, gas turbines, biomass, transportation, oil and natural gas. The opportunities also include current practical professions such as heating, ventilation, and air conditioning, and energy systems in commercial and residential buildings. Graduates will also have the background to pursue careers related to energy systems that require skills in mechanical and electrical engineering disciplines. Other career paths include working as consultants, entrepreneurs, and researchers. Opportunities for graduate studies at the Master's or PhD level include certain disciplines in electrical, mechanical, and chemical engineering related to energy systems.*

The Honours option in the B.A.Sc. will enhance the potential career paths for students around research in sustainable technologies. It is not expected that the honours degree will have any negative impacts on students gaining meaningful employment after graduation.

- **Delivery methods:**

Delivery will be in conjunction with the B.A.Sc. in SEE for all courses except SEE 498 and SEE 499 which will be supervised by a three-person committee. At least one committee member must be a SEE Faculty member.

- **Program strengths:**

This honours degree is linked to the SEE degree. There are no programs similar to the SEE bachelors degree in western Canada.

- **Level of support and recognition:**

A full consultation process was undergone for the Bachelor of Applied Science in Sustainable Energy Engineering program when it was developed. As this is an optional path within the context of the larger program, no additional consultation has taken place. However, an honours option is generally recognized in both industry and academia so this honours option should similarly be recognized.

- **Related programs:**

A full evaluation of similar programs was undertaken for development of the Bachelor of Applied Sciences in Sustainable Energy Engineering. This Honours proposal does not change the original assessment that this was the first such program in Western Canada. Most other engineering programs at SFU have similar Honours options for their students.

h) Contact information:

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2 Credential Recognition and Nomenclature

2.1 Post-secondary recognition

The graduates from the proposed program will be awarded a Bachelor of Applied Science (B.A.Sc.) Honours degree in Sustainable Energy Engineering (SEE).

Detailed information on possible options with this degree is quoted from the B.A.Sc. SEE full program proposal,

> *Within engineering and applied sciences, SEE graduates are expected to be able to pursue further graduate study leading to master's and doctoral degrees in Mechanical Engineering, Mechatronics Engineering, Industrial Engineering, Power Engineering, Environmental Engineering, Electrical Engineering and Computer Science. Those interested in business or entrepreneurial careers will be able to pursue graduate business or management programs, especially those related to Management of Technology. Finally, broad exposure to environmental, societal, regulatory, health and safety issues related to energy will open the doors for SEE graduates to pursue graduate studies in social sciences, especially those in Environmental Policy, Sustainability, and Urban Studies.*
>
> *It is further expected that students transferring into (or out of) the SEE program would receive recognition and credit for completed courses where appropriate and on the basis of program accreditation.*
>
> *Letters of support for the proposed program from other institutions can be found in Appendix 8.4.*

The addition of an honours option would enhance students' ability to pursue Masters' and Ph.D. studies at other institutions.

2.2 Industry/employer recognition

A survey of industry/potential employers was concluded for the SEE B.A.Sc. program, and the conclusions from that survey are included here from the B.A.Sc. full program proposal:

> *SFU's Faculty of Applied Sciences, in collaboration with the City of Surrey, commissioned Delphi Group for a market survey to determine the specific learning outcomes that industry and credentialing bodies will require from graduates of the new Sustainable Energy Engineering program, as well as the specific areas of the cleantech sector they predict will grow most over the next decade. Canadian industry leaders from the clean power generation, energy storage and battery storage, clean transportation, energy efficiency and conservation, and demand side management sectors were surveyed through telephone interviews and online questionnaires.*
>
> *Of the companies interviewed, 68%, or 65 companies, were based in British Columbia, and 48 of those were located in Metro Vancouver. Companies of various sizes participated in the survey, though most (79%) had fewer than 50 full time employees. 83% of responding companies have plans to hire additional engineering staff over the next three years, and 24% indicated they will be looking to hire between 11 and 50 engineers in the short term.*

Industry respondents highlighted the need for graduates to be prepared for the workforce with skills in engineering, energy and interdisciplinary systems and integration; mechanical engineering; electro-mechanical devices and IoT/software development; modeling and simulation; engineering design and prototyping; understanding advanced instrumentation and controls; and computer engineering and ICT systems. Respondents were asked to indicate all of the skills of importance, and the highest priority was given to mechanical engineering skills, with 67.6% of respondents indicating this was an important job requirement. Modelling/simulation followed with 58.1% and engineering design and prototyping with 55.4%.

Regarding non-technical skills, industry respondents suggested there is significant need for new graduates to be skilled in business fundamentals; engineering economics and financial literacy; sustainability and climate policy; and creative thinking, problem solving and troubleshooting.

The Honours option would be expected to enhance students' ability to go into research focused industry positions, but overall does not change the general industry environment for SEE graduates.

3 Curriculum/Program Content

3.1 Program structure

Length of Program and Units

Students taking the B.A.Sc. (Honours) in SEE would be required to take the core SEE program courses as outlined from the original B.A.Sc. Program Proposal below, as well as take two additional courses, SEE 498 Thesis Proposal and SEE 499 Undergraduate Honours Thesis. The addition of these two courses would increase the program length by one or two academic terms.

The Honours Thesis written for SEE 399 would be expected to be larger in scope than most one course term projects, and significantly smaller in scope than a Masters' thesis, fitting with the 9 credits assigned to the course. This will allow students to delve into a specific topic more deeply without the requirement that they commit to a Masters' program.

To be eligible for the Honours program students will need to meet all SFU Honours Degree requirements, including maintaining a CGPA of 3.00.

The original program proposal and structure is included here for reference.

Program Requirements

- ***Required Courses****: The curriculum consists of 39 required courses, five elective courses and three co-op terms.*

- ***Options, Electives and Elective Focus Areas****: The SEE program will include specialized elective courses that are clustered into three focus areas: Smart City Energy and Environmental Systems, Clean Transportation Systems and Sustainable Manufacturing Systems. Each cluster will include an identified GEOG course and several SEE technical electives. Students will select one of the GEOG courses, one of GEOG 324 and GEOG 362 and any three of the remaining technical electives, noting that technical electives can be chosen from within one cluster or freely across all three. Elective courses in Sustainable Manufacturing will be delivered by the School of Mechatronic Systems Engineering, building upon specific expertise in this area. Within the scope of Smart City Energy and Environmental Systems, students may also select courses in an elective concentration on Low Power Electronics Design for Sustainable Engineering Applications (including courses in VLSI Systems Design, Microelectronic Fabrication and Low Power Wireless Communications), offered by the School of Engineering Science at SFU's Burnaby Campus. Finally, the fifth elective is selected from any SFU B-Hum designated course.*
- ***First Year, Third Year and Final Year (Capstone) Design Courses****: Four design courses provide students the in depth engagement with a real world design project, in collaboration with an industry or academic partner. Two courses in the final year provide the capstone experience. A prerequisite of the first capstone course is completion of two co-op work terms.*
- ***Co-op and Alternative Experience****: Mandatory co-operative education terms ensure that students gain working experience as student engineers. The co-op portion of the curriculum is detailed below.*

3.2 Core courses

Two additional courses would be developed for the Honours Program:

SEE 498 – Sustainable Energy Engineering Thesis Proposal (3)

Supervised study, research and preliminary work leading to a formal proposal for the thesis project work in SEE 499. This activity can be directly augmented by other course work and by directed study. The locale of the work may be external to the University or within a University laboratory, or may bridge the two locations. A plan for the student's SEE 498 activities must be submitted to the school at the time of enrolment in the course and must include agreement from the supervisory committee. At least two of the three supervisors must be registered professional engineers, and at least one must be a faculty member in SEE. Completion of the undergraduate thesis project proposal is the formal requirement of this course and the basis upon which it is graded. Grading will

be on a pass/fail basis. Prerequisite: At least 115 units or permission of the academic supervisor.

SEE 499 – Sustainable Energy Engineering Thesis (9)

A thesis based on a research or development project that incorporates a significant level of engineering design. Typically undertaken in the student's final year, but in no case before the student has completed 115 units. Registration for SEE 499 takes place in the term in which the thesis will be presented and defended. The locale of the work, supervision and other arrangements follow those for SEE 498. Grading of the thesis will be on a pass/fail basis, but recognition will be given to outstanding work. Prerequisite: SEE 498.

3.3 Existing and new courses

The two above listed courses (SEE 498 and SEE 499) are the two new courses required for the program.

3.4 Curriculum and program goals

The curriculum and program goals are to enhance the current SEE program with a research component for those students who are interested in pursuing graduate research. The two courses (SEE 498 and SEE 499) would allow students to do a graduate level research project to learn research skills. Other than this, the main curriculum and program goals mirror the SEE B.A.Sc. program and curriculum goals, provided here for reference from the B.A.Sc. SEE program proposal.

The SEE program educational goals are to:

1. *Integrate energy, social and environmental factors with the principles of energy conversion, utilization and systems for engineering design.*
2. *Analyze and design energy components and systems using scientific and engineering principles and tools with reference to a sustainable energy industry, including smart city energy and environmental systems, clean transportation systems, and sustainable manufacturing systems.*
3. *Use foundational and specialized knowledge to design and implement sustainable energy solutions, from generation to utilization.*
4. *Analyze and investigate global economic, environmental, societal, regulatory, health and safety factors in the context of energy systems.*
5. *Analyze and apply business and entrepreneurship principles, and economic models, to the development and implementation of sustainable energy systems.*

6. *Demonstrate adaptability, ability to work individually and in teams, and the skills to communicate effectively in multidisciplinary and interdisciplinary settings, using a variety of media and forums.*
7. *Serve the public interest through competency in engineering practice and commitment to environmental stewardship using ethical conduct, professionalism and application of life-long learning skills.*

These educational goals are achieved through a series of content and pedagogical components in the curriculum, including: design and capstone; elective focus areas; environmental, societal, regulatory, health and safety factors; engagement with multiple disciplinary perspectives; interdisciplinarity and sustainability; co-op term and alternative experience; and communication skills. In addition, the program will be housed in an extraordinary building that will provide numerous curricular opportunities.

Design and Capstone (#1, #2, # 3)

Engineering design processes are introduced in two courses in the first term and revisited in numerous other courses. Three project design courses, two of which make up the capstone experience, allow the student to engage more deeply with the design process and grapple with the vagaries and complexities of real world considerations.

Interdisciplinarity and Sustainability (#1, #3, #4)

Projects and real world scenarios and problems require the student to integrate factors and specifications from multiple sources to carry out their learning and assessment tasks. Throughout the curriculum, numerous smaller projects and assignments use real-world scenarios and problems. These primarily occur within the classroom, but occasionally involve working with industry, community or academic partners.

Elective Focus Areas (#2)

In fourth year, students will select courses from three elective focus areas: Smart City Energy and Environmental Systems, Clean Transportation Systems, and Sustainable Manufacturing Systems. Within the scope of Smart City Energy and Environmental Systems, students may select courses in an elective concentration on Low Power Electronics Design for Sustainable Engineering Applications, offered by the School of Engineering Science at SFU's Burnaby Campus. Students build on their foundational knowledge and skills as they learn about a specialized area of their choice.

Environmental, Societal, Regulatory, Health and Safety Factors (#4)

Economic, environmental, societal, regulatory, and health and safety factors are introduced in the first term in SEE 110 Energy, Environment and Society, touched on in several courses in second and third year, and then

revisited at a deeper level in fourth year courses in REM 321 Environmental Economics, SEE 402 Professional Engineering Ethics and Practice, and the GEOG electives.

Engagement with Multiple Disciplinary Perspectives (#5 and #6)

In the third and fourth year, students are exposed to multiple disciplinary perspectives. This encourages the development of critical and creative thinking skills that students will bring to their future engineering practice.

For example, across the subjects of business, economics and entrepreneurship, students take courses from three different SFU faculties, SEE 300 The Business of Engineering, REM 321 Ecological Economics, and BUS 238 Introduction to Entrepreneurship and Innovation.

Similarly, each of the three elective focus areas includes a geography course along with SEE technical electives, and students are required to select one of these geography courses. Thus, through their elective focus area students engage in a specialized subject from more than one disciplinary lens.

Communication Skills (#6)

The curriculum includes two W designated courses, SEE 101W and SEE 410W, which bookend the students' writing practice. In addition, five other courses, SEE 110, SEE 111, SEE 310 and SEE 402, have a special emphasis on communication skills including writing, presenting and interpersonal skills. Within these additional courses, some aspects of the W criteria have guided the design of the learning

3.5 Work experience/field/practicum placement

The B.A.Sc. SEE program includes a mandatory co-op program and this would be maintained for the B.A.Sc. SEE Honours option. From the original program proposal for the B.A.Sc. SEE:

Upon completion of a co-op term, students will be required to write a technical report, describing the work they completed during their co-op term and how it relates to what they have learned in their course work. Students receive a pass/fail grade on these reports.

In order to successfully fulfill their co-op requirement, students must complete three co-op terms (a minimum total of 12 months) working in technical roles in industry.

Co-op work terms for the SEE program will take place in BC, throughout Canada and around the world. Co-op salaries for all SFU engineering programs are competitive and approach those of graduating engineers by the end of the program. Students may begin their co-op terms as early as

> *their second semester in the program. Many students receive job offers from their co-op employers during their last co-op semester.*

If there is a work experience/field/practicum placement component to this program, provide some details on placement opportunities and the level of support the institution will provide to students seeking placements. Describe any anticipated outcomes, how the experience ties into the curricular outcomes and goals, and how students will be evaluated.

4 Program Resources

4.1 Target audience and enrolment plan

The B.A.Sc. SEE Honours program targets students who, before they complete their B.A.Sc. program, are interested in exploring a research project. The first graduates of the B.A.Sc. SEE program are expected in 2022, and it is expected that ~3-5% of B.A.Sc. graduates would elect for the honours option. In the first year this would be a maximum of one or two students, commensurate with the small first graduating class. In follow-on years this would increase to around 3-10 students at steady state, when the SEE B.A.Sc. program is fully subscribed.

4.2 Resources

The B.A.Sc. SEE Honours program would not require additional resources. Faculty in SEE are expected to supervise/mentor students during their existing capstone projects and the Honours thesis supervision would be similarly supported by faculty who have an interesting research project that an undergraduate student could take on. Lab equipment, software and other resources would be provided by the faculty member(s) as part of their ongoing research activities.

5 Program Review and Academic/Administrative Oversight

Similar to B.A.Sc. SEE program, the proposed Honours program will undergo the Canadian Engineering Accreditation Board (CEAB) accreditation. From the B.A.Sc. full program proposal:

> *All engineering programs in Canada are assessed at least every six years and must meet stringent standards in order to maintain their accreditation status. The underlying basis for accreditation is that regulatory authorities in each Canadian province (in BC, the Association of Professional Engineers and Geoscientists of British Columbia) recognize graduates of accredited programs as meeting the academic requirements for licensure as a P.Eng., which is needed to practice engineering.*

One of the requirements of the CEAB assessment is that the program must demonstrate that its graduates possess attributes under the following headings:

- *knowledge base for engineering*
- *problem analysis*
- *investigation*
- *design*
- *use of engineering tools*
- *individual and team work*
- *communication skills*
- *professionalism*
- *impact of engineering on society and the environment*
- *ethics and equity*
- *economics and project management*
- *lifelong learning*

To satisfy these, and other, requirements the curriculum of the program must meet a minimum number of hours in a variety of subject areas as defined by the CEAB. This requirement includes a given amount of engineering science and design hours that must be delivered by faculty with a P.Eng.

Included below is a breakdown of the minimum AU requirements for an accredited engineering program.

CEAB Content Component	***Accreditation Units (AU)***
Engineering Design (ED)[1]	*≥ 225 AU*
Engineering Science (ES)	*≥ 225 AU*
ES +ED combined[2]	***≥ 900 AU***
Natural Sciences (NS)	*≥ 195 AU*
Natural Sciences and/or Mathematics	***≥ 420 AU***
Complementary Studies	*≥ 225 AU*
Open (expected to be used	*≤ 405 AU*

predominantly for ES +ED)	
Entire Program	***≥ 1950 AU***

[1] A minimum of 225 AU of engineering design curriculum content in an engineering program shall be delivered by faculty members holding professional engineering licensure.

[2] A minimum of 600 Accreditation Units (AU) of a combination of engineering science and engineering design curriculum content in an engineering program shall be delivered by faculty members holding professional engineering licensure.

The program will apply for recognition and accreditation from CEAB a year before its first cohort of students are due to graduate.

In addition, as mandated by Senate, the program will be externally reviewed at seven-year intervals.

6 Program Consultation

The proposed Honours option for the SEE program has been discussed in the School of Sustainable Energy Engineering, at the SEE Undergraduate Curriculum Committee (which includes a SEE Student Society representative) and with other Schools within the Faculty of Applied Sciences.

Apart from this, a series of letters and statements of support for the SEE B.A.Sc. program are provided in Appendices 8.3 and 8.4 of the B.A.Sc. full program proposal are reflective of the consultation that has taken place for SEE program.

7 Evidence of Student Interest and Labour Market Demand

7.1 Evidence of student interest

There is broad interest in the SEE student body for research experience as evidenced by undergraduate students volunteering for research projects with SEE faculty, students expressing interest in continuing on to Masters' programs, as well as strong application interest in SEE graduate programs.

7.2 Evidence of labour market demand

The results from the survey completed for the B.A.Sc. SEE program are also applicable to this Honours proposal:

> *A survey of 96 cleantech and sustainable energy technology companies in Canada (conducted by The Delphi Group in the Fall of 2016 as part of the*

development process for this FPP[1]) identified the following cleantech segments as those expected to see the highest global growth over the next decade:

1. *Energy storage and battery technology;*
2. *Clean power generation;*
3. *Smart grid, transmission, and distribution;*
4. *Clean transportation technology;*
5. *Energy efficiency, conservation, and demand-side management;*
6. *Green building design and construction; and*
7. *Water and wastewater.*

For the market opportunities in British Columbia more specifically, BC-based companies selected (1) green building design and construction, (2) clean transportation technology, and (3) energy efficiency, conservation, and demand-side management as the top growth segments over the next decade. Many see higher growth potential outside of BC for their cleantech solutions in the short-term, although it may not require going far from home given potential increasing demand from other Western provinces such as Alberta and/or West coast states including California, Oregon, and Washington.

Cleantech companies that responded to Delphi's survey identified a shortage of skilled and qualified engineers available in Canada for supporting the growth of their businesses. In addition, only 54% of the 74 companies surveyed that hire engineers felt that post-secondary institutions in Canada are currently offering undergraduate engineering programs that adequately cover the knowledge and skills needed by their companies at an entry level.

Survey respondents suggested that a program offering a more "broad-based" energy systems focus that includes techno-economics and a specialization in certain areas of environmental or clean technology (such as energy storage and smart grid, a broad range of renewable energy technologies, alternative fuels and technologies, and resource optimization solutions) would add value to the industry and fill a current gap in the market. Findings from the market research suggest that the program should be global in outlook, multi-disciplinary in nature, be grounded in solid engineering fundamentals, and include hands-on, practical experience (such as a co-operative education program).

[1] Canadian Cleantech Industry Consultation. Findings & Summary Report. October 2016. The Delphi Group.

The top suggestions from the survey respondents for topics of a new undergraduate-level engineering program focused on sustainable energy systems and clean technology included:

- *An understanding of energy systems;*
- *An understanding of mechanical, electrical, and computer engineering / ICT systems (including an understanding of the Internet of Things, software development, and coding);*
- *An understanding of advanced instrumentation and controls;*
- *An understanding of business / entrepreneurship fundamentals and financial literacy;*
- *An understanding of global market demand for certain technologies and their related economics;*
- *An overview of sustainability and public policy drivers; and*
- *Hands-on, practical instruction and experience (e.g., co-ops).*

In terms of non-technical skills, survey respondents look for Bachelor's level engineering graduates with: strong creative thinking and problem-solving capabilities, interpersonal / teamwork skills, strong communication and presentation skills, and project management skills. This information reinforces findings from an additional survey of BC-based cleantech companies that was undertaken in support of the BC Government's New Technology Strategy. This survey identified interpersonal and creativity skills as the most needed 'non-technical' junior-level skills needed by BC cleantech companies.

In addition to the market survey done specifically for this proposal, market research for BC's Technology Strategy identified top talent challenges for BC cleantech companies that include a lack of technically skilled candidates and a shortage of junior-level hires with specialized skills relevant to cleantech. This is also reflected in the testimonials from cleantech industry professionals provided below:

"The area of renewable power and smart energy has experienced an exponential growth for the last decade and presents a significant economic opportunity for Canada. Our industry requires a steady stream of job-ready and well-trained engineers and entrepreneurs, who can ideally be productive on their first day of employment. SFU's proposed Sustainable Energy Engineering option has the potential to train tomorrow's engineers in successfully managing future green engineering challenges."

Victor Goncalves, Chief Technology Officer – Alpha Technologies Ltd.

"B.C needs to offer cutting-edge technology engineering education to stay ahead of advances and to compete on the world stage."

Amyn Rajan, Former CEO, Simba Technologies

"There is a great demand for engineers who are well-versed in managing environmental challenges and incorporating sustainability into their design solutions and we find that we usually will have to go outside the province if not outside Canada to find the right skills. It would benefit Powertech and many others in the sector if B.C. was able to expand engineering education, particularly in the sustainability area."

Raymond Lings, CEO, Powertech Labs

"We see tremendous benefit in expanding SFU's Surrey campus and introducing a program dedicated to sustainable energy engineering. This type of innovative program would serve companies such as Ballard very well in terms of developing a greater pool of talent to draw upon in the alternative energy sector."

Dr. Kevin Colbow, Vice President Technology and Product Development, Ballard Power

The research for the BC Technology Strategy also found that jobs in BC's cleantech sector are increasingly seeing an integration of ICT related skills. Top companies posting cleantech-related positions in BC over the last year included BC Hydro, Schneider Electric, FortisBC, Canfor, AMEC, Foster Wheeler, Ocean Networks Canada, Awesense Wireless, Carmanah Technologies, and Tantalus Systems.

8 Appendices

8.1 Calendar entry

A complete proposed Calendar entry must be attached.

8.2 New Courses

Attach new course approval forms, sample course outlines, and library reviews for each course.

8.3 B.A.Sc. in Sustainable Energy Engineering – Full Program Proposal (December 2017)

Refer to S.17-68

SFU SIMON FRASER UNIVERSITY
ENGAGING THE WORLD

Sustainable Energy Engineering (Honours) Program

Appendix 8.1: Calendar Entry

December 2020

Faculty of Applied Sciences

Sustainable Energy Engineering, Honours Option

Bachelor of Applied Science

This program, located at the Surrey campus, leads to a Bachelor of Applied Science (Honours) degree.

Admission Requirements

Admission is competitive. A supplemental application, along with related documentation, may be required for specific entry routes. For specific admission requirements, visit http://www.sfu.ca/students/admission-requirements.html.

For more information, contact an Applied Sciences Advisor.

External Transfer from Another Post-Secondary Institution

Admission is competitive and all SFU General Requirements apply. For specific admission requirements, visit http://www.sfu.ca/students/admission/admission-requirements.html.

In addition to the general requirements, the following are required:

- A minimum of 24 units of transferable coursework, including courses that are accepted by SFU as equivalents to the following:
    - One MATH course from: MATH 152, 232, or 240
    - One CMPT course from: CMPT 128, 130, 135, or (both CMPT 125 and 127)
    - One CHEM course from: CHEM 120, 121, or (CHEM 122 and CHEM 126)
    - One PHYS course from: PHYS 120, 121, 140, or 141
- Meeting all SEE program high school admission requirements

A supplemental application, along with related documentation, may be required.

Internal Transfer from Another Simon Fraser University Program

Admission is competitive, with the following minimum requirements:

- The program, and graduation with honours, requires a cumulative grade point average (CGPA) and upper division grade point average (UDGPA) each of at least 3.0 in accordance with University graduation requirements.
- Registration in at least 12 units in the term prior to admission
- No more than 5 repeats
- Meeting all SEE program high school admission requirements

A supplemental application, along with related documentation, may be required.

Co-operative Education Work Experience

Every Sustainable Energy Engineering student completes a three-term co-operative education program of practical experience in an appropriate industrial or research setting leading to a project under the technical direction of a practicing engineer or scientist. The goal is a complementary combination of work, in an industrial or research setting, and study. The placement may be within the University but in most cases the work site is off campus.

At least two of the three mandatory co-operative education terms must be completed in industry (SEE 290, 390, 490). Students may participate in additional co-op terms but are encouraged to seek diversity in their experience. The three mandatory co-op terms may include one special co-op term (SEE 294, 394, 494). Special co-op may include, but is not restricted to, self-directed, entrepreneurial, service or research co-op work terms. Permission of the Sustainable Energy Engineering co-op office is required.

Program Requirements

The following core courses are required for the Sustainable Energy Engineering (Honours) Major and cannot be substituted for "equivalent" courses in other areas without prior approval. "Equivalent" courses taken without prior approval will not be applied to graduation requirements. Students should consult an academic advisor within their program for details on obtaining permission.

The program requires a cumulative grade point average (CGPA) and an upper division grade point average (UDGPA) of at least 2.0 in accordance with University graduation requirements. A grade of C- or better in prerequisite courses is required to enroll in Sustainable Energy Engineering courses.

Students complete all of

BUS 238 - Introduction to Entrepreneurship and Innovation (3)
CMPT 130 - Introduction to Computer Programming I (3)

CMPT 135 - Introduction to Computer Programming II (3)
MATH 152 - Calculus II (3)
MATH 232 - Applied Linear Algebra (3)
MATH 251 - Calculus III (3)
MATH 260 - Introduction to Ordinary Differential Equations (3)
PHYS 140 - Studio Physics - Mechanics and Modern Physics (4)
PHYS 141 - Studio Physics - Optics, Electricity and Magnetism (4)
REM 321 - Ecological Economics (4)
SEE 100 - Engineering Graphics and Software for Design (3)
SEE 101W - Process, Form and Convention in Professional Genres (3)
SEE 110 - Energy, Environment and Society (3)
SEE 111 - Integrated Energy Solution I (4)
SEE 221 - Statics and Mechanics of Materials (4)
SEE 222 - Engineering Materials for Energy Systems (3)
SEE 224 - Thermodynamics for Energy Engineering (3)
SEE 225 - Fluid Mechanics (4)
SEE 230 - Electric Circuits (4)
SEE 231 - Electronic Devices and Systems (4)
SEE 241 - Measurement, Analysis and Forecasting (3)
SEE 242 - Computational Methods for Engineers (3)
SEE 251 - Electric Machines and Energy Conversion (3)
SEE 300 - The Business of Engineering (3)
SEE 310 - Integrated Energy Solution II (4)
SEE 324 - Heat and Mass Transfer for Energy Engineering (3)
SEE 331 - Power Electronics (4)
SEE 332 - Power Systems Analysis and Design (3)
SEE 341 - Signals and Systems (3)
SEE 342 - Feedback Control Systems (4)
SEE 351 - Bioprocess Engineering Systems (3)
SEE 352 - Power Generation and Conversion (3)
SEE 354 - Energy Storage (3)
SEE 402 - Professional Engineering Ethics and Practice (2)
SEE 410W - Sustainable Energy Design Project I (3)
SEE 411 - Sustainable Energy Systems Design Project (3)
SEE 498 - Sustainable Energy Engineering Thesis Proposal (3)
SEE 499 - Sustainable Energy Engineering Thesis (9)

and one of

SEE 325 - Mechanical Design and Finite Element Analysis (3)
SEE 333 - Network and Communication Systems (3)

and one of

MATH 150 - Calculus I with Review (4)
MATH 151 - Calculus I (3)

and either

CHEM 121 - General Chemistry and Laboratory I (4)

or

CHEM 122 - General Chemistry II (2) and CHEM 126 - General Chemistry Laboratory II (2)

Within their program, students must also complete technical, interdisciplinary and complementary studies electives as indicated below.

Elective Courses

Technical Elective Courses

Students must complete three technical elective courses from the following SEE Technical Elective list. With permission from the SEE undergraduate curriculum committee chair, students may replace one technical elective with either a directed study (SEE 486) or a special project laboratory course. Approved special topics courses may also be counted here.

ENSC 450 – VLSI Systems Design (4)
ENSC 495 – Introduction to Microelectronic Fabrication (4)
MSE 480 – Manufacturing Systems (3)
MSE 481 – Industrial Control systems (3)
SEE 460 – Additive Manufacturing and Sustainable Design (3)
SEE 461 – Electronics Manufacturing and Assembly (3)
SEE 462 – Manufacturing Processes and Materials (3)
SEE 463 – Embedded Computer Systems (3)

Interdisciplinary Elective Courses

To contribute to the program's focus on interdisciplinary knowledge, students must also take one of the following interdisciplinary electives:

GEOG 324 – Geography of Transportation (4)
GEOG 362 – Geography of Urban Built Environments (4)

Complementary Studies Elective Courses

The Canadian Engineering Accreditation Board (CEAB) requires that one complementary studies elective within the SEE curriculum meet the requirements for classification as a Central Issues, Methodologies, and Thought Processes course. Within the SEE curriculum, the course BUS 238– Introduction to Entrepreneurship & Innovation, meets this requirement.

Writing, Quantitative, and Breadth Requirements

Students admitted to Simon Fraser University beginning in the fall 2006 term must meet writing, quantitative and breadth requirements as part of any degree program they may undertake. See Writing, Quantitative, and Breadth Requirements for university-wide information.

WQB Graduation Requirements

A grade of C- or better is required to earn W, Q or B credit

Requirement	Units	Notes	
W - Writing	6	Must include at least one upper division course, taken at Simon Fraser University within the student's major subject	
Q - Quantitative	6	Q courses may be lower or upper division	
B - Breadth	18	Designated Breadth	Must be outside the student's major subject, and may be lower or upper division 6 units Social Sciences: B-Soc 6 units Humanities: B-Hum 6 units Sciences: B-Sci
	6	Additional Breadth	6 units outside the student's major subject (may or may not be B-designated courses, and will likely help fulfil individual degree program requirements) Students choosing to complete a joint major, joint honours, double major, two extended minors, an extended minor and a minor, or two minors may satisfy the breadth

			requirements (designated or not designated) with courses completed in either one or both program areas.

WQB Requirement Modifications for Sustainable Energy Engineering

For students in the Sustainable Energy Engineering program, the total number of Breadth-Social Sciences (B-Soc) and Breadth-Humanities (B-Hum) courses is reduced to 9 units (three courses), with at least 3 units (one course) in each category.

As the curriculum already requires two B-Soc designated courses (BUS 238 and REM 321), students need only take one breadth-humanities course, in addition to the required and elective courses indicated above, in order to complete the university breadth and SEE complementary studies requirement.

Residency Requirements and Transfer Credit

- At least half of the program's total units must be earned through Simon Fraser University study.
- At least two thirds of the program's total upper division units must be earned through Simon Fraser University study.

Please see Faculty of Applied Sciences Residency Requirements for further information.

Elective Courses

In addition to the courses listed above, students should consult an academic advisor to plan the remaining required elective courses.

SFU SIMON FRASER UNIVERSITY
ENGAGING THE WORLD

Sustainable Energy Engineering (Honours) Program

Appendix 8.2: Course Information Sheets

December 2020

Faculty of Applied Sciences

COURSE SUBJECT SEE **NUMBER** 498

COURSE TITLE LONG — for Calendar/schedule, no more than 100 characters including spaces and punctuation

Sustainable Energy Engineering Undergraduate Honours Thesis Proposal

COURSE TITLE SHORT — for enrollment/transcript, no more than 30 characters including spaces and punctuation

SEE Honours Thesis Proposal

CAMPUS where course will be normally taught: ☐ Burnaby ☑ Surrey ☐ Vancouver ☐ Great Northern Way ☐ Off campus

COURSE DESCRIPTION — 50 words max. Attach a course outline. Don't include WQB or prerequisites info in this description box.

Supervised study, research and preliminary work leading to a formal proposal for the thesis project work in SEE 499. This activity can be directly augmented by other course work and by directed study. The locale of the work may be external to the University or within a University laboratory, or may bridge the two locations. A plan for the student's SEE 498 activities must be submitted to the school at the time of enrollment in the course

REPEAT FOR CREDIT ☐ YES ☑ NO Total completions allowed ☐ Within a term? ☐ YES ☐ NO

LIBRARY RESOURCES

NOTE: Senate has approved (S.93-11) that no new course should be approved by Senate until funding has been committed for necessary library materials. Each new course proposal must be accompanied by the email that serves as proof of assessment. For more information, please visit www.lib.sfu.ca/about/overview/collections/course-assessments.

RATIONALE FOR INTRODUCTION OF THIS COURSE

Introducing an honours program in the SEE Bachelor of Applied Science provides more options for our students. This course matches similar courses in ENSC, MSE and CS.

SCHEDULING AND ENROLLMENT INFORMATION

Effective term and year (e.g. FALL 2016) Summer 2022

Term in which course will typically be offered ☐ Spring ☐ Summer ☐ Fall

Other *(describe)* Available anytime.

Will this be a required or elective course in the curriculum? ☐ Required ☑ Elective

What is the probable enrollment when offered? Estimate: 5

UNITS

Indicate number of units: 3

Indicate no. of contact hours: ☐ Lecture ☐ Seminar ☐ Tutorial ☐ Lab ☐ Other; explain below

OTHER

Honours thesis - no classroom hours - contact with supervisory committee as needed.

FACULTY

Which of your present CFL faculty have the expertise to offer this course?

SEE Faculty - as appropriate for the honours topic for any given student. Since the honours topic will be chosen in consultation with a faculty member, and any faculty member can supervise an honours thesis, potentially any faculty member in SEE could offer the course.

WQB DESIGNATION

(attach approval from Curriculum Office)

PREREQUISITE AND / OR COREQUISITE

3.0 GPA, approval of the department.
At least 115 units or permission of the academic supervisor.

EQUIVALENT COURSES [For more information on equivalency, see Equivalency Statements under Information about Specific Course components.]

1. SEQUENTIAL COURSE [is not hard coded in the student information management system (SIMS).]

Students who have taken (*place relevant course(s) in the blank below (ex: STAT 100)*) **first** may not then take this course for further credit.

2. ONE-WAY EQUIVALENCY [is not hard coded in SIMS.]

(*Place relevant course(s) in the blank below (ex: STAT 100)*) will be accepted in lieu of this course.

3. TWO-WAY EQUIVALENCY [is hard coded and enforced by SIMS.]

Students with credit for (*place relevant course(s) in the blank below (ex: STAT 100)*) may not take this course for further credit.

Does the partner academic unit agree that this is a two-way equivalency? ☐ YES ☐ NO

Please also have the partner academic unit submit a course change form to update the course equivalency for their course(s).

4. SPECIAL TOPICS PRECLUSION STATEMENT [is not hard coded in SIMS.]

FEES

Are there any proposed student fees associated with this course other than tuition fees? ☐ YES ☑ NO

COURSE – LEVEL EDUCATIONAL GOALS (OPTIONAL)

RESOURCES

List any outstanding resource issues to be addressed prior to implementation: space, laboratory equipment, etc:

None.

OTHER IMPLICATIONS

Final exam required ☐ YES ☑ NO

Criminal Record Check required ☐ YES ☑ NO

OVERLAP CHECK

Checking for overlap is the responsiblity of the Associate Dean.

Each new course proposal must have confirmation of an overlap check completed prior to submission to the Faculty Curriculum Committee.

Name of Originator

Mehran Ahmadi

SEE 498 – Sustainable Energy Engineering Thesis Proposal (3)

Supervised study, research and preliminary work leading to a formal proposal for the thesis project work in SEE 499. This activity can be directly augmented by other course work and by directed study. The locale of the work may be external to the University or within a University laboratory, or may bridge the two locations. A plan for the student's SEE 498 activities must be submitted to the school at the time of enrolment in the course and must include agreement from the supervisory committee. At least two of the three supervisors must be registered professional engineers, and at least one must be a faculty member in SEE. Completion of the undergraduate thesis project proposal is the formal requirement of this course and the basis upon which it is graded. Grading will be on a pass/fail basis. Prerequisite: At least 115 units or permission of the academic supervisor.

Grading

Grading will be pass/fail and evaluated through a defense of the proposal to their honours thesis committee.

COURSE SUBJECT SEE **NUMBER** 499

COURSE TITLE LONG — for Calendar/schedule, no more than 100 characters including spaces and punctuation

Sustainable Energy Engineering Undergraduate Honours Thesis

COURSE TITLE SHORT — for enrollment/transcript, no more than 30 characters including spaces and punctuation

SEE Honours Thesis

CAMPUS where course will be normally taught: ☐ Burnaby ☑ Surrey ☐ Vancouver ☐ Great Northern Way ☐ Off campus

COURSE DESCRIPTION — 50 words max. Attach a course outline. Don't include WQB or prerequisites info in this description box.

A thesis based on a research or development project that incorporates a significant level of engineering design. Typically undertaken in the student's final year, but in no case before the student has completed 115 units. Registration for SEE 499 takes place in the term in which the thesis will be presented and defended. The locale of the work, supervision and other arrangements follow those for SEE 498.

REPEAT FOR CREDIT ☐ YES ☑ NO Total completions allowed ☐ Within a term? ☐ YES ☐ NO

LIBRARY RESOURCES

NOTE: Senate has approved (S.93-11) that no new course should be approved by Senate until funding has been committed for necessary library materials. Each new course proposal must be accompanied by the email that serves as proof of assessment. For more information, please visit www.lib.sfu.ca/about/overview/collections/course-assessments.

RATIONALE FOR INTRODUCTION OF THIS COURSE

Introducing an honours program in the SEE Bachelor of Applied Science provides more options for our students. This course matches similar courses in ENSC, MSE and CS.

SCHEDULING AND ENROLLMENT INFORMATION

Effective term and year (e.g. FALL 2016) Summer 2022

Term in which course will typically be offered ☐ Spring ☐ Summer ☐ Fall

Other *(describe)* Available anytime.

Will this be a required or elective course in the curriculum? ☐ Required ☑ Elective

What is the probable enrollment when offered? Estimate: 5

UNITS

Indicate number of units: 9

Indicate no. of contact hours: ☐ Lecture ☐ Seminar ☐ Tutorial ☐ Lab ☐ Other; explain below

OTHER

Honours thesis - no classroom hours - contact with supervisory committee as needed.

FACULTY

Which of your present CFL faculty have the expertise to offer this course?

SEE Faculty - as appropriate for the honours topic for any given student. Since the honours topic will be chosen in consultation with a faculty member, and any faculty member can supervise an honours thesis, potentially any faculty member in SEE could offer the course.

WQB DESIGNATION

(attach approval from Curriculum Office)

PREREQUISITE AND / OR COREQUISITE

SEE 498

EQUIVALENT COURSES [For more information on equivalency, see Equivalency Statements under Information about Specific Course components.]

1. SEQUENTIAL COURSE [is not hard coded in the student information management system (SIMS).]

Students who have taken (*place relevant course(s) in the blank below (ex: STAT 100)*) **first** may not then take this course for further credit.

2. ONE-WAY EQUIVALENCY [is not hard coded in SIMS.]

(*Place relevant course(s) in the blank below (ex: STAT 100)*) will be accepted in lieu of this course.

3. TWO-WAY EQUIVALENCY [is hard coded and enforced by SIMS.]

Students with credit for (*place relevant course(s) in the blank below (ex: STAT 100)*) may not take this course for further credit.

Does the partner academic unit agree that this is a two-way equivalency? ☐ YES ☐ NO

Please also have the partner academic unit submit a course change form to update the course equivalency for their course(s).

4. SPECIAL TOPICS PRECLUSION STATEMENT [is not hard coded in SIMS.]

FEES

Are there any proposed student fees associated with this course other than tuition fees? ☐ YES ☑ NO

COURSE – LEVEL EDUCATIONAL GOALS (OPTIONAL)

RESOURCES

List any outstanding resource issues to be addressed prior to implementation: space, laboratory equipment, etc:

None.

OTHER IMPLICATIONS

Final exam required ☐ YES ☑ NO

Criminal Record Check required ☐ YES ☑ NO

OVERLAP CHECK

Checking for overlap is the responsiblity of the Associate Dean.

Each new course proposal must have confirmation of an overlap check completed prior to submission to the Faculty Curriculum Committee.

Name of Originator

Mehran Ahmadi

SEE 499 – Sustainable Energy Engineering Thesis (9)

A thesis based on a research or development project that incorporates a significant level of engineering design. Typically undertaken in the student's final year, but in no case before the student has completed 115 units. Registration for SEE 499 takes place in the term in which the thesis will be presented and defended. The locale of the work, supervision and other arrangements follow those for SEE 498. Grading of the thesis will be on a pass/fail basis, but recognition will be given to outstanding work. Prerequisite: SEE 498.

Grading

Grading will be pass/fail and evaluated through a defense of the thesis to their honours thesis committee.