UNIT REPORT

Energy Systems Research Center - Institutional Effectiveness Final Annual Report 2019

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Definition of Unit

Definition of Unit: Center for Energy Systems Research (CESR)

Reporting Year:

Providing Department: Energy Systems Research Center

Department/Unit Contact: Satish Mahajan

Mission/Vision/Goal Statement:

Mission: The Center for Energy Systems Research (CESR) was established to advance and apply scientific and engineering knowledge and academic programs associated with energy systems and in particular with electric power while supporting the instructional program of Tennessee Technological University (TTU). Research efforts, both theoretical and experimental, are focused on solving current and anticipated problems associated with energy systems. Special emphasis is given to the needs of the electric power industry.

Vision: The center will be known and be recognized nationally for its research contributions in energy systems and Infrastructure areas.

Goals: The 5 current Goals have been developed on the basis of the mission of the Center. The numerical objectives have been arrived at using historical data with a view on advancement towards reaching the vision.

Goal/Objective/Outcome

Goal 1. Increase research activity in the areas of the Center

Define Goal:

Increase research activity in the areas of the Center

Intended Outcomes / Objectives:

1. Generate external funding that will contribute to the long term growth and sustainability of the Center. As a minimum, the external funding generated per year by the center should match the state funding.
2. Center faculty and the R&D Engineer will produce at least 5 publications in total. Once sufficient data is collected it will be reported on a running 3 year average to smooth differences between publication timing and research project timing.

Goal 2. Increase Student Research Activity

Define Goal:

Increase Student Research Activity

Intended Outcomes / Objectives:

1. Increase the number of MS and Ph.D. graduates in the strategic research areas of the Center by 25% during the next three years and hold steady.
2. Support at least two undergraduate research projects per year in the areas related to energy systems.

Goal 3. Increase Collaborative Research

Define Goal:

Increase collaborative research

Intended Outcomes / Objectives:

Develop and submit two collaborative proposals with interdisciplinary focus. The number of collaborative proposals submitted per year should be at least two per year.

Goal 4. Add Laboratory Facilities

Define Goal:

Add laboratory facilities.

Intended Outcomes / Objectives:

1. Acquire a research trailer for in the field testing.
2. Continue to support the development of the wireless power laboratory.

Goal 5. Increase Outreach Activities

Define Goal:

Increase Outreach Activities.

Intended Outcomes / Objectives:

1. Organize a minimum of two seminars by external speakers per year.

Assessment Tools

Assessment Tool 1: External grants activated

Goal/ Outcome/ Objective: Goal 1 and Goal 3

Type of Tool: Tracking Spreadsheet

Frequency of Assessment: Annually

Rationale:

External grants activated indicate success in bringing funded research into the university, the result of which will benefit students, the scientific body of knowledge as a whole, and the funding source itself by solving some research problem. It does not address the idea that a bigger project may be better or more smaller projects is better but it does give us a general measure to compare progress. Hopefully some of these projects will also represent collaborative efforts but this tool is not a direct metric of collaboration.

Assessment Tool 2: Number of Journal Publications and Conference Publications

Goal/ Outcome/ Objective: Goal 1 and Goal 2 and Goal 3

Type of Tool: Tracking Spreadsheet

Frequency of Assessment: Annually

Rationale:

Papers represent the increase in knowledge from research activities. By concentrating on journal and peer reviewed conference papers the quality of the research is acknowledged by peers in the field of study. By examining the list of authors on these publications we can get a measure of the success in the collaboration goal.

Assessment Tool 3: Number of M.S. and Ph.D. graduates during the year

Goal/ Outcome/ Objective: Goal 1 and Goal 2 and Goal 3

Type of Tool: Tracking Spreadsheet

Frequency of Assessment: Annually

Rationale:

If the graduates this year took a long time getting their degrees then this measure might not directly correlate to effectiveness in achieving the goals but on average this assessment tool is expected to historically follow the quantity of research achieved in the center. By examining the graduate committee for each student we can get an indication of the amount of collaborative research.

Assessment Tool 4: Number of M.S. and Ph.D. students supported by the center during the year

Goal/ Outcome/ Objective: Goal 1 and Goal 2 and Goal 3

Type of Tool: Tracking Spreadsheet

Frequency of Assessment: Annually

Rationale:

While quantity of students may not directly measure the amount or quality of research being conducted by the center, it is generally perceived that statistically this metric will be relevant to the goals.

Assessment Tool 5: Number of undergraduate research projects supported

Goal/ Outcome/ Objective: Goal 1, Goal 2, and Goal 3

Type of Tool: Tracking Spreadsheet

Frequency of Assessment: Annually

Rationale:

Often undergraduate student research results in some of the best innovations since the undergraduate is not burdened knowing what can or can't be done. Including this metric with the others is important to assess the total amount of research being conducted by the center.

Assessment Tool 6: Number of collaborative proposals submitted

Goal/ Outcome/ Objective: Goal 3

Type of Tool: Tracking Spreadsheet

Frequency of Assessment: Annually

Rationale:

This metric will directly reflect energy expended toward Goal 3. By comparing proposals to activations an effectiveness can ultimately be determined to guide future proposal writing endeavors.

Assessment Tool 7: Laboratory projects completed/initiated

Goal/ Outcome/ Objective: Goal 4

Type of Tool: Tracking Spreadsheet

Frequency of Assessment: Annually

Rationale:

The number of new laboratories created, renovated, expanded, etc. will directly affect the research infrastructure making more meaningful, up-to-date research possible.

Assessment Tool 8: Number of seminars by external speakers to our faculty and students ensures exposure to new ideas.

Goal/ Outcome/ Objective: Goal 5

Type of Tool: Tracking Spreadsheet

Frequency of Assessment: Annually

Rationale:

Seminars are important to inform researchers what the current state of the art is in various research disciplines and provide new contact opportunities to promote collaborative efforts. This tool directly reflects the efforts expended toward Goal 5. The feedback from the faculty and students could directly reflect effectiveness of this effort and guide future efforts.

Assessment Tool 9: Number of outreach activities planned for the upcoming year with a list of persons to be invited for the activities.

Goal/ Outcome/ Objective: Goal 5

Type of Tool: Tracking Spreadsheet

Frequency of Assessment: Annually

Rationale:

This assessment tool forces Center administration to be forward thinking about Goal 5 since many of the activities related to this goal must be planned well in advance.

Results

Result for Goal 1. Increase research activity in the areas of the center

Goal/Objective/Outcome Number: 1

Results:

Increase research activity in the areas of the center

- Generate external funding that will contribute to the long term growth and sustainability of the Center. As a minimum, the external funding generated per year by the center should match the state funding.
- Center faculty and the R&D Engineer will produce at least 5 publications in total, which will be reported on a 3 year moving average basis.

This goal intersects the University Flight Plan's Multidisciplinary Research Innovation sub goal. The creation of the Smart Grid and Resilient Infrastructure focus areas is to foster multidisciplinary research efforts. Even if considered to be primarily one department; getting power engineers, communication engineers, cyber security researchers, etc. to focus on a common laboratory for collaborative efforts has resulted in several collaborative proposals being prepared.

The Center Focus Areas also intersect the University Flight Plan focus areas to Create Distinctive Programs and Invigorate Faculty.

This year we are continuing to report on the fiscal year to reduce reporting efforts by aligning with our other annual report. This also brings us inline with the other centers reporting.

There were a total of 40 activations which totaled $ 2,246,109.18, which is a higher quantity and more money than last year. **The history of external funding of the center over last 34 years indicates crossing of $ 2M level only 3 times including the current fiscal year. It also indicates a record level of external funding for the CESR !!!.** Of course, the external funding handily meets the goal of matching the state appropriations for the center. A full listing of activations can be found in the attachments.

Faculty evaluations are based on a calendar year and getting data on a fiscal year for our report was problematic during the summer when many faculty are gone. Instead of evaluations based on incomplete information, it was decided to change to a 'center only' basis and have the target goal to 5 publications which is appropriate for the 3 researchers (Director, Research Assistant Professor, and the R & D Engineer) in the Center. The publications listed in the publications attachment can be summarized for the Center's associated faculty by totalling the 7 conference papers and 2 journal articles which handily surpasses the goal of a total of 5 papers. This metric is to be on a 3 year average but since the metric has changed, 3 years of data has not accrued yet.

Attachments: Attached Files

CESR Publications for 2018-2019 Fiscal year.docx

SM 3 List of Activations 2018-2019 - with PIs Names.xlsx

Results for Goal 2. Increase Student Research Activity

Goal/Objective/Outcome Number: 2

Results:

Increase Student Research activity

- Increase the number of MS and Ph.D. graduates in the strategic research areas of the Center by 25% during the next three years and hold steady.
- Support at least two undergraduate research projects per year in the areas related to energy systems.

This goal intersects the University Flight Plan's New Graduate Programs sub goal. Since the Center now has the Smart Grid and Resilient Infrastructure focus areas, graduate degrees resulting from this focused Center attention will yield more hire-able graduates in these areas of recognized national importance.

The number of M.S. and Ph.D. graduates for the Fiscal Year 2018-2019 can be seen in Table 1 below. The listing of the graduating students Masters Thesis and the Ph.D. Dissertation topics can be found in the attachment.

Though CESR has traditionally focused on graduate research there are several points that can be made about progress toward the Flight Plan focus area for improving the undergraduate student experience. Encouraging faculty to utilize graduate research labs in their undergraduate teaching is the best way to meet this objective.

Thirty undergraduate students from a multidisciplinary array of departments conducted research under the umbrella of CESR (see attachment). For the second year in a row, the CESR facilitated undergraduate students through the NSF supported Research Experience for Undergraduates (REU).

The highlighted undergraduate researcher this year is Brandon Nieman who preformed exemplary in programming an Arudino Uno to control a novel power electronic inverter design used to operate a Quasi-Wireless Capacitive (QWiC) Energy transfer system for powering sensors through soil.

Increasing student research activity can be partially assessed by the number of students supported. Students have been supported by the Center in a number of ways including financially, office space, and R&D Engineering support. Figure 1 shows the historic number of students supported financially for the last 5 years.

Table 1. Students supported by the Center.

Number of Students Supported by the CESR during Fiscal Year 2018-2019			
	B.S.	M.S.	Ph.D.
Financial Support			
Assistantships		21	13
Hourly Student Payroll	30	40	30

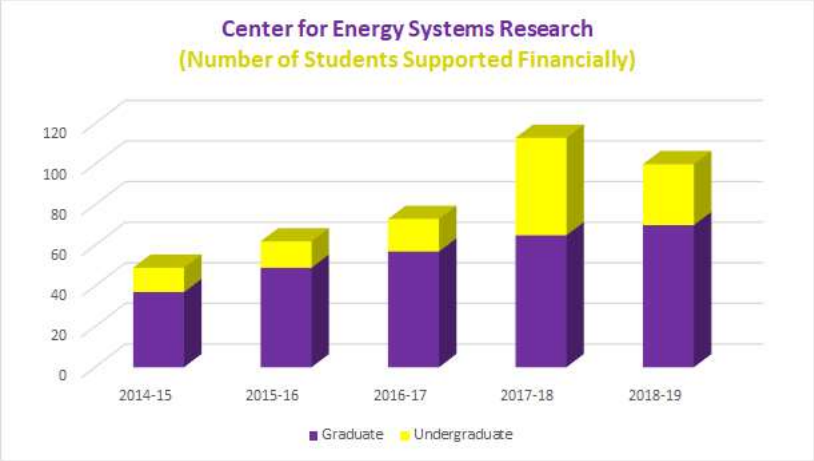

Figure 1 Students Supported for the last 5 years.

Figure 1 shows that we did meet the goal of 25% increase over the year 2014-15 in the number of graduate students and further quantified in Table 2. The center is definitely holding steady the increased growth.

Table 2. Historic support of graduate students

Fiscal Year	MS/PhD Students Supported	% Increase over previous year	% Increase over first year
2014-15	37		
2015-16	49	32.4	32.4
2016-17	57	16.3	54.1
2017-18	65	14.0	75.7
2018-19	70	7.7	89.2

Attachments: Attached Files

SM-10 HOURLY STUDENT 2018-2019.docx

SM-11 Undergraduate Student Research 2018-2019.xlsx

Results for Goal 3. Increase Collaborative Research

Goal/Objective/Outcome Number: 3

Results:

Increase Collaborative research

- Develop and submit two collaborative proposals with interdisciplinary focus. The number of collaborative proposals submitted per year should be at least two per year.

This goal intersects the University Flight Plan's Multidisciplinary Research Innovation sub goal.

The collaborative proposals listed in the Attachment include 13 proposals with an 'internal to TTU' collaborative aspect, 8 with collaborations with an 'external to TTU' component. There were also 4 project activations with a collaborative component.

We are very proud of the collaborative activations with: The University of Tennessee Institute of Agriculture, and State University of NY at Buffalo; The University of Tennessee Knoxville; and two with The University of Florida and The Georgia Institute of Technology.

Attachments: Attached Files

2018-2019 Collaboration Efforts CESR Revised Aug 13 2019 1.xlsx

Results for Goal 4. Add Laboratory Facilities

Goal/Objective/Outcome Number: 4

Results:

Add Laboratory facilities

- Acquire a research trailer for field testing.
- Continue to Support the development of the wireless power laboratory.

Since the wireless power laboratory is still in it's infancy, it required:

- More basic supplies
- New electrical outlets installed by facilities.
- Removal of old research projects to make way for new research stations

But perhaps the most exciting is the new research trailer currently sitting at Shipley Farms to facilitate the NSF project, Sensors in the Soil.

Figure 1. Research trailer at Tennessee Tech Shipley Farm

Attachments:

Results for Goal 5. Increase Outreach Activities

Goal/Objective/Outcome Number: 5

Results:

Increase outreach activities

- Organize a minimum of two seminars by external speakers per year.

This goal intersects the University Flight Plan's Co-Curricular Undergraduate Program sub goal and the Multidisciplinary Research Innovation sub goal. By having research area experts from outside the university come teach seminars, workshops or short courses the students will be exposed to a broader base of information and hopefully promote collaborative efforts from TTU researchers with those at other institutions.

The 2 seminars presented by external speakers in the fiscal year 2018-2019 are presented in the attachments.

Attachments: Attached Files

Maheshwari Seminar - September 2018.pdf

Rafailov Seminar - November 2018.pdf

Modifications and Continuing Improvement to Goals/Objectives/Outcomes

New Modifications and Continuing Improvement to Goals/Objectives/Outcomes Item

Goal/Objective/Outcome Number:

Program Changes and Actions due to Results:

Link to Assessment:

Link to 'Tech Tomorrow' Strategic Plan: