Washington University in St.Louis

I-CARES International Center for Advanced Renewable Energy & Sustainability

Energy and Environment

An Academic's View on National and International Partnerships

Himadri Pakrasi

Director

I-cares.wustl.edu

University Statement

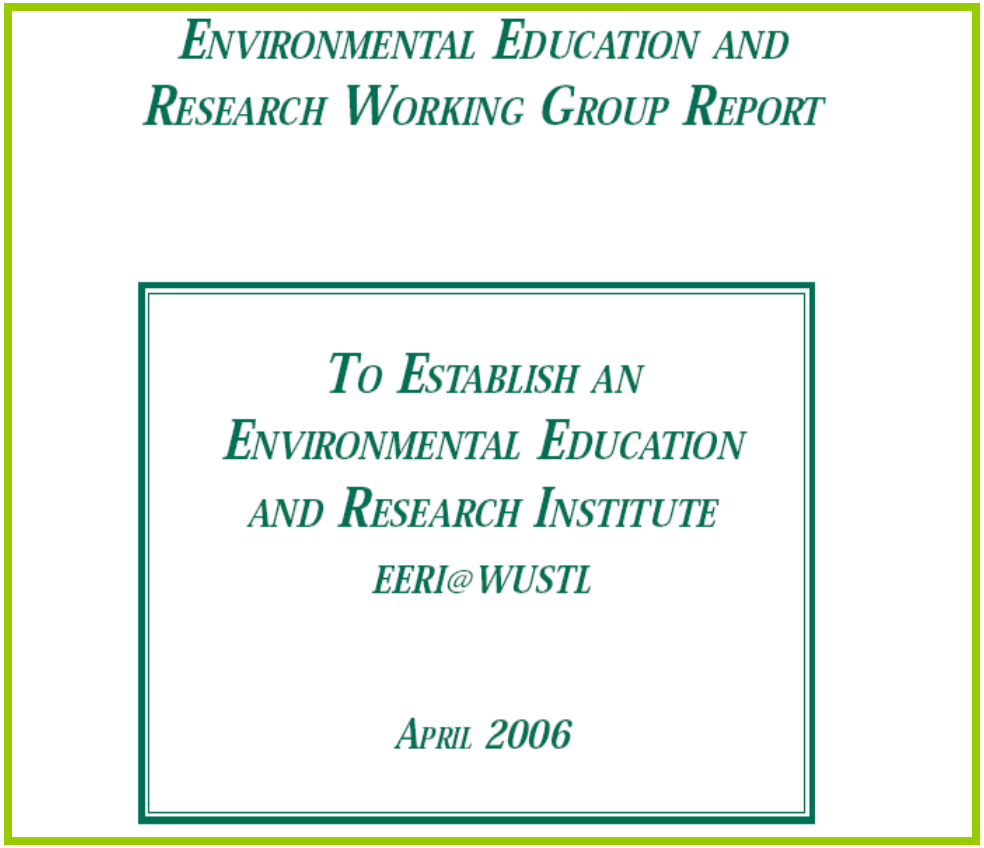
Issues related to energy, environment and sustainability present grand challenges for people of the 21st century. Washington University in St. Louis with its community of scholars is addressing these issues through education, research and outreach. The University will seek and define best practices in its own operations and aspires to be a model for others in responsible use of energy and other resources. Through innovative research activities, the University will contribute to the creation of new knowledge needed to achieve a bright and sustainable future and will foster collaborations regionally, nationally and internationally to bring about rapid progress. Washington University will prepare tomorrow's leaders and innovators engaged in securing abundant, affordable energy while preserving the environment and advancing economic and social development for the nation and our world.

Mark S. Wrighton, Chancellor

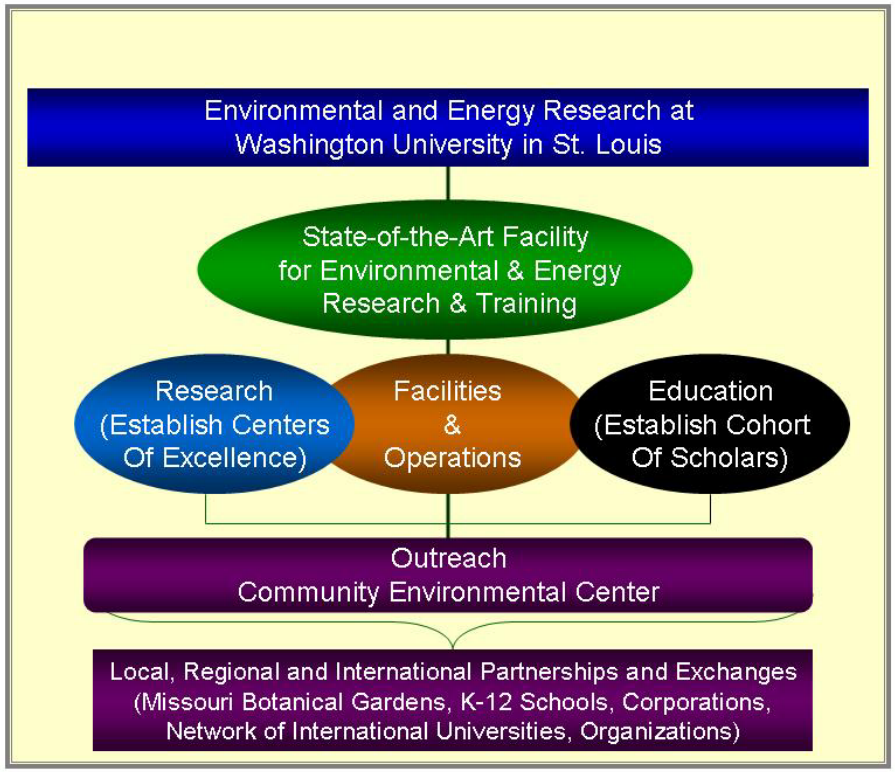
Background

- Department of Energy, Environmental, and Chemical Engineering in *Engineering and Applied Science*
- Environmental Studies in *Arts & Sciences*
- Environmental Law Clinic in *Law*
- Environmental Health in *Medicine*
- Year long assessment of environmental research/ education
- New Sustainability Officer
- International Symposium on Energy and Environment organized by the McDonnell International Scholars Academy

University wide Initiative (www.ees.wustl.edu)



* 47 participating faculty w/ research support over last 3 years of $ 54 Million
* 14 additional interested in University operations



Establish Washington University in St. Louis (WUSTL) as a node for activities related to ***energy and environment*** *with* ***the goal of making St. Louis a hub for environmental research, education, innovation and action****.*

McDonnell International Scholars Academy

A Global Partnership

for Research and Education

McDonnell Academy Goals

- Build understanding and cooperation among people and nations of the world
- Educate talented students destined to be the next generation of leaders
- Collaborate more effectively with international corporations
- Improve the image of the United States
- Enhance the global impact and expand the mission of Washington University

Academy as a Model for a Global University

- Close collaboration with a select group of "preferred partners" from around the world
- Multilateral research and education efforts
- Various experiments in two-way collaboration
- Ambassador to build "academic commerce" with each partner institution and the region

McDonnell Academy University Partners

- Bogazici University
- Budapest University of Technology and Economics
- China Agricultural University
- Chinese University of Hong Kong
- Chulalongkorn University
- Fudan University
- IDC Herzliya
- Indian Institute of Technology, Bombay
- Jawaharlal Nehru University
- Korea University
- Middle East Technical University
- National Taiwan University
- National University of Singapore
- Peking University
- Seoul National University
- Technion - Israel Institute of Technology
- Tsinghua University
- University of Campinas
- University of Chile
- University of Hong Kong
- University of Indonesia
- University of Tokyo
- Yonsei University

Core Mission: Academy Scholars

Goal: Educate talented students destined to be the next generation of leaders in

- Education
- Business
- Government

McDonnell Academy Scholars

- First group of 18 Scholars in fall 2006
- Second group of 12 in fall 2007
- Cohorts of future leaders in education, government, and business
- Degree candidates in any graduate or professional field
- Full tuition and living stipend

McDonnell Academy Scholars

Selection and recruitment goals and process:

- At least one from each University Partner
- Admissions decisions by the Academy Steering Committee

McDonnell Academy Programs

- Cultural, intellectual, and social programs
  - American politics and culture
- Professional and academic seminars, retreats, and trips
  - Washington, D.C. in March 2007
  - New York City in Spring of 2008

Academy Funding

- $10M sustaining endowment gift from John F. McDonnell
- Additional $17M in endowment pledges for Scholars
- Expendable gifts: $500K
- 13 Corporate Sponsors @ $60K/year

McDonnell Academy Funding: Corporate Fellows

- Corporate Fellows:
  - Have special opportunities to spend time at corporate partners
  - Develop ties with corporations and alumni in the Academy network

McDonnell Academy Corporate Sponsors

- **Boeing Company**
  St. Louis, MO
- **Brown Shoe**
  St. Louis, MO
- **Cabot Corporation**
  Boston, MA
- **Charoen Pokphand Indonesia Pt**
  Jakarta, Indonesia
- **Corning Inc.**
  Corning, NY
- **Covidien**
  St. Louis, MO
- **DuPont**
  Wilmington, DE
- **Emerson**
  St. Louis, MO
- **Energy & Environment Research Group**
  Ames, IA
- **Fila Korea**
  Seoul, South Korea
- **Monsanto Company**
  St. Louis, MO
- **Nestlé Purina PetCare Company**
  St. Louis, MO
- **Rohm and Haas**
  Philadelphia, PA

Progress to Date: Scholars

- 200+ applications for 2006 cohort
  - 22 offers to very strong candidates
  - Yield of 18 Scholars:
    - 6 in Engineering
    - 3 in Chemistry
    - 3 in Division of Biology and Biomedical Sciences
    - 3 in Olin School of Business (MBA)
    - 2 in Law School (LLM)
    - 1 in Political Science

Progress to Date: Scholars

- 250+ applications for 2007 cohort
  - 12 offers to very strong candidates
  - Yield of 12 Scholars:
    - 3 in Olin School of Business (MBA)
    - 2 in Engineering
    - 2 in Social Work (MSW)
    - 1 in Law School (LLM)
    - 1 in Economics
    - 1 in Philosophy
    - 1 in Art (MFA)
    - 1 in Architecture (March)

Progress to Date: Network Activities and Plans

- August 2006. “Translating Global Cultures” conference at Tsinghua University (participants from Peking U, IIT, Yonsei U)
- May 2007 meeting at Washington University on “International Symposium on Energy and Environment” (CEO from 11 partners. Energy & Environment experts from all 20 partners)
- August 2007. “Philosophy, Neuroscience, and Psychology” at Tsinghua University

Presidents and Directors of Partner Institutions with Chancellor Wrighton and Dean Sansalone

Presidents, Directors and Leaders of Partner Institutions

McDonnell Academy "Call to Action"

- Education
- Research
- Social Science and Policy Studies
- Operations

Washington University's initial response:

1. $500,000 to "seed" collaborations
   - Call for Proposals: multi-institutional, significant engagements amongst the partners
   - 18 proposals submitted
   - Awards to be made within the next 2 weeks
2. Energy and Environment Summit in Hong Kong, December 2008

McDonnell Academy Global Energy & Environmental Partnership

www.mageep.wustl.edu

- Partnership of 21 Universities across the globe – collaboration on Energy & Environmental Education, Research and Sustainable Campuses
- First International Symposium on Energy & Environment. See: http://eer.wustl.edu/McDonnellMayWorkshop/MainWorkshopPage.asp
- Next summit in Hong Kong – Dec 8 & 9, 2008
- Educational Collaborations – more than 500 courses from 20 institutions listed – visit www.eeed.wustl.edu for more information

McDonnell Academy
Global Environment and Energy Partnership

- 20 Partner Universities in McDonnell Academy
- Coordinating Committee for Research
  - Professor James V. Wertsch, Chair
  - Professor Pratim Biswas (Engineering)
  - Professor Vickie Fraser (Medicine)
  - Dean Bruce Lindsey (Architecture)
  - Professor Himadri Pakrasi (Biology, Engineering)
  - Professor Ping Wang (Economics)
  - Professor Gautam Yadama (Social Work)

Washington University in St.Louis

I-CARES International Center for Advanced Renewable Energy & Sustainability

- Director: Professor Himadri Pakrasi
- Purpose: Promote collaborative research within WU and with regional and international partners in areas related to renewable energy and sustainability
- Initial Research Thrusts: Biofuels, CO_2 mitigation, and International Collaborations via McDonnell Academy

International Center for Advanced Renewable Energy and Sustainability

- **Accountability: Director reports to Vice Chancellor for Research**
- **Internal Steering Committee**
  - Pratim Biswas, the Stifel and Quinette Jens Professor and Chair, Department of Energy, Environmental & Chemical Engineering, School of Engineering
  - Bruce Lindsey, Dean, College of Architecture and Graduate School of Architecture & Urban Design
  - Edward S. Macias, Chair: Executive Vice Chancellor; Dean, Arts & Sciences; and the Barbara & David Thomas Distinguished Professor in Arts & Sciences
  - Himadri Pakrasi, the George William and Irene Koechig Freiberg Professor, Arts & Sciences; Professor of Energy, School of Engineering
  - Mary J. Sansalone, Dean, School of Engineering
- **External Advisory Committee**

External Advisory Committee

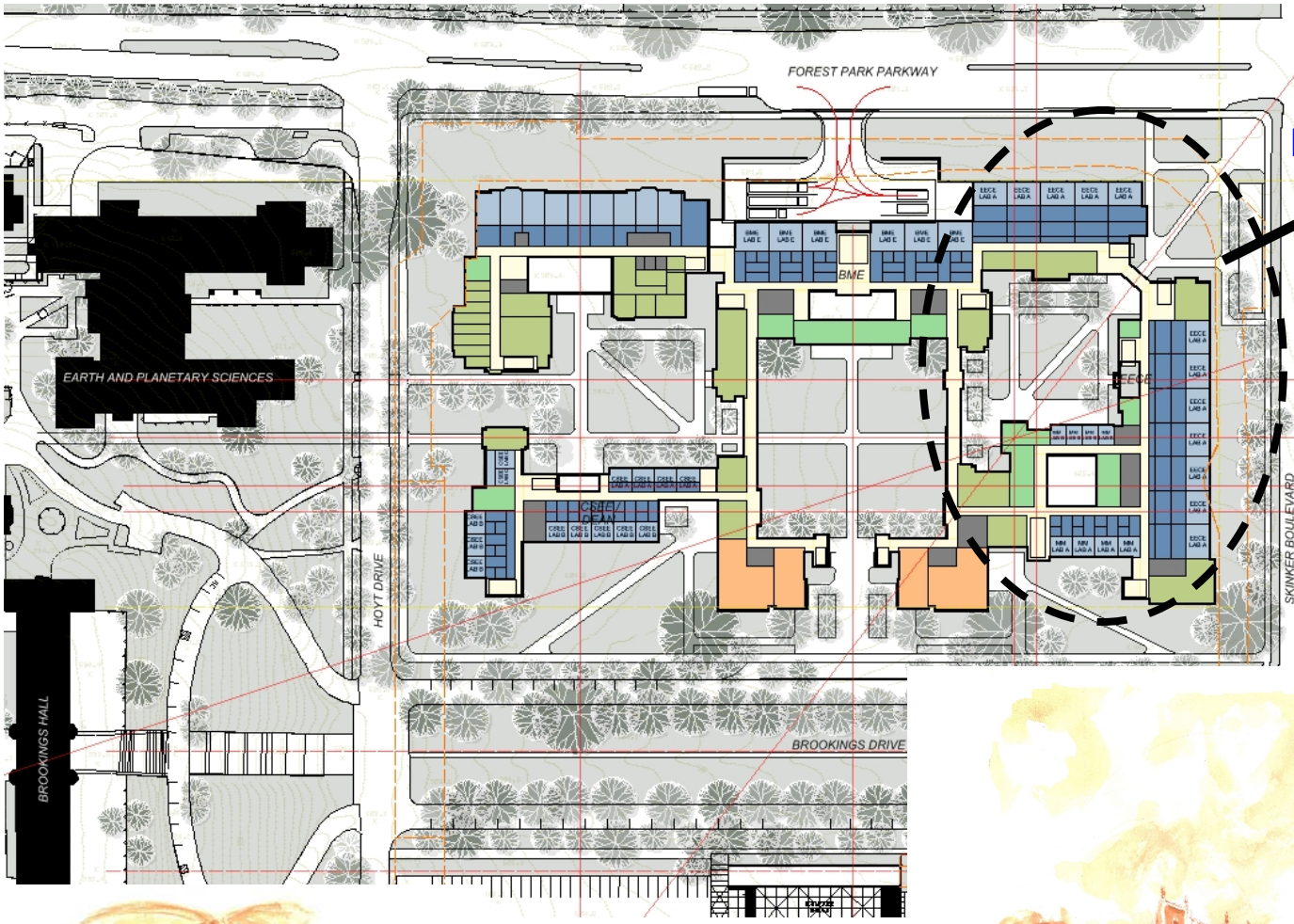
- Tony Arnold, CEO, Solae
- Gregory H. Boyce, CEO, Peabody Energy
- Daniel F. Cole, Senior VP, Ameren Corporation
- Robert T. Fraley, Executive VP and CTO, Monsanto
- Carl Hausmann, CEO, Bunge North America
- Ganesh Kishore, Managing Director, Burrill & Company
- Randall Ledford, Senior VP and CTO, Emerson
- Steven F. Leer, CEO, Arch Coal
- Martha A. Schlicher, VP, Renewable Agricultural Energy.
- John Stier, Group Director Environmental Affairs, Anheuser-Busch, Inc.
- Mark D. Stowers, VP Research & Development, Poet
- S. Richard Tolman, CEO, National Corn Growers Association

(June, 2007)

New Resources

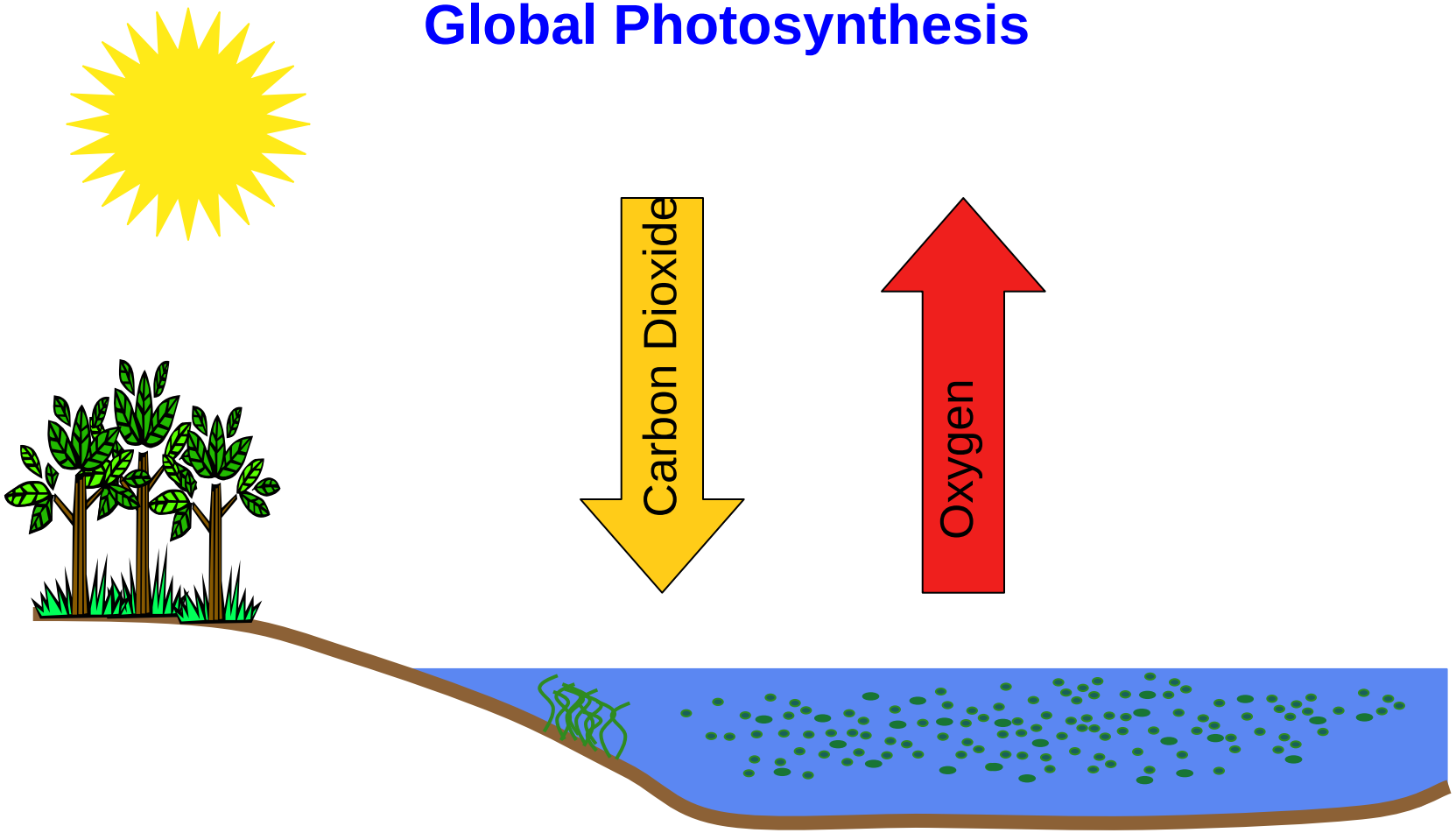
- ~$40 Million for New Building for the Department of Energy, Environmental, and Chemical Engineering
- At least $2.5 Million over five years for support of the International Center for Advanced Renewable Energy and Sustainability
- $10M to endow five new professorships in key areas of research of importance to the Center + ~$2.5M in start up costs
- $500,000 to support development of international projects with the McDonnell Academy partners
- >$500,000 over five years to support the new Sustainability Officer

New Building for I-CARES / Department of Energy, Environmental & Chemical Engineering (LEED Platinum)



Example Sustainable Bioenergy Research Activity at I-CARES

Global Photosynthesis



$$6CO_2 + 6H_2O \xrightarrow{\text{light}} C_6H_{12}O_6 + 6O_2$$

National Geographic, October 2007

Algae as sustainable sources of biofuels and biomaterial

First flight using biofuel to take off soon from Boeing and Air New Zealand.

Boeing and Air New Zealand (Air NZ) are finishing the last details to test a plane running on biofuels. The fuel is made up from algae that develop in sewers.

Alternate Fuels for use in Commercial Aircraft (2007)

Daggett (Boeing), Hendricks (NASA), Walther (Munich) and Corporan (Airforce)

Sustainability

"A recent trend has been to develop soybean crops as feedstock for lipid (i.e. oil-based) biofuels. However, in order to create sufficient farm land capacities, deforestation, using slash and burn practices, can take an extreme toll on rainforests. The resulting CO_2 emissions are anticipated to exacerbate global warming issues. Thus, great care has to be taken to assure that bio-feedstock is sustainable and will not cause new anthropogenic issues through deforestation."

- “One promising feedstock is algae. This feedstock is projected to produce anywhere from 10k to 20k gallons/acre/year of bio-derived oil. With such a high production rate, algae could produce 150-300 times more oil than a crop of soybeans.”

- “With the potential for algae of providing 10,000 gal/acre/year, some 85 billion gallons of bio-jet could be produced on a landmass equivalent to the size of the US state of Maryland. Moreover, if these bio-jet fuels were fully compatible with legacy aircraft, it would be sufficient to supply the present world’s fleet with 100 percent of their fuel needs as well into the future.”

Membrane Biology Grand Challenge

Systems Analysis of the Dynamics of Membrane Architecture, Composition and Function in Cyanobacteria (blue-green algae)

Washington University in St.Louis

Himadri B. Pakrasi
Bijoy K. Ghosh

PURDUE UNIVERSITY

Louis A. Sherman

William R. Wiley EMSL Environmental Molecular Sciences Laboratory

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

David W. Koppenaal
Gordon A. Anderson
Chris Oehmen
Hans Scholten
Garry Buchko
Galya Orr
Richard D. Smith
H. Steven Wiley
+ others

DONALD DANFORTH PLANT SCIENCE CENTER

Thomas J. Smith

SAINT LOUIS UNIVERSITY

Rajeev Aurora

SIPPE
Institute of Plant Physiology and Ecology, SIBS, CAS

Teruo Ogawa

Office of Science U.S. DEPARTMENT OF ENERGY

Washington University in St.Louis

Membrane Biology Grand Challenge Workshop, The Village, Washington University, April, 2007

Renewable Bioenergy from Cyanobacteria
(blue-green algae)

Photobioreactor

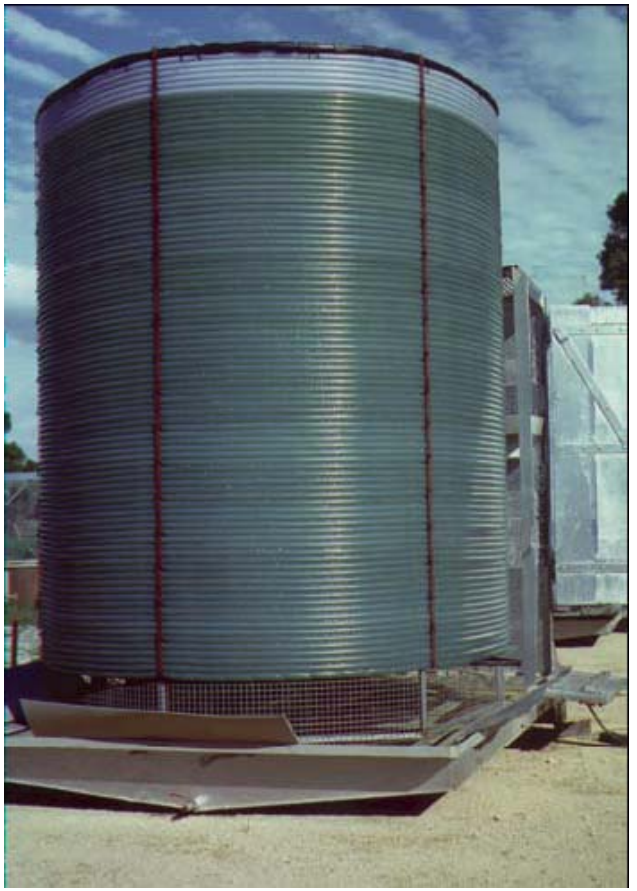
- Light-driven, CO_2-utilizing microbial cell factories
- Rapid Growth
- Well Developed Genetic Systems
- Genomes of Over 30 Different Species Sequenced
- Ease of Metabolic Engineering for Carbon Neutral Biofuel and Biomaterial Production

National Geographic, October 2007, pg. 58-59

High hopes hang on bags of algae outside the Redhawk power plant near Phoenix. Researchers say the fast-growing green scum, fed by power plant exhaust, could soak up carbon dioxide while cranking out 5,000 gallons of biodiesel an acre each year—at least in theory.

Thank You!

High-end tubular photobioreactor in Nové Hrady, CZ



1000 L pilot-scale BIOCOIL at Murdoch University, Australia.

Spirulina Production Ponds, India

1) In your view, is there an optimum way to structure partnerships to achieve an impact on the environment (as opposed, perhaps, to just an impact on the literature)?

2) Are there positive examples (case studies) where industry or government engagement with a university-led effort (other than providing the funding) has led to outcomes that couldn't be achieved by the university sector alone? If so, please describe; if not, why not? What would it take to enable more fruitful government-university-industry interactions in the area of environmental sustainability?