The Energy University

Presented to the Board of Trustees
November 20, 2015
Power of Confluence of Strategic Plan and Campaign

• Call for Penn State to focus on Energy Security that is:
  – Abundant
  – Affordable
  – Safe
  – Clean
• Expectation and desire to advance our current efforts
Fossil fuels have made up at least 80% of U.S. fuel mix since 1900.

Source: U.S. Energy Information Administration, Monthly Energy Review
The Future…

50% increase in energy requirements by 2040
Expected Energy Trends

• Continued reliance on fossil fuels for the foreseeable future
• Opportunity for research to end the roadblocks for renewable sources of energy
• Growing importance for national security and U.S. energy independence
• Advances in efficiency and effectiveness
• Evolution of regulatory environment
• Greater knowledge about environmental impacts
Pennsylvania: The Energy State

• Nation’s second-largest natural gas producer
• Ranks second in nation in electricity generation from nuclear power
• Fourth-largest coal producing state in the nation and only state producing anthracite coal
• Renewable energy accounts for 4% of PA’s net electricity generation

Source: http://www.eia.gov/state/?sid=PA (Last Updated: May 21, 2015)
Energy Research and Education at Penn State

- Broad involvement across ALL Colleges and Campuses
- Connected to industry
- Community Outreach and Ag Extension
- Penn State Energy IP: 93 active licenses and 7 startups, including:
Energy Education at Penn State

- 30+ undergraduate and graduate degrees with a focus on energy
- 20 programs available through the World Campus
- 20+ Workforce Development and Continuing Education Programs
- K-12 Education in Energy and the Environment
Energy Research Capacity at Penn State

More than **320 individual investigators** including:
- Engineering (115)
- EMS (70)
- AgSci (35)
- Eberly (25)
- Ag Ext (20)
- Smeal, Law/School of International Affairs, Liberal Arts, Arts & Arch, Comm, HHD, Educ. (55+)
Example: Petroleum and Natural Gas Engineering (PNGE) Program

- More than 500 students enrolled
- Interactive teaching and learning, so graduates are prepared to contribute immediately as professionals and leaders
- Grounding in PNGE fundamentals; emphasis on design and decision-making
- 100% placement rate for graduates
Example: EMS Energy Institute

- Nine faculty-led research programs for UG and Grad students
- Improving coal and petroleum processes, photovoltaic technology, and energy storage and transformation
- Commitment to industry partnerships and resource development
- $4+M in funded research and 2,000+ published citations a year
Example: Mining Technology Associate of Science at Penn State Fayette

- Students can choose to focus on Maintenance or Production
- Prepares students for supervisory roles in the mining industry
- Accredited by the Engineering Technology Accreditation Commission of ABET Inc.
Example: Center for Collaborative Research and Intelligent Natural Gas Supply Systems (CCRINGSS)

- Faculty from EMS, Eng., Smeal, IST
- Focus on efficiency and sustainability through technological innovations and improved supply chain management
- Established through a gift from GE
Example: Breazeale Nuclear Reactor

- Celebrated its 60th anniversary this year
- Longest-running university nuclear reactor in America
- Built as part of the “Atoms for Peace” program
Example: DOE GridSTAR Center

- A smart grid education and research center that focuses on efficient building systems
- Result of a three-year $5M contractual award by DOE
- Offers for-credit and non-credit programs in Phila., Pittsburgh, University Park and online
Example: Penn State Facilities Engineering Institute (PSFEI)

- Partners with the PA Department of General Services to procure electricity and natural gas for Commonwealth agencies that results in annual saving of approx. $11M.
- Training and management includes solar and wind
Other Areas of Research and Education

• Engineering (Nanomaterials)
• Agricultural Sciences (Biofuels)
• IST (Smart systems)
• Business (Energy supply chain)
• Law (Governance, regulation and energy security)
• Liberal Arts (Economics and ethics)
• Arts and Architecture (Sustainability, Net Zero buildings)
• Penn State Extension (Marcellus Center is a global leader)
How do we measure impact?

• Metrics on research dissemination
• Scholarly output
• Rankings
• Engagement by students, faculty and staff
• Breadth of programs
Energy Categories (5 Key Areas)

- Energy: policy, economics and law including incentives, geopolitics, local, national and international law
- Fossil fuels: maximizing efficiency including extraction, conversion, combustion, transportation, carbon capture and sequestration
- Renewable energy (all sources)
- Systems/Technology (smart city, smart systems): grid technology, vehicle and building efficiency, energy storage and management
- Environmental impact: energy-water-food nexus, carbon footprint, climate change, land use
Energy law, policy, economics, social and geo-political implications
Renewable energy (all sources) and nuclear
Distribution, efficiency, grid, storage, smart buildings, campuses, cities
Penn State Ranks in Top 5 of Each Category

<table>
<thead>
<tr>
<th>Rank (Scholarly output)</th>
<th>Energy: Policy, Economics and Law</th>
<th>Fossil Fuels, Combustion, Turbo., Carbon Capture</th>
<th>Renewable energy (All types) and nuclear</th>
<th>Dist., efficiency, grid, storage, smart build</th>
<th>Energy and the Environment (including Climate)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Massachusetts Institute of Technology</td>
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The Opportunity at Penn State

As one of America’s powerhouse energy research universities, we can:

• Assess and address societal needs and industry demands
• Accelerate the trajectory of fundamental discovery and applied innovation
• Transform the energy sector to meet the challenges of the 21st century
The Vision: Becoming The Energy University

Stepping forward as the higher education leader in:

- *Research*: Generating the knowledge and technology that will drive the next energy revolution
- *Education*: Preparing a workforce that is both highly trained and highly adaptable, ready for global careers and collaboration
- *Service*: Partnering with industry to address urgent, real-world needs for energy production and policy
The Challenges

- Competition with well-funded peers (e.g. MIT, Stanford, UC Berkeley) for top faculty and students
- Misconception that PA isn’t prepared for real energy industry leadership
- Limited institutional resources, despite strong institutional interest and will
Next Steps

Identify investments that will create even greater excellence in:

• Faculty leadership
• Industry expertise
• State-of-the-art infrastructure
• State-of-the-art thinking
• The next energy leaders
Next Steps

• Engaging partners across Penn State and beyond
• Committing university resources
• Creating a fundraising plan
• Partnering with lead donors
Discussion. Questions?