

# Office of Emerging Frontiers in Research and Innovation

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Acting Director

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## **ENG Program Directors**

My colleagues and friends in ENG and NSF



# Outline

- Background
- EFRI Office Vision Statement
- Review of the Process
- Proposed Areas Selected for 2007
- Plans for 2007



# Motivation: ENG VISION

*NSF/ENG will be the global leader in advancing the frontiers of fundamental engineering research, stimulating innovation, and substantially strengthening engineering education.*



# **Purpose/Mandate of EFRI**

***EFRI will serve a critical role in helping the Directorate for Engineering focus on important emerging areas in a timely manner. EFRI will recommend annually a prioritization, fund, and monitor initiatives at the emerging frontier areas of engineering research and education.***



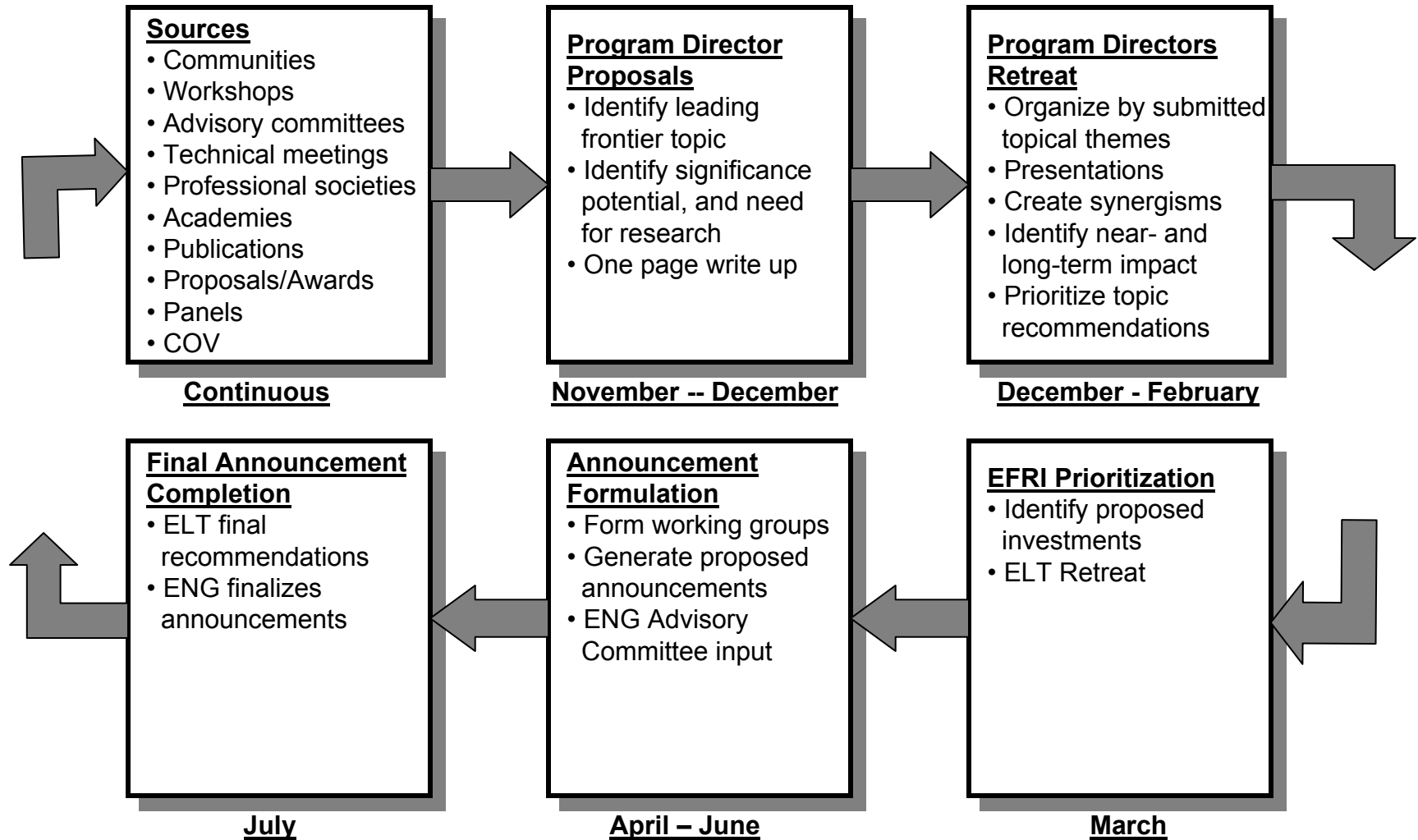
# Office of Emerging Frontiers in Research and Innovation

*~Working Vision Statement~*

**All NSF ENG Programs support research at the frontiers of research and innovation.**

**EFRI Office provides opportunities in interdisciplinary areas at the *emerging* frontiers of research and innovation that (a) are transformative, (b) address national needs/grand challenges, and (c) will make ENG unrivaled in its global leadership.**

# EFRI Annual Process





# ENG Programs Snapshot

- 72 Program Leaders (PDs, Senior Advisors, SES, and Experts)
- 52 Programs (20 Program Clusters)
- 7 Divisions/Offices (→ 5 + EFRI Office)

✓ *Program Leaders are key connections to ENG community*

✓ *EFRI Challenge: Think Beyond Programs and Divisions*





# PD Activities for EFRI

- Frontier Idea Proposals
- Brown Bag Presentations
- PD Retreat
- Candidate EFRI Topics
- Working Groups
- Proposals for ELT Retreat
- Present at ELT Retreat



# Frontier Idea Proposals

## THINK ENGINEERING

- 1. Introduction and Description** – Provide an introduction and overview of the topic or area of opportunity, including relevant history, recent progress, and indicators for future directions.
- 2. Significance and Potential Impact** – Describe the significance of the topic or area of opportunity, including the potential for impact on engineering and society. Note that topics or areas of opportunity should be those that cannot be provided through existing programs at NSF.
- 3. Current Status** – Describe the current status of the topic or area of opportunity. This should include information on whether current, frontier research and education in the field is being done within or outside the United States, and whether other funding agencies or the private sector might have important roles to play.
- 4. Potential Role of ENG and NSF** – Describe possible roles for ENG and NSF in promoting progress in the topic or area of opportunity especially those that take advantage of the unique resources and distinct mission of the foundation.

Credit: Format/instructions adapted from NSF/BIO Annual Planning One-Pager Instructions; Joann Roskoski



# EFRI Criteria

- **TRANSFORMATIVE**- Does the proposed topic represent an opportunity for a significant leap or paradigm shift in a research area, or have the potential to create a new research area?
- **NATIONAL NEED/GRAND CHALLENGE**- Is there potential for making significant progress on a current national need or grand challenge?
- **BEYOND ONE DIVISION**- Is the financial and research scope beyond the capabilities of one division?
- **COMMUNITY RESPONSE**- Is the community able to organize and effectively respond? [but not in very large numbers; i.e., it is an "emerging" area]
- **ENG LEADERSHIP**- Are partnerships proposed, and if so, does NSF/ENG have a lead role?



# **BROWN BAG PRESENTATIONS**

- Four Meetings
- Ample Time For Presentations
- Well attended



# PD Retreat Goals

1. Candidate Areas for EFRI 2007
2. Review/Discuss Priorities for 2008

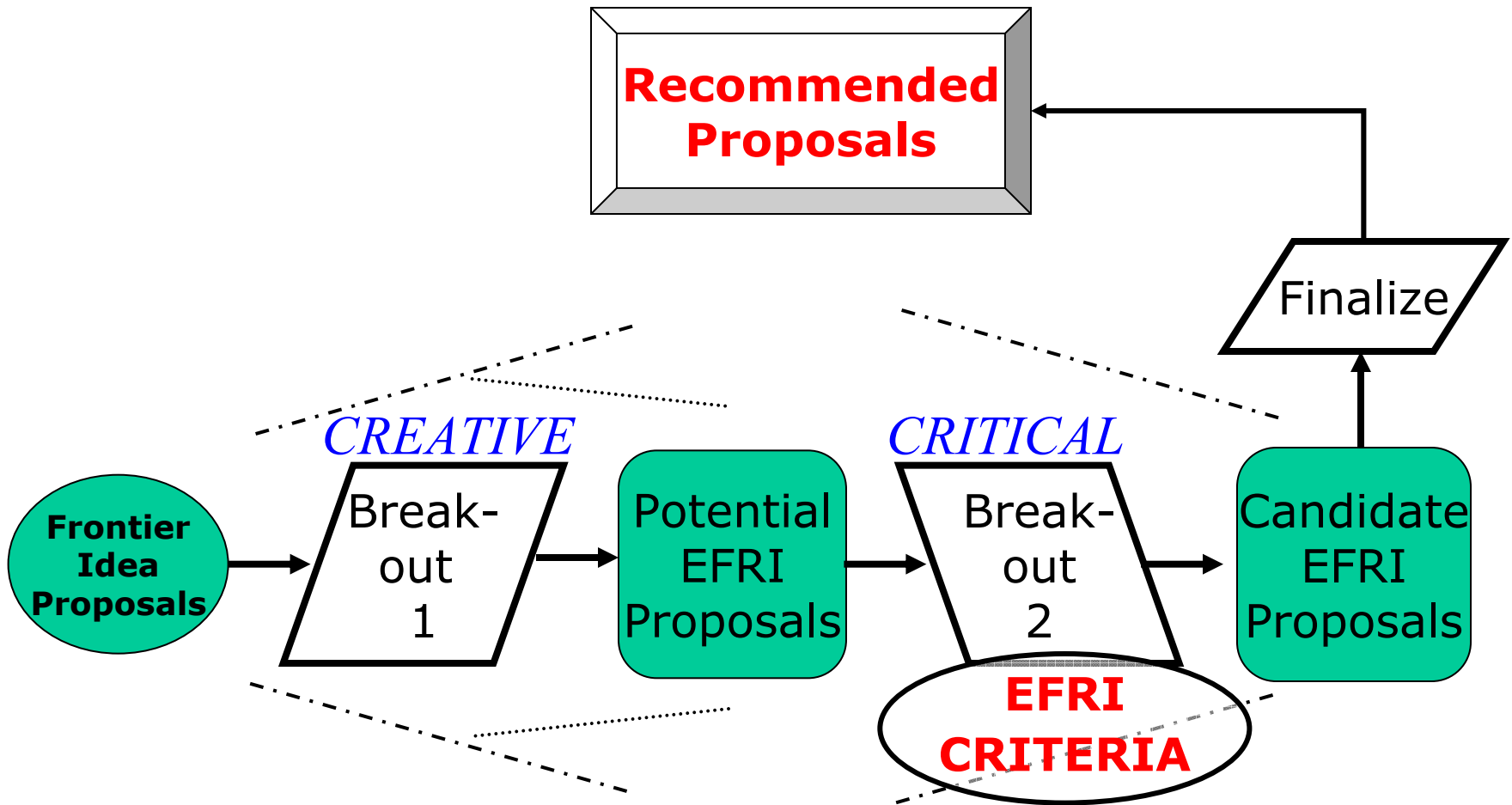
THINK ENGINEERING!

*"my program"  
shoes off*

*"DD hats off"*



# Retreat Format





# **PD Retreat**

## **Some Survey Feedback**

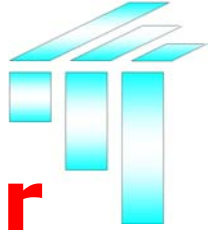
- 89% attended Brown Bags before Retreat
- 96% found them effective to learn about the ideas
- 80% were satisfied with the PD Retreat



# Topics Considered After PD Retreat

- **For Presentation/Evaluation at ELT Retreat:**
  - **Cellular and Biomolecular Engineering**
  - **Transformative Energy Engineering**
  - **Adaptive Systems for Cyberinfrastructure**
  - **Modeling and Simulation for Engineering Systems**
- **For Workshop/Planning Grant**
  - **Resilient Infrastructures for Sustainable Coastal Communities**





# Guidelines for EFRI Proposals for ELT Retreat

- Under Transformative criteria,
  1. Describe the state of the art clearly (for example with reference to recent articles in a major science or engineering publication).
  2. Describe the compelling new science and engineering knowledge base that will be expanded.
  3. Describe how the proposed topic is different from current NSF and ENG investments.
- Refine the key ideas into a much more focused definition.
- Describe your strategy for supporting the community after EFRI funding.



# Post-EFRI Support

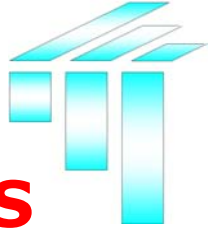
## Possible Routes

- Possible routes
  - ERC Program
  - New Program in a Division
  - Change/Restructure an existing Program
  - New Program at interface of Divisions



# **Proposals Presented at ELT Retreat**

- 1. RECONFIGURABLE ENGINEERED SYSTEMS ENABLED BY CYBERINFRASTRUCTURE**
- 2. CELLULAR AND BIOMOLECULAR ENGINEERING: CONTROLLING MOLECULAR, CELLULAR, AND INTERCELLULAR/INTERFACIAL BEHAVIOR**
- 3. SIMULATION-BASED ENGINEERING SCIENCE (SBES) OF MULTI-PHENOMENON AND MULTI-SCALE SYSTEMS IN MANUFACTURING OPTIMIZATION**
- 4. THE ENERGY INTERGRID**



- **RECONFIGURABLE ENGINEERED SYSTEMS ENABLED BY CYBERINFRASTRUCTURE**
  - **Key idea:** Autonomously Reconfigurable engineered systems robust to unexpected/unplanned failure events
  
- **CELLULAR AND BIOMOLECULAR ENGINEERING: CONTROLLING MOLECULAR, CELLULAR, AND INTERCELLULAR/INTERFACIAL BEHAVIOR**
  - **Key idea:** Comprehensive modeling, measurement, and control of coupled biological, chemical, electrical, mechanical, and thermal processes at the cellular and biomolecular level under multiple stimuli.



- **ENERGY INTERGRID**

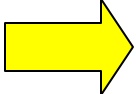
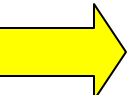
- **Key idea**: Integration of alternative energy sources (e.g., wind, solar, sterling) into the power grid using an internet style network.

- **MULTI-PHENOMENON AND MULTI-SCALE SYSTEMS IN MANUFACTURING OPTIMIZATION**

- **Key idea**: Manufacturing optimization for semiconductors, aircrafts, medical devices, and drugs, and others.



# **Proposed Areas Selected for EFRI for 2007**

-  **1. AUTO-RECONFIGURABLE  
ENGINEERED SYSTEMS ENABLED BY  
CYBERINFRASTRUCTURE**
-  **2. CELLULAR AND BIOMOLECULAR  
ENGINEERING: CONTROLLING  
MOLECULAR, CELLULAR, AND  
INTERCELLULAR/INTERFACIAL  
BEHAVIOR**

# Auto-reconfigurable Engineered Systems Enabled by Cyberinfrastructure (ARES-CI)

## (Preliminary Ideas)



- Cyberinfrastructure and other engineering advances now provide the capability to embed reconfigurability into systems.
- Design of autonomously configurable engineered systems integrating physical, information and knowledge domains
- Novel methods to sense, self-diagnose, and auto-reconfigure the system to function uninterruptedly when subject to unplanned failure events
- Auto-reconfigurability will provide robustness to unanticipated/unplanned failure events in the same way Complexity provides it to anticipated failure events.

# Cellular and Biomolecular Engineering (CBE) (Preliminary Ideas)



- Develop and validate experimental and simulation tools to model and measure the interaction of multiple stimuli (force, electrical current, biochemical reaction rate, etc.) on cellular and biomolecular interfacial responses;
- Build on integrative knowledge of cellular functions to develop biomolecules to achieve tunable biological, chemical, and mechanical functions;
- Design materials interfaces and biomolecules to control the role of external stimuli on biological activities to regulate cellular functions, identify and neutralize undesired substances, or produce desired substances.





# EFRI Preliminary Plans for FY07

- Two topic areas
- Team Proposals
  - Three or more PIs
  - Three or more disciplines
- Up to 4 years in duration
- Up to \$500K/year
- Require short (~5-page) pre-proposals followed by invited Full Proposals

**11, \$2M Standard Awards**



# Summary of PD and ELT Activities for EFRI

- Frontier Idea Proposals
- Brown Bag Presentations
- PD Retreat
- Working Groups...ELT Retreat Proposals
- ELT Retreat
- Plans for 2007:
  - Two Topics for 2007