



Advanced Materials

For Energy Applications and Extreme Environments

Darryl P. Butt,
Professor and Chair, Boise State University
Associate Director, CAES

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BOISE STATE
UNIVERSITY



Idaho State University



Idaho National Laboratory

University of Idaho

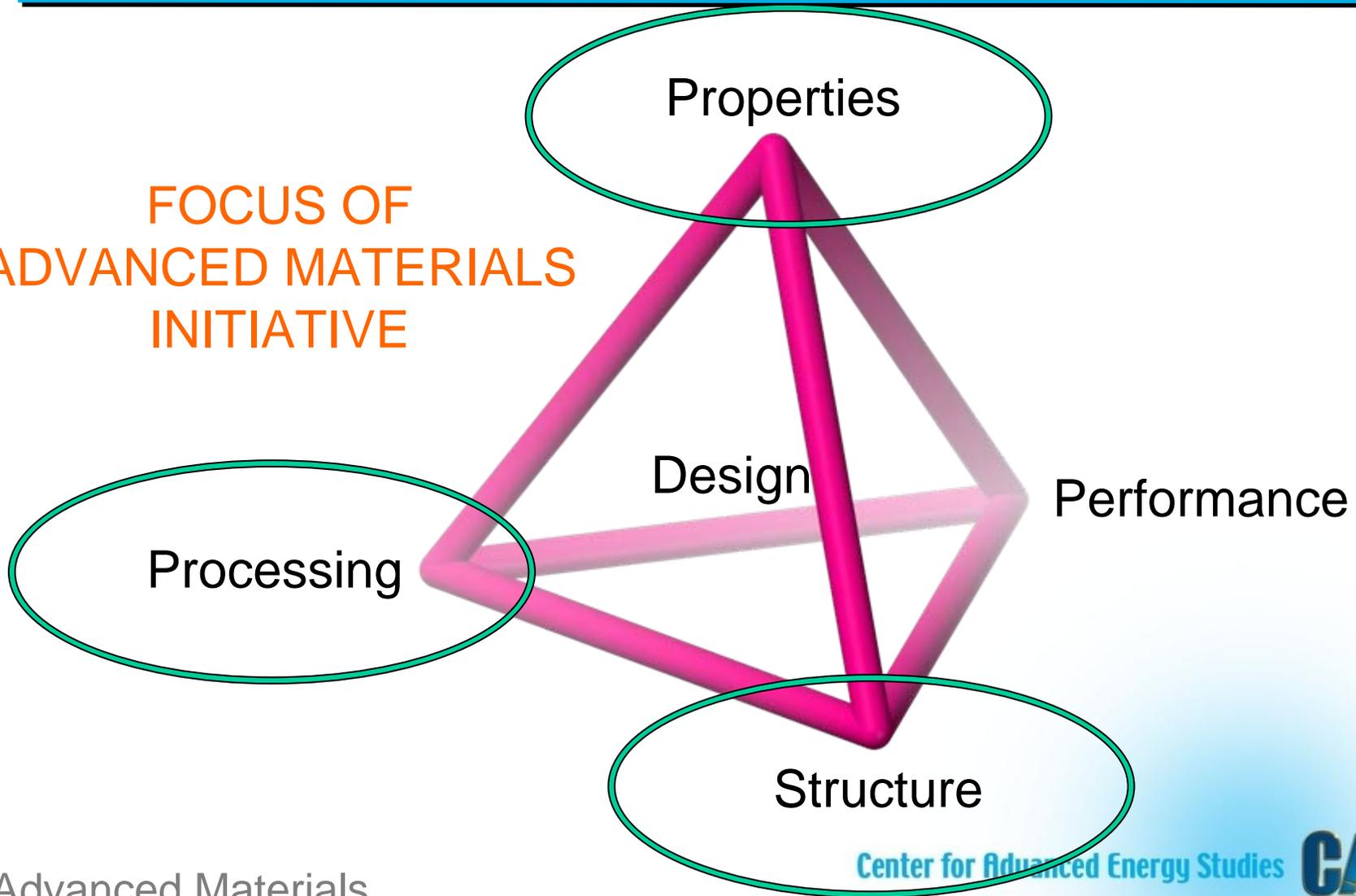
CAES

**Center for Advanced
Energy Studies**

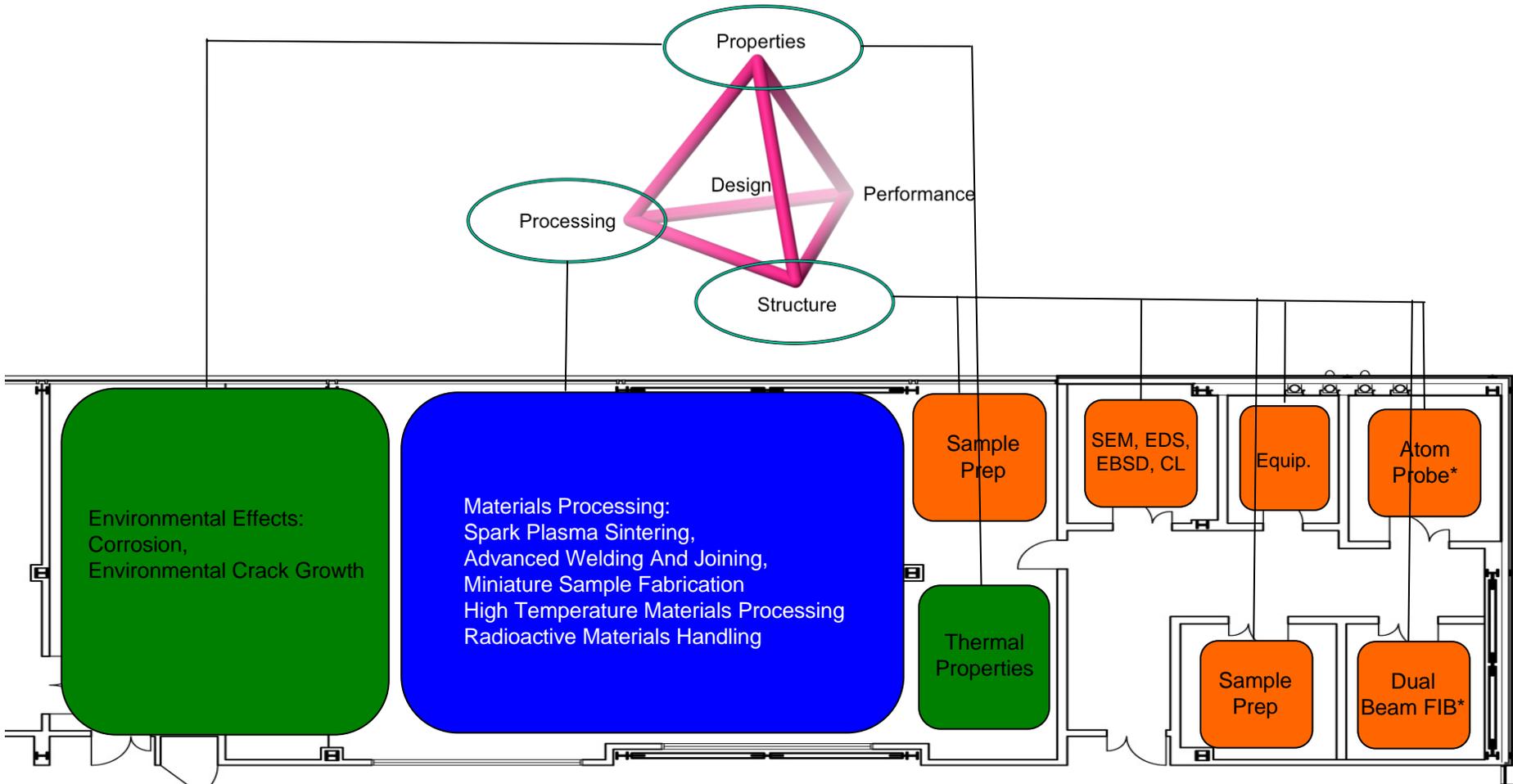


Initiative Description and Focus

FOCUS OF
ADVANCED MATERIALS
INITIATIVE



Initiative Description and Focus



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- Target and current customers:
 - INL programmatic (NGNP, AFCI...)
 - DOE NE (NEUP)
 - DOE BES
 - DOE Other*
 - NSF
 - NASA
 - Industry

Initiative – Goals (Short Term)

- Procure and install equipment in CAES
 - \$1.1M in FY10
 - MRI proposal for atom probe in FY10 (~\$2M)
 - \$2M in FY11
 - MRI proposal for major instrument in FY11
- Staff CAES with permanent materials scientists (BSU 1-2) and technicians (BSU 1-2, INL 1-2) by 2011—*minimum required staffing*
- Encourage collaborations to grow materials research in CAES to \$8M/year by 2012 (40% of CAES research)
 - \$4M DOE NE/Programmatic
 - \$2M DOE BES and Other
 - \$1M NSF
 - \$1M Industry and Other

Initiative – Goals (Long Term)

- In less than five years, we will outgrow the CAES facility—[plan for CAES 2...](#)
 - 20 university faculty
 - 20 PhDs/year
 - \$20M in annual funding
- Established unique [experimental and modeling capabilities](#) to contribute to the BES and NSF objectives (grand challenges) to [understand structure-property relations over a range of length and time scales](#)
- CAES university scientists will be closely [integrated into](#) INL and DOE [programs](#)
- [Idaho universities'](#) materials and related departments will be [strengthened](#) significantly [by](#) synergy with [CAES](#)
- CAES will be a [recruitment center](#) for nuclear and energy materials scientists

Initiative – Strategy and Tactics

- All projects in CAES *must* be collaborative and communicated
 - Collegial, inclusive, non-parochial, non-toxic, competent, hard working faculty and staff encouraged to apply
 - Others... please don't let the door hit you in the ■■■ on the way out...
- Advocacy for each other is critical
- All equipment shall be accessible (recharge center likely necessary)
- Establish baseline capabilities (SEM, EDS, sample prep...)
- Add unique capabilities thoughtfully and incrementally (SPS, Atom Probe...)
- Focus on bridging scales: electronic to mesoscale, picoseconds to centuries
- Strategic project selections and focus: (e.g., graphite and ODS alloys)
- Attract industry to the laboratory (e.g., via NSF I/UCRC)
- Foster national and international collaborations with experts (e.g., UMan, Sussex)
- A philosophy of accountability is critical to our reputation
- Produce students savvy in nuclear and hazardous materials handling

Initiative Description and Focus

- Strong alignment with other CAES/INL initiatives, and university strategic plans:
 - Sequestration
 - BioFuels and BioEnergy
 - Separations Chemistry
 - Modeling
 - Policy
 - ATR
 - Community and Industry Engagement
 - Internationalization

Initiative – Investments

Year	Funding Level	Initiative Title	Source	Institution
2009	\$250k	Spark Plasma Sintering	LDRD	INL, UI, ISU, BSU
2010-2013	Pending	Spark Plasma Sintering of ODS Alloys	LDRD	INL, UI, BSU
2010-2013	Pending	Fabrication of Miniature Specimens for the ATR	LDRD	INL, BSU,
2009	\$80k	Glovebox Fab	BEA/Premiere	INL, BSU, UI
2009-10	\$75k	CAES Management	BEA	BSU
2009	\$4k	CAES Program Development Funds	BEA	INL, BSU
2010	Pending	CAES Program Development Funds	BEA	TBD
2010	\$1.1M	CAES Equipment	BEA	INL, UI, ISU, BSU
2011	Pending	CAES Equipment	BEA	INL, UI, ISU, BSU
2009	\$160k	CAES Materials Research	ID	BSU
2010	\$341k	CAES Materials Research	ID Stimulus	BSU
2009-2010	n/a*	CAES Research	ID	ISU/UI*
2009	\$125k	ACE	DOE-NE	UI, ISU, BSU
2010	TBD	ACE	DOE-NE	UI, ISU, BSU
2009	\$180k	BSU Facilities Enhancements	BSU	BSU

*A portion of UI/ISU funds are directed to materials research.

Initiative – Investments 2010*

Funds	Faculty and Staff	Students	Other
IUC Carry Forward \$39k	\$8k	\$5k	\$14k Hot Press Install \$12k Analytical Support
ID Stimulus \$341k	\$148k	\$193k	Not Permitted

*Reflects only BSU Materials Initiative Support

Initiative Outcomes: Highlights

Institution	Engaged Faculty**	Research Faculty and Staff**	Student Outcomes	Peer Reviewed Publications*
BSU	4	5	4 MS Awarded 8 MS in Process 16 Undergrads	14
UI	3	-	2 MS Awarded 2 MS, 2 PhD in Process 1 Undergrad	5
ISU	2	-	- 1 PhD in Process -	-

*J. Nucl. Mater., Phil. Mag., J. Mater. Sci. Lett., Electrochimica Acta., J. Mater. Processing and Tech., Met. and Mater. Trans., Thermochemica Acta, Nucl. Engr. and Design

**Covers fraction of year in most cases.

Initiative Outcomes: Projects Awarded (Involving IUC)

Duration	Funding Level	Projects	Customer	Collaborators
2009-10	\$1.3M	1. Synthesis of Mixed Oxide Fuels	DOE-AFCI	INL, BSU, UI, PSU, UNLV, UC-Davis
		2. Welding and Crack Growth of ODS Alloys	DOE-AFCI	INL, UI, BSU
2010-13	\$5.5M+	1. Microscopy of Irradiation Creep of Graphite	DOE-NEUP	BSU, INL
		2. Spark Plasma Sintering of W-Re Cladding	DOE-NEUP	UI, BSU, NCSU, INL
		3. Effects of Fission Products on Triso Fuel	DOE-NEUP	CSM, BSU, INL
		4. Chalcogenide Radiation Sensors	DOE-NEUP	BSU, ASU, INL
		5. Triso Thermomechanics	DOE-NEUP	UI
		6. Creep Fracture of HT-9	DOE-NEUP	UI
		7. Removal of 14C from Irradiated Graphite	DOE-NEUP	UI, Julich GmbH, UMan, INL
		8. HT Characterization (Equipment Grant)	DOE-NEUP	UI
		9. Ion Slicer (Equipment Grant)	DOE-NEUP	BSU
		10. DOE NEUP Fellowships	DOE-NEUP	UI, ISU, BSU
2009- indefinite	\$341K+ n/a*	1. Fellowships	NRC/BSU	BSU
		2. Fellowships/Scholarships *Fellowships/Scholarships at ISU and UI not directed specifically to materials	NRC	ISU, UI*
2009-10	\$15k	NASA Fellowship	NASA	BSU
2009-10	\$60k	Crack Growth in Nuclear Alloys	DOE-NE	BSU, UNLV, INL
2009-10	\$67k	Mech Properties of Nuclear Fuel	INL	UI
2009	\$25k	TEM and Porosity Characterization of Graphite	INL	BSU, INL, UMan
2009-10	\$50k	1. Corrosion Resistant Joints	NSF	BSU, CMRDI
		2. I/UCRC Radioactive Materials Center	NSF	BSU, USU
	\$7.3M			

Initiative Outcomes: 2010 Proposals

Submitted or Planned

Funding	Initiative	Source	Lead Institute
TBD	TBD	DOE NEUP	ISU, UI, BSU, Other
\$1.2M	Microprobe	NSF MRI	BSU*
\$759k	Early Career (SPS)	NSF	BSU*
\$2M est.	Atom Probe	NSF MRI	BSU, INL
\$470k+	I/UCRC	NSF/Industry	BSU, USU
\$75k	Graphite Creep ATR	DOE NE/ATR	BSU, UMan
\$75k	Triso ATR	DOE NE/ATR	BSU, CSM*
\$75k	U ₃ Si ₂ ATR	DOE NE/ATR	BSU, UWis*

*Submitted, all others pending submission

Initiative – Discussion Points

- Need for administrative support
- Need for BSU faculty and staff in CAES
- Need for reliable support for RAs
- Promote international collaborations with program development funds
- Need improved system for distance teaching
- Student recruitment to universities
- Capital requirement for CAES 1 Materials Initiative \approx \$7M

Initiative – Discussion Points

- Collaborations
 - Some “forced” collaborations have not evolved (accountability)
 - Some relationships have grown naturally (foster these)
 - Some relationships that should be developing haven’t (INL culture, hopeful that NEUP program will help)
- University Weaknesses
 - State funding level is insufficient to support three engineering colleges—dilution breeds mediocrity
 - BSU has a weak presence at CAES, lack of PhD program
 - UI lacks critical mass in materials, heavy teaching load
 - ISU has no materials program, physics and welding tech programs could engage
 - Materials Scientists are in Moscow and Boise

Initiative – Discussion Points

- One time funding creates personnel mortgages
- Current mortgages create challenges for hiring staff in Idaho Falls
- Retain CAES Champions (e.g., give Bob Smith a raise and support)
- Budget holdbacks, potential salary cuts could lead to loss of top faculty and will prevent strategic hires
- We must be constantly sensitive to potential for conflicts between CAES and university/departmental goals
- Challenging to gather data and assess return on investment
- New faculty are essential to growth and reputation of CAES and IUC—mechanism is problematic
- Housing and travel are necessary

I/UCRC Center Structure

Leveraged Funding Model

BSU and USU

-75% overhead waived

NSF

\$150k/year

IUCRC Program
Portfolio

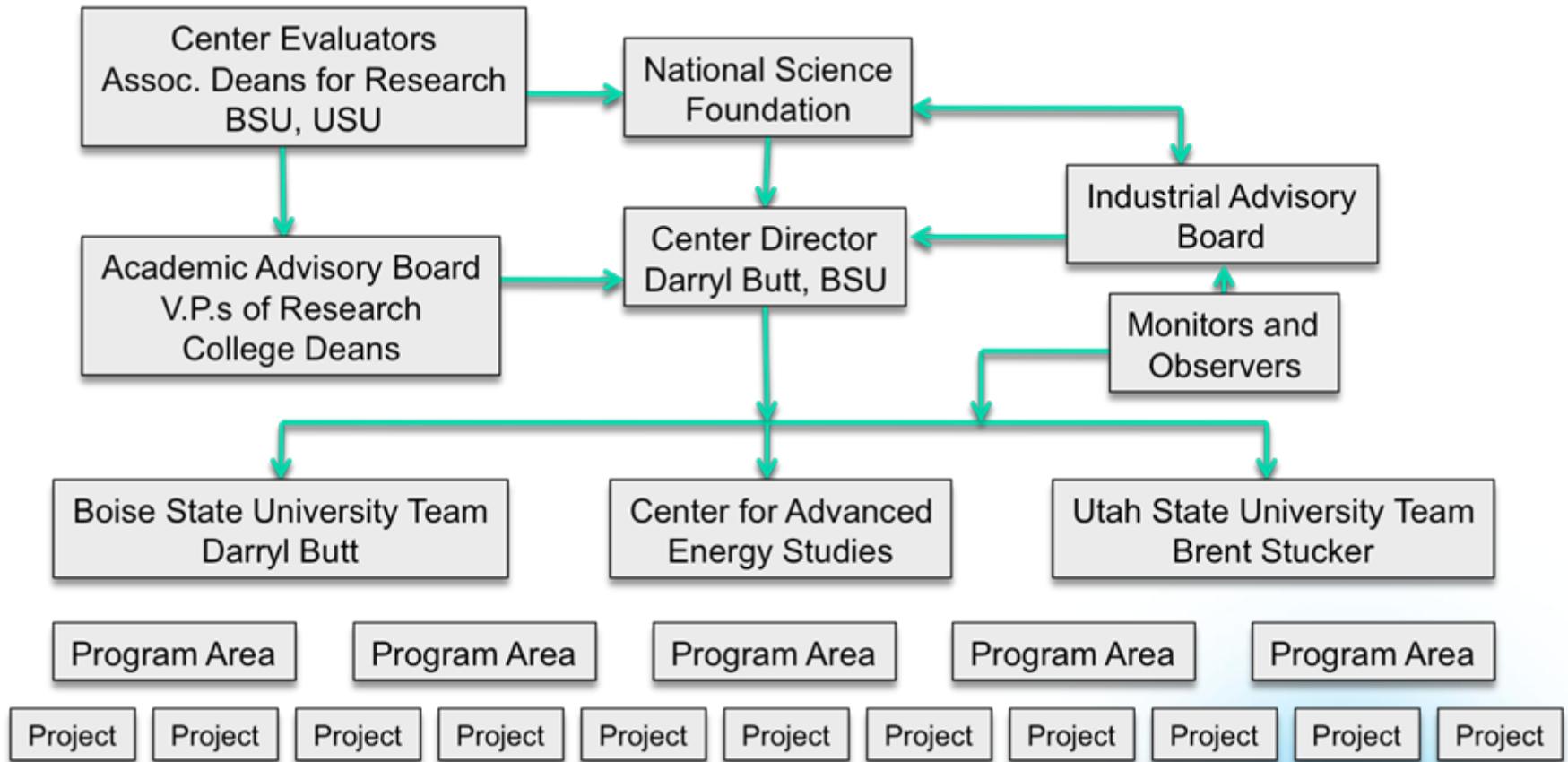
\$300k+/year

Industry/Government
Membership Pool

Access to Students
Access to Faculty
Access to IP
Access to Facilities
Incubator for Ideas
Development of Workforce
Influence CAES Direction
Leverage CAES Resources
SBIRs/STTRs/EPSCoR...

Synergistic Externally
Funded Projects

I/UCRC Center Structure



I/UCRC: Where Are We in the Process?

