



Updates on NSF Initiative: Innovations at the Nexus of Food, Energy and Water Systems (INFEWS)

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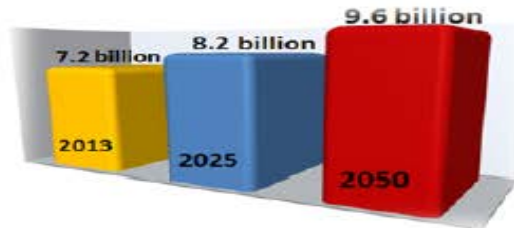


Food, Energy and Water System

THE 2050 PICTURE

WORLD'S POPULATION BOOMS

↑ >9 BILLION by 2050



Larger, more urban and richer population

Food production will need to **increase**

~60%



2010



2050

FOOD

Water demand will **increase**

~30%



2010



2050

WATER

Energy production will need to **increase**

~50%



2010



2050

ENERGY



Image credit: <http://www.aquate.com>

INFEWS: Innovations at the Nexus of Food, Energy, and Water Systems

- Growing populations
- Land use change
- Change in precipitation

Stress



Amy Landis studies the feasibility of restoring soils degraded by industrial wastes and other pollutants for growing bioenergy crops. *Credit: Jessica Hochreiter/Arizona State University*

Unique NSF Aspects of INFEWS

- Interdisciplinary



Unique NSF Aspects of INFEWS

- Interdisciplinary
- Investigation of the system of systems



Unique NSF Aspects of INFEWS

- **Interdisciplinary**
- **Investigation of the system of systems**
- **Education, workforce and outreach**



Food, Energy, and Water in FY 2014

MPS AC Report on Food, Energy and Water

Michelle V. Buchanan (Chair)

- Ensuring a Sustainable Water Supply for Agriculture;
- “Closing the Loop” for Nutrient Life Cycles;
- Crop Protection;
- Innovations to Prevent Waste of Food and Energy;
- Sensors for Food Security and Safety; and
- Maximizing Biomass Conversion to Fuels, Chemicals, Food, and Materials.



Food-Energy-Water in FY 2015

DCL: SEES: Interactions of Food Systems with Water and Energy Systems

Workshop grants
(17 awards, \$1.2 M):

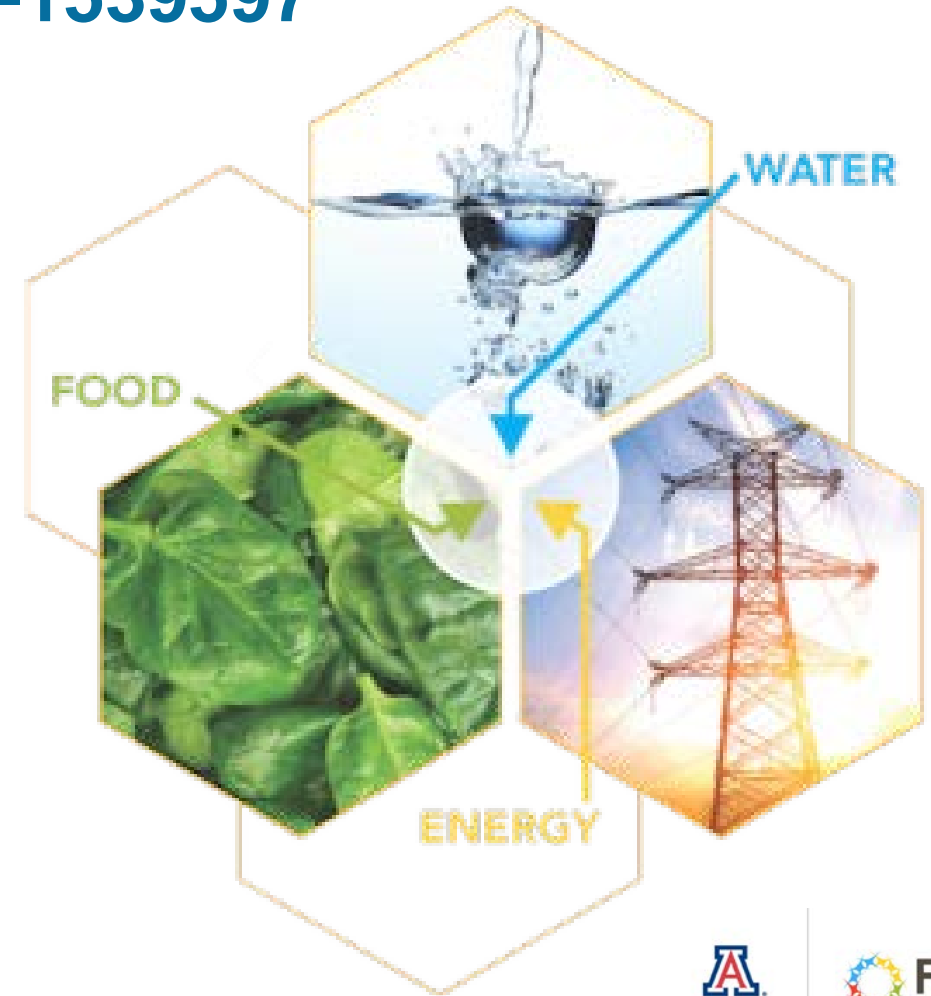
- Planned across the country
- Facilitate partnerships
- Enhance communication
- Define fundamental science and engineering questions and research needs

http://nsf.gov/news/news_summ.jsp?cntn_id=135642



Enabling Resiliency in Energy Water and Food Systems for Society: Addressing the Scientific, Technological and Societal Challenges of the Energy, Water and Food Nexus, CHE-1539597

- *Situational scarcity*
- *New materials, new technologies, and unit operations*
- *Smart data and decision-making*
- *Policy response*
- *Regional test beds and private / public partnerships*



Workshop Led by: Neal R. Armstrong, Ardeth Barnhart and Kim Ogden, U AZ
Workshop report forthcoming

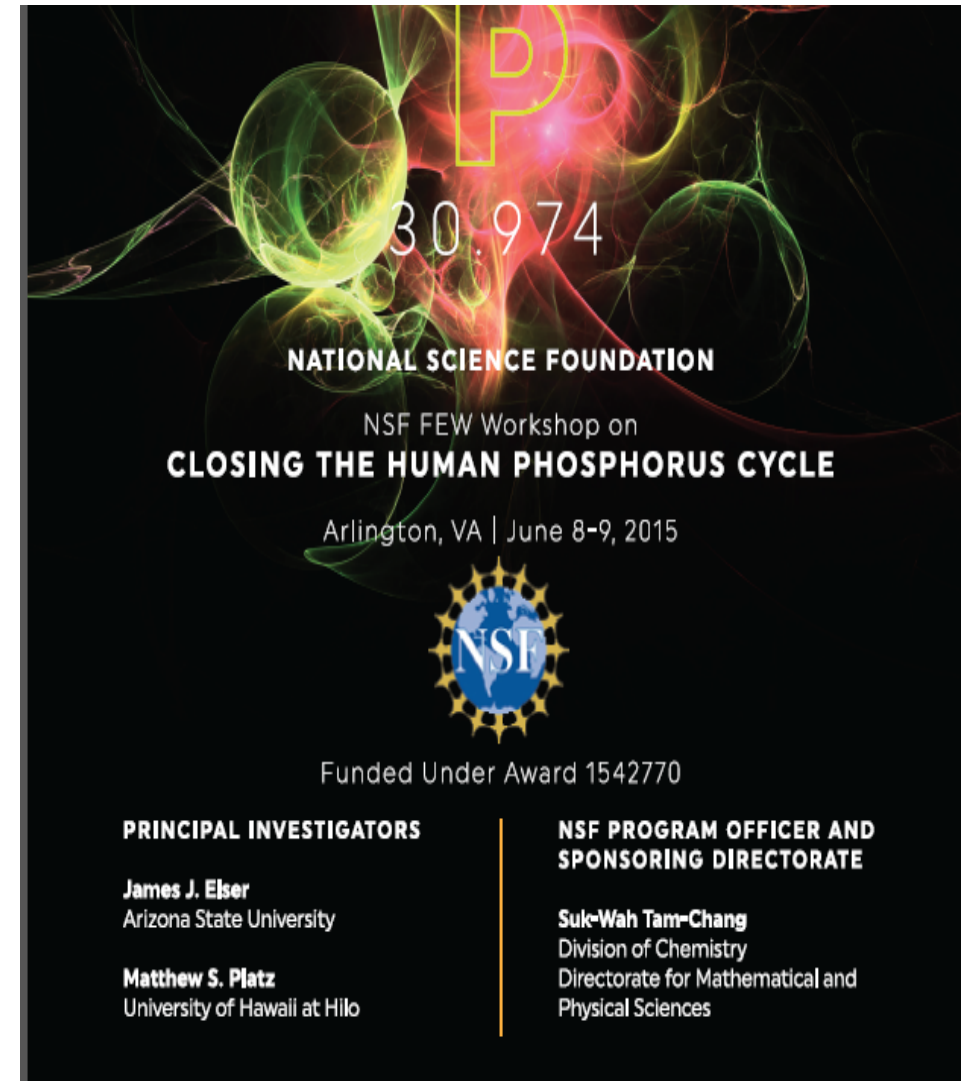
NSF FEW Workshop on Closing the Human Phosphorus Cycle

Workshop led by Matthew Platz (U. of Hawaii at Hilo) and James Elser (Arizona State U.) on June 8-9, 2015:

Challenge: 75% of the world's population is fed with food produced using phosphorus-containing fertilizer.

The U.S. and China have an estimated 30-year domestic supply of minable phosphate.

Workshop report available at www.nsf.gov/chem





NSF Workshop

FEWS: Food-Energy-Water Systems Challenging Chemists in the 21st Century

October 13-15, 2015 | Arlington, Virginia



Sponsored by CHE and CBET (CHE-1541860)

Workshop Chairs: Timothy Long, Virginia Tech; Frank Bright, University at Buffalo; Paul Edmiston, College of Wooster

Workshop Findings (pending final report):

- 7 billion people in 60 countries will experience water scarcity by 2050
- Groundwater is non-renewable
- Pollution

Feeding the World in the 21st Century: Grand Challenges in the Nitrogen Cycle

Workshop led by Nicolai Lehnert (U. of Michigan) Eric Hegg (Michigan State U.) Gloria Coruzzi (NYU), Lance Seefeldt (Utah State) on Nov. 2-10, 2015:

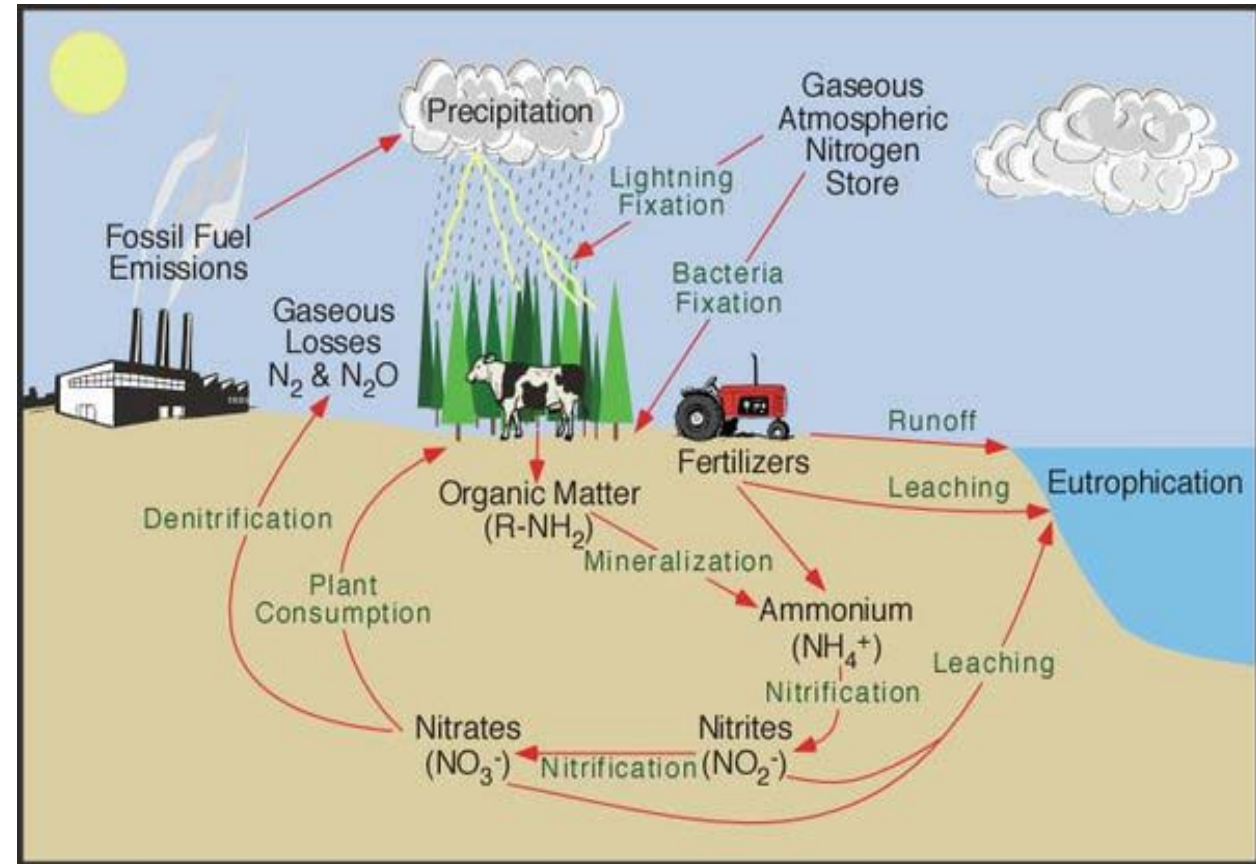
Challenges: 450 M tons of N-fertilizer / y:

- Uses 3–5% of the world natural gas
- Uses ~1–2% of the world's energy / y

Need 4 x land (1/2 all ice-free continents) to produce crops w/o fertilizer

80% of the N used to produce food is lost to the environment.

Workshop report available at www.nsf.gov/chem





FY 2016 NSF Budget Request: INFEWS



INFEWS Funding by Directorate

(Dollars in Millions)

Dir/Office	FY 2014 Actual	FY 2015 Estimate	FY 2016 Request
BIO	-	-	\$7.50
CISE	-	-	13.50
EHR	-	-	6.00
ENG	-	-	13.00
GEO	-	-	14.78
MPS	-	-	8.90
OISE	-	-	1.28
SBE	-	-	5.00
IA	-	-	5.00
Total, INFEWS	-	-	\$74.96

Totals may not add due to rounding.



FY 2016: INFEWS NSF-Wide Goals

- Advance understanding through modeling;
- Develop real-time interfaces to increase decisional capabilities;
- Innovate scientific and technical solutions;
- Grow scientific workforce.



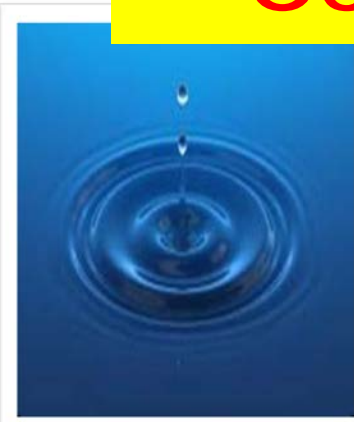
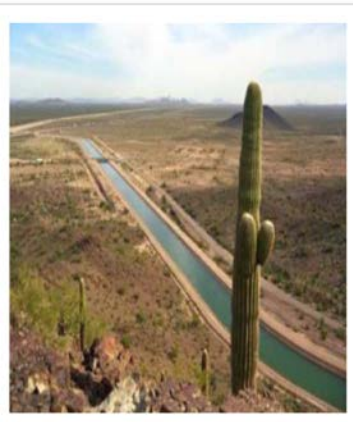
DCL: FY 2016 INFEWS Funding Opportunity on Nitrogen, Phosphorus, and Water (CHE/CBET NSF 15-108)

- ▶ Advance catalytic methods for **fertilizer production**;
- ▶ Develop **new sensing modalities** for N- or P-species;
- ▶ **Detect, sequester / separate, and recycle.**



DCL: FY 2016 INFEWS Funding Opportunity on Nitrogen, Phosphorus, and Water (CHE/CBET NSF 15-108)

- ▶ Advance c
 - ▶ Develop n
 - ▶ Detect, se
- Proposals due to CHE between September 1- November 2, 2015**
- to CBET between October 1-October 20, 2015**



Thank you!

INFEWS: Innovations at the Nexus of Food, Energy, and Water Systems

World Supply:

US Energy Budget:

- 3-20% to pump, treat, transport and heat water
- 10% for food production, processing, distribution

