DECISION PACKAGE TITLE:

Recommendation Summary Text:

This proposal outlines plans to expand enrollment in the Manufacturing Engineering (MFGE) and Plastics & Composites Engineering (PCE) programs by 50% each. Both programs are currently oversubscribed, so this expansion will allow both programs to better meet employer demand for qualified engineers and student demand for access to engineering degrees. In this expansion, MFGE will add a Robotics, Automation, & Systems Integration concentration, PCE will add a Sustainable Materials & Processes concentration, and there will be a new Humanitarian and Sustainable Engineering GUR. Implementing these two concentrations concurrently will take advantage of the significant overlap in these two degrees.

Fiscal Detail: [BUDGET AND FINANCIAL PLANNING (BFP) WILL COMPLETE THIS SECTION BASED ON ACCOMPANYING COST & REVENUE TEMPLATE]

	2021-22	2022-23	2021-23
RESOURCES			
Fund xxx, Net Tuition			
Fund 001, General Fund - State	$ -	$ -	$ -
Total Resources	$ -	$ -	$ -
USES (EXPENDITURES)			
Faculty	$ -	$ -	$ -
Graduate Teaching Assistants	$ -	$ -	$ -
Exempt	$ -	$ -	$ -
Classified	$ -	$ -	$ -
Hourly	$ -	$ -	$ -
Salaries and Wages	$ -	$ -	$ -
Employee Benefits	$ -	$ -	$ -
Goods and Services	$ -	$ -	$ -
Equipment	$ -	$ -	$ -
Total Expenditures	$ -	$ -	$ -
STAFFING FTE (B6)			
Faculty	0.00	0.00	
Professional Staff	0.00	0.00	
Classified Staff	0.00	0.00	
Hourly	0.00	0.00	
Total FTE	0.00	0.00	

Package Description

Narrative Justification and Impact Statement:

This document outlines the proposed expansion of Western's Manufacturing Engineering (MFGE) and Plastics & Composites Engineering (PCE) programs to increase student access, to add concentrations in Robotics, Automation, & Systems Integration and Sustainable Materials & Processes, and to develop a GUR course. This GUR course will allow students outside of the Engineering and Design Department (ENGD) to learn about issues of sustainability related to materials and manufacturing processes and humanitarian engineering in general. This proposal will require five new tenure-track faculty lines and three staff positions, two technical and one support, to implement.

The expansion of MFGE and PCE will allow both programs to expand their graduating classes by 50%. Both programs will increase from 24 graduates/year to 36 graduates/year, resulting in a total capacity of 72 engineering graduates/year from the two programs. Both of the program will also add new concentrations. These new concentrations will address local industry demand and State needs, and concurrent implementation of them will allow for current curricula to be adapted to include more aspects of automation and sustainability and take advantage of the shared foundation of the two programs. These concentrations will provide students with more options, both in terms of focus on critical areas and potential technical electives to improve breadth, and they will provide students with more flexibility as they move through their degrees, by leveraging the shared foundation of these two programs. Based upon the current experience with concentrations in the Electrical and Computer Engineering (ECE) program and prior experience with concentrations in the old Engineering Technology programs, having concentrations is an efficient way for students to focus their degrees to better prepare them for specializations within their field. Concentrations have been attractive to both potential students and potential employers, yet they are relatively low cost since they take advantage of a common core of coursework. The new GUR course will serve as an introduction to humanitarian and sustainable engineering, but the GUR will be designed for non-majors who may only be interested in learning more about these areas than in pursuing one of them as a major and career.

The MFGE and PCE programs both currently have student demand that they cannot meet. In 2018-19 they received ~80 applications from qualified students for 48 spots (see Table 1), and this year they should receive more applications due to an anticipated increase in qualified and major-ready transfer students. Both programs also have strong industry connections and good placement rates into engineering positions or graduate schools in or related to engineering. Increasing the size of both the MFGE and PCE programs by 50% will not only address unmet student demand and add engineers that Washington needs, it will add engineers prepared in areas of current need and growing importance – automation and sustainability. The sustainability of materials and manufacturing processes also has been shown to be of special interest to a more diverse population than is often attracted to traditional engineering programs. By having a sustainability concentration, the PCE program expects to be able to accelerate current efforts in the recruitment and retention of a more diverse student population. Finally, expanding the MFGE and PCE programs will also increase the number of faculty members with expertise in these areas, which will allow for more and stronger connections with local and regional industries.

The case for a Robotics, Automation, & Systems Integration concentration:

The proposed Robotics, Automation, & Systems Integration concentration is driven by an increasing need for engineers to support manufacturing operations in Washington, particularly those that are incorporating an increased use of robotics and automation. A prime example of this trend can be seen at the Boeing Company, the leading manufacturer in the State. New assembly lines and the re-tooling of old ones are incorporating greater use of robots and automation. One example is Boeing's efforts at developing a Fuselage Automated Upright Build (FAUB) system where robots drill holes and work in pairs to install over 50,000 rivets that hold the metal skins of the front and rears sections of the 777X fuselage in place. Challenges faced by Boeing in the development of FAUB that have delayed its implementation underscore the need for manufacturing engineers skilled in robotics, automation, and the integration of systems. Other examples can be found in Boeing's new Composite Wing Center in Everett that is currently producing the first composite wings for the new 777X commercial airplane. Here robots work alongside human workers performing operations such as providing flexible fixtures and automated carbon-fiber tape-laying in fabricating the U-shaped carbon fiber composite wing spar. According to Jason Clark, Vice President of 777 operations and an alumnus of WWU's Engineering & Design (ENGD) department, this is "a change in the history of how we (Boeing) manufacture". An increase in engineers with experience and knowledge in the area of automation and robotics and more faculty with expertise in this area at Western will help programs such as FAUB and Boeing's other automation initiatives succeed in the future.

Another example at the other end of the size spectrum and even closer to home can be seen at Superfeet™, a Ferndale based company that specializes in the design and fabrication of insoles. The company recently opened a manufacturing facility called Flowbuilt for making custom shoes and insoles. Customers using the company's Fitstations at retailers across the nation send their measurements in to have a customized product created for them using the new automated production facility. This use of automation is an example of how new jobs are created through retraining and skills development in the latest technologies. This facility has the potential to employ up to 50 workers in Whatcom Country to do the work of 140 offshore workers using older, more manual manufacturing processes.

Manufacturing Engineers are at the vanguard of the efforts to design, integrate, install, operate and maintain these new automated systems, be they at the largest or smallest companies. WWU's MFGE program is ideally positioned to develop the next generation of engineers who are both knowledgeable and skilled in robotics, automation, and systems integration. These graduates will be indispensable in advancing the State's manufacturing competitiveness and in creating new jobs for an automation driven economy. Increased use of automation in manufacturing will transform but the nature of work by replacing menial, repetitive, or dangerous jobs with jobs that are higher paying and that require more education. Automation also leads to higher efficiency in terms of energy and materials usage and can make processes efficient enough to be affordable. Increased use of automation is one of the requirements for improving sustainability of manufacturing operations.

The case for a Sustainable Materials & Processes concentration:

A parallel requirement for improving the sustainability of manufacturing is improving the materials that are used in manufacturing processes and how we are able to recapture and reuse them. The proposed Sustainable Materials & Processes concentration is also driven by regional need as well

as global issues. In the Pacific Northwest, there is a high concentration of companies developing, producing, and using plastics, composites and other advanced materials. These companies include a range of aerospace manufacturers and suppliers, producers of automotive and marine vehicles, producers of feedstock materials (fibers, polymers, resins, alloys, commodity and specialty chemicals), operators of degradable plastics composting facilities and plastics recyclers. For these companies, issues of sustainability are increasingly important for both their bottom line and their desire to reduce potential impacts on the environment. These include questions such as:

- What are the impacts of the ways in which a material is sourced?
- What is the energy and environmental footprint of the production process?
- Can the material be repurposed or recycled?
- Can material waste be used to generate energy?
- What are the possibilities for the adoption of bio-based and biodegradable materials?
- How can material and supplies usage be minimized for a particular application?
- How can automation be used to reduce material and energy usage?
- How can properties of materials be predicted computationally in order to optimize the development of new sustainable technologies by reducing the time, cost, and waste?

Essentially, the old concept of cradle-to-grave in the consideration of materials usage and development has given way to models of cyclic, cradle-to-cradle materials systems, so there is a need to increase the number of engineering graduates with a strong foundation in sustainable materials and processes. A current example of this is that the European Union has set to ban phenolic materials in aerospace applications due to its inherent toxicity (releasing phenol and formaldehyde) during manufacturing. Safran has partnered with WWU to investigate an alternative to phenolic. WWU has successfully created a new resin system from Benzoxazine that has been formulated to be a drop-in replacement for the phenolic. WWU has proven that this material can be prepregged, stored, and processed using the same equipment and timelines of their current phenolic system – all while ensuring that the material successfully meets all FAA and mechanical requirements.

Despite a strong need, Washington State and the Pacific Northwest are currently underserved by academic programs with a focus in sustainable materials and processing methods, and there appears to be a strategic opportunity to satisfy several regional workforce and development needs while simultaneously improving access to bottleneck courses and programs in CSE, increasing diversity in ENGD programs, and increasing the research opportunities available to WWU students. WWU's PCE program is ideally positioned to develop the next generation of engineers who are both knowledgeable and skilled in sustainable materials and processing methods, and to lead the effort to develop a GUR course to allow students outside of engineering to learn more about sustainable materials and manufacturing processes and humanitarian engineering. These graduates will be indispensable in helping the State and the world address these critical issues in the future.

Concentrations overview:

Funding this proposal will allow both the MFGE and the PCE programs to graduate 36 students/year, a 50% increase on their current capacities. Because MFGE and PCE majors share a foundation of a dozen ENGD classes, growing the two programs simultaneously reduces the number of sections of foundation classes that must be added while providing all of the students in both majors with more options to satisfy graduation requirements. The addition of concentrations in the

proposed areas will provide students with more flexibility in their degrees and with degrees that are focused towards growing industry needs, resulting in degrees that are more marketable.

The new concentrations in automation and sustainability in the MFGE and PCE programs will be designed to accommodate half of the students in each major, but with the flexibility to adjust to up to two-thirds of any given cohort if there is more interest. Both concentrations would add a small number of classes to allow students to achieve greater depth of understanding and experience in the concentration areas. The Robotics, Automation, & Systems Integration concentration would be able to build off of three existing automation classes, so it will only require two additional classes and a focused senior project. The Sustainable Materials concentration will require three new classes and a focused senior project. Some of these classes will also serve as elective options for students not in the concentrations. In addition, we anticipate changes to some existing classes to more broadly introduce students to issues of automation and sustainability. For example, MFGE 333 Design for Manufacturing, a required course for MFGE majors, will become Design for Sustainable Manufacturing, and MFGE 350 Introduction to Manufacturing Automation, a brand-new course for MFGE majors, will become a required course for PCE students rather than an elective. While the new classes could be created now, and one is being piloted this year, we do not have the resources to offer them on a regular basis or to allow the additional students into the MFGE and PCE programs. The additional 5 faculty and 3 staff positions requested in this proposal would allow all of these classes to be taught annually and allow for growth to a total of 72 graduates/year. In addition to the newly created MFGE 350, the new classes we intend to introduce are:

ENGR 2xx Introduction to Humanitarian and Sustainable Engineering – The application of engineering to meet the needs of communities and individuals, with a focus on equity, inclusion, and diversity. Design of products and manufacturing systems to use energy, materials, and other resources sustainably. Developing locally-sourced, cradle-to-cradle material systems. *This class will be taught as a GUR three times per year.*

MFGE 4xx Systems Integration – The theoretical fundamentals and hands-on experience of using the different standard programming languages of automation and controls to program PLC, HMI and SCADA systems, developing industrial communication, networking and protocols such as Modbus and EthernetIP, integrating automation equipment such as robots, actuators, sensors, motors, and vision systems. *This class will be a required class for the Robotics, Automation, & Systems Integration concentration. It is being offered for the first time as an experimental technical elective this quarter, winter 2020.*

MFGE 4xx Sensors, Data Acquisition, and Analytics in Manufacturing – Explores the theory and practice of sensors used in manufacturing processes. Studies data acquisition techniques and the management, analysis, visualization, and interpretation of large-scale data sets extracted from processes. Use of results to eliminate root causes of production problems and to optimize processes. *This class will be a required class for the Robotics, Automation, & Systems Integration concentration and will serve as an elective option for PCE majors.*

PCE 3xx Introduction to Sustainable Polymer Materials – Provides an introduction to the environmental, financial, and social impacts of polymer materials. Difference between degradable, biodegradable, compostable, and persistent. Discussion of processing, degradation, and recycling of polymer materials. Life Cycle Assessment case studies will be utilized to discuss Design for Sustainability. *This class will be a required class for the Sustainable Materials & Processes concentration and will serve as an elective option for MFGE majors.*

PCE 4xx Characterization and Processing of Reclaimed Materials – Techniques for the identification of plastics and composites from waste streams and the performance of those reclaimed materials. Relationship between structure, properties and processing. Automation and recycling methods for waste streams including chopping, washing, identification and separation. *This class will be a required class for the Sustainable Materials & Processes concentration.*

PCE 4xx Design and Manufacturing of Sustainable Composites – Sustainable Composites Design and Manufacturing – Design of composite structures utilizing sustainable matrix materials (thermoplastics, bio-based resins, reversible thermosets) and reinforcements (reclaimed, natural fibers). Design, manufacturing, and characterization of composites will be included. *This class will be a required class for the Sustainable Materials & Processes concentration and will serve as an elective option for MFGE majors.*

All of the new courses for the new concentrations will be lab-based courses, and we will look to have lab-based experiences in the GUR class as well. In addition to these new courses, both new concentrations would have their own senior project sequences, a three course, ten-credit, year-long experience that allows students to apply their course work to open-ended industry-sponsored or research problems appropriate to their concentration.

a) What specific performance outcomes does the agency expect?

The expected outcomes from funding this proposal are:

- A 50% increase in the combined MFGE and PCE graduates from 48/yr to 72/yr. This also represents a 25% increase in the overall capacity in all engineering programs.
- There will be a group of graduates who are more thoroughly prepared to work on problems related to robotics, automation, and the integration of manufacturing systems.
- There will be a group of graduates who are more thoroughly prepared to work on problems related to sustainable materials and manufacturing processes.
- All graduates of both MFGE and PCE will have increased exposure to and knowledge of automation and sustainability.
- Maintenance of persistence and graduation rates that exceed 92%.
- An increase in the number of students of color and Pell Grant eligible students who graduate with engineering degrees, due to the combination of better prepared pre-majors (see section (d) for details) and more space in the majors.
- When coupled with the approval of the new Major-Ready Pathway track (see section (d) for details), the increase in space in the majors will lead to a decrease in time to graduation for transfer students.
- ~150 students will have opportunities to learn about sustainable and humanitarian engineering through a new GUR course.

b) Performance measure detail.

Specific targets:

- Up to 36 MFGE graduates per year.
- 16-20 graduates per year from the Robotic, Automation, & Systems Integration concentration.

- Up to 36 PCE graduates per year.
- 16-20 graduates per year from the Sustainable Materials concentration.
- Including ECE graduates, up to 120 engineering graduates per year.
- Persistence and graduation rates for MFGE and PCE remaining above 92%.
- Increase in the number of students of color and Pell Grant eligible students receiving engineering degrees.
- Reduced time to graduation for transfer students in engineering.
- Increased faculty and staff expertise in the areas of automation and sustainability.

c) Is this proposal an expansion or alteration of a current program or service? If so, provide detailed historical financial information for the prior two biennia.

Both the MFGE and PCE programs were funded to transition from engineering technology to engineering as part of the 2013-15 budget. Both programs were oversubscribed as engineering technology programs, both saw a sag in interest in during the 2015-16 academic year due to the uncertainty around the pending accreditation review, and both saw a quick growth in interest once ABET accreditation was earned. The numbers that seem to be important relative to historical financial information are the faculty FTE assigned to each program, the number of applications for each program, and for each application cohort the number of students accepted and the number of graduates. Table 1 shows these data from AY2014-15 to AY2018-19. Note that in addition to the major courses, the MFGE and PCE program faculty support the pre-major ENGR courses as well as the courses for the two majors. The application numbers also include summer applications, except for the 2018-19 academic year during which no spaces were held for summer applications due to the large number of students already in both programs. The primary application period is winter of sophomore year, so there is a two-year delay between applications and graduates, and a handful of students in most cohorts graduate a quarter late or in the summer.

Table 1: Faculty FTE, Number of Applications, and Number of Graduates from that cohort for the MFGE and PCE Programs

		MFGE				**PCE**		
AY	Fac. FTE	# Appl.	# Acptd	# Grads	Fac. FTE	# Appl.	# Acptd	# Grads
2014-15	4.5	34	19	19	3.5	38	21	19
2015-16	4.5	23	20	16	4.5	24	19	18
2016-17	4.5	44	22	20	4.5	34	23	19
2017-18	3.5	41	28	tbd	4.5	39	29	tbd
2018-19	4.5	43	28	tbd	4.5	36	27	tbd

A few notes regarding the data in Table 1:

- Both the MFGE and PCE programs are design to graduate 24 students/year.
- For the years shown, the average number of students who applied to both programs was ~9.
- Up through 2016-17, spaces were held for transfer students, but there were not enough junior-ready transfer students to justify this practice, so it was ended. The adoption of a Major-Ready Pathway (see section (d) for details) should improve transfer students' ability to be junior-ready for both the MFGE and PCE majors.

- The 2016-17 cohorts include students who are still working toward their degrees.
- The 2017-18 and 2018-19 cohorts were overenrolled to give students in the Industrial Technology-Vehicle Design (IT-VD) degree the opportunity to get ABET accredited degrees without reducing the size of the cohorts of new students. Overenrolling the MFGE and PCE majors has been very challenging and is not sustainable.
- The MFGE 2018-19 cohort includes one student who transferred to MFGE from the PCE 2017-18 cohort.

d) Is this decision package essential to implement a strategy identified in Western's strategic plan?

The proposed expansion aligns well with Western's Core Themes and supports the goals and a number of the objectives in the strategic plan.

Alignment with Core Themes:

Advancing Inclusive Success – The ENGD department is fully committed to advancing inclusive success, and this proposal is a piece in the overall puzzle to do so. As is stated in the theme's description, in order to advance inclusive success we must "increase retention and persistence rates and the number of graduates, while eliminating achievement gaps for students from diverse and under-represented socio-economic backgrounds." Expanding the number of spaces for students interested in engineering degrees is *part* of the solution for advancing inclusive success. The MFGE and PCE programs have a combined persistence rate of over 92%, so increasing the size of these majors has a very high probability of increasing the number of graduates. The development of a GUR class on Humanitarian and Sustainable Engineering is intended to make a broader, more diverse group of students aware of the breadth of engineering, and hopefully encourage a few of them to give it a try. Finally, automation and sustainable materials have proven to be very rich areas for undergraduate research, so increasing capacity and the number of faculty will provide more students with research opportunities.

Given the very high persistence rate in MFGE and PCE, we have focused our efforts for improving equity and inclusion at the pre-major level with the expectation of increasing equity, inclusion, and diversity in the majors by helping students to successfully navigate their pre-major experience. In the last two years ENGD has:

- Hired a part-time Director of Pre-Engineering Program Development (DPEPD).
- Received funding for and has successfully completed a search to hire a First-Year Program Director. This is a TT faculty position replacing the part-time DPEPD.
- Received an NSF funded S-STEM grant, Becoming Engaged Engineering Scholars (BEES) to support high-need students through their pre-major periods. While this program only supplies a limited number of scholarships for students, the portions of it that support student success are going to be scaled up next year to increase its impact and improve student success more broadly.
- Introduced a pre-major orientation.
- Opened a Maker Space to support pre-majors.
- Amended ENGR 104 Introduction to Engineering & Design to make the major team-based design project a humanitarian engineering project.

- Developed plans to replace ENGR 104 with a more inclusive pair of classes, Engineering, Design & Society and Engineering Innovation & Design. The plan is to pilot these two courses next year and make them permanent replacements for ENGR 104 in AY2021-22.

The goals of these efforts are 1) to make sure that the percentage of women, students of color, Pell Grant eligible students, and first-generation students do not decline from the pre-majors to the majors and 2) to increase the diversity of the pre-majors by improving equity and inclusion and students' sense of belonging.

In addition to changes in the ENGD department listed above, we have been working with the Washington Council on Engineering and Related Technical Education (WCERTE), the Joint Transfer Council (JTC), Council of Presidents (COP), and the State Board for Community and Technical Colleges (SBCTC) to develop and get approval for a Major-Ready Pathway (MRP) that will help community college students be able to join the MFGE and PCE majors as true juniors. The MRP is ready but still going through the approval process, and a number of community colleges have implemented the necessary courses for smooth transfer into the MFGE and PCE majors. This we anticipate will lead to a significant increase in transfer applications during AY2019-20. All of these changes are designed to advance inclusive success, but they will only serve to make entrance to the majors more competitive with no guarantee of increased diversity if we do not also increase capacity. There is no single thing that we can do to advance inclusive success; it must be a systemic effort, and increased capacity in the majors is part of that effort.

Increasing Washington Impact – Increasing the number of graduates and the size of the faculty in engineering will both have a positive Washington impact, and educating those additional engineers so that they are prepared to address challenges regarding automation and sustainability will increase that positive impact. As is stated in this theme's description, "we must prepare our students to be successful in a continuously changing work and social environment, where technology and automation are driving employment trends, and significantly changing the nature of work and relationships." The Governor has identified increases in STEM graduates as a goal and has specifically cited a gap in the number of engineering graduates in Washington; this proposal would help both of those issues. The Governor has also cited the need for efficient industrial processes and a clean and restored environment as goals as well. Educating engineers who have additional depth of knowledge and experience in the areas of automation and sustainability will further those goals, as will having more faculty members pursuing research in these areas. As mentioned in the first section, based upon our experience with industrial partners and companies that recruit our graduates, most Washington companies, large and small, are looking to increase their use of automation to increase efficiency and reduce waste. There are also a number of Washington companies, such as, Boeing, Safran, PACCAR, SGL Automotive Carbon Fibers, Janicki Industries, Vartega, Weyerhauser, and Idex, that have developed sustainability goals or initiatives. Furthermore, members of the Washington State Academy of Sciences, in consultation with advisors from Boeing, Blue Origin, JCDREAM, the WA Dept. of Commerce, and others have identified sustainable materials development as a strategic area for research and development investment in the state of Washington.

Enhancing Academic Excellence – Expanding the MFGE and PCE majors will enhance high quality undergraduate programs, set the stage for developing graduate programs in these areas, and allow for progress on critical issues such as sustainability and Western becoming a greater

catalyst for regional economic development through industrial partnerships. Both the MFGE and PCE programs have well established records of engaging undergraduate students in meaningful and innovative industry-sponsored projects and research through senior projects, directed research, and sponsored summer research. There will be an increase in high-impact experiences that are available to students as the number of faculty doing research in these areas increases. Moreover, automation and sustainability have shown themselves to be very good research areas for undergraduates and have engaged many students since the MFGE and PCE programs transitioned to engineering in 2014. The MFGE and PCE programs have been so successful at attracting industrial partners that recently these programs have been getting more opportunities for students through industry-sponsored projects and grants than there have been students to complete them. So, there is already capacity to engage more students, and increasing the size of the tenure-track faculty will continue to grow these opportunities and promote opportunities for external funding to support faculty and student research.

Alignment with the Strategic Plan:

<u>Goal #1: Western will provide a transformational education grounded in the liberal arts and sciences and based on innovative scholarship, research, and creative activity.</u>

A. Strengthen the liberal arts and sciences foundation to ensure and expand student access to the breadth of our undergraduate, graduate, and professional programs.

- By adding a GUR course that introduces Humanitarian and Sustainable Engineering there will be more opportunities for students to broaden their experiences.

B. Provide tools and experiences for all students to follow their intellectual curiosity, to work across disciplines, and to develop the skills, knowledge, and habits of mind that will enable them to effectively contribute to evolving societal needs.

- Evolving societal needs includes a shift in the workplace to the use of higher levels of automation to produce goods and services. The growing mismatch between worker capabilities and this need can only be remedied through greater access to education. The Robotics, Automation, & Systems Integration concentration will address this by graduating more engineers with "industry-ready" knowledge and skills to design, implement, operate, and maintain robotic and automated systems.

- Students today are acutely aware of the critically important issues of sustainability and the environmental impact of technologies and are eager for their Western education to better equip them to be part of the solution to these important and pressing interdisciplinary problems. The Sustainable Materials & Processes concentration will provide students with opportunities to better understand the problems and be part of developing the solutions to them.

C. Increase support and infrastructure for all types of scholarship, research, and creative activity.

- Growth in the tenure-track faculty in MFGE and PCE will result in more opportunities for grants, industrial partnerships, and student research opportunities, especially in the areas of automation and sustainability.

D. Ensure that all students have access to high quality educational experiences beyond the classroom.

- Both MFGE and PCE have well-established records of providing students with research and project opportunities that are grant-funded or supported by industrial sponsors. Increasing the size of these programs will give more students access to these opportunities.

G. Provide technological and other academic infrastructure to support curricular innovation, research, scholarship, and creative activity, civic engagement and social justice.

- New faculty members bring fresh ideas and require new equipment to support their research. The development of the new flexible manufacturing cell, The Learning Factory, is a good example of this. We expect this to repeat itself and for start-up packages to be used to enhance existing research and teaching equipment.

Goal #2: Western will advance a deeper understanding of and engagement with place.

E. Weave the ecological, social, and economic dimensions of sustainability into and through the University's practices.

- While improving University practices is not a primary goal of this proposal, we expect that by helping students learn about issues of sustainability and possible solutions to them that we will also improve our own efforts in this area.

F. Give all students educational experiences both in and beyond the classroom that help them develop the knowledge, skills, and abilities to nurture and create the conditions for people and planet to thrive.

- The MFGE and PCE programs are lab-intensive programs that provide students with opportunities to work on problems that are of real interest and importance to areas of engineering. By increasing opportunities for students to work on and explore issues regarding automation and sustainable materials, graduates will be more thoroughly prepared to solve some of the most pressing problems for industry and society in general.

Goal #3: Western will foster a caring and supportive environment where all members are respected and treated fairly.

F. Expand networks between students, staff, faculty, and alumni/ae.

- Both MFGE and PCE have active and vibrant Industrial Advisory Committees with good alumni/ae representation. Alumni/ae are critical for building the connections that lead to sponsored projects, internship opportunities, and recruitment for permanent positions for graduates. The more student who graduate with Western engineering degrees who stay in the region for work, the stronger these connections get and the broader our network gets.

Goal #4: Western will pursue justice and equity in its policies, practices, and impacts.

C. Recruit, retain, and support more underrepresented and first-generation students at the undergraduate and graduate levels.

- While most of our work to recruit and retain students from underserved populations, which in engineering includes women, and first-generation students, is being done at the pre-major level, providing more access to the MFGE and PCE majors is a necessary piece of the puzzle to increase diversity in the majors. We believe that the combination of our efforts to improve students' pre-major experience, the introduction of a GUR to make a larger group of students aware of engineering options, more space in MFGE and PCE, and the very high persistence and graduation rates in MFGE and PCE will lead to measurable improvements in this area.

D. Implement model practices to improve our recruitment and retention of a diverse staff, faculty, and administration.

- The ENGD department has adopted many best practices for recruitment, including that every current member of the faculty has completed EOO's Implicit Bias training, and ENGD has a good track record of recruiting diverse candidates for faculty positions. Based on past experience, we believe that automation and sustainability are areas that will have diverse candidate pools, at least for engineering areas.

e) How does this package relate and contribute to the Governor's Results Washington goal areas and statewide priorities?

Goal 1: World-class education

A major priority here is an increase in the number of graduates from STEM and identified high-demand employment programs from public 4-year colleges. These graduates need to be equipped with the knowledge and skills to maintain and extend the State's leadership in key areas such as manufacturing and environmental stewardship. This proposal supports exactly this by increasing the number of engineering graduates knowledgeable and skilled in automation and sustainability practices.

Goal 2: Prosperous economy

This priority seeks to create a "Competitive and Diversified Economy". One goal is to increase gross business income (GBI) in a range of economic areas that include the *clean technology* and *aerospace* sectors. Automation and sustainability work together to support this goal. Automation improves efficiency of operations and helps reclaim high-paying jobs outsourced due to a low-wage advantage. At the same time, the use of sustainable materials and manufacturing processes to create products appeals to environmentally conscious consumers which directs their purchasing power towards companies that incorporate use of these materials and processes. Both directions expand economic activity but require a new workforce that is appropriately skilled and knowledgeable about automation and the impact of design and production choices on the environment. Engineers graduated by this decision package will be ideally suited to be part of and leaders for this workforce, and faculty members hired

through this decision package will contribute to efforts in automation and sustainability through their research.

Goal 3: Sustainable energy & a clean environment

This priority's stated goal is to "Reduce our Greenhouse Gas Emissions". A concentration on Sustainable Materials & Processes will graduate engineers knowledgeable about the impact of materials choices throughout a product's lifecycle. This will include energy usage to process the material into its raw form, turn it into a product, and its end-of-life disposal. It will also raise in prominence the role of bio-degradable and renewable materials as choices in the design of products and recycling, particularly in the area of composites, as the diversity of available options and its use for consumer products grows. Engineering graduates skilled in automation also have a role in reducing waste in both energy and material consumption through designing processes and production systems with greater operational efficiency. Automation also has the potential to provide alternatives to labor-intensive recycling currently outsourced to countries where growing concerns about the environment and worker exploitation are creating a backlash against dumping practices.

1.3.b: Increase the number of students who are enrolled in STEM (academic transfer and professional-technical programs) in public community and technical colleges from 82,695 in 2012-13 to 84,349 by 2016-17

1.3.d: Increase the number of graduates in STEM (academic transfer and professional-technical programs) in public community and technical colleges from 14,526 in 2012-13 to 14,817 in 2016-17

As mentioned above, the Major-Ready Pathway initiative, which has been approved by WCERTE and JTC and is currently under review for approval by COP and SBCTC, will increase opportunities for students enrolled in STEM in the State's community colleges to have a streamlined pathway to transfer to Western to complete a 4-year degree in engineering. As also stated above, this mechanism will only be fruitful if there is more opportunity for placement in one of Western's engineering programs. By increasing the size of the MFGE and PCE majors by 50%, this decision package will do exactly that. As prospective students learn about the MRP, this will boost enrollment in community and technical college engineering programs by those interested in pursuing a four-year engineering degree. This will also lead to growth in graduates either indirectly through those who successfully transfer to Western (or other 4-year universities) and complete an engineering degree or those, who unable to do so for varying reasons, continue to complete a certificate program.

1.3.f: Increase number of students enrolled in STEM and identified high-demand employment programs in public 4-year colleges from 31,282 to 32,642 by 2016-17

1.3.h: Increase number of graduates in STEM and identified high-demand employment programs in public 4-year colleges from 10,726 to 11,661 by 2017-18

This decision package will directly impact both these stated goals. Combined Western's MFGE and PCE programs will increase enrollment to allow us to go from 48 to 72 engineering graduates per year in these programs, an increase of 50%. As stated previously, the historical graduation rates from these programs is over 92%. This is evidence that there will be a high return-on-investment from funding this package that will help the State in meeting the increase in number of STEM graduates from 4-year universities.

f) What are the other important connections or impacts related to this proposal?

In addition to all of the positive outcomes for students, the State, and the University outlined above, the automation and sustainability concentrations that will be created by funding this proposal have been developed in consultation with the Industrial Advisory Committees (IACs) of the MFGE and PCE programs, and have been identified by the IACs as the top needs of the region. Between them, the MFGE and PCE IACs have representatives from Airtech International, The Boeing Company, Cascadia Custom Molding, Fluke, Hexcel, Hewlett Packard, Janicki, Korry Electronics, Nike, PACCAR, Pacific Research Laboratories, R&D Plastics, Safran, Toray, and Vaupell. All of these companies stand to benefit from both the increase in the number of engineering graduates and the development of the aforementioned concentrations in automation and sustainability, as will other companies that hire Western's engineering graduates.

On campus, there will be some impact on the departments that provide foundational courses for the MFGE and PCE programs, specifically Chemistry, Math, and Physics. The majority of courses that engineering students take from those three departments are taken by pre-major students. Increasing the size of the MFGE and PCE majors to allow more of the engineering pre-majors to become majors will not increase the load on Chemistry, Math, or Physics since those pre-majors already exist in sufficient numbers to fill additional majors in this proposal. There are, however, a few classes, specifically two Chemistry classes and two Math classes, that students generally take after being accepted to the major. Thus it is likely that an additional section will be needed for two Chemistry classes and possibly for up to two Math classes as well. Of these, the more significant concern is in Chemistry since both of the required classes are lab classes and will require lab access as well as instructors.

g) What alternatives were explored by the agency, and why was this alternative chosen?

Since the transition to engineering during the 2013-15 budget, there has been more student interest in Western's engineering programs than space to accommodate them, and a growing interest in hiring graduates of the programs on the part of regional companies. Growing the MFGE and PCE programs during this cycle was selected over growing the ECE program because the ECE program needs additional space before it can accommodate any additional growth, and over transitioning the Industrial Technology-Vehicle Design (IT-VD) program to engineering because of the current budget climate in the University and the additional effort and risk of creating an accredited engineering program from scratch compared to expanding already accredited engineering programs.

MFGE and PCE originally submitted two independent pre-proposals for consideration. After further discussion amongst the faculty of the two programs it was decided that because of the integrated nature of the curriculums of the programs, it would not be possible to expand one independently without creating significant resource deficiencies in the other. Both programs had ambitions for larger growth during this biennial cycle, with MFGE seeking to double in size and PCE seeking to partner with AMSEC to create an M.Sc. program in Sustainable Materials, but there were concerns about the ability of the Ross ET building to accommodate everything that was proposed. After more examination, it became apparent that it would be better to grow both the MFGE and PCE programs together to try to meet current student demand at the undergraduate level and to couple further growth and the implementation of M.Sc. programs with a request for additional space at some time in the future.

h) What are the consequences of not funding this package?

In both Robotics, Automation, & Systems Integration, and Sustainable Materials & Processes there are an increasing number of opportunities for placement of graduates in regional companies looking for engineers with this combination of knowledge and skills. In addition, there are significantly more opportunities for collaboration with local industries on student projects and research and development on problems in these areas than currently can be serviced by the existing faculty and staff resources in MFGE and PCE. Without funding of this decision package these opportunities will be lost, as will be the opportunity for Western to strengthen its engineering programs. In addition, other investments being made by the ENGD department to improve equity, inclusion, and diversity particularly those in the pre-majors as described in Section (d), will likely not realize their desired outcome as measured by the number of engineers graduated from traditionally underserved and socioeconomically challenged populations. Efforts to better articulate with pre-engineering programs at community colleges to enhance transfer rates will be limited in their success without an increase in capacity. Since community colleges are a more cost-effective pathway towards a 4-year degree, this restricts a potential source of applicants that can increase diversity in engineering at Western.

i) What is the relationship, if any, to the state's capital budget? How does this proposal impact state facilities?

There should be little to no connection of the proposed expansion of the MFGE and PCE programs to the capital budget. The ENGD department is currently assessing the best ways to use space in its large-equipment labs to support expansion, but there is no doubt that the Ross ET building can support the expansion proposed herein. There may be the need to renovate some of the current lab spaces, to relocate equipment to optimize space usage, or to install new equipment to support new faculty, research, projects, or courses, but any of those would be at the level of a minor capital project or smaller. Expansion of MFGE or PCE beyond what is currently being proposed would require significant capital investment, but the increases in size proposed above will not.

j) What changes would be required to existing statutes, rules, or contracts, in order to implement the change?

No changes to statutes, rules, or contracts are required to implement the expansion of the MFGE and PCE programs.

k) Does this Decision Package include funding for any IT-related costs, including hardware, software, (including cloud-based services), contracts or IT staff? If so, please identify.

Not specifically. One of the staff positions included in this request will be for a new technical staff position to support the development of a Robotics, Automation, & Systems Integration concentration in MFGE. Part of the responsibilities of this position will be IT related, for the person who has the job will need to manage and maintain integration of the equipment that supports the concentration, but it will not be an IT position per se. Hardware and software needed for our current courses are supported by student lab fees. Any additional hardware and software needed for the new curricula will continue to come from student lab fees.

l) Expenditure and revenue calculations and assumptions.

m) Which costs and functions are one-time? Which are ongoing? What are the budget impacts in future biennia?

Recurring:

3 Manufacturing Engineering faculty (2 in year one, 1 in year two): $390,000
2 Plastics/Composites Engineering faculty (1 in year one, 1in year two): $260,000
2 ICST 3 staff: $170,000
1 Program Coordinator: $78,000
Supplies, materials, travel: $22,500

One-time:

Startup for faculty hires: $500,000
Other onboarding expenses: $15,000

Use this tab to enter personnel budget

PLEASE INCLUDE **BOTH** HEADCOUNT AND FTE

All Positions assumed to be permanent & recurring unless noted otherwise

Enter Proposed Annual salary, Headcount, and FTE

		STATE BIENNIAL BUDGET REQUEST YEAR 1						STATE BIENNIAL BUDGET REQUEST YEAR 2					
		FY2021-22						FY2022-23					
POSITION TITLE	Full Time Average CUPA Salary (Divisional Budget Personnel to Provide CUPA)	Proposed Annual Salary	Headcount	FTE	Budgeted Salary	Benefits	TOTAL	Proposed Annual Salary	Headcount	FTE	Budgeted Salary	Benefits	TOTAL
Faculty Salaries													
Assistant Prof--Manufacturing	$90,720	$96,245	2.0	2.00	$192,490	$58,768	$251,258	$99,132	3.0	3.00	$297,396	$89,747	$387,143
Assistant Prof--Plastics/Composites	$90,720	$96,245	1.0	1.00	$96,245	$29,384	$125,629	$99,132	2.0	2.00	$198,264	$59,831	$258,095
Total Assistant Professors		$192,490	3.0	3.00	$288,735	$88,152	$376,887	$198,264	5.0	5.00	$495,660	$149,578	$645,238
Faculty Salary and Benefit Total		**$192,490**	**3.0**	**3.00**	**$288,735**	**$88,152**	**$376,887**	**$198,264**	**5.0**	**5.00**	**$495,660**	**$149,578**	**$645,238**
Professional Salaries													
Exempt Professional Staff Salary and Benefit Total		**$0**	**0.0**	**0.00**	**$0**	**$0**	**$0**	**$0**	**0.0**	**0.00**	**$0**	**$0**	**$0**
Classified Salaries													
ICST 3	$56,568	$60,013	2.0	2.00	$120,026	$48,863	$168,889	$61,813	2.0	2.00	$123,626	$49,628	$173,254
Program Coordinator	$51,240	$54,361	1.0	1.00	$54,361	$23,229	$77,590	$55,991	1.0	1.00	$55,991	$23,576	$79,567
Classified Staff Salary and Benefit Total		**$114,374**	**3.0**	**3.00**	**$174,386**	**$72,092**	**$246,478**	**$117,804**	**3.0**	**3.00**	**$179,617**	**$73,204**	**$252,821**
Student Salaries													
Student Salary and Benefit Total		**$0**	**0.0**	**0.00**	**$0**	**$0**	**$0**	**$0**	**0.0**	**0.00**	**$0**	**$0**	**$0**
Total Salary and Benefits - All Positions		**$306,864**	**6.0**	**6.00**	**$463,121**	**$160,244**	**$623,366**	**$316,068**	**8.0**	**8.00**	**$675,277**	**$222,782**	**$898,059**

WESTERN WASHINGTON UNIVERSITY

MFGC-PCE Expansion

	FY2021-22	FY2022-23
STUDENT FTE *(1FTE =15 Student Credit Hours) GENERATED FROM PROPOSAL*	0	0

	STATE BIENNIAL BUDGET REQUEST YEAR 1					STATE BIENNIAL BUDGET REQUEST YEAR 2				
	FY2021-22					FY2022-23				
Salary & Benefit Information Automatically Populated from Personnel Budget Tab	Employee FTE	One Time Costs	Recurring Costs	Total Costs	Total Cost Per SFTE	Employee FTE	One Time Costs	Recurring Costs	Total Costs	Total Cost Per SFTE
DO NOT ENTER SALARY & BENEFITS DATA HERE										
Faculty Salaries	**3.00**		$ 288,735	$ 288,735		**5.00**		$ 495,660	$ 495,660	
Professional Salaries	**0.00**		$ -	$ -		**0.00**		$ -	$ -	
Classified Salaries	**3.00**		$ 174,386	$ 174,386		**3.00**		$ 179,617	$ 179,617	
Student Salaries (Graduate Assistants, Hourly Student, etc)	**0.00**		$ -	$ -		**0.00**		$ -	$ -	
Benefits	6.00		$ 160,244	$ 160,244		8.00		$ 222,782	$ 222,782	
Total Salaries & Benefits		$0	$623,366	$623,366	$0		$0	$898,059	$898,059	$0
Enter "Goods and Services" here										
Supplies and Materials			$ 10,000	$ 10,000				$ 10,000	$ 10,000	
Professional Service Contracts (please detail below)				$ -					$ -	
Equipment and Personal Technology - including new faculty set-up costs *		$ 300,000		$ 300,000			$ 200,000		$ 200,000	
Other Goods and Services (includes memberships, supplies, materials)				$ -					$ -	
Total Goods and Services		$300,000	$10,000	$310,000	$0		$200,000	$10,000	$210,000	$0
Enter "Travel" here										
Lodging				$ -					$ -	
Automobile Rental				$ -					$ -	
Air Travel				$ -					$ -	
Ground Transportation				$ -					$ -	
Other travel costs		$ 15,000	$ 7,500	$ 22,500			$ 10,000	$ 12,500	$ 22,500	
Total Travel		$15,000	$7,500	$22,500	$0		$10,000	$12,500	$22,500	$0
Total Expenditures (including Indirect Costs)		**$315,000**	**$640,866**	**$955,866**	**$0**		**$210,000**	**$920,559**	**$1,130,559**	**$0**

* Set-up for new Faculty Positions should be included, ranging from $7,500 to more than $75,000, depending on discipline.