Center for Energy and Environmental Sustainability

Overview and Updates

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Director and PI

Professor of Civil & Environmental Eng.

EAB Meeting, August 12, 2013

CREST Program Mission

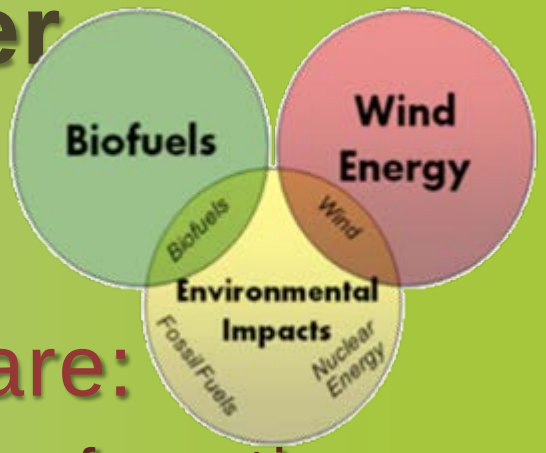
- CREST makes resources available to enhance the research capabilities of minority-serving institutions through the establishment of centers that effectively integrate education and research. CREST promotes the development of new knowledge, enhancements of the research productivity of individual faculty, and an expanded diverse student presence in STEM disciplines.

Source: CREST Program Solicitation

Vision for CEES

- Build a nationally recognized multi-disciplinary, self sustaining education and research community around CEES that will enhance research infrastructure and productivity of the university and provide educational and research experiences to diverse group of undergraduate and graduate students in the STEM disciplines and prepare them for workforce.

Goals of the Center



Overarching goals of the Center are:

1. Research focus on transitional and transformative technologies for global energy solutions
2. Develop new national and international partnerships to form collaborative teams of researchers in three major areas: Biofuel Productions, Wind Energy, and Energy and the Environment
3. Lead the development of "Energy Engineering Minor" and graduate a level energy focus at PVAMU
4. Serve as a source for developing manpower in the area of sustainable energy

Objectives

- Significantly increase productivity in energy research
- Establish energy research infrastructure (both shared laboratory facilities and technical support personnel)
- Increase connections and collaborations among PVAMU energy research programs
- Strengthen current research collaborations and build new collaborations
- Provide national visibility for CEES
- Provide well-rounded postdoctoral experiences
- Integrate CEES research into the curriculum
- Provide training for workforce development

Strategic Plan

- Develop Research Infrastructure and collaborative partnerships to enhance research capabilities and productivity
  - Multidisciplinary team of faculty researchers working as a team and developing partnerships both within and outside university
  - Establish state of the art laboratories through leveraged funds
  - Ensure sustainability by securing external funding

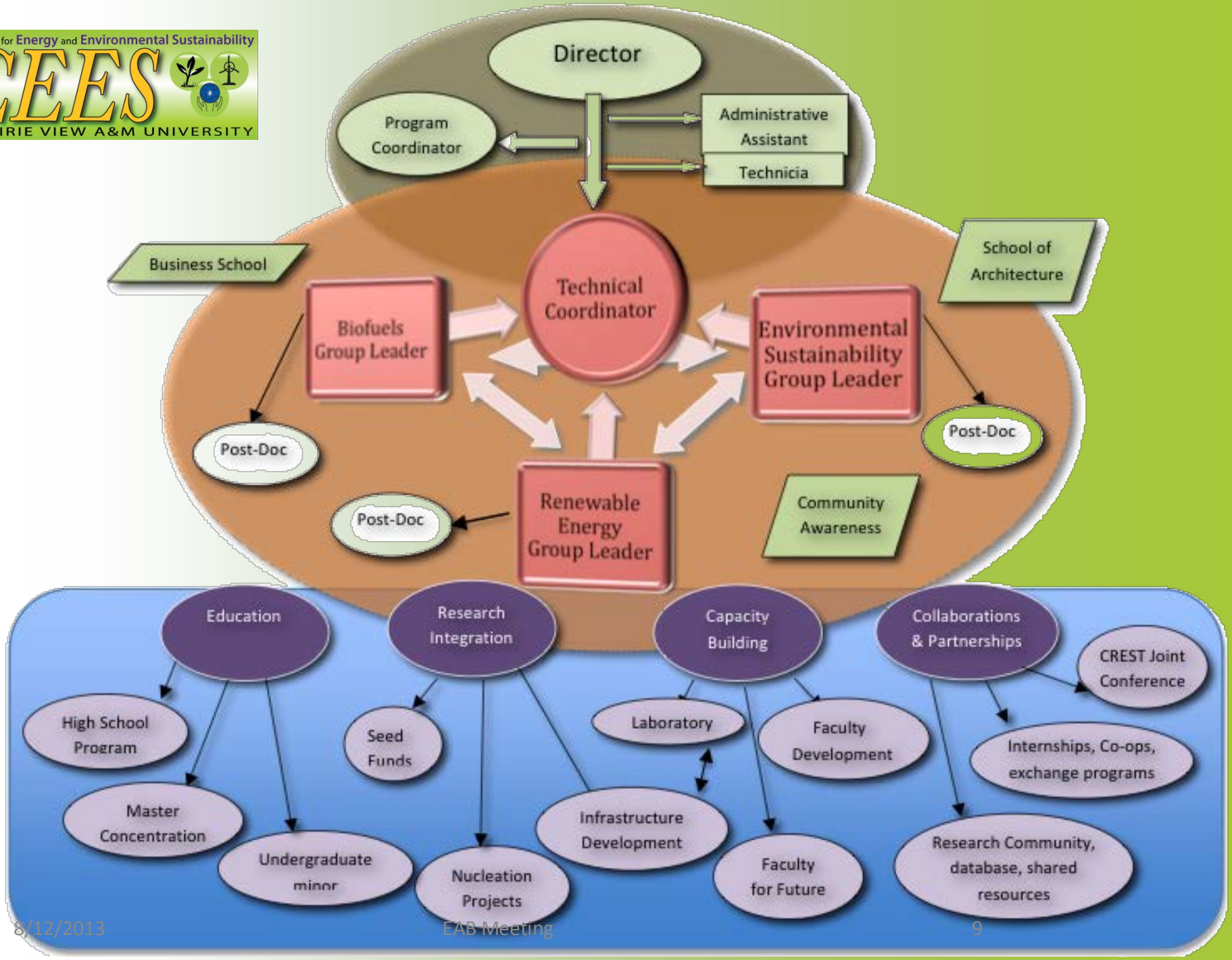
Strategic Plan

- Promote Energy Engineering Education for workforce development
  - Develop a Energy engineering minor at Undergrad level and a Energy Engineering Concentration at Graduate level
  - Integrate current research into curriculum
  - Develop a pipeline for recruitment of diverse student populations into STEM disciplines and prepare them for workforce
  - Promote Energy and Environmental Sustainability awareness across the community

Strategic Plan

- Develop Center into a National Resource
  - Research focus on global energy solutions through collaborative research in Biofuel Production, Wind Energy, and Energy and Environmental sustainability
  - Collaborate among the teams to study the Impact of various energy technologies on the environment and their sustainability

Center for Energy and Environmental Sustainability
CEES
PRAIRIE VIEW A&M UNIVERSITY



CEES Research Team

CEES Personnel

- **Biofuels:**
  Ananda Amarasekara, Chemistry
  - Lignocellulosic Biomass Hydrolysis (Co-PI and Group Lead)

  Paul Biney, Mechanical Engineering
  - Biofuels Pyrolysis (Co-PI and Technical Coordinator)

  Michael Gyamerah, Chemical Engineering
  - Bioprocess Engineering, Biofuels from Biochemical Processes
- Collaborators
  - *Dr. Robert C. Brown, Iowa State University*
  - *Dr. Clyde Munster, Texas A&M University*

CEES Personnel

- **Wind Energy:**
  Ziaul Huque, Mechanical Engineering
  - Computational Fluid Dynamics, Design of Turbine Blades (Co-PI and Group Lead)
- **Collaborators**
  - Dr. Steve Barson – Pratt & Whitney Rocketdyne
  - Dr. Andy Swift – Former Director, Wind Science and Engineering Research Center, Texas Tech Univ.

CEES Personnel

- **Energy & Environment**:
  Raghava Kommalapati, Civil & Environ. Eng.
  - Environmental Impacts, Photochemical Modeling (Director, PI and Group Lead)
- Collaborators
  - David Allen, University of Texas, Austin
  - Dr. Venkatesh Udamaneni - Texas Tech University, Lubbock
  - Dr. Neelesh Sule, Providence Engineering
  - Drs. Pavel Tsvetkov & Karen Vierow - Texas A&M University

CEES Personnel

- **Education and Outreach:**
  - Felecia M. Nave, Chemical Engineering,
    - Assoc. Provost &Assoc. VP for Academic Affairs
    - NSF Education Research Project, HBCU-UP
  - Raghava R. Kommalapati, Civil & Env. Eng.
    - Summer Transportation Institute since 2000
  - Kelvin K. Kirby, Electrical Engineering
    - NSF STEM Enhancement (HBCU-UP)
    - NASA – CRESSE
  - All research team members

CEES Personnel

- Post-Doctoral Researchers
  - 3 Post-docs (March 2013)
  - 2 Shared Post-docs (1 in CEE and 1 in Chemistry) with partial support from center
- Students
  - 8 Graduate Students (spring 2013)
  - 10 Undergraduate Students (spring 2013)

Organizational Structure

Role of External Advisory Board

- Consist of Representatives from academic institutions, industry, national labs and governmental agencies.
- Provide guidance and Advice
- Review Center Activities and Progress to meet its vision, goals and objectives
- Make suggestions for possible new strategies or directions.
- Provide feedback on the needs of the Center's stakeholders
- Function as the champions of the center, helping to increase national visibility
- Working to connect the center with potential collaborators and stakeholders in academia, industry and national labs.

External Advisory Board

- Dr. Kalliat T. Valsaraj, Vice-Chancellor of Research and Economic Development. Louisiana State University (Chair)
- Dr. Robin Autenrieth, Interim Department Head, Department of Civil Engineering, Texas A&M University. **(new)**
- Dr. Akwasi Boateng, Lead Scientist, Bioenergy and Energy Alternatives National Program, US Department of Agriculture
- Dr. Kuruvilla John, Associate Dean of Research and Graduate Studies, College of Engineering at University of North Texas. **(new)**
- Dr. John Pappas, Interim Director, Texas A&M Energy Engineering Institute & Vestas Director, Wind Energy Center, Texas A&M University
- Dr. Robert Shepard, Executive Director, Science and Engineering Alliance
- Dr. Munir Sindhir, Director, Engineering Technical Disciplines, Pratt & Whitney Rocketdyne
- Dr. Bala Subramaniam, Director, Center for Environmentally Beneficial Catalysis (CEBC), University of Kansas
- Dr. Timothy Valentine, Director Radiation Safety Information Computational Center (RSICC), Oak Ridge National Laboratory

2012 EAB Meeting

- We had our first EAB meeting on April 3, 2012
- 4 of the 7 EAB members and NSF program director, Dr. Richard Smith participated
- Attended by Dr. Thomas-Smith, Dr. Trotty (via Video conference) and Dean Harris
- Shared the report with VPR and ISC Chair, Provost and Dean of Engineering
- Discussion on the Comments later in the presentation

Internal Steering Committee

- Dr. Willie Trotty, VP for Research and Dean of Graduate School (Chair)
- Dr. E. Joahanne Thomas-Smith, Provost & Sr. VP for Acad. Affairs
- Dr. Corey S. Bradford, Sr VP for Business Affairs
- Dr. Kendall T. Harris, Dean, Roy. G. Perry College of Engineering
- Dr. Danny R. Kelly, Dean, Brailsford College of Arts and Sciences
- Dr. Munir Quddus, Dean, College of Business
- Dr. Ikhlas Sabouni, Dean, School of Architecture
- Dr. Irvine W. Osborne-Lee, Department Head, Chemical Eng.
- Dr. Aderemi Oki, Department Head, Chemistry and Physics

Energy Engineering Learning Community

- The Learning Community will incorporate:
  - linked, interdisciplinary courses
    - Through the Energy Engineering minor (Fall 2011)
  - professional development and social activities
    - *Colloquia and seminar series* with nationally known invited speakers
    - *Brown bag lunch series* for graduate students (started internally)
    - Starting in Fall 2013
  - research experiences
    - Multi-level research groups, interdisciplinary mini-projects, internship opportunities
    - Formal and informal mentoring
    - Ongoing – started in Spring 2012

Lab Development

- Development of three major laboratory facilities:
  - Biofuels process laboratory;
  - Wind turbine testing laboratory and
  - Environmental laboratory.
- These facilities, although established primarily for research, will also be used for teaching, training and outreach demonstration experiments.
- Several Ongoing Lab development activities are used to leverage equipment for the CEES
  - Title III Grant for Civil & Environmental Eng Lab development (Kommalapati)
  - Other sources

Sustainability

- Many functions of CEES will be institutionalized, including the Energy Engineering curricula and new laboratories developed under NSF CREST funding
- The enhanced research programs, personnel, infrastructure and collaborations developed through CEES will enable PVAMU to compete more effectively for external research funding and continue Center activities

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Biofuels Research

- Thermochemical processing of biomass into bio-oil production through fast pyrolysis
- Biochemical processing of biomass into ethanol through catalytic hydrolysis of lignocellulose using ionic liquids followed by fermentation
- Bio-oil upgrading into transportation fuels.

Wind Energy Research

- Determine the optimum design of wind turbine blades by applying multi-objective techniques with surrogate models

Major sub tasks

1. Improve understanding of the complex flow field around wind turbine blades and determine the relevant aerodynamic loads on the blades using primarily CFD.
2. Perform structural analysis of the turbine blades using Finite Element Method (FEM).
3. Study fluid-structure interaction.
4. Develop surrogate models and perform multi-objective optimization of the rotor blades using surrogate models.

Energy &Environment Research

- **Sustainable Nuclear Energy** (SNE) through radiological safety, spent fuel management and advanced reactors
- **Photochemical Modeling (PCM) of Emissions Control Scenarios** to investigate effects on air quality of the various energy technologies under study by CEES
- **Life Cycle Analysis (LCA) of Greenhouse Gas Emissions** from conventional (fossil fuels), nuclear, and renewable (biofuels, wind) energy technologies.

Student Papers & Presentations

- AY 2011-12
- Biofuels
  - 2 Peer Reviewed Publications
  - 4 Undergrad Student Posters
- Wind Energy
  - 1 Peer Reviewed Publication
  - 5 undergrad student posters and 1 oral presentation
  - 2 International Conference presentations
- Energy and Environment
  - 4 undergrad student posters
  - 4 grad student poster/Presentations
- Additionally
  - 12 (5 oral and 7 poster) presentations at the TAMU-K CREST center Conference in April 2012

Papers & Presentations

- 2012-13 AY
- 7 Peer Reviewed Journal Articles, 1 Conference Proceeding, 2 thesis, 2 Masters Projects, 2 Oral Presentations and 11 poster presentations
- Biofuels
  - 2 Peer Reviewed Publications
  - 1 Conference Proceeding
  - 1 Grad Student Poster
- Wind Energy
  - 3 Peer Reviewed Publications
  - 2 Grad Student posters
  - 1 Thesis, 2 Masters Projects
- Energy and Environment
  - 2 Peer Reviewed publications
  - 2 Undergrad oral presentations
  - 6 Undergrad student posters
  - 2 Grad student posters
  - 1 Thesis

Other Activities

- Professor Brewster's group at Univ of Illinois, Urbana, visited Center in spring 2013 and made presentation to COE students
- Developed curriculum and presented to freshman students participating in the CE^2I Summer Program in Chemical, Civil and Mechanical disciplines
- Presented to high School students participating in the Summer Transportation Institute
- Working with the University Administration for TAMU system level recognition of the Center
- Submitted a Supplement Request to NSF for a collaboration project with Dr. Haynes at Ga. Tech
- Submitted 3 proposals and got funding for 1 of the projects from TAMUS Chancellors Research Initiative

Energy Engineering Minor

- Courses added Effective Fall 2011
  - Introduction to Energy Systems (CHEG 3113)
  - Energy and Environment (CVEG 4113)
  - Renewable Energy and Energy Sustainability (MCEG 3123)
  - Energy Conversion (ELEG 4013)
  - Courses will be offered starting in AY 2013-14
- Other Courses
  - Energy System Design (MCEG 4123)
  - Air Pollution Control (CVEG 4243)
- Offered 4 nuclear energy related courses in last 2 years as part of NRC curriculum and Scholarship Grants
- Looking to offer these courses on more regular basis

Graduate Courses

- Working with College and University to develop Energy Engineering Concentration as part of MS in Engineering
- Graduate Courses Offered
  - Design Optimization
  - Computational Fluid Dynamics
  - Renewable Energy
  - Environmental Modeling

External Evaluation

- Conducted by West Texas Office of Evaluation and Research (WTER)
  - Graduate student Interviews
  - Undergraduate student Focus Groups
  - Overall very positive input from both groups of students and very valuable suggestions for improvements

WTER Recommendations and Concluding Comments- UG Students

- Undergraduate students are benefiting from their participation with CEES. Project leaders should continue to use a team approach to research that allows undergraduate students to work with faculty, post docs, graduate students, and other undergraduates across various disciplines. The weekly team meetings have provided valuable learning experiences for the students and should be continued. Having the students make presentations at these meetings as well as at conferences has definitely contributed to their increased presentation and communication skills. This model of working with students that includes clearly defined expectations is significantly contributing to their development of a sense of professionalism and responsibility.
- CEES leaders should consider expansion of their efforts to develop students' presentation and oral communication skills to also include helping students learn about publishing their research. Since most of the students may someday be graduate students, being able to publish or at least go through the process of submitting a manuscript for publication would be a valuable experience. Having student publications or at least included on publications would also be valuable for CEES to document.

WTER Recommendations and Concluding Comments- UG Students

- It is important for all CEES students to be engaged in as much hands-on research experience as possible. CEES leaders should work with faculty and post docs who mentor CEES students to help them understand how important it is for their students to understand the "big picture" of the research and how what they are doing relates to and fits in with the research being conducted.
- If possible, CEES leaders should find ways to provide better computer access for the students in a place that is more conducive to their research than open access computer labs across campus. CEES leaders should also consider the students' suggestions about increased dissemination of environmental research findings to PVAMU students and faculty.

WTER Recommendations and Concluding Comments- Grad Students

- The Center has provided positive learning experiences for graduate students that prepare them for the future. Students who would not have been able to attend graduate school without CEES support are now planning or considering pursuit of PhDs. Adding post docs to the Center's research teams has benefited the graduate students.
- The CEES strategies of facilitation of research by teams made up of a diverse group of individuals with various disciplinary backgrounds should be continued. The weekly meetings of research teams during which students make presentations of their progress are very beneficial for students. Project leaders should consider bringing all the teams together in order to help everyone have a better understanding of each other's work and how their work fits into the big research picture supported by CEES.
- If possible, CEES leaders should provide a dedicated computer lab for the high performance computing needed for simulations. Project leaders should also review other concerns and suggestions students provided in their interviews to determine if they would strengthen the Center and if they are possible to implement.

EAB Comments from 2012 Meeting

EAB Comments

- Positives
  - Commended the university leadership for their strong support of the director and the team
  - Commended the university administration for providing the space to the center
  - Team made considerable progress on various objectives in spite of the difficulties due to leadership issues and other delays
  - Research plans among the three focus area are progressing well
  - Energy Minor is a very positive development
  - Promotion of energy engineering concentration is commendable and could serve as niche area for PVAMU

EAB Comments

- Need to work on
  - Develop a clearly articulated strategic plan that addresses
    - Inter-relationships between the three research themes
    - Where does the university want this program by the end of the grant
    - Define the roles and responsibilities of the leadership team
  - Clearly spell out research aims that set us apart from other on-going and more established ideas in the three focus areas
  - Focus and highlight educational aspects of this center such as recruitment, retention and job placement for underrepresented groups
  - Clearly Delineate the connection between research and education
- Addressed these with the revised vision and strategic plan

EAB Comments

- Need to work on
  - Recruitment of graduate students and post-docs
  - Center should be used as a tool in recruiting graduate students
  - Develop Website fully – increase visibility – can be a great recruitment tool

EAB Comments

Student Recruitment and Support

- Center recruited and supported 8 grad students and 12 undergrad students in AY 2012-13 and plans to hire similar number of students for coming AY
- In addition several students work with the researchers on projects without financial support
- Center supports 3 post-docs full-time and 2 post-docs are shared with other grants.
- Will continue to recruit more grad and undergrad students to pursue Energy research and prepare them for careers in the energy industry

EAB Comments

CEES Website

- Updated CEES website with some of the suggestions made by EAB and will continue to keep the website relevant and informative

  www.pvamu.edu/cees

- However as of June 2013 university closed updates for the current website as they start migration to new website (which will go live in September)

  http://wordpress.pvamu.edu/cees

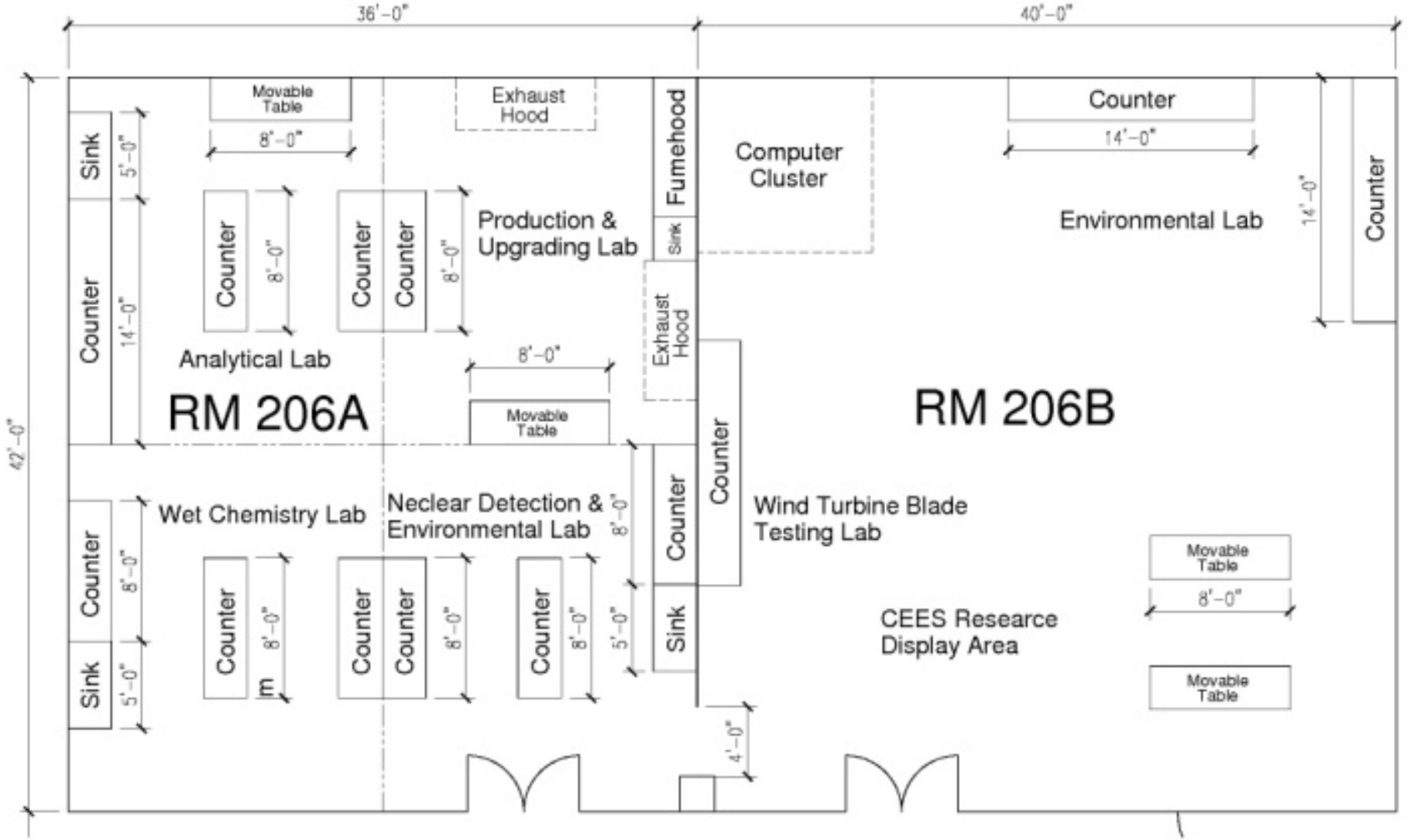
EAB Comments

- Need University to Support
  - Program Coordinator/Administrative Assistant
    - Dr. Trotty worked with VPBA, Dr. Bradford and Dean Harris to find funds for the position. The funding request is being approved at this time. Hiring process has started.
  - Renovation of lab space to make it into a usable space
    - Support is being arranged through Title III
    - Obtained preliminary estimates and paper work for A&E but due to some organization changes,we will be starting back again.

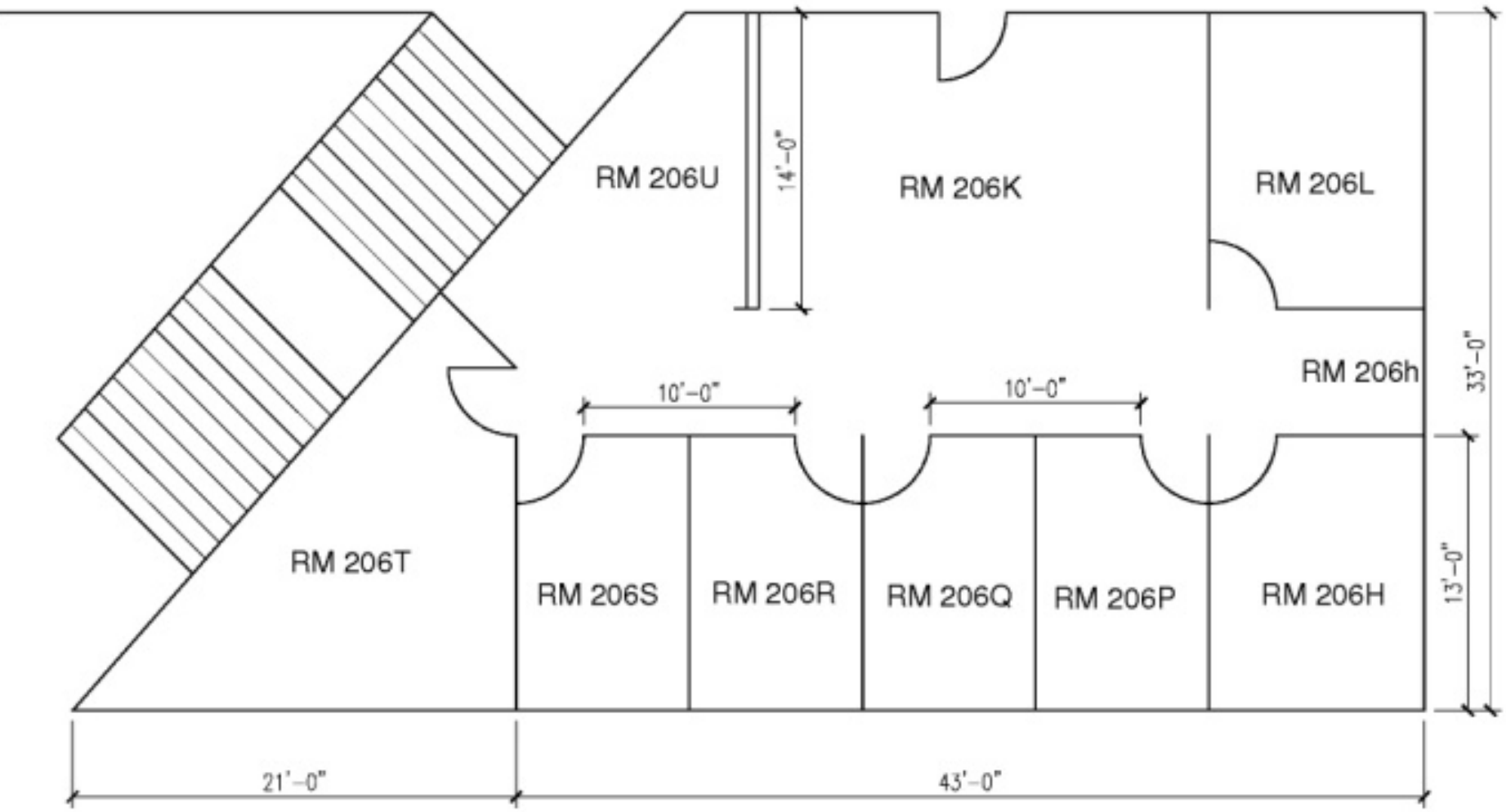
Space Management

- New space
  - ~2900 Sq ft of Lab space (requires renovation)
  - ~1500 sq ft of Office space (7 office spaces, 1 conference room and reception area (student desks)
  - This is in addition to the lab spaces that the research team already have
    - Amarasekara – Chemistry (232 New Science Bldg)
    - Biney – FAST center (105 SR Collins and Farm House)
    - Gyamerah – Chemical Engineering (143 & 143 A Gilchrist)
    - Huque - Mechanical Engineering, 208 A Gilchrist
    - Kommalapati – Environmental Research Lab(213 Wilson)
    - Nave – Chemical Engineering (142 &143 Gilchrist)

New Lab Space



New Office Space



Equipment

- Acquired or in the process of being delivered
  - 48 node Cluster (CAMx, CFD & FEA)
  - TOC, HPLC, GC-MS, Ion chromatograph, UV/Vis spectrophotometer, CHNOS analyzer, TGA, etc..
  - Micro-Pyrolyzer
  - Micro-Balance
  - Pyrolysis Reactor
- Hi-Vol Air Sampler, URG Air Sampling system, Fog Collector
- Al facilities available for different groups are on the CEES website

Thank you

Questions/Comments ??