

### P/O/E/T/S

CENTER FOR POWER OPTIMIZATION OF ELECTRO-THERMAL SYSTEMS

POETS Sustainability and Industry/Faculty Partnering on External Funding Opportunities

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### **Presentation Overview**

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- The Grand Challenge of NSF ERC Sustainability
- A Look at NSF Reporting on Graduated ERCs
- Reading Between the Lines Regarding Graduated ERCs and Sustainability
- Why ERCs Struggle with Sustainability
- Where does POETS Currently Stand, and What are our Prospects for Sustainability?
- What can we do to Increase our Post-Graduation status?
- Open discussion of ideas to strengthen our chances of sustainability.



### The Grand Challenge of NSF ERC Sustainability

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ERC's pursuit of sustainability is a bit like.....



..... the search for the Holy Grail.



### **NSF ERC Sustainability Info**

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### Status of ERCs: 1985-2021 Currently Self-Sustaining: 38 out of 47 Graduated ERCs=81%

Range of funding (last known data; in most cases 2019) for responding Centers in each year (Millions)



\$9.7 \$0.2-6.2 \$0 \$1.0-1.5 \$2.0-50.4 \$5.0 0.3-5.5 \$0.1-2.5 \$2.5-7.0 \$5.7-9.0 \$0.3 \$4.0-6.2 \$1.7-7.5 \$3.9 \$2.6-6.3

ERC Year Class (number of respondents)

\*Three Earthquake Engineering Research Centers were funded in 1997 with funds outside of the ERC Program but were managed by the ERC

Program from 1999 through their graduation from NSF support.



- Range of funding numbers across
  top of chart provide some idea
  of extent of funding
- Funding should be reported for full support, not just direct costs

Source: https://ercassoc.org/content/status-ercsyear

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# NSF ERC Sustainability Reporting



- NSF claims 38 of 47 graduated ERCs are active and selfsustaining (i.e. "continue to exist on campus as functioning centers with <u>ERC-like characteristics</u>." (integration of research, education and industrial interaction and collaborative, cross-disciplinary research)
- However, many if not most, post-graduation have a reduced/limited amount of funding and research, and become less interdisciplinary, less inter-institutional, fewer or single-investigator centers.
- "most common changes are de-emphasized industrial involvement, increased single-investigator grants, less strategic planning, and reduced synergy between university departments."
- Few NSF Centers are truly successful at long-term sustainability.



### Why Centers Struggle with Sustainability





- Lack of industry interest
- Late start at developing industry partners
- Wrong value propositions/pricing structure
- Place sustainability largely/entirely on the shoulders of the ILO
- Failure to achieve "centeredness" and keep the team together post-graduation
- Over-reliance on industry membership fees and failure to develop other funding sources
- Hope for successful start-ups
- Failure to adequately plan ahead and/or manage the ramp-down of NSF support.
- The research area has its run and cools off. The center fails to adapt/modify its research programs and scope to more lucrative/related research areas.

#### **Center Sustainability - The Multi-Legged Funding Model**



• When the NSF funding ends, many institutions cut their support, and center doesn't have the legs to stand on.



#### NSF Funding Ramp Down......



**Other resources:** 

 CoE funded research and admin space.

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- Cost-sharing funds of \$205,000 to support graduate student appointments in Years 9 and 10.
- Discretionary funding from the College of \$40,000/year.
- REU Site award helps offset the drop in the education budget in years 9 and 10.





Industry membership income trend and projections......

- **POETS Membership Fee Trend** \$1,600,000 \$1.500.000 \$1,400,000 \$1,300,000 \$1,200,000 \$1,000,000
- Original target of \$1.5M as the viable threshold to sustain research

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- Take advantage of the 15% overhead vs. ~60% overhead
- Targeting ~ 15-20 projects to maintain a core set of activities and faculty
- Grow a base via industry membership fees to support research, education, and admin
- Education partially funded by College/Campus partnerships
- Augment research funding with associated projects from government agencies



### POETS – Where we are Currently/ A Short Look Ahead to Years 9-11

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Associated project support (in dollars).....



- The systems we implemented to grow associated project funding are paying off.
- Our associated project funding has surpassed our NSF base funding.
- Significant additional associated project funding is expected in Year 8. Currently \$5.147 million (and counting).
- These are direct costs only!!!!



### POETS – Where we are Currently/ A Short Look Ahead to Years 9-11

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Associated project support (in projects).....

**POETS - NSF/Industry/Associated Projects by Year** 



- Our base NSF funding supports an average of about 24 projects per year.
- Our industry memberships support an average of about 8 projects per year.
- Our associated project funding now supports 27 projects.
- Together, our industry and associated project funding now support more projects than the NSF base award.



### POETS – Where we are Currently/ A Short Look Ahead to Years 9-11

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Newly Awarded Associate Projects will Offset Year 9 and 10 NSF Budget Reductions

Funding Source		Year 5		Year 6		Year 7		Year 8		Year 9		Year 10
NSF Base Funding	\$	4,000,000	\$	4,000,000	\$	4,000,000	\$	4,000,000	\$	2,680,000	\$	1,795,600
NSF Supplements	\$		\$	456,836	\$		\$	L.N	\$	(199 <u>7</u> )	\$	1997 / <u>-</u> -
NSF REU Site	\$		\$		\$		\$	134,835	\$	132,823	\$	133,691
Membership Fees	\$	445,000	\$	457,500	\$	460,000	\$	650,000	\$	800,000	\$	950,000
Associated Projects	\$	1,499,804	\$	3,781,256	\$	4,202,597			)	88.69	100	1
New Associated Project	<mark>s Con</mark>	ning in Y8*		6 5				100			x07	
Hinetics ARPA-E							\$	257,845	\$	263,534	\$	1,412,835
Nokia ARPA-E	111						\$	254,621	\$	253,268	\$	241,448
UIUC/Ampaire ARPA-E			1				\$	1,042,314	\$	1,350,119	\$	942,382
Low GHG (estimate)					1.0		\$	400,000	\$	400,000	\$	400,000
Hinetics AF STTR	2						\$	180,000	\$	45,000	\$	
Hinetics NASA SBIR			13				\$	135,063	\$	87,612	\$	<u> </u>
	1		201	19/11/-	Tota	ls	\$	2,269,843	\$	2,399,533	\$	2,996,665
* Full budget amounts, r	not di	irect costs onl	у	7_6 <i>P</i> //6	2		$\mathcal{D}^{e}$			N N 18"		

- Newly-awarded associate projects starting in Year 8 will provide funding for Years 9 and 10 (and beyond) to offset the reductions in NSF funding.
- Additional associated projects added in the coming years will provide post-NSF funding.



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- We expect to continue to see an increase in our number of associated projects and funding therefrom during Year 8, as we are in the process of adding several additional projects, which are listed below.
- NASA: NSPIRES: High-Fidelity Experiments and Computations of Transient Two-Phase Flow for Understanding Cryogenic Propellant Tank Transfer (Miljkovic/Raytheon) \$1,228,188 total, \$665,823 for UIUC
- DOE VTO Low Greenhouse Gas (GHG) Vehicle Technologies: Articulated Dump Truck (ADT) Electrification – GHG Reductions and Commercialization of New Technology in Construction Vehicles Fleet (Deere/Zhao/Miljkovic) \$2,756,732
- **DOE ARPA-E: Cryogen-Free Ultra-High Field Superconducting Electric Motor** (Hinetics/UIUC/UMN) \$5,761,467 total, \$1,934,214 for UIUC
- DOE ARPA-E: Delivering Energy & Exergy Efficiency in the Converged 5G RAN/Edge Compute Network (Miljkovic/Nokia/Facebook) \$749,337 for UIUC
- DOE ARPA-E: Ultra-Efficient and Ultra-Rapid Electro-Thermal Pulse Deicing, Defrosting, and Desnowing for Renewable Energy and Electrified Aircraft Systems (Miljkovic/UIUC/Ampaire/VaporTech) \$3,974,649 total, \$2,824,183 for UIUC



## **POETS Sustainability Plan**

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- NSI C
- Building a diversified funding portfolio/aka., multi-legged table
- POETS sustainability is best assured if we can strengthen existing legs, and add additional legs, to the stool.
- Ideas for additional legs include:
  - Workforce development funding
  - Federal/State special appropriations
  - Cross-center partnerships (ASPIRE, others)
  - DoE EERE VTO/ARPA-E Awards
  - NSF TIP Programs (Regional Engines/Others)
  - New areas (Fast Charging/Batteries/Other areas?)

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Are we on the path to sustainability? How can we strengthen our post-graduate prospects?

- IDEA #1: Y8 Significant NSF Supplement Request
  - Significant supplement request in new/existing/tangential research area
  - Bring in new researchers/facilities/equipment/expertise
  - Partially offsets decrease in Y9 an Y10 NSF base funding
  - Need to finalize the request this coming spring (at the latest)
  - Already had \$500K instrumentation supplement in Year 6.
  - Your ideas are welcome!

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- NSF

Are there ways we can use our NSF funding during the last 2 years to better/best position ourselves for sustainability?





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Are there ways we can use our NSF funding during the last 2 years to better/best position ourselves for sustainability?

- Post-graduation, industry partners will have more influence over the research initiatives and which projects are funded
  - This is true by eliminating the NSF funded projects alone.
  - Post graduation, the thrust structure may not be as important or relevant as well.
  - Projects may become more directed, or vary more in terms of size or scope (they've been on similar scale to NSF-funded projects thus far.
  - Soooooo, are there ways we can modify our processes to start to smoothly usher in this transition?

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- IDEA #2: Reconsider how we use/allocate our NSF research funding in Years 9 and 10 to help set us up for post-graduation.
  - Can/should we invite more IAB input on the use/allocation of the NSF funds to strengthen our POETS/industry partnerships?
    - For example, allocate more weight to IAB feedback in the project selection process?
    - Should we move toward funding fewer, but larger projects?
  - Can/should we use these funds as seed funding for new initiatives, larger projects and teams, in preparation of upcoming significant opportunities? (EERE VTO, ARPA-E, others)
  - Can/should we use these funds as matching funds toward larger directed projects? That would increase industry ROI.
  - Other ideas?





- IDEA #3: Reconsider our research scope in how we use/allocate our NSF research funding in Years 9 and 10 to help set us up for post-graduation.
  - Can/should we be morphing into adjacent research areas? Which ones?
  - If so, should we use these funds to recruit new partner institutions, investigators? Obtain new research facilities/equipment?
  - Other ideas?



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- IDEA#4: Can we use our NSF funds to help bring in new industry members, or bring back prior members?
  - For example, offer matching to new members who wish to fund a directed project?
- IDEA#5: Can/should we use our NSF funds to match directed projects of our existing POETS industry members?

Other ideas?







- Significant and impactful ERC Sustainability is a tough challenge
- POETS is well positioned to have significant impact post-graduation from NSF Support
- We should continue discussions and entertain ideas regarding how to best use our available resources during years 8 to 10, and beyond, to strengthen our industry partnerships and prospects for continued long-term success