

Engineering and Technology Industry Council Campus Investment Proposal Biennium from July 1, 2011 to June 30, 2013

Campus: Oregon State University

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Summary of Proposal:

OSU seeks investment from ETIC that will have near term impact in building centers of excellence within our Focus Center on Sustainable Energy and Infrastructure (SENERGI) and generate results that will lead to job creation. The major components include restoring our ability to retain existing top faculty, replacing one time private funds used to grow BS degrees, and investments aimed at building on our strengths to become a leader nationally in the following three areas:

- Smart Energy Living: Using information technology and distributed systems to reduce energy consumption
- Sustainable Buildings and Infrastructure: Developing green infrastructure materials that require less energy, reduce green house gas emissions, and increase resilience
- Micro-technology Energy Systems: Using micro reactor technology to produce green nano scale materials for renewable energy applications

Vision and Goals Statement

We strive to create *world class innovative engineers by leading in advancement of* engineering education, collaborating in research, and driving research results into applications *that create new high wage jobs*. Our goal is to deliver the graduates, BS through PhD, and research results seen at America's top 25 engineering schools. *We will make progress during the next decade through our focus on solutions for sustainable energy and infrastructure. Ultimately we will help ensure a prosperous future for Oregon* thanks to top engineering talent that will enable Oregon to be globally competitive and remain a high quality place to live.

Investment Description

OSU is working to achieve the impact of the nation's top 25 engineering colleges by building a world-class research and education enterprise. And we are seeing results in increased quality and quantity of graduates, growth of world class centers of excellence, and research results spinning out into new job creating enterprises. Using the composite measure of degree and research outputs, our faculty are already performing on a par with those at top 25 schools. At half the number of professors found at top 25 schools, we simply lack sufficient numbers of these top performing faculty.

OSU's Impact through prior ETIC Investment

ETIC's past investment has been leveraged nearly 10 to 1 (accumulative total of research funding, private gifts, and private investments in spin out companies) to achieve the following results:

- *Recruitment and retention of top faculty.* Today 30 percent of OSU's engineering faculty are funded by ETIC. This crucial support has stemmed some of the loss of state base budget funding. ETIC funding has helped OSU build a faculty that includes 1 National Academy of Engineering (NAE) member, 18 Fellows, and 25 prestigious early career awardees.
- *Building excellence, growing research, and commercializing research results.* OSU is the lead or partner in 14 national research centers that include collaborators from OUS, Oregon's SRCs, other global universities, national labs, and industry. We have grown research funding by 2.5x since 1999 and during the past 5 years, OSU has spun out its research breakthroughs into 17 new start-up companies. This spin out rate is greater than ever in OSU's history and is 6x the rate for the previous 5 years.
- *Increasing the quality and number of engineering graduates.* OSU has succeeded in tripling the number of top tier new freshmen, is generating educational innovations adopted by U.S. and international universities, and has grown the number of engineering graduates by 1.4x. An increased focus on PhD recruiting has grown the PhD program by 50%, a move that will increase Oregon's competitiveness in innovation and help drive more job creating spin outs. As the demand for OSU's engineering education has grown, OSU is now among the nation's top 30 in the total enrollment of undergraduate and graduate engineering students.

The legislated reduction in ETIC funding together with additional OUS reductions resulted in a \$3.3M cut for the biennium. Our ability to meet ETIC goals has been further eroded by the biennial payments of \$2.9M required to service the COP debt. Together these cuts represent a 12 percent reduction compared to the previous biennium. As noted above roughly 30 percent of our faculty is supported by ETIC. Reducing the number of faculty in response to the cuts is neither desirable from the perspective of maintaining momentum towards our top 25 goal nor is it permitted by OSU administration. Thus budget reductions were managed by reducing financial support for graduate students, eliminating instructor positions (with a resulting shift of teaching responsibilities to tenured faculty thereby reducing research capabilities), and postponing replacement of faculty who retired or otherwise left the university.

These cuts come at a time when the student demand for engineering and computer science education is at an all time high. First-year student enrollment has grown approximately 8 percent in each of the last two years. ETIC support of our recruitment and retention efforts are bearing fruit at a time when we are now forced to make cuts in programmatic support. This year the College of Engineering used private monies to provide additional support to Civil and Construction Engineering (CCE) and Mechanical, Industrial, and Manufacturing Engineering (MIME) in order to accommodate fifty additional students in professional school. The use of private funds is not sustainable and consequently many qualified students will likely be turned away during the 2011 academic year.

Our drive to ensure prosperity for Oregon will stall and inevitably falter without additional resources.

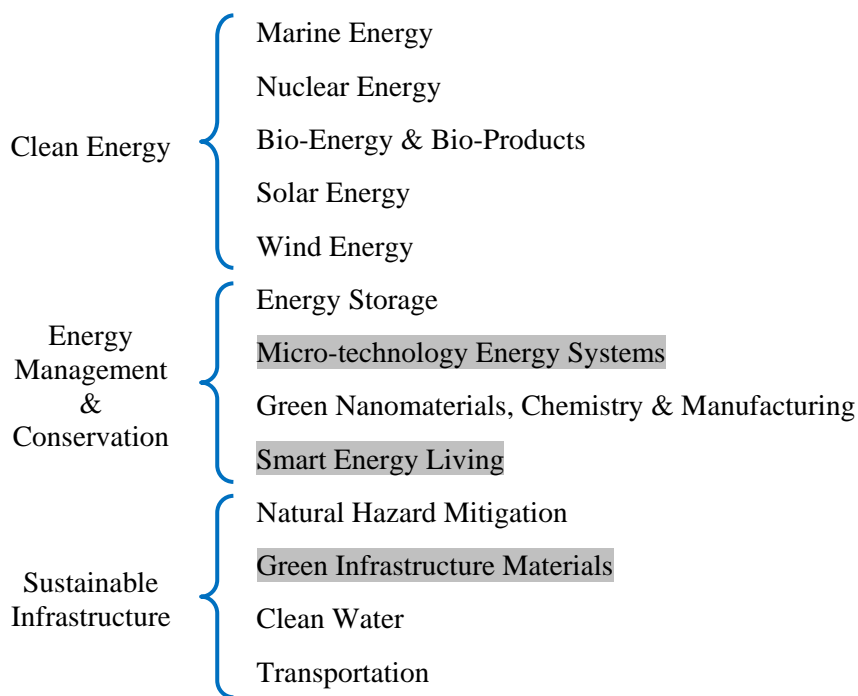
Future Impacts of ETIC Investments

Over the next 10 to 15 years Oregon State University led by the College of Engineering will focus on some of the critical issues facing the world – sustainable energy and infrastructure. This broad topic allows us to build on existing strengths in the College and University and provides a clear focal point for our near term future while allowing development of several centers of excellence.

SENERGI is a comprehensive Focus Center that complements Oregon State University’s strategic plan striving for healthy people, planet and economy. It represents a significant strength university-wide in sustainable energy and infrastructure **research, education, outreach, and policy**. The goal of SENERGI is to build research strengths relating to sustainable energy and infrastructure that are among the top 1-2 in the nation while promoting related innovative education programs, supporting engaging outreach to the public and helping define and refine related policies.

The SENERGI research elements are shown below. Today, a few of these areas have already achieved top national rankings. For example, the Department of Energy recently awarded one of only two national marine energy centers to OSU in partnership with the University of Washington - designated as the Northwest National Marine Renewable Energy Center (NNMREC). With the investment from state and national sources, this effort is a culmination of growth over the last 10 years into an internationally distinctive center. In addition to exceptionally qualified and internationally recognized faculty, OSU has unique power lab testing facilities, wave testing facilities and ocean testing sites at the Hatfield Marine Science Center. Combined with strategic partnerships with utilities, industry, other leading universities, OSU will continue to build on this strength and help to solve some of the nations’ most pressing challenges to marine energy generation and deployment.

Elements of SENERGI



A second area of national distinction is in Nuclear Energy. Not only is OSU's Nuclear Engineering program ranked 10th in the nation, its unique research has led to the commercialization of a modular nuclear reactor through a startup company, NuScale Power. Green Tech Media (one of the premier media sources for green technology) recently named NuScale's technology the next big thing in "Green Energy". In the last decade enrollment in the Department of Nuclear Engineering and Radiation Health Physics (NERHP) has grown 3.4x. Existing facilities are at capacity, thereby limiting the ability of the top-ranked program to expand enrollment or research. The College plans to expand the existing facility using a combination of private gift and state match funds. New facilities will enable continued growth in nuclear and health physics research related to key areas of energy, environment, and health.

In several of the other areas represented by SENERGI, OSU is among the nation's best but not yet recognized at top 1-2. We have initially identified three areas of strength within the College that have the potential to be developed into national centers of excellence within the broad topic of SENERGI. In each of the three areas we have developed strong collaborative partnerships with other universities, national laboratories or industry. With the support of ETIC, we will hire ten faculty with expertise spread across these three areas in the next biennium. The three signature areas are noted, and briefly described, below.

1 – Center for Smart Energy Living

Today over 30% of the energy consumption in the U.S.A. is in residential and commercial buildings. To forestall the inevitable need for growth in additional energy generation, it is imperative that major advancements be made in creating energy efficiencies in existing and future buildings. Oregon State University has nationally recognized strengths in several areas critical to reducing energy use in buildings and homes. Ongoing programs in both artificial intelligence/machine learning for intelligent operation and mixed-signal integrated circuits for wireless sensor networks that sense local feedback for control are recognized nationally as top 5 programs. In addition to this expertise, we also have strengths in design, distributed HVAC (micro-energy systems), power systems, and control systems which are critical to developing meaningful solutions to smart energy living. Currently, we are building collaborations with PNNL, Intel, PGE, BPA, PSU, UO and Pacificore to create the research agenda that will guide these collaborations resulting in national impact. Additionally, Western Oregon University, Eastern Oregon University and PSU have all expressed interest in collaboration related to sensing and sustainability. The investment through ETIC new faculty hires will strengthen this team so that Oregon is a national leader in smart energy living.

2 - Center for Sustainable Buildings and Infrastructure

A key element to our sustainable future is making the most of what we have through efficient use of our material and energy resources. In the broad sense, *efficient use* includes a range of ideas: green building materials developed locally with a low carbon footprint, buildings that operate with minimal energy and water use, and a resilient infrastructure adaptable to the effects of climate change, as well as to our own changing needs as we move to the future. The Center for Sustainable Buildings and Infrastructure will be focused on the concept of *efficient use*.

Oregon State University is already making great strides towards efficient use. Our Green Building Materials Laboratory (GBML) focuses on development of new materials for green construction. The Viscoelastic Thermal Compression (VTC) process being developed in the GBML will enable Oregon's 40,000 acres of poplar trees to be used for structural materials instead of wood pulp, resulting in up to 200 new manufacturing jobs for the state. The GBML is also developing

durable low carbon-footprint concrete from recycled and waste materials, as well as energy efficient building insulation from recycled plastic. Our School of Civil and Construction Engineering (CCE) Laboratories are world-renowned for improving the resilience of our infrastructure, from mitigating the effects of natural disasters, such as tsunamis, to revitalization of our aging infrastructure. Our experience with green materials and resilience is critical as we move to address the challenges around our energy needs and climate change.

Based on the strong foundation of our existing laboratories and faculty, we propose to add three to four new faculty in order to broaden our impact and address these challenges by forming the Center for Sustainable Buildings and Infrastructure. In addition, we propose a \$26M state-of-the-art research laboratory aimed at large-scale validation today of tomorrow's sustainable solutions for the nation's buildings and infrastructure. This facility will boast one of the largest environmental chambers in the United States, and in combination with the full-scale reaction wall/strong floor, material testing pit, and green building materials laboratory, will be the only facility of its kind in the world. The new faculty and facility will allow us to expand our development of innovative materials for commercialization, as well as to implement the new materials into practice.

3 - Micro Technology Energy Systems Center

The Micro-technology energy Systems Center will build on successful research and development within ONAMI and the Microproducts Breakthrough Institute (MBI) and the Green Materials Science and Engineering collaboration between OSU and UO. The Center will focus on commercial applications for technologies involving nanoparticles for energy production and is poised to grow to national prominence. Nanoparticles will be extensively used in the future for advanced energy production devices including photovoltaics (PV), concentrated solar chemical processing and batteries. One of the first focus efforts of the center will be to transform the production and delivery of nanomaterials through the integration of microreactor technology directly within nanomanufacturing processes, enabling revolutionary reductions in the costs, environmental impacts and safety risks associated with the manufacturing of a broad diversity of nano-enabled products. The Center's research will demonstrate that microreactor-assisted synthesis, separation and scale-up of nanomaterials can significantly improve the throughput, yield and energy efficiency of nanoparticle and macromolecular production over standard batch processes while reducing environmental risks and impacts by eliminating existing vapor-phase deposition techniques. A team of industry partners have expressed support for the Center and will collaborate on research and commercialization. ETIC investments to elevate this area to national leadership include the following:

- Augment the existing team with 3 new faculty in the areas of nanomanufacturing, sustainable manufacturing, and microtech energy systems.
- Facilities Capital: The laboratory component of the Micro Energy Systems Center will be housed at the present ONAMI and MBI facility on the HP campus and the faculty, staff and graduate students will be housed in the new CBEE building. We anticipate capital needs of approximately \$2M on the HP campus and additional \$30M for the new CBEE building (1/2 private, 1/2 state bonds).
- Equipment Capital: \$2M for laboratory equipment (to match competitive federal funding)

The linkage with the Green Materials Science and Engineering collaboration enables applications of advances in materials chemistry. That collaboration including science and engineering faculty at OSU and UO along with 70 industrial partners is funded as one of the National Science Foundation's Centers for Chemical Innovation. The NSF funded effort is led by OSU Chemistry Professor Doug Keszler and

the OSU collaborators include 7 engineering faculty of which 5 are existing ETIC hires. This collaboration is focused on materials discovery, development and application predominantly in renewable energy, and commercialization. Investment in the OSU component of this collaboration will help the group win Phase II funding expected to total \$20M over five years, and includes the following:

- Facilities Capital: \$7.5M to expand research facilities in green materials
- Equipment Capital: \$1M seed funding for acquisition of laboratory equipment (to match competitive federal funding)
- Staff Support: \$200k to expand engagement with industry including joint R&D, technology transfer, and student internships

Private Support

2009 –2011Biennium: The College has an ETIC private fund raising goal of \$10M in the 2009 – 2011 biennium. OSU is in the final phase of a capital campaign that includes a goal of raising \$138M in gifts for the College of Engineering by June 2011. The \$20M remaining to be raised to achieve this goal is directed toward retention and recruitment of faculty and recruitment of top graduate and undergraduate students. The College is on track to reach the capital campaign goal, thus meeting the ETIC private support goal.

2011 – 2013 Biennium: Our proposal for the 2011-13 biennium will require private investment over and above the proposed \$18.5M increase in ETIC support. We plan to direct private funds to endowments for faculty and students and infrastructure. Specifically, those components are:

	Infrastructure*	Faculty	Students
SENERGI (NERHP Radiation Center Addition)	\$10M		
Center for Sustainable Buildings and Infrastructure (Laboratory Facility)	\$13M	\$7M	\$2M
Micro-Energy Systems Center (CBEE Building)	\$15M**		

* Infrastructure projects anticipate a state match to the private gift amount shown.

** COE has nearly completed a \$9.5M infrastructure investment in HP B-11 (April 2010)

Long Term to 2025: Although the ETIC time horizon is 2020, OSU President Ray established 2025 as an important milestone year for OSU and as a result we will benchmark our anticipated accomplishments to 2025.

Our goal to reach the impact of the nation’s top 25 engineering colleges will require substantial private investment over the next 15 years. We will need to raise nearly \$600M over this period in order to augment state investment to double the number of faculty, expand facilities, and provide scholarships and

fellowships for top students. Our current discussions with individual donors that will help achieve this investment level strongly support the need for a public-private partnership: one prospective donor considering a very large gift specifically asked if the state would cut our budget if we were to receive the gift.

Our preliminary estimates of the long term private gift components are:

- Expansion of infrastructure: \$110M to be matched by state bonds
- Endowment for faculty positions: \$410M to supplement state funding for faculty
- Endowment for scholarships and fellowships: \$80M

Results and Benefits

Short-term

- Results and benefits to 2013
 - Qualitative
 - Expect at least one of the centers of excellence to have move to the top of area nationally and receiving significant federal support.
 - Increased global partnerships both within the centers of excellence and in the classroom for our students.
 - Increased commercialization success in part due to improved collaboration with the College of Business within the structure of the Division of Business and Engineering.
 - Increased student competition wins based on historic success and additional funding available from private gifts.
 - Increased percentage of COE faculty receiving career awards and being elected fellows of their respective professional societies.
 - Increased high paying jobs for Oregonians resulting from COE spin-outs. Just two of our existing spin-out companies employ 50 people with an average salary of \$100,000.
 - Quantitative:
 - Completed hiring ten new faculty to compliment each of the Centers of Excellence identified above.
 - Graduated 750 engineers and computer scientists in 2013; 200 advanced and 550 baccalaureate degrees.
 - Grown research expenditures to \$35M
 - Experienced modest growth in women and minority graduate rates

Medium-term

- Results and benefits to 2020
 - Qualitative
 - All three of the centers of excellence identified in this proposal will have move to be nationally/international recognized and funded by the federal government.
 - Three additional centers of excellence have emerged from the campus wide SENERGI discussions and are moving to national/international recognition.

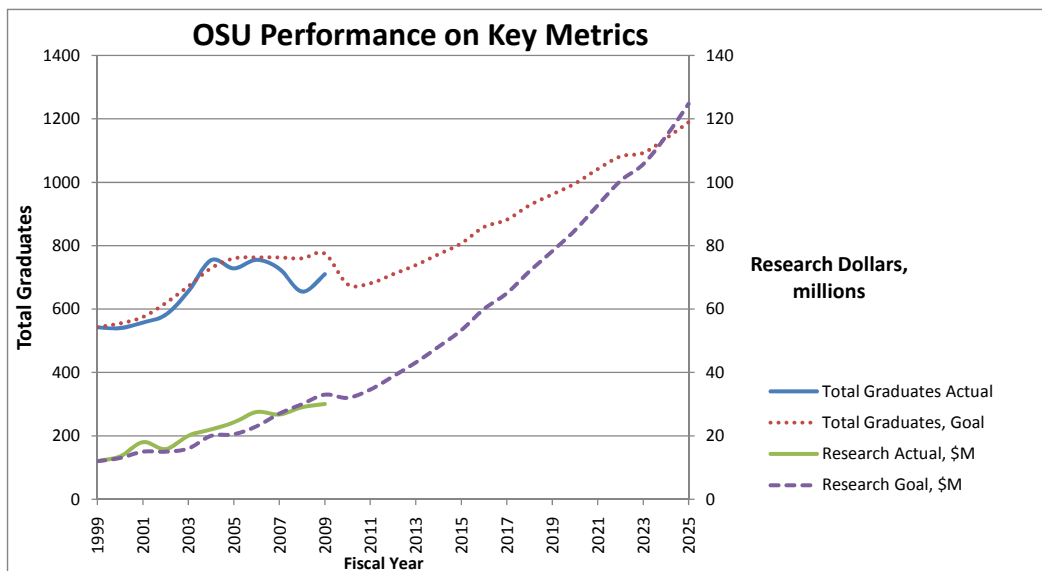
- Commercialization/Innovation at OSU will be led by the Division of Business and Engineering (includes Colleges of Business and Engineering) with three times the number of annual spinouts compared to 2009.
- Top undergraduate and graduate students from around the world will come to OSU to be a part of the College of Engineering.
- Quantitative
 - Total COE faculty number about 175
 - Graduated 1080 engineers and computer scientists in 2020; 330 advanced and 750 baccalaureate degrees.
 - Grown research expenditures to \$85M
 - Graduating classes are about 20 percent women and 20 percent minority

Future Plans & Resources

OSU will continue to build toward the impact of the nation’s top 25 engineering colleges. Key to achieving this goal is recruitment and retention of world class faculty, reaching the critical mass of 210 to 220 faculty commensurate with our aspiration peer institutions, or approximately double the number of engineering faculty at OSU today. During the next decade, SENERGI, university-wide focus center, will help build the faculty, attract the best students, and grow the research and commercialization impacts. By 2025 we will

- Develop numerous centers of excellence within SENERGI
- Grow global partnerships with other universities and industry
- Expand our commercialization efforts and triple new job creation impacts
- Develop innovations in engineering education that significantly improve recruitment and retention of students. Our entering freshman class will contain an equal number of top tier engineering students as typically found at elite private schools.

Achieving this growth in faculty will enable growth of our research and graduate program and move us toward the 1.8x degrees and 5x research (compared to 1999 values) by 2020 and to 2.2x and 10X by 2025.



Proposed Investment and Private Support Forecast (\$M)

		2011-2013 Biennium
1	Sources of funds	
2	Base budget for ETIC-related programs -- all sources except ETIC allocation & private support	\$ 33,461,002
3	Proposed allocation from ETIC budget (\$M)	\$ 33,906,432
4	Expected private support (\$M)	\$ 40,000,000
5	Total (\$M)	\$ 107,367,434
6	Personnel supported (FTE)	
7	Existing faculty (1)	44.0
8	New faculty(2)	10.0
9	Existing staff (1)	10.0
10	New staff	0.0
11	Total	64.0
12	New positions created	
13	Faculty (2)	10.0
14	Staff	0.0
15	Total	10.0
16	Uses of ETIC funds in line 3	
17	New facilities	\$ -
18	Improvements to facilities	\$ 7,500,000
19	Laboratory equipment	\$ 1,000,000
20	Other equipment	\$ -
21	Other one-time expenses (3)	\$ 2,000,000
22	Existing faculty salaries & benefits (1)	\$ 13,200,000
23	New faculty salaries & benefits (2)	\$ 3,000,000
24	Existing staff salaries & benefits (1)	\$ 1,745,950
25	New staff salaries & benefits	\$ -
26	Services & supplies	\$ -
27	Other (4)	\$ 5,460,482
28	Total - ETIC Expenditures	\$ 33,906,432
	(1) Hired through June 2011 that will be supported by ETIC funds during 2011-13 biennium.	
	(2) To be hired with ETIC funds during 2011-2013 biennium.	
	(3) Start up funding for 10 new faculty.	
	(4) Consist of: graduate assistant support; UG Program support; COP debt service offset; university administrative fee; and general operating support of ETIC activities.	

Metrics Forecast (for programs/departments receiving ETIC funding):

	Actuals (1)		Projected (2)		
	AY 99	AY09	AY13	AY15	AY20
Undergraduate student credit hours	52690	64344	67000	70000	80000
Graduate student credit hours	12870	19981	23000	28000	42000
Graduation rate, 6-year (3)	40/63	45/67	45/67	46/67	48/68
Bachelor's degrees granted	390	536	550	580	650
Master's degrees granted	123	138	150	170	250
PhD degrees granted	27	36	40	50	80
Women graduating (4)	13	13	14	16	20
Minorities graduating (5)	8	5	7	10	20
Externally-funded research expenditures (6)	12	30	35	45	80
Invention disclosures (7)		23	25	30	50
License/options (8)		3	3	5	8
License income received (9)		64000	75000	90000	150000
Spin-off Companies (10)		2	3	5	8
National ranking of <program or department> (11)					
National ranking of <college>					
(12)					
Notes/instructions.					
(1) Actuals for 12-month period ending in June of the year shown.					
(2) Forecast for the 12-month period ending in June of the year shown.					
(3) xx/yy xx = % completing ETIC-related degree, yy=% completing degree at OSU, AY 99 actually AY 2000 data (no data available for AY 93 cohort), AY 09 data actually AY 08 as AY 09 data not yet available.					
(4) From engineering, computer science, and other programs directly benefiting from ETIC funding, stated as percent of all those graduating.					
(5) Racial and ethnic minorities who are US citizens or permanent residents, stated percent of US citizens or permanent residents graduating.					
(6) Total external dollars spent by ETIC-related departments towards research during academic year.					
(7) See Association of University Technology Managers (AUTM) survey definitions.					
(8) Number of license or option agreements executed during the year. See AUTM survey definitions.					
(9) License issue fees, payments under options, annual minimums, running royalties, termination payments, the amount of equity received when cashed in, and software end-user license fees equal to \$1000 or more, but not research funding, patent expense reimbursement, valuation of equity not cashed-in, or end-user license fees less than \$1000. See AUTM survey definitions.					
(10) New companies that were dependent on the licensing of your program's technology for their initiation. See AUTM survey definitions.					
(11) Forecasts for multiple programs and departments are encouraged. Each ranking should be footnoted with the ranking body or ranking methodology.					