DECISION PACKAGE TITLE:

Recommendation Summary Text:

The Advanced Materials Science and Engineering Center proposes to establish a Master of Science program in Materials Science and Engineering. The plan leverages our already extensive faculty expertise in this area to address swelling student interest and the demands of regional industry for qualified graduates educated in the proposed core areas, and for solutions to the ever-growing challenge of balancing technological development with environmental stewardship. Briefly, we propose:

- To expand the Center's current academic offerings to include a **Master of Science degree in Materials Science and Engineering** encompassing three tracks: **(1)** *Sustainable and Earth-Abundant Materials*, **(2)** *Additive Manufacturing of Advanced Materials*, and **(3)** *Computational Materials Science.*
- To **develop broad course offerings** for WWU students, including a Viking Launch course, and 5-6 core and elective courses to support the proposed M.S. program and to be available as new electives for all undergraduate and graduate STEM students.

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:

The Advanced Materials Science and Engineering Center (AMSEC) proposes to establish a Master of Science program in Materials Science and Engineering. The plan includes leveraging our already extensive faculty expertise in this area to address swelling student interest as well as the demands of regional industry for qualified graduates educated in the burgeoning fields of additive manufacturing and computational materials science, and for solutions to the ever-growing challenge of balancing technological development with environmental stewardship. Briefly, we propose:

- To expand AMSEC's current academic offerings to include a **Master of Science degree in Materials Science and Engineering** encompassing three tracks: **(1)** *Sustainable and Earth-Abundant Materials*, **(2)** *Additive Manufacturing of Advanced Materials*, and **(3)** *Computational Materials Science.*
- To **develop broad course offerings** for WWU students, including a Viking Launch course, and 5-6 core and elective courses to support the proposed M.S. program and to be available as new electives for undergraduate and graduate students pursuing degrees in related areas.

(1) Sustainable and Earth-Abundant Materials: In the Pacific Northwest, there is a high concentration of companies developing, producing, and using plastics, composites and other advanced materials. For these companies, issues of sustainability are increasingly important. 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?
- Can the material be repurposed or recycled? Can it be reused for additive manufacturing?
- Can materials waste be used to generate energy?
- How can properties of materials be predicted computationally in order to drastically enhance the development of new sustainable technologies?

Despite a strong need, academic programs with a focus in these areas do not currently serve the needs of Washington State and the Pacific Northwest. 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 the College of Science and Engineering (CSE), increasing diversity in our programs, and dramatically increasing the research opportunities available to WWU students.

(2) Additive Manufacturing of Advanced Materials: Additive manufacturing (AM) is an industry-disrupting set of technologies that is changing the ways we design, manufacture, and utilize advanced materials. Also known as 3D printing, AM creates three-dimensional parts from computer-aided design models by successively adding materials layer by layer until a physical

structure is fabricated. The AM industry is projected to grow to over $22 billion by 2020. This rapid maturation requires training more materials scientists with in-depth knowledge of the materials and processes of AM to overcome a multitude of current and future challenges in AM. Current challenges and questions include:

- What novel AM materials (metals, polymers, and ceramics) can be developed to increase manufacturing rates, improve recyclability, reduce part weight, and improve overall performance?
- How does the layer-by-layer processing influence part properties and can material feedstocks be tailored to minimize the impacts on part performance?
- How can AM parts be characterized and tested to ensure integrity to the design, and can new methods be developed to ensure testing is standardized throughout the industry?
- Can material and part properties be simulated and predicted computationally?
- Can new generative design techniques be implemented to improve part weight, material use, and manufacturing efficiency?

Washington state industries such as aerospace, sporting goods, biomedical and health, automotive, and energy have all embraced AM to accelerate innovation and support business. Despite an industrial need for experts in materials processed for AM, there are no material science programs devoted to additive manufacturing in Washington State.

(3) Computational Materials Science: Computation, modeling, and simulation play a substantial and growing role in materials science research and development. Recent advances in multiscale modeling and in data-driven approaches to materials design, in alignment with the federal Materials Genome Initiative, have created new opportunities for computational materials scientists to accelerate regional R&D efforts in biomaterials, energy materials, plastics, and composites. Science and engineering applications include multi-scale, multi-physics modeling, from molecular dynamics to chemical reactions, and from material interfaces to complex composite structures and beyond. Over the past six years, AMSEC has hired several faculty with computational materials science expertise, and several additional faculty incorporate computational modeling within their research programs.

With the recent establishment in (CSE) of a stand-alone computer cluster and support staff for computational science research, AMSEC and the College is well positioned to support the infrastructure needs of an M.S. program with a computational materials science track. This track would provide essential support to the other tracks through research collaborations, strengthening AMSEC's vision of fostering collaboration in materials science research and education across CSE, and it would fill a key gap in the state's currently limited pipeline of students prepared for the increasingly data- and software-driven materials science jobs of tomorrow.

Materials Science and Engineering M.S. degree:

Based in part on consultation with AMSEC's External Advisory Board (EAB), this initiative includes the creation of a two-year research-based M.S. degree in Materials Science and Engineering, featuring a "4+1" option for WWU students graduating with the materials science minor as well as options for industry sponsorship. Industry-sponsored projects can follow one of two models; students can work on projects funded by a company and developed collaboratively between WWU and company researchers, or an active company employee can pursue a master's degree, focused on a project of direct relevance to their work and sponsored by their employer. There will be three **core graduate courses** required for the proposed new degree that will all be new to WWU;

- Thermodynamics of Materials,
- Kinetics and Phase Transformations of Materials, and
- Structure and Properties of Materials.

Electives will be grouped into three tracks: **(1)** *Sustainable and Earth-Abundant Materials*, **(2)** *Additive Manufacturing of Advanced Materials*, and **(3)** *Computational Materials Science.* Students' applications will be assessed individually and admission will be granted on a competitive basis, up to the capacity of the program.

The "4+1" option is a fast-tracked opportunity for students majoring in any of Engineering and Design, Chemistry, Physics and Astronomy, or Geology, and who complete the materials science minor at Western. They will be required to have an overall GPA of 3.0 and a GPA of 3.0 in all classes in their major, and in the materials science minor. While still an undergraduate, they will take one of the core graduate courses, complete 9-10 credits of elective courses, and at least one seminar credit. Once admitted to WWU Graduate School, the remaining requirements for completion of the M.S. degree will include completion of remaining core courses, thesis credits, and remaining seminar credits, as necessary. Note that many of these credits will already be part of the student's major and so would not adversely increase the undergraduate course load required of the student.

Online courses will be developed, beginning with the three core courses listed above, then expanding to include some electives. This will be attractive to industry professionals, enabling them to make progress on the M.S. without the need for release from their employment. For students who complete their first year on Western's campus and then complete their thesis component at a partnering industrial company, the ability to continue some coursework during their second year off campus will reduce the course load required of them in the first year.

The AMSEC EAB membership includes two active members of the Washington State Academy of Sciences (WSAS), who identified several areas of high importance for technology development in WA by WSAS in consultation with advisors from Boeing, Blue Origin, JCDREAM, the WA Dept. of Commerce, and others. The degree tracks listed above were chosen because they represent areas of strategic overlap between this list and existing strengths at WWU, and because they are highly synergistic. Specifically, additive manufacturing is a promising route to the drastic reduction of waste in manufacturing, in addition to being a critical emerging area of research in materials science more generally. Similarly, computational methods are critical to the rational design of new materials, and combinatorial approaches to materials design in particular are becoming increasingly important for rapid and inexpensive screening of materials with desired properties. These two tracks, in addition to the track focused specifically on sustainable materials, put all of the pieces in place to enable cutting-edge, competitive research in materials science and engineering research at WWU.

The primary "competing" program in WA is the UW Applied M.S. degree in materials science, which admits only 50% of the up to 200 applicants per year, of which about 60% are international students. The proposed M.S. degree at WWU would therefore help address a significant unmet demand for programs of this type in WA State. Further, the UW degree is 100% self-funded; students are disallowed from accepting a research or teaching assistantship for this program. In addition, the UW students take lower priority with regard to instrumentation access. **WWU's program would therefore offer several advantages for prospective students**, including:

(1) Students would have more access to instrumentation at WWU;
(2) WWU offers more opportunities to engage in collaborative projects with industry;

(3) WWU's program would be cheaper and would offer the possibility for funding;
(4) WWU's program would be targeted in key research areas identified as high importance in WA State; and
(5) Students in teaching assistant positions will be exposed to, and learn, the pedagogy of student and inquiry based learning, and will gain the skills in successfully communicating scientific ideas.

Proposed Curriculum: (45 credits – for comparison, the Math M.S. program requires 48 credits, Geology requires 45-48, and Chemistry requires at least 45.)
Core classes (15 cr.) MSCI 5XX:
Introduction to Graduate Research in Materials Science and Engineering (3 cr.); Thermodynamics of Materials (4 cr); Kinetics and Phase Transformations (4 cr.); Structure and Properties of Materials (4 cr.)
Electives (9-12 cr.): (no more than 10 cr. from 400-level; other courses may be accepted with prior approval)
CHEM 4/534 (3), 4/536 (2), 4/5XX (3-5); GEOL 4/552 (5), 4/554 (4), 4/557 (4), 4/561 (4), 4/597 (4); MATH/CS 573 (4), 4/575 (4), 577 (4);
PCE 444 (3), 471 (3), 476 (3); PHYS 444 (3), 475 (3), 476 (3); MSCI 410 (4), 497 (3)
Seminar (5-11 cr.) MSCI 5XX:
Seminar Attendance (3 cr.), Seminar Presentation (2 cr.)
Research (12-15 cr.) MSCI 6XX Thesis.

Anticipated workload: As well as performing the duties of a TA or RA, if relevant, a typical schedule might consist of the following (note that this workload structure matches the structure of the thesis-based M.S. programs in Geology and Chemistry):

- Year One (23 cr.): Fall – Core class (4 cr.), Intro to Research (3 cr.); Winter – Core class (4 cr.), Elective (4 cr.); Spring – Core class (4 cr.), Elective (4 cr.). Plus, Seminar Attendance (3 cr.)
- Year Two (21-24 cr.): Research (12-15 cr.), Elective (4 cr.), Seminar Attendance (3 cr.), Seminar Presentation (2 cr.)
- (For a student completing research with an industry partner, Year Two (17 cr.): Research (15 cr.), Seminar Presentation (at WWU) 2 cr. Such a student would not have TA duties and so would have more time available to commit to completing core classes and electives in the first year.)

Student Prospects: Students completing Western's MS in Materials Science and Engineering are expected to successfully find employment in industry, or to be competitive in gaining admission to competitive PhD programs. This is evidenced by experiences at existing regional MS programs. For example, the University of Washington has been graduating 20 or more students per year, 20% of which go on to PhD programs, the remainder finding employment in industry (Honeywell, Intel, Boeing, Micron, for example). Similarly, Washington State University has 5 – 10 students per year, the majority going on to PhD programs, others going to industry and government labs. In support of this proposal are two letters written by members of the AMSEC external advisory board and from industry. These letters attest to the fact that there is a need for highly trained graduates "who can innovate our industry with new materials that maintain the structural and safety needs but provide a completely sustainable lifecycle," for example. As further evidence, approximately half of the students graduating with the current

materials science minor are getting employed in industry, and half are going on to pursue graduate work.

Resources Requested: The following summarize the estimated funding and space needs to initiate these programs (one-time costs ~$758,000) and the recurring costs (~$425,000).

1. *Number and types of positions*
   a. Faculty: Two FTE TT faculty members are needed to support the additional graduate courses, research advising, and service. These faculty members will have a joint appointment with other CSE departments and can expand access for our new and existing majors (1/2 AMSEC, 1/2 Chem/Phys/Eng/Geol).
   b. *Staff.* 0.5 FTE staff (program coordinator or program assistant level) to manage the graduate program (admissions, teaching assignments, student management, etc.). 1 FTE instrument/instructional technician (1/2 AMSEC, 1/2 Engineering).
   c. *Graduate Teaching Assistants*. 5 additional graduate TA positions. TAs will be distributed among the departments, depending on student expertise and teaching needs of the departments. TAs will support the new courses and offset increased demand on existing courses. The ability to offer assistantships will help recruit students to the graduate program.

2. *Space needs:* Office and research space will be needed for the 2 TT faculty members. Office space for the new staff positions will be provided in the current space.
3. *Recurring Costs*

Faculty: 2 FTE TT faculty members	*$210,000/yr (including salary and benefits)*
Staff: 1 + 0.5 staff positions	*$120,000/yr (including salary and benefits)*
Graduate Teaching Assistants: Five additional graduate TA positions.	*$80,000/yr (stipends for full time teaching assistants)*
Operating budget to support master's students: Increase in AMSEC budget for research supplies	*$15,000/yr*

4. *Nonrecurring (one-time), non-capital costs.* Equipment funds are requested to support the additional curriculum and research activities. For example, additive manufacturing research will require a ball mill for making powder and a metal SLS (selective laser sintering) printer. Raman spectroscopy is needed for the identification of waste plastics. Granulators and a compression molder are needed to process polymers and composites.

Start-up Funds for Faculty. Funds to initiate research at WWU are needed for the 2 TT faculty. (Including $50,000 for computational needs.) (Also includes search costs.)	*$360,000*

Teaching Release. Teaching release (for the AMSEC director and additional faculty) for 6 courses in the year before and during the first year of implementation. This release time will be needed for curriculum development, outreach, meeting with advisory members, faculty/staff searches, etc.	*$24,000*
Online Course Content: Teaching release for faculty during the first year to develop online courses, beginning with the three core classes.	*$24,000*
Equipment. Equipment funds to update or expand shared instrument holdings to meet increasing research demand. Primary equipment needs include: Raman IR Spectroscope, Universal Test Stand, Environmental/Weathering Chamber, Thermoset Printer, Fume Hood, and Vacuum Oven.	*$350,000*

5. The impact on other units in CSE is expected to be small, and in many ways, positive. The two FTE hires requested will result in two half-FTE positions in other units, thus providing desperately needed additional teaching capacity in those units. Most electives are designed to leverage existing upper division classes, supplementing them with additional projects to meet requirements of the MS program when necessary. This will increase enrollments in these classes. In recognition that the computational track might increase demand on university computer clusters, funding has been included in the relevant faculty start-up package to either provide additional hardware, or to fund use of third-party external clusters.

a) What specific performance outcomes does the agency expect?

The proposed initiatives will benefit students, AMSEC, CSE and WWU, and the state of Washington. It will also address important strategic goals of the programs, college, and university. Specifically, outline the anticipated benefits to these groups below.

Student

1) Offer a much deeper, richer, and more targeted research experience in materials science than is possible at the undergraduate level through the new M.S. program.
2) Offer a path for WWU undergraduates to pursue graduate study locally from departments that do not currently have an M.S. program.
3) Enhance access broadly to STEM programs at WWU.
4) Provide research opportunities to work with regional companies.
5) Enhance the elective course offerings for majors from all STEM fields.
6) Introduce prospective WWU students to materials science.

Program

1) Grow the number of students educated in materials science at WWU.
2) Enhance the elective course offerings for the materials science minor and other CSE departments.
3) Offer AMSEC faculty the chance to work with graduate students that have interdisciplinary backgrounds and training and to elevate their materials science related research.
4) Enhance and expand scholarship in materials science at WWU.
5) Expand and deepen research collaborations with regional industry.

6) Increase diversity by offering curriculum that has been proven to appeal more broadly to underrepresented students than our traditional offerings.
7) Attract students who are driven to learn about industrially-relevant fields of study and modern, cutting edge technologies and processes.

College and University

1) Allow CSE to address multiple access issues across the college by hiring additional faculty members that would teach in both AMSEC and their home department. Similarly, requested teaching assistantships and equipment will also broadly benefit the college.
2) Offer faculty from departments that do not currently have an M.S. program the opportunity to elevate their scholarship by working with graduate students.
3) Support increased diversity of the faculty in CSE; faculty hiring best practices consistently indicate that targeting interdisciplinary fields enhances the diversity of the hiring pool.
4) Grow the enrollment of international students at WWU.
5) Address almost all aspects of the CSE strategic plan, including meeting the needs of the state of WA in STEM, increasing diversity and access, strengthening scholarship across the college, and educating students in STEM (as described below).
6) Address several aspects of the WWU strategic plan, primarily within goal #1, including expanding access to educational programs, increase scholarship, and enhance academic infrastructure to support research (as described below).
7) Interface with existing expertise and equipment capabilities already at WWU (including the Institute for Energy Studies, Scientific and Technical Services, etc.).
8) Broadly benefit scholarship across WWU through the generation of significant revenue in the form of indirect cost recovery from external grants.

Washington State

1) Provide relief for the high, and unmet, student demand for M.S. degrees in materials science in western Washington. (See statistics on existing programs in the PNW above).
2) Help meet the demand for high-quality students prepared to contribute to the industrial R&D workforce; materials science and materials engineering are important industries in Western Washington and the broader PNW. There is therefore a high demand for undergraduate and graduate students in materials science in Washington State as described below, and these programs would help meet this demand.
3) Help meet the demand for an M.S. program in NW Washington State that will allow current working R&D professionals to further their education while working on problems that directly benefit their employers.

Outreach Courses: Viking Launch is an opportunity to introduce new WWU students to the science of materials and to engineering, while also exposing them to potential academic paths. The current Viking Launch courses are primarily opportunities for students to explore a particular major. Many students come to WWU due to the excellent science and engineering offerings, and the opportunities to have hands-on experiences in laboratories. They are attracted by our commitment to the environment and the variety of academic programs and research opportunities related to sustainability. The proposed "Materials Side of 3D Printing" Viking Launch course will allow students from various backgrounds to learn how material choices affects many aspects of manufacturing and the environment. The course will have students print parts and examine the layer-by-layer structure using microscopy. Students will also grind failed old parts, reprocess the reclaimed material into new filament, and produce new parts. They will test these parts to failure

using tensile fixtures or will test the filament itself at AMSEC to measure fundamental material properties such as stiffness and glass transition temperature. Students will discover how additive manufacturing provides a powerful means for
reusing materials, and will gain familiarity with what is a new paradigm in manufacturing.

Efficiencies: This initiative builds on the following core strengths and capabilities that already exist at WWU:

- With faculty members in Chemistry, Physics and Astronomy, Plastics and Composites Engineering, Geology, Biology, and Mathematics, AMSEC combines expertise in the development, simulation/modeling, and analysis and application of new, advanced, and sustainable materials. An example of an interdisciplinary collaboration that involved numerous students and faculty members across WWU is the Solar Window project, which received an EPA award, and the technology was successfully transferred to a private company.
- AMSEC's centralized instrument laboratories ensure that Washington State's resources are effectively and efficiently utilized. WWU's high-cost instruments are utilized by numerous faculty members and research students, incorporated into coursework so that hundreds of students can gain experience, and structured so that Washington-based companies can gain access easily and at low cost.
- AMSEC provides an ideal structure for this initiative. AMSEC nurtures collaboration and interdisciplinary research, breaking down traditional barriers by hiring across departments and supporting shared college-wide resources. AMSEC's mission is to educate students in materials science, support interdisciplinary research, and enhance regional industry competitiveness and innovation.
- The strong scholarly culture and excellence in undergraduate programs in Physics and Astronomy and Engineering will be elevated by access to graduate students in Materials Science.
- The Materials Science club has created a vibrant student community, offering a welcoming environment to all students, including those from groups under-represented in STEM. The club is also active in humanitarian work, 3D printing prosthetic hands for a charitable organization "e-NABLE."

Most elective courses students will take to fulfill the M.S. requirements will leverage upper-division electives already offered in other CSE departments. These courses will be modified, as needed, to require additional work from M.S. students to elevate the courses to the appropriate level, and to bring a focus to applications in Materials Science. This reduces, significantly, the number of new faculty hires needed to implement the program. We also propose the development of a number of online courses. These will access to instruction for students who are not always able to attend courses on Western's campus, but they will also help to further reduce the number of faculty lines needed.

b) Performance measure detail.

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.

Not applicable.

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

1. WWU Strategic Plan

Goal #1.A: (*Transformational Education: Strengthen the liberal arts and sciences foundation to ensure and expand student access to the breadth of our undergraduate, graduate, and professional programs*.)
This initiative would add a new M.S. degree to WWU's offerings, thereby expanding access to graduate education at WWU. Moreover, the addition of faculty with split appointments across CSE departments would increase access by addressing bottleneck areas across the college. The Viking Launch course will introduce students to the technical, economic, and ethical aspects of material choices in products we use every day and will give students an experience of seeing the life of materials extended through use in additive manufacturing.

Goal #1.B: (*Transformational Education: 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*.)
Students today are acutely aware of the critically important issues of sustainability and the environmental impact of technologies, and are eager for their WWU education to better equip them to be part of the solution to these important and pressing interdisciplinary problems. The first track of the M.S. program directly addresses these needs through its focus on sustainable materials.

Goal #1.C: (*Transformational Education: Increase support and infrastructure for all types of scholarship, research, and creative activity*.)
Through the acquisition of shared instrumentation and technical support staff, this initiative would benefit research programs broadly across STEM at WWU.

Goal #1.D: (*Transformational Education: Ensure that all students have access to high quality educational experiences beyond the classroom*.)
AMSEC supports a broad and extensive array of undergraduate opportunities for independent scholarship, including many in partnership with local industry.

Goal #1.G: (*Transformational Education: Provide technological and other academic infrastructure to support curricular innovation, research, scholarship, and creative activity, civic engagement and social justice*.)
AMSEC shared research facilities are used heavily for teaching in CSE. The acquisition of additional shared instrumentation, and technical staff to support classroom and research use of those resources, will broadly impact research and STEM teaching at WWU.

Goal #2.E: (*Engagement with Place: Weave the ecological, social, and economic dimensions of sustainability into and through the University's practices*.)
One track of the MS program puts WWU students and faculty at the forefront of the global effort to develop sustainable technologies and materials. This initiative ensures that students at different

stages in their education (Viking Launch, AMSEC minors, graduate students in materials science) are enlightened about the ecological, social and economic dimensions of sustainable materials.

Goal #2.F: (*Engagement with Place: 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.*)
Students will work hand-in-hand with faculty and technological innovators across the Pacific Northwest to make our region a leader in sustainable technology development.

Goal #3 C: (*Enhance student services and co-curricular opportunities to foster students' intellectual, personal, and professional development and success.*)
The interdisciplinary nature of materials science and engineering within WWU naturally fosters a development of personal skills needed to succeed in an environment with people coming from many different life and educational histories. An intimate connection with industry partners will provide opportunities for professional development, and growth of interpersonal skills.

Goal #3 F: (*Expand networks between students, staff, faculty, and alumni/ae.*)
As the number of graduates from the proposed MS program increases, AMSEC will leverage having graduates placed in area industries, reaching out to alumni/ae for internship possibilities, and for providing advice and mentorship to current and future students.

Goal #4.C and D: (*Justice and Equity: Recruit, retain, and support more underrepresented and first-generation students at the undergraduate and graduate levels*; *Implement model practices to improve our recruitment and retention of a diverse staff, faculty, and administration.*)
It is well known that STEM has a deep and pervasive problem when it comes to under-representation of women and racial and ethnic minorities, among other minoritized identities. However, studies have indicated several approaches can be helpful in recruiting and retaining a diverse student body as well as a diverse faculty in STEM, and therefore have been incorporated into the best practice recommendations of most major professional societies in STEM. Some of these include increased focus on interdisciplinary and collaborative research initiatives, a clear connection between the research area and its global human or environmental impact, and a clear connection with non-academic career options, in particular industry-relevant research.(Diekman, Brown, Johnston and Clark, *Psych. Sci*. 21 (8) 2010 (1051-1057); Stout, Grunberg and Ito, *Sex Roles* 75 (9) 2016 (490-499); Wang and Degol, Develop. Rev. 33 (4) 2013 (304-340); Diekman, Clark, Johnston, Brown and Steinberg, *J. Person. Soc. Psych.* 101 (5) 2011 (902-918))

2. WWU Core Themes.

Advancing Inclusive Success: As described above, expanding AMSEC's offerings to include a Master of Science program offers an opportunity to introduce topics shown to draw non-traditional students and students from underrepresented populations to STEM due to its interdisciplinary nature, connection to industry, and humanitarian implications. In addition, research has shown that students who lacked the confidence to pursue careers in STEM fields were more confident after taking just one class, deepening the impact of our proposed bridge course.

Increasing Washington Impact: Despite a strong need, Washington State and the Pacific Northwest are currently underserved by graduate programs in materials science, and in particular including an option to focus on the area of sustainable materials. In our region, there is a high

concentration of companies developing, producing, and using plastics, composites and other advanced materials. For these companies, issues of sustainability are increasingly important. 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: AMSEC has a great record of involving students in research, encouraging undergraduate authors, and bringing external funding to WWU for research, curriculum and equipment purchases. This initiative will encourage further interdisciplinary collaborations by faculty from all CSE departments. It could also be a test bed to better understand how to improve equity, inclusion and diversity in our curriculum.

3. CSE Strategic Priorities.

This initiative addresses each of the five core elements of the CSE strategic plan, including:

Access: CSE aims to improve access in part through targeted program growth and targeted growth of faculty and staff.
Meeting needs: A strategic priority of CSE is meeting the needs of the students and the state of Washington by investing in programs of demonstrated strength and quality, developing new signature programs, and strengthening interdisciplinary and community linkages, all of which are directly targeted by this proposed initiative.
Research: Strengthening the scholarly culture at CSE by investing in infrastructure, faculty and research support staff, and expanding opportunities for undergraduate research.
Diversity: As described above, we believe that this initiative will positively impact the diversity of faculty and staff in CSE and will therefore speak to CSE's strategic aims in the area of equity and inclusion.
Teaching: CSE aims to expand interdisciplinary awareness and leadership skills.

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

Goals 1.3.e and i (Increase percentage of postsecondary graduates…who…are either enrolled in post-secondary education or training or are employed in Washington): There is a demand within Washington for graduates trained in Materials Science.

Goals 1.3.d, f and h (Increase the number of students enrolled in and graduating in STEM and high-demand employment programs): The proposed program is in STEM, and there is a demand for graduates with advanced training in Materials Science.

Goals 1.3.c and g (Increase the number of students enrolled in online and hybrid programs): The proposed program will develop classes which can be taken online. Together with thesis work done at Western's campus, or with industry partners, students will have access to hybrid degree options.

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

State Allocation: The programs proposed are attractive for state funding due to the high impact on the needs of Washington State. The proposal leverages existing expertise and capabilities to expand material science research and educate much needed scientists and engineers. The programs also increase the diversity of STEM programs at WWU.
Recently, Governor Inslee's NMA Council released their recommendations regarding how the state should direct its efforts related to STEM education and research in the state (specifically related to the aerospace industry). Their report details the current strengths of the state in addition to the areas that the state should direct additional resources. The report states that Washington State needs:

- additional engineering capacity at 4-year universities
- to expand research capabilities at Washington universities
- a workforce with skills that center around innovation, adaption, precision and development of complex systems and technologies.

Fundraising: Additional opportunities for funding come from industry partnerships, WWU Foundation opportunities, and federal grant programs. WWU already has numerous industry partner-ships to pursue research in materials science and engineering. Some examples include PAC-CAR, Safran-Zodiac Aerospace, Toray, Corumat, and Hexcel. Undergraduate and graduate programs in materials science and engineering will allow for the expansion of this type of research funding. Philanthropy funding is likely due to the high number of regional companies with corporate sustainability goals and initiatives.

Self-Sustaining Funding: The Advanced Materials Science and Engineering Center (AMSEC) has a strong record of working with regional companies. Project fees are collected when AMSEC assists companies to advance research, develop new materials, analyze failures, and develop novel characterization methods.

Industry Support: Appended to this proposal are two letters of support. A letter from two members of AMSEC's External Advisory Board is authored by a Professor Emeritus of Chemistry at UW, and a researcher at Pacific Northwest National Laboratories. The second comes from a manager at Torray Composite Materials America, Inc.

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

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

Not funding this package will result in the continued decline in the number of graduate student degrees awarded at Western. However, this is primarily an opportunity to initiate a new program for a discipline that is in demand from industry and prospective students.

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

The program will use existing facilities and infrastructure. It will lead to an increase in available instrumentation and expertise, and an increase in connections with area industries by way of graduate student internships.

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

Not applicable.

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.

One of the core tracks of the M.S. program is in computational Materials Science. This will likely involve increased use of computations performed on clusters. We have included in the budget funding, either for adding hardware to existing clusters on Western's campus, or for funding use of externally hosted computing clusters.

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?

See above section.

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	74,591	79,134	2	2.00	$158,268	$52,469	$210,737	81,508	2	2.00	$163,016	$53,343	$216,359
Total Assistant Professors		$79,134	2	2.00	$158,268	$52,469	$210,737	$81,508	2	2.00	$163,016	$53,343	$216,359
Faculty Salary and Benefit Total		**$79,134**	**2**	**2.00**	**$158,268**	**$52,469**	**$210,737**	**$81,508**	**2**	**2.00**	**$163,016**	**$53,343**	**$216,359**
Professional Salaries													
Exempt Professional Staff Salary and Benefit Total		**$0**	**0**	**0.00**	**$0**	**$0**	**$0**	**$0**	**0**	**0.00**	**$0**	**$0**	**$0**
Classified Salaries													
Program Coordinator	51,240	54,361	1	0.50	$27,181	$11,615	$38,795	55,991	1	0.50	$27,996	$11,788	$39,783
ICST 3	56,568	60,013	1	1.00	$60,013	$24,431	$84,444	61,813	1	1.00	$61,813	$24,814	$86,627
Classified Staff Salary and Benefit Total		**$114,374**	**2**	**1.50**	**$87,194**	**$36,046**	**$123,239**	**$117,804**	**2**	**1.50**	**$89,809**	**$36,602**	**$126,411**
Student Salaries													
Note: Graduate Asst 1 HC = 20 hrs per week per academic year. .5 HC= 10 hrs per week per academic year.													
TA		14,750	5	5.00	$73,750	$5,736	$79,486	15,665	5	5.00	$78,325	$6,091	$84,416
Student Salary and Benefit Total		**$14,750**	**5**	**5.00**	**$73,750**	**$5,736**	**$79,486**	**$15,665**	**5**	**5.00**	**$78,325**	**$6,091**	**$84,416**
Total Salary and Benefits - All Positions		**$208,258**	**9**	**8.50**	**$319,212**	**$94,250**	**$413,462**	**$214,977**	**9**	**8.50**	**$331,150**	**$96,036**	**$427,186**

WESTERN WASHINGTON UNIVERSITY

AMSEC

	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	**2.00**		$ 158,268	$ 158,268		**2.00**		$ 163,016	$ 163,016	
Professional Salaries	**0.00**		$ -	$ -		**0.00**		$ -	$ -	
Classified Salaries	**1.50**		$ 87,194	$ 87,194		**1.50**		$ 89,809	$ 89,809	
Student Salaries (Graduate Assistants, Hourly Student, etc)	**5.00**		$ 73,750	$ 73,750		**5.00**		$ 78,325	$ 78,325	
Benefits	8.50		$ 94,250	$ 94,250		8.50		$ 96,036	$ 96,036	
Total Salaries & Benefits		$0	$413,462	$413,462	$0		$0	$427,186	$427,186	$0
Enter "Goods and Services" here										
Supplies and Materials			$ 10,000	$ 10,000				$ 10,000	$ 10,000	
Professional Service Contracts (please detail below)		$ 48,000		$ 48,000					$ -	
Equipment and Personal Technology - including new faculty set-up costs *		$ 700,000		$ 700,000					$ -	
Other Goods and Services (includes memberships, supplies, materials)				$ -					$ -	
Total Goods and Services		$748,000	$10,000	$758,000	$0		$0	$10,000	$10,000	$0
Enter "Travel" here										
Lodging				$ -					$ -	
Automobile Rental				$ -					$ -	
Air Travel				$ -					$ -	
Ground Transportation				$ -					$ -	
Other travel costs		$ 10,000	$ 5,000	$ 15,000				$ 5,000	$ 5,000	
Total Travel		$10,000	$5,000	$15,000	$0		$0	$5,000	$5,000	$0
Total Expenditures (including Indirect Costs)		**$758,000**	**$428,462**	**$1,186,462**	**$0**		**$0**	**$442,186**	**$442,186**	**$0**

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

** For high-cost library services, please override formula and include actual anticipated cost of library periodical and purchases on one-time and/or recurring basis.