



Industry Collaboration and Innovation Program



Lisa Beard (retired)

(Presented by Kevin Tomsovic)

Industry Liaison Officer



NSF-DOE Site Visit

November 9, 2020

Knoxville, Tennessee



Rensselaer



Northeastern



TUSKEGEE
UNIVERSITY

Year 9 Achievement Summary

Membership and Industry Collaboration

- 35 members have signed agreements – 11 at Principal level
- 11 industry fellowships and seven industry internships
- 90 seminars and 23 workshops this year.

Tech Transfer Impacts

- Four patents awarded in Year 9 – Example: A protection scheme for a microgrid with dynamic point of common coupling
- Two licenses - Large-scale system testbed software; another in process of being signed
- Five patent applications

Innovation Program

- EIR – continues recruitment of new members to CURENT FNET/GridEye System. Collaborating on data modeling with Integrated Power Engineering.
- Engineer in Residence from ConEd

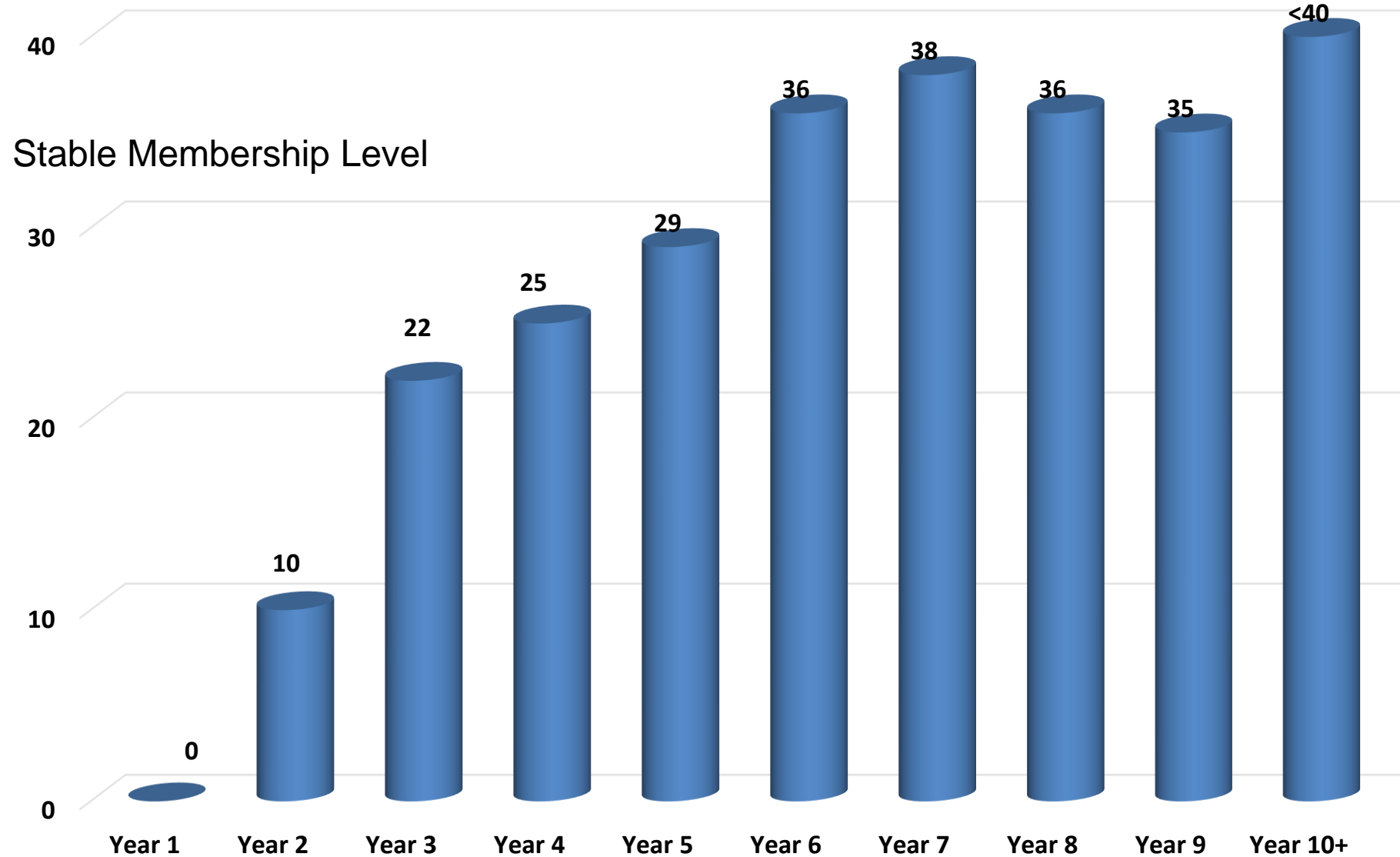
Industry Impact

- R&D 100 Winner for Large Scale Testbed and R&D 100 Finalist for Deep Convolutional Neural Network for N-1 (DCNNN)
- Licensed two Large Scale Testbed LTBnet Emulator and service-based supporting agreement
- 15 Associate projects with various levels of industry support
- Leadership in the North American Synchrophasor Initiative (NASPI)
- Daily usage of FNET data displays at NERC headquarters and numerous companies

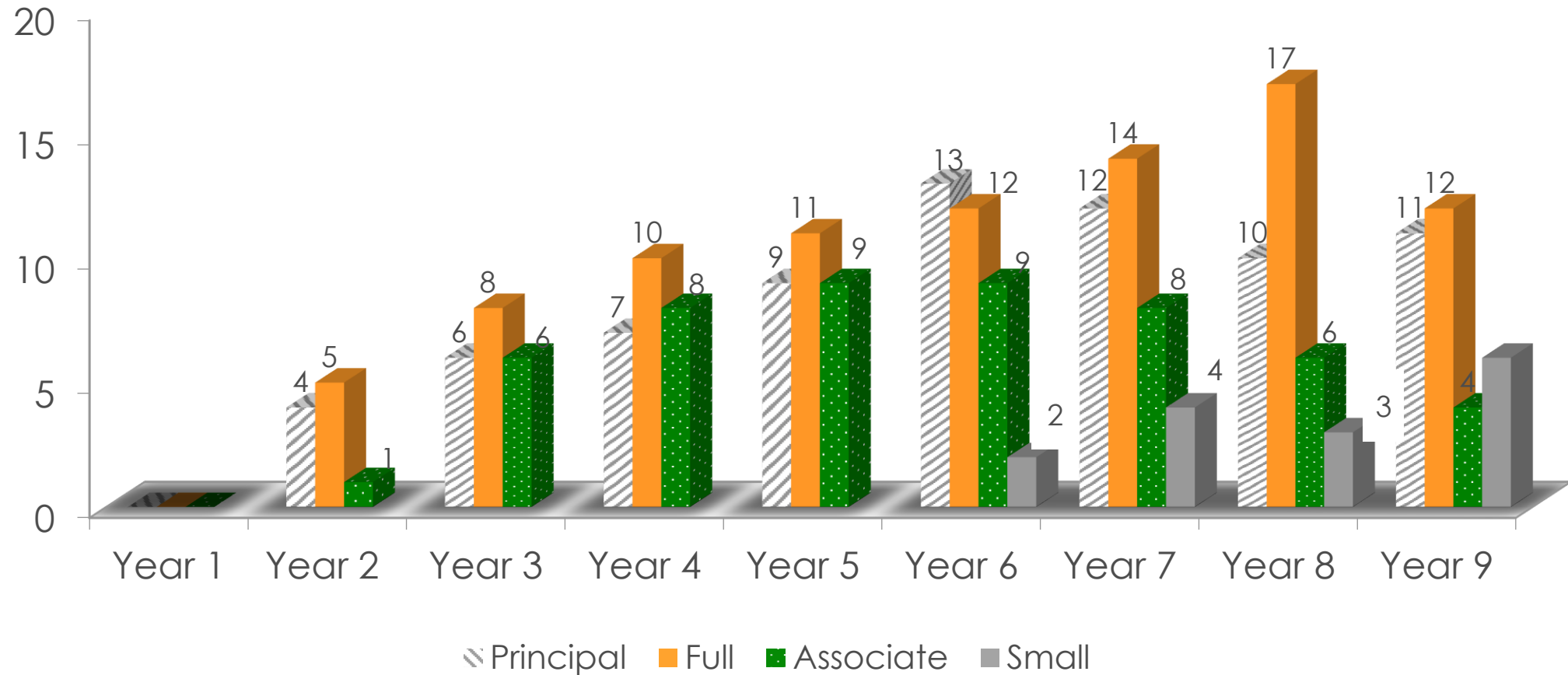
Membership Structure and Benefits

	Principal	Full	Associate	Small Business
Contribution	\$50,000/yr	\$10,000/yr	In-kind (\$10,000/yr)	\$2,000/yr. cash In-kind (\$10,000/yr)
Focused research projects	✓			
IAB representative	✓	✓		
Industry/Practitioner thrust partners	✓	✓	✓	✓
Non-exclusive royalty free IP rights for internal and specified partner's use	✓	With IPPF		
Option for licensing to ERC's IP	1 st option	2 nd option		
IPPF member	Automatic	Optional		
Access to Non-IP information, including technology roadmaps	✓	✓	✓	✓
Free or discounted access to ERC conferences and short courses	✓	✓	✓	✓
Free access to industrial seminar series	✓	✓	✓	✓
Priority access to student interns and recruits	✓	✓	✓	✓

CURRENT Membership Growth

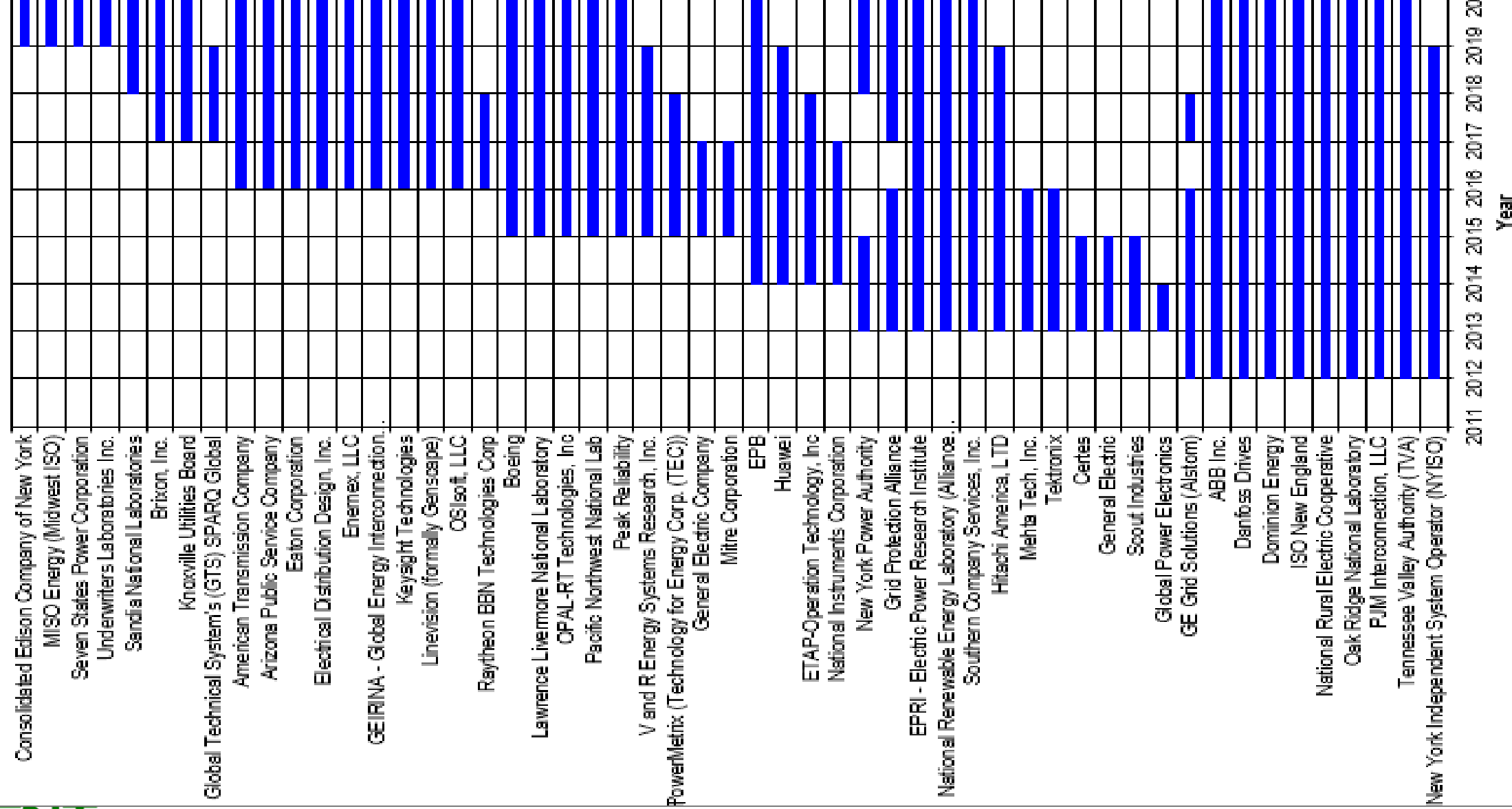


Membership Breakdown by Level

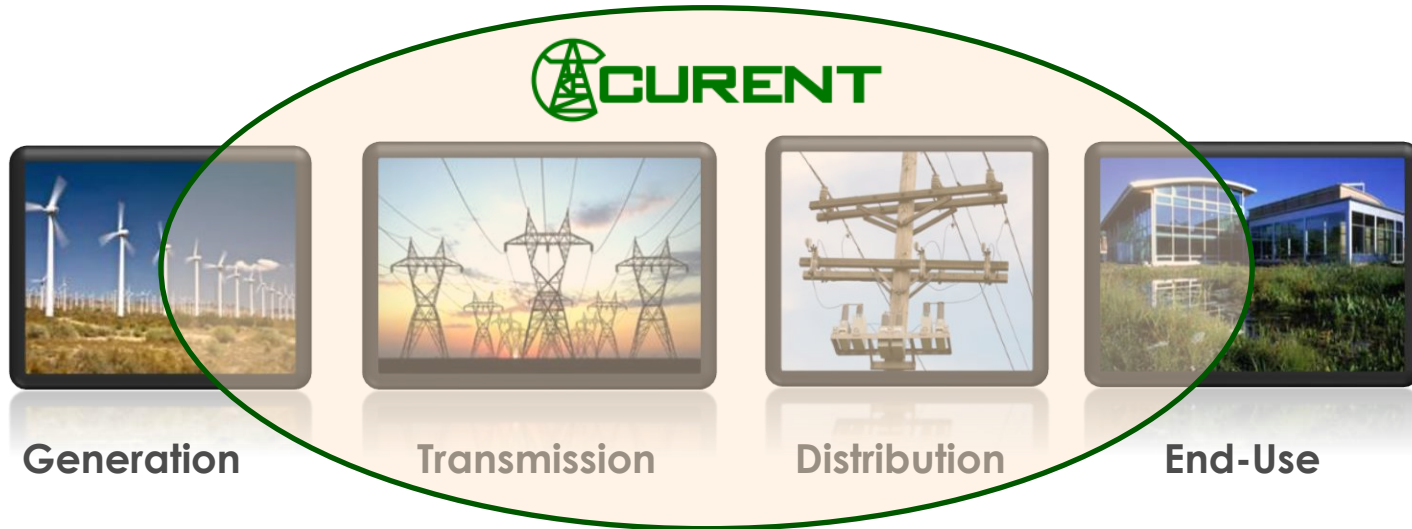


Industry Long Term Commitment

Figure 5b: Lifetime Industrial/Practitioner Membership History



Industry Program



Utilities
RTOs/ISOs

Vendors

Consultants,
Research,
Consortia



Industry Advisory Board



Matthew Gardner
Dominion Energy
Chair

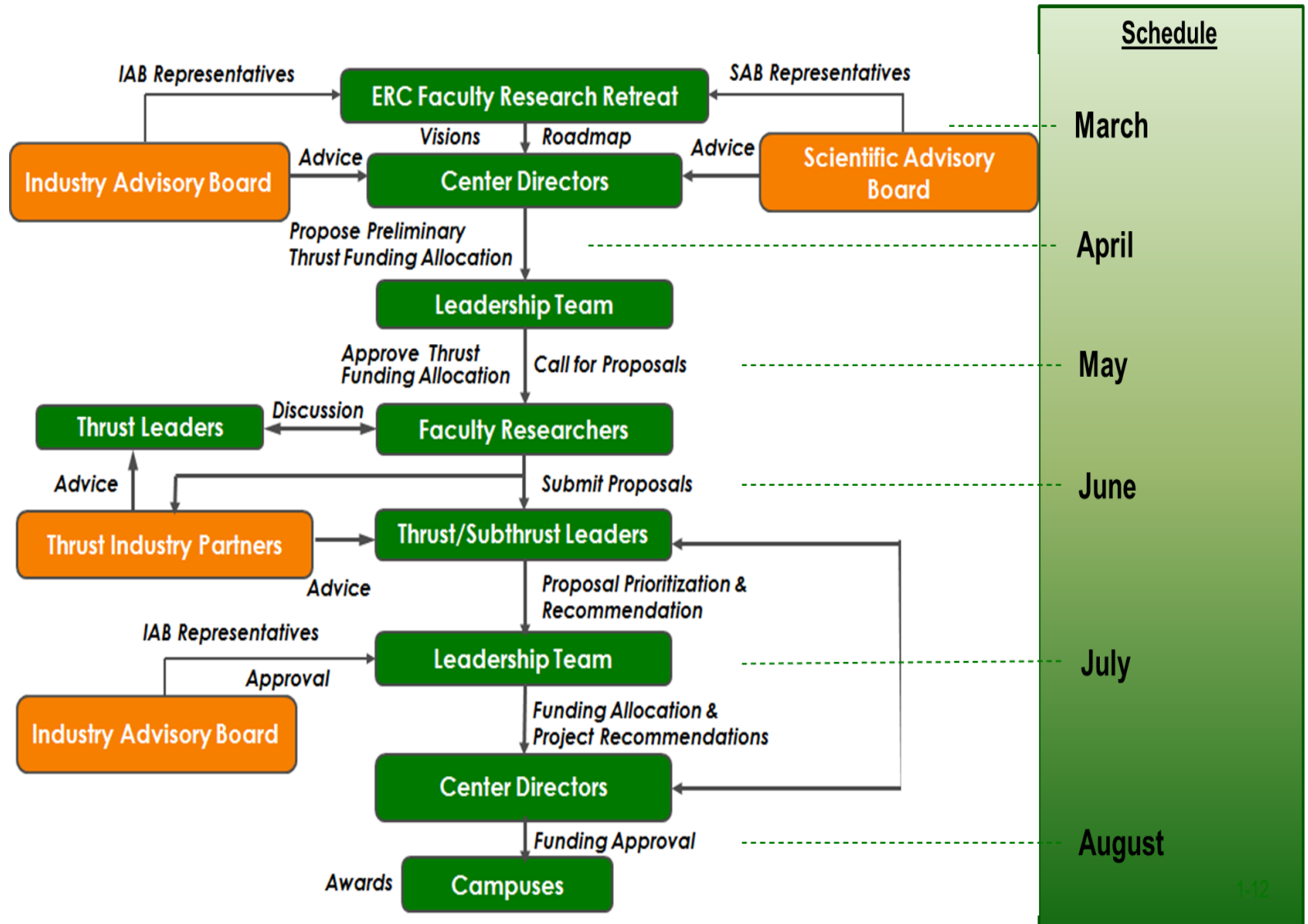


Xiaoming Feng
ABB
Vice Chair



Project Planning Process

- Annual research retreat held virtually in May
 - presentations on industry challenges
 - review and update center and thrust roadmaps
 - sustainability
- Virtual meeting following the IEEE PES General Meeting to finalize projects for year 10



Value Proposition for Members

Research partnerships



Access to Students



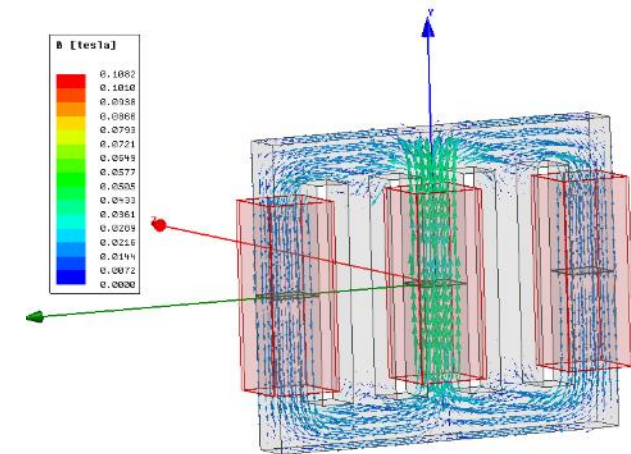
Workshops



Networking



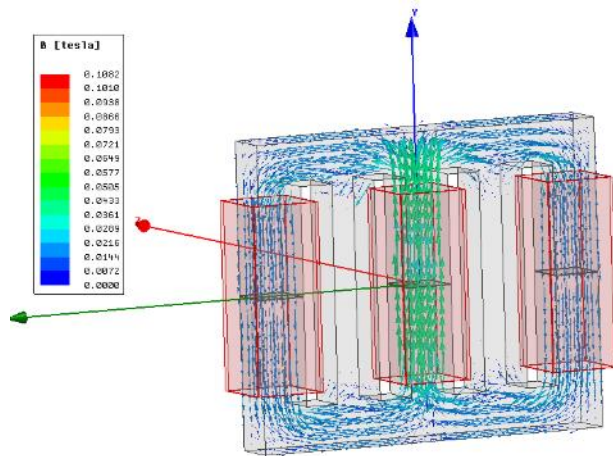
Example of leveraging on-going research



CVSR for networked distribution flow control

Industry Focused Research

Principal members have the option for focused research aligned with CURENT's strategic plan. Funding is used to support graduate students in the form of industry fellowships.



Company	Project	Primary Thrust	Secondary Thrust
ABB	Hybrid HVDC modeling and control	Monitoring	Control
Dominion Energy	Short circuit capability of IBR vs gas generation for Richmond area	Modeling	
ORNL	FNET/Grideye event data feed for ORNL Eagle-I	Modeling	
EPRI	NYPA PMU Measurement based oscillation damping control, modeling, Phase II HIP testing	Modeling	Control
TVA	PMU location analysis	Monitoring	Control
Boeing	Advanced power converter design	Actuation	
Keysight	Wide bandgap semiconductor characterization	Actuation	
LLNL	Integration of GridDyn to CURENT Large-scale Test Bed	LTB	
Geirina	Interface design of graph computing	Monitoring	Control
ConEd	Battery technology research	Actuation	
Southern Co	Angle change based line switching detection	Monitoring	

Industry Connectivity

- Annual conference – virtual on Nov. 6th, 2020. Five industry speakers. Student posters and industry panel.
- 90 seminars
- 23 Workshops
- Hosted two industry retreats. Spring retreat was virtual and held across two days in May. Summer retreat
- Monthly faculty project webinars and monthly project reviews
- Internships
- Members-only web-based portal
- Yearly proposal process



Technology Transfer Maturity

SAMPLE IP	
A Versatile Power Electronics Converter Based Reconfigurable Grid Emulation Platform	P34

TRL Level	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
2	P1, P2, P3	P1, P2, P3	P8	P8, P12	P8, P12	P8, P12	P8, P38	P8
3	P5, P6 P9	P5, P6	P2, P3, P5, P9, P10, P11	P1, P5, P9, P10,	P1, P5, P9, P10, P18	P1, P5, P9, P18		P52
4	P7	P7	P6	P2, P3, P6, P14,	P2, P3, P6, P14, P20, P21, P22, P23	P2, P3, P6, P1, P20, P21, P22, P23, P24, P27, P32, P33, P34	P2, P5, P18, P20, P22, P23, P33, P43, P44, P45	P2, P5, P18, P20, P22, P23, P33, P43, P50, P53, P54
5			P7	P7, P11, P13,	P7, P11, P13, P19	P7, P11, P13, P14, P19, P26, P28, P29, P30, P31, P35	P6, P7, P30	P6, P7, P30, P38, P46
6				P16	P16	P16, P25	P1, P3, P16, P19, P24, P26, P29, P31, P34, p35, P36	P1, P16, P19, P26, P31, P34, P35, P44, P48, P55
7				P17	P17	P17	P28, P32, P40, P41, P42	P24, P28, P29, P32, P36, P40, P41, P45, P49, P51
8		P4	P4	P4, P15	P4, P15	P4, P15	P4, P15, P25	P4, P15, P25, P42
9							P27	P3, P27

Technology Readiness Level

Valley of Death

Technology Transfer



Innovation Ecosystem Transfer Highlight

Large-Scale Test Bed

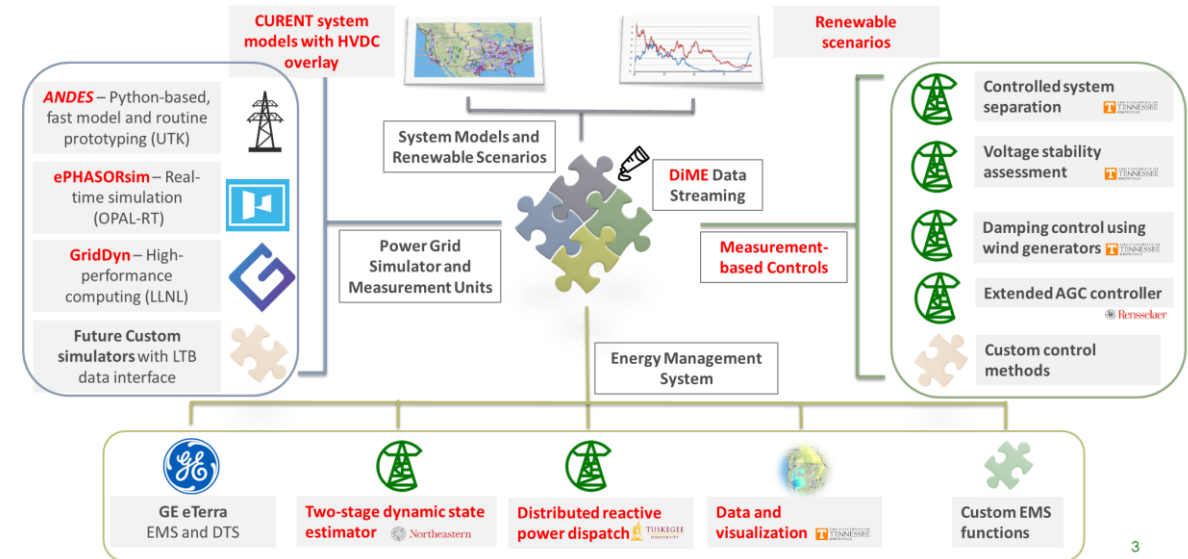
Accomplishment

- Develop a **real-time integrated cyber-physical** platform for **continuously simulating** the operation of a power grid under small or large disturbances, with communication, wide-area monitoring, and control in the loop

Transfer and leveraging

- Two software maintenance & support agreements signed
 - Missouri University of Science and Technology (signed in 2020)
 - University of Denver (signed in 2020)
- Two national lab users
 - Lawrence Livermore National Laboratory
 - Idaho National Laboratory
- Played a critical role to obtain funding in
 - DOE CEDS project: WISP (UTRC + UTK) 2019-2022 \$2.9 M
 - DOE SBIR project (Achillea Research + UTK) 2020-2021 \$186 K
 - NSF EPCN project (H. Pulgar + F. Li, UTK) 2020-2022 \$210 K
 - NREL AOP project (NREL + UTK) 2020-2022 \$350 K

Total: \$3.65M



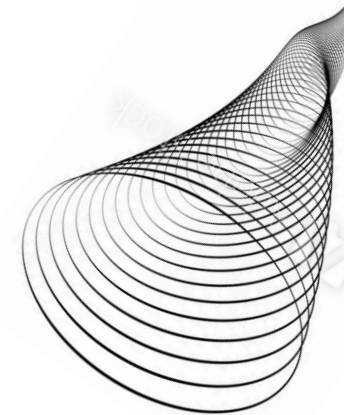
LTB architecture

Building an Innovative Culture

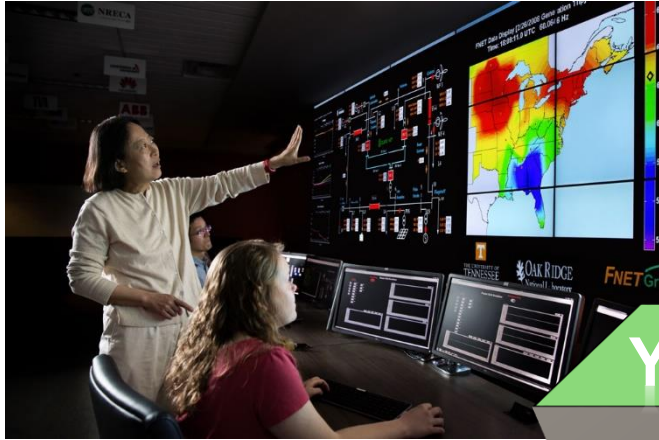
Innovation Program

- Entrepreneurship & Intellectual Property training:
 - All schools have entrepreneurship courses for students
 - Engineering Entrepreneurship: How to start a company and to generate an SBIR proposal
 - Entrepreneurship and economics training are required for IMPACT Students
 - Incentives
 - ❖ SBIR/STTR matching: research funding award to any faculty involved in a winning project

Next Big
Idea



Innovation Program



Phase 1

- Develop intellectual property
- Identify potential partners
- Small business partnerships

Phase 2

- Patenting & Licensing
- Working with innovation partners
- SBIR/STTR proposals

Phase 3

- Venture partnerships
- Incubator programs
- Deployment of CURENT technologies

Year 1-3

Gridquant



Year 4-6

TN Investco
Tech2020
SwRi

NBIC
EmergeMemphis
ConduIT
MABI

Year 7-10

Entrepreneurs in Residence
Engineer in Residence
Surface Mount Coaxial Shunt Resistor
License
LTB Open Source Software Service
Agreement
Licensed Microgrid Controller



Year 9 Status and Plans for Year 10 and beyond

Category	Year 9	Year 10+
Membership	35 companies; \$615K	40 companies; \$1.0M, Designed for post-ERC
IAB	IAB meets regularly and provide guidance on project formulation. Prepare to lead post-ERC	Ready to lead post-ERC
Industry Partners, Thrust Partners, & Mentors	Integral part of project planning, execution process; Part of education, Continue Monthly Project Reviews and Industry Seminars	Continue
IP and Technology Transfer	14 disclosures and 6 patent applications per year, 8 transfer activities per year	10 disclosures and 5 patent applications per year, 10 transfer activities per year
Entrepreneurship	continue to engage researchers and partners, work with EIRs	2 start-ups; continue to engage researchers and partners, work with EIRs
Small Firms and Translational Research	4 translational projects per year	4 translational projects per year

Acknowledgements



This work was supported primarily by the ERC Program of the National Science Foundation and DOE under NSF Award Number EEC-1041877 and the CURENT Industry Partnership Program.

Other US government and industrial sponsors of CURENT research are also gratefully acknowledged.