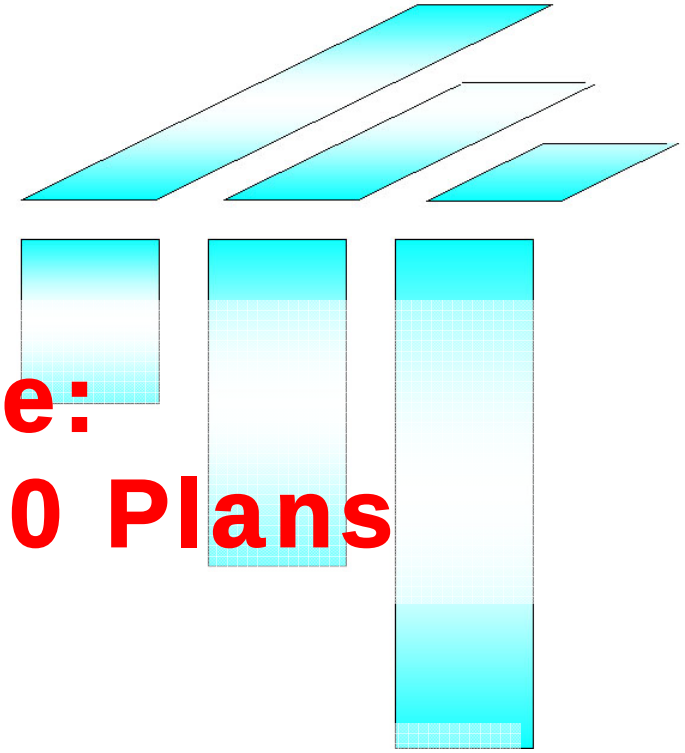


EFRI Update: FY 2009 and 2010 Plans

Sohi Rastegar

Office of Emerging Frontiers in Research and Innovation

NSF ENG Spring Advisory Committee Meeting
April 24-25, 2008

EFRI- "One Slide Description"

- **Established on October 1, 2006, EFRI supports higher risk, higher payoff opportunities leading to:**
  - **new research areas for NSF, ENG, and other agencies**
  - **new industries/capabilities resulting in a leadership position**
  - **significant progress on advancing a "grand challenge"**
- **Successful topics would likely require:**
  - **small- to medium-sized interdisciplinary teams**
  - **the necessary time to demonstrate substantial progress and evidence for follow-on funding through other established mechanisms**
- **The current investment for EFRI totals $25 million for 4-year awards at $500k per year.**

EFRI OFFICE TOPICS

Steady State: **8-10 Active Topics**

~50 Active Awards

FY 07: Auto-Reconfigurable Engineered Systems (ARES)	**FY 07:** Cellular and Biomolecular Engineering (CBE)	**FY 08:** Cognitive Optimization & Prediction (planned)	**FY 08:** Resilient and Sustainable Infrastructures (planned)
FY 09: Hydrocarbons from Biomass (HYBI)	**FY 09:** BioSensing & BioActuation (BSBA)	**FY 10:**	**FY 10:**
FY 11:	**FY 11:**		

Current competition

New Topics

Modified Approach

EFRI Personnel

Office Director
Sohi Rastegar

Current competition

FY 07: Auto-Reconfigurable Engineered Systems (ARES)

COORDINATORS:
Scott Midkiff, ECCS
Abhi Deshmukh*,CMMI

TEAM MEMBERS:
Kishan Baheti, ECCS
Mario Rotea*, CMMI
Maria Burka, CBET
Bruce Hamilton, CBET
Stephen Nash, CMMI
Glen Larsen, IIP

FY 07: Cellular and Biomolecular Engineering (CBE)

COORDINATORS:
Fred Heineken, CBET
Jimmy Hsia*, CMMI

TEAM MEMBERS:
Lenore Clesceri*, CBET
Lynn Preston, EEC
Robert Wellek, CBET

FY 08: Cognitive Optimization (COPN)

COORDINATORS:
Paul Werbos, ECCS
Semahat Demir, CBET

TEAM MEMBERS:
Fred Heineken, CBET
Eduardo Misawa, CMMI
Scott Midkiff, ECCS
Stephen Nash, CMMI
Lynn Preston, EEC
Kenneth Whang, CISE

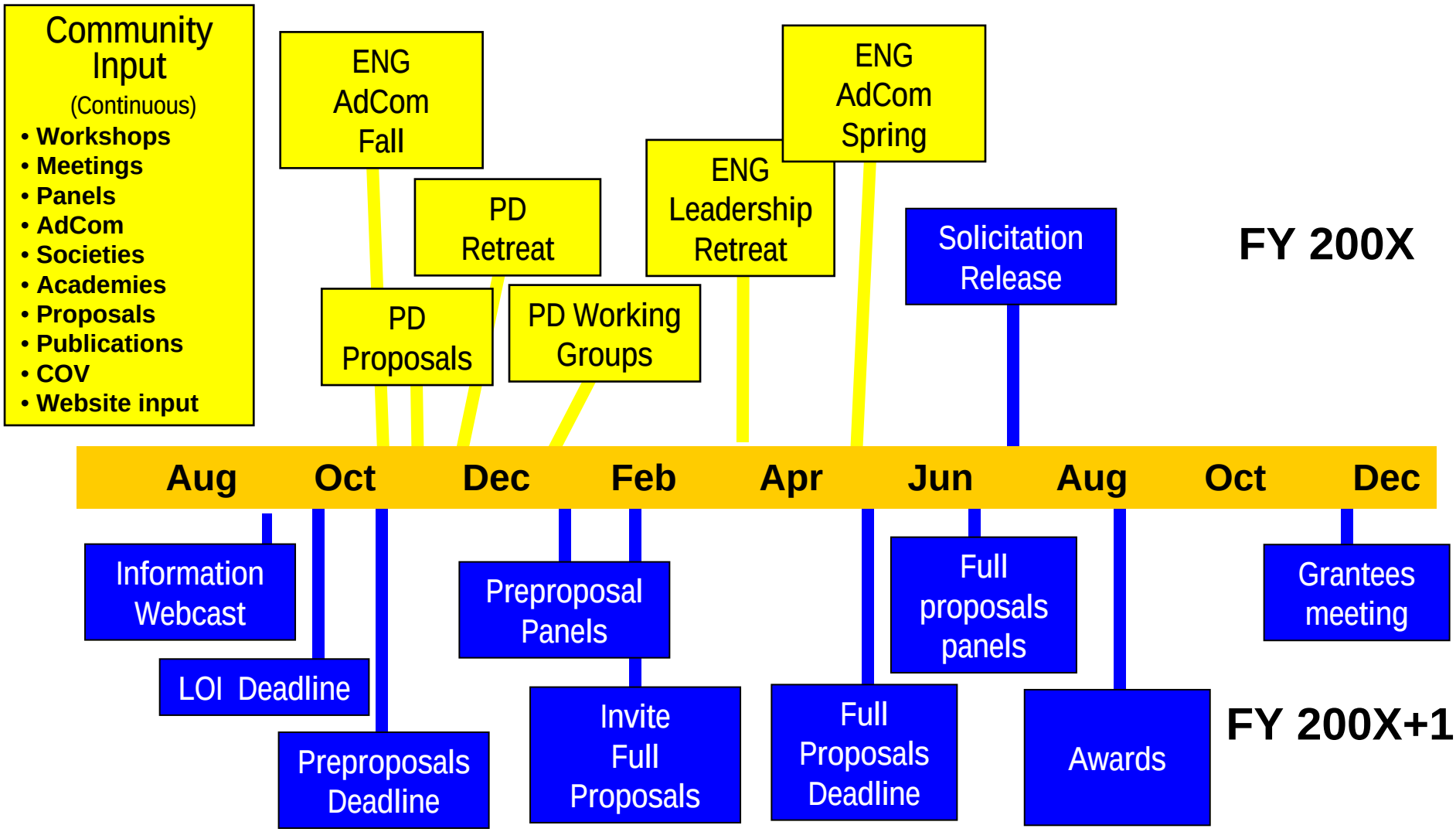
FY 08: Resilient and Sustainable Infrastructures (RESIN)

COORDINATORS:
Joy Pauschke, CMMI
Bruce Hamilton, CBET
William Schultz, CMMI
Matthew Realff*, CMMI

TEAM MEMBERS:
Richard Fragaszy, CMMI
Barbara Kenny, EEC
Dagmar Niebur, ECCS
Dennis Wenger, CMMI

* Former PD / IPA

EFRI Timeline



FY 2007
Recap

Autonomously Reconfigurable Engineered Systems (ARES)

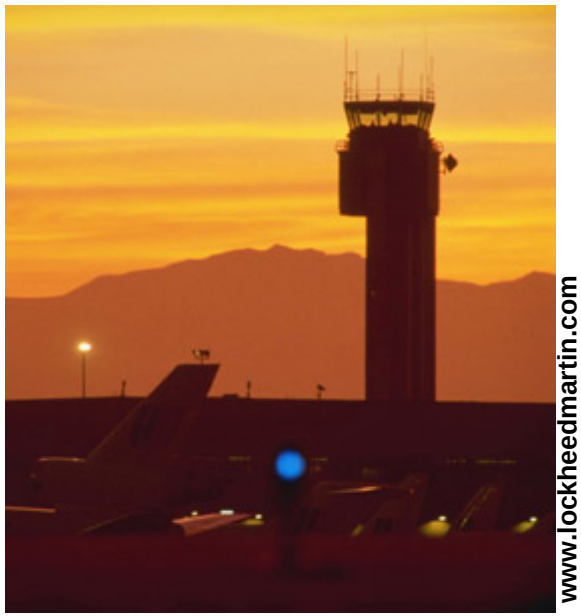
Systems that Modify Themselves

(5 Active Awards)

Key idea: *Autonomously reconfigurable engineered systems robust to unexpected/unplanned events*

An Efficient Air Transportation System

Recent studies suggest that congestion and delays can render the national air transportation system unstable and limit its growth. The team will work to understand how the system could automatically correct for unplanned disturbances and realize maximum efficiency on a daily basis.



www.lockheedmartin.com

Led by Cynthia Barnhart of the Massachusetts Institute of Technology (MIT), along with Dimitris Bertsimas (MIT), Constantine Caramanis (University of Texas at Austin), Amedeo Odani (MIT), and Georgia Perakis (MIT Sloan School of Management) Theory and Algorithms for Autonomous Reconfigurability of the National Air Transportation System (0735905).

Cellular and Biomolecular Engineering (ARES)

How Cells Work: Uniting Engineering and Biology

(7 Active Awards)

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.**

Cell Functions and Brain Disease

Sialic acid is the first juncture between the cell and its surroundings. Combining computation and experimentation, this study will investigate how changes in a cell's environment are related to changes in the cell's ion channels—how it allows some electric signals to pass through and not others—and in turn related to the formation of neurological defects. This work aims to develop a foundational understanding for the treatment of brain diseases, such as epilepsy and memory and learning loss, at the molecular level.

Courtesy of Michael J. Betenbaugh, Johns Hopkins University.

A mutation that changes the chemical behavior of cells causes an even larger change in the organ, here a *Drosophila* brain. The arrow indicates a missing lobe.

Led by Michael J. Betenbaugh (Johns Hopkins University), along with Dilipkumar Asthagiri (Johns Hopkins University), Allan Gottschalk (University of Pennsylvania), Karen B. Palter (Temple University), Esperanza Recio-Pinto (New York University), and titled, "An Integrated Computational and Experimental Model for Biochemical and Electrical Interactions in Ion Channels and the Impact of Sialic Acid on Neuronal Function" (grant #0736000).

FY 2008
Program Solicitation Status

EFRI 2008 Topics (NSF 07-579)

1. **COGNITIVE OPTIMIZATION AND PREDICTION: FROM NEURAL SYSTEMS TO NEUROTECHNOLOGY (COPN)**
   - **Key idea**: *Understanding subsymbolic intelligence can lead to development of new designs and algorithms for optimal decision making and prediction in engineered systems.*

2. **RESILIENT AND SUSTAINABLE INFRASTRUCTURES (RESIN)**
   - **Key idea:** *Build, renew, expand, monitor, and control critical interdependent infrastructures to be both resilient and sustainable.*

Important Dates
EFRI 2008 (NSF 07-579)

• Sep 5, 2007	Information Webcast Over 200 registered viewers 85 Universities, 35 States
• Sep 25, 2007	Letters of Intent Due (<u>required</u>)
• Oct 26, 2007	Preliminary Proposals Deadline Received 204 proposals
• Early February 2008	Invitations to submit full proposals. 52 Full Proposals Invited
• Apr 30, 2008	Full Proposals Deadline (by invitation only)
• May/June 2008	Review of Full Proposals
• By September 2008	Make Awards
• Spring 2009	Grantee Meeting

FY 2009
Planned Topics

EFRI Topics for FY 2009

1. BioSensing & BioActuation: Interface of Living and Engineering Systems (BSBA)
2. Interfaces for In-vivo Systems
3. Hydrocarbons from Biomass (HyBi)
4. Renewable Electric Energy Integration for a Sustainable Environment

BioSensing & BioActuation: Interface of Living and Engineering Systems (BSBA)

(Preliminary Ideas)

Key idea:

Develop and employ bio-derived and bio-inspired technologies for sensing and detection, monitoring, actuation and control of stimuli and the environment.

- to produce technological innovations for the hybrid integration of biosensing and bioactuaction systems with embedded human-centric & bio-inspired intelligence and with auto-adaptive, self-monitoring, self-diagnostic, self-control and self-renewal capabilities.
- Understand data mining, prioritization & decision-making processes in living organisms, and emulate them to facilitate design of complex engineering systems in sensor rich environments.
- Engineering *in vivo* interfaces that provide real-time information, the ability to communicate with cells near the interface, and the means to selectively alter the interfacial conditions.

Hydrocarbons from Biomass (HyBi)
(Preliminary Ideas)

Key Idea:

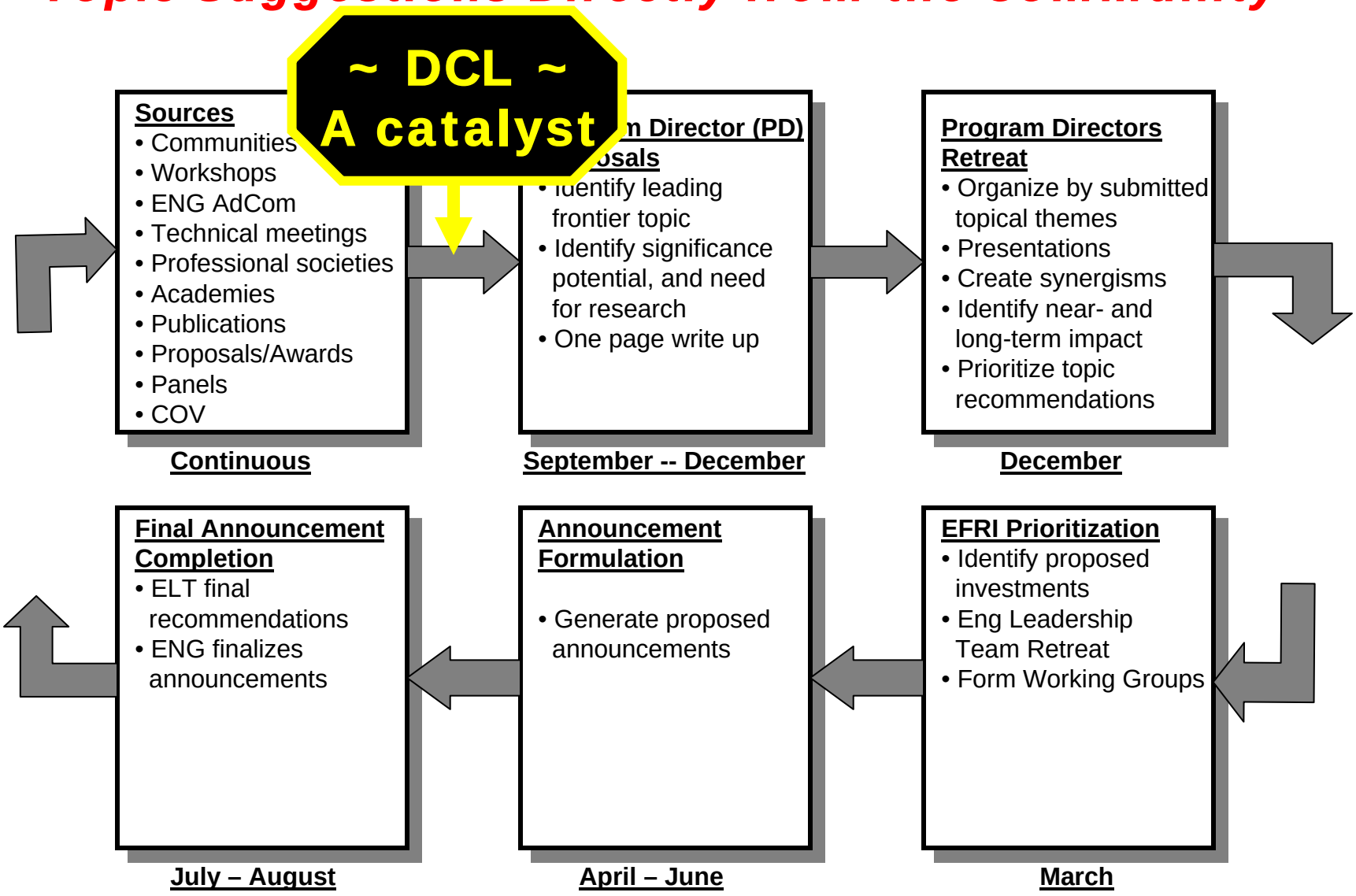
Hydrocarbon biofuels such as green gasoline are an attractive alternative to ethanol; their production in a network of rural biorefineries can be accompanied by the distributed generation of electricity.

- Biology and biomass conversion: to engineer better biomass and better pathways to convert it to hydrocarbon fuels. A new paradigm in biofuels: “green gasoline”.
- Biorefinery and process design: to discover better unit operations, heat integration and co-generation strategies
- System design: to integrate small-scale resilient co-generating biorefineries with systems of distributed electricity production.

FY 2010
Modified Approach

EFRI Annual Process and Plans for FY10 Competition:

Topic Suggestions Directly from the Community



PLANS FOR FY 10 Competition
Dear Colleague Letter (DCL)

GOALS:

- Engender wider community involvement and input into the EFRI process of identifying topics at ***Emerging Frontiers in Research and Innovation***
- Provide a mechanism for submission of well defined ideas for EFRI topics via EFRI website- www.nsf.gov/eng/efri

WHO MAY SUBMIT:

- Individuals and groups may submit suggestions for topic areas
- Format and guidelines will be provided
- Submissions will be confidential
- No direct feedback provided to submitters

EFRI

TRANSFORMATIVE ~ NATIONAL NEED ~ ENG LEADERSHIP