United States Department of Agriculture

National Institute of Food and Agriculture

Air Quality Program

Institute of Bioenergy, Climate, and Environment

BIOENERGY, CLIMATE, AND ENVIRONMENT

FOOD PRODUCTION AND SUSTAINABILITY

YOUTH, FAMILY, AND COMMUNITY

FOOD SAFETY AND NUTRITION

INTERNATIONAL PROGRAMS

USDA NIFA

NATIONAL INSTITUTE OF FOOD AND AGRICULTURE

National Institute of Food and Agriculture

- Catalyzes transformative discoveries, education, and engagement to address agricultural challenges.
- Brings groundbreaking discoveries from research laboratories to farms, communities, and classrooms.
- Integrate (research, education and extension) and transdisciplinary approaches.

National Institute of Food and Agriculture (NIFA)

- Mission -- **financial assistance** and **national leadership**
- $ 1.3 – 1.7 B per year of extramural **competitive funds** such as the Agriculture Food Research Initiative (AFRI) and **capacity funds** such as those to land-grant institutions through the Smith-Lever (extension) and Hatch Act (research).

NIFA AFRI Challenge Areas

- Climate Variability and Change
- Water for Food Production Systems
- Food Safety
- Childhood Obesity Prevention
- Food Security
- Sustainable Bioenergy

NIFA AFRI Foundational Science

- Plant health and production and plant products
- Animal health and production and animal products
- Food safety, nutrition, and health
- Bioenergy natural resources and environment
- Agriculture systems and technology
- Agriculture economics and rural communities

Critical Issues for Stakeholders

- The effects of climate change on rangelands and grasslands.
- Water quality, quantity, and drought—no longer a western state problem.
- The need for hard data and better communication among landowners, policy makers and appropriators, and non-farmers.
- “Bring research to management” and we need more “conservation on working lands.”

NIFA's Air Quality Program Goals

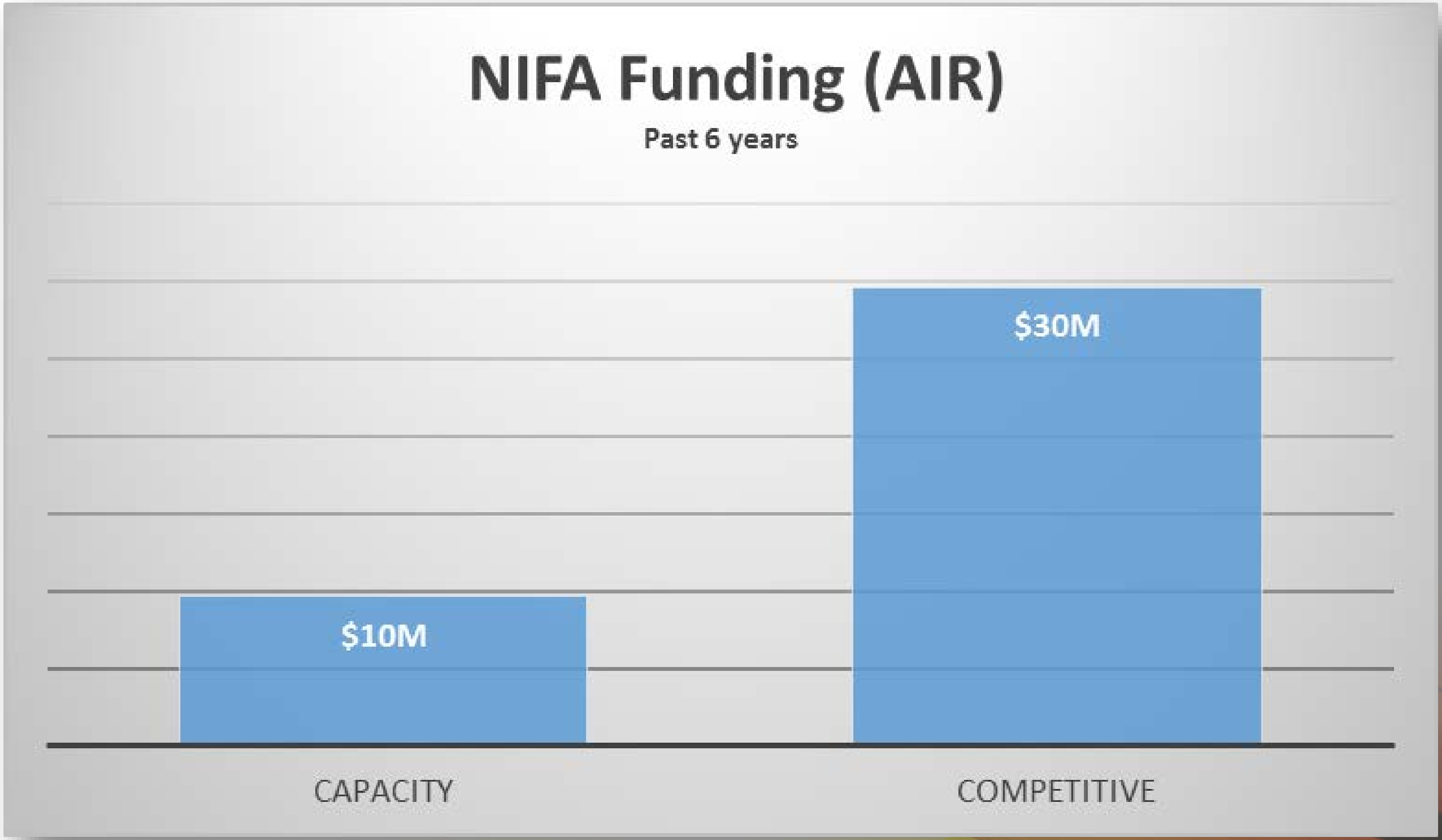
- To predict an emission rate at any point in the production cycle for the whole farm.
- To predict the fate and transport of emissions downwind.
- To validate regional and local transport models.
- To mitigate emissions.
- To measure dry and wet deposition.

What have we learned over the last 5 years?

- Better understanding of gas and particulate matter concentrations in animal and crop production systems
- Better understanding of the fate and transport of gas and particulates
- Better characterization of the diurnal and seasonal nature of gas concentrations
- Better monitoring and measurement systems
- Better understanding of particle size distributions
- Better estimates of errors associated with particulate matter measurements and methods

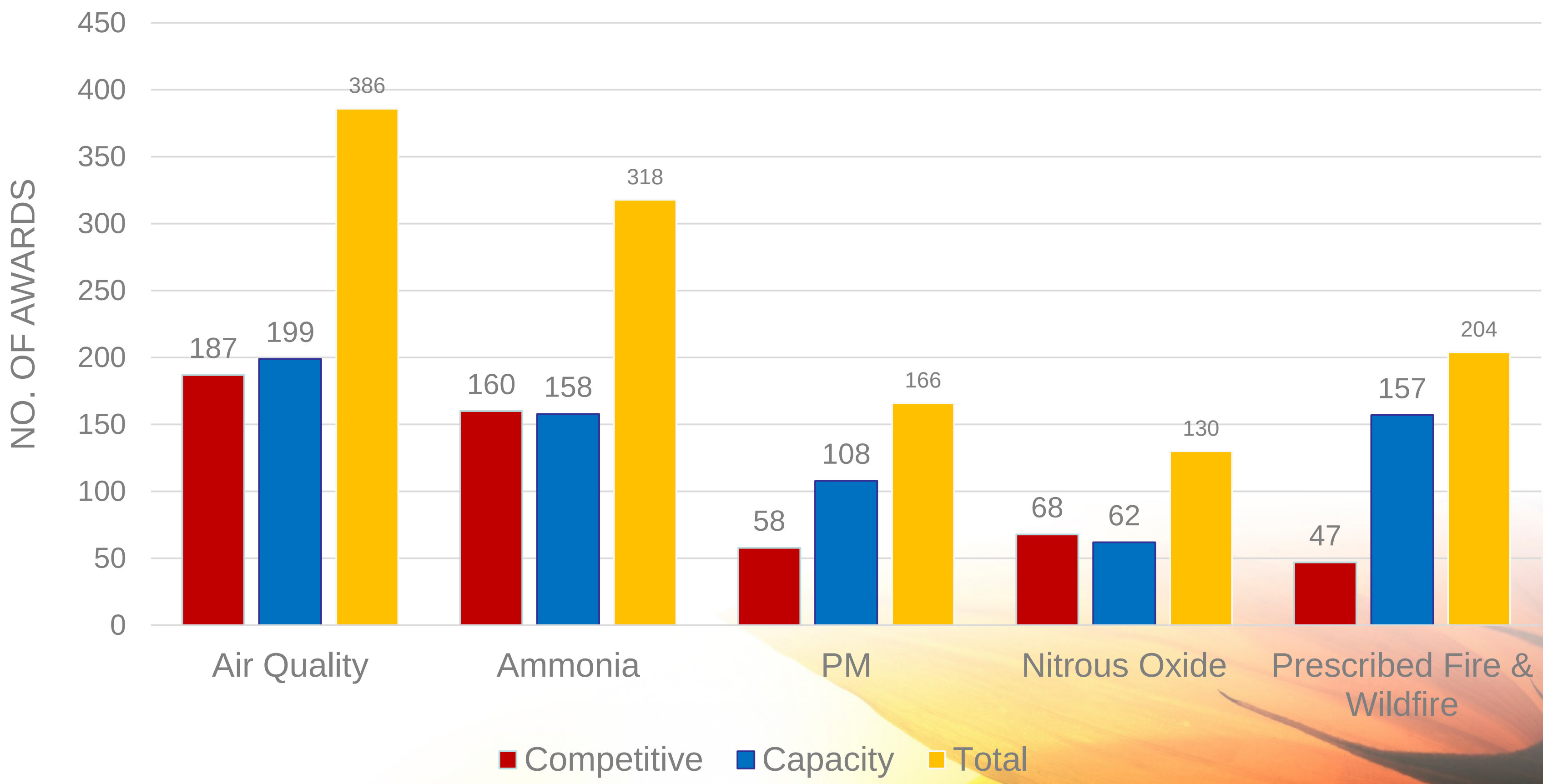
NIFA Air Quality Investments (2009 – 2014)

Fiscal Year:	Total Capacity Expenditures	Total Competitive Grant Obligations
	Air Resources Protection and Management (KA:141 & SOI: 0410)	Air Resources Protection and Management (KA:141 & SOI: 0410)
2009	$1,312,000	$7,508,167
2010	$1,211,000	$8,889,819
2011	$1,722,000	$4,050,984
2012	$2,209,000	$3,624,513
2013	$1,917,000	$3,126,329
2014	$1,259,000	$2,405,561
Total	$9,630,000	$29,605,373


NIFA Funding (AIR)
Past 6 years
$10M
$30M
CAPACITY
COMPETITIVE

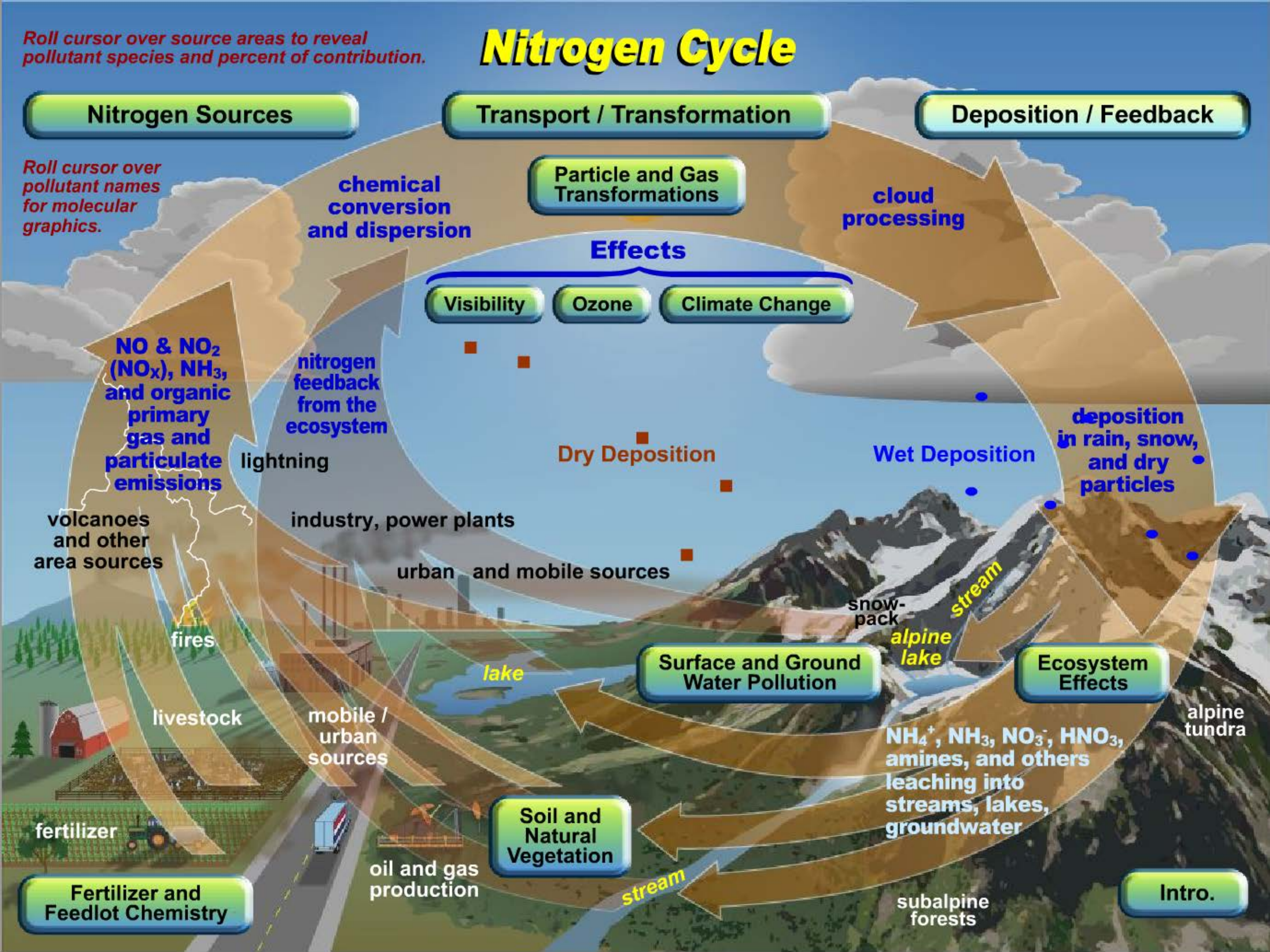

Air Quality Funding Trend
$10,000,000
$9,000,000
$8,000,000
$7,000,000
$6,000,000
$5,000,000
$4,000,000
$3,000,000
$2,000,000
$1,000,000
$0
2006
2007
2008
2009
2010
2011
2012
2013
2014
Capacity
Competititve

NIFA Air Quality Investments 2001-2014



NIFA Air Quality Program Emphasis Areas

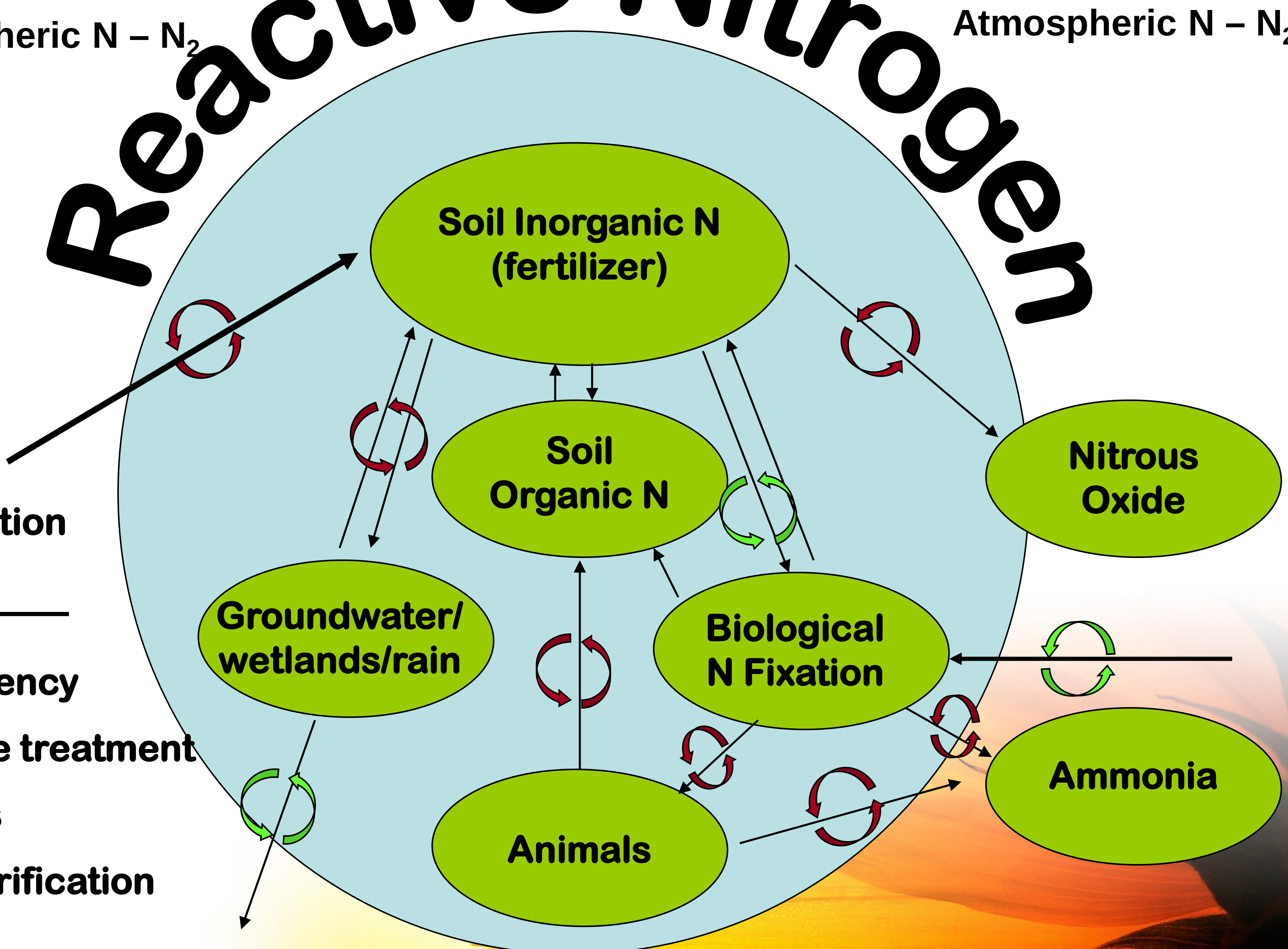
- New focus on understanding the Nitrogen Cycle and the role of Reactive Nitrogen (Nr) on Environment and Air Quality
- Emission data from production practices – particulates, gases/odors (more focus on crop production).
- Improved measurement protocols/ instrumentation for within field and edge of field boundaries
- Practices for mitigating emissions
- Fate and transport of emitted particulates and gases


Nitrogen Cycle
Roll cursor over source areas to reveal pollutant species and percent of contribution.
Nitrogen Sources
Transport / Transformation
Deposition / Feedback
Roll cursor over pollutant names for molecular graphics.
chemical conversion and dispersion
Particle and Gas Transformations
cloud processing
Effects
Visibility
Ozone
Climate Change
NO & NO_2 (NO_X), NH_3, and organic primary gas and particulate emissions
nitrogen feedback from the ecosystem
lightning
Dry Deposition
Wet Deposition
deposition in rain, snow, and dry particles
volcanoes and other area sources
industry, power plants
urban and mobile sources
snow-pack
stream
alpine lake
fires
lake
Surface and Ground Water Pollution
Ecosystem Effects
livestock
mobile / urban sources
NH_4^+, NH_3, NO_3^-, HNO_3, amines, and others leaching into streams, lakes, groundwater
alpine tundra
fertilizer
Soil and Natural Vegetation
oil and gas production
stream
subalpine forests
Fertilizer and Feedlot Chemistry
Intro.

Reactive Nitrogen (Nr)

In contrast to non-reactive gaseous N_2, includes all biologically active, chemically reactive, and radiatively active nitrogen compounds in the atmosphere and biosphere of the earth.

Reactive Nitrogen

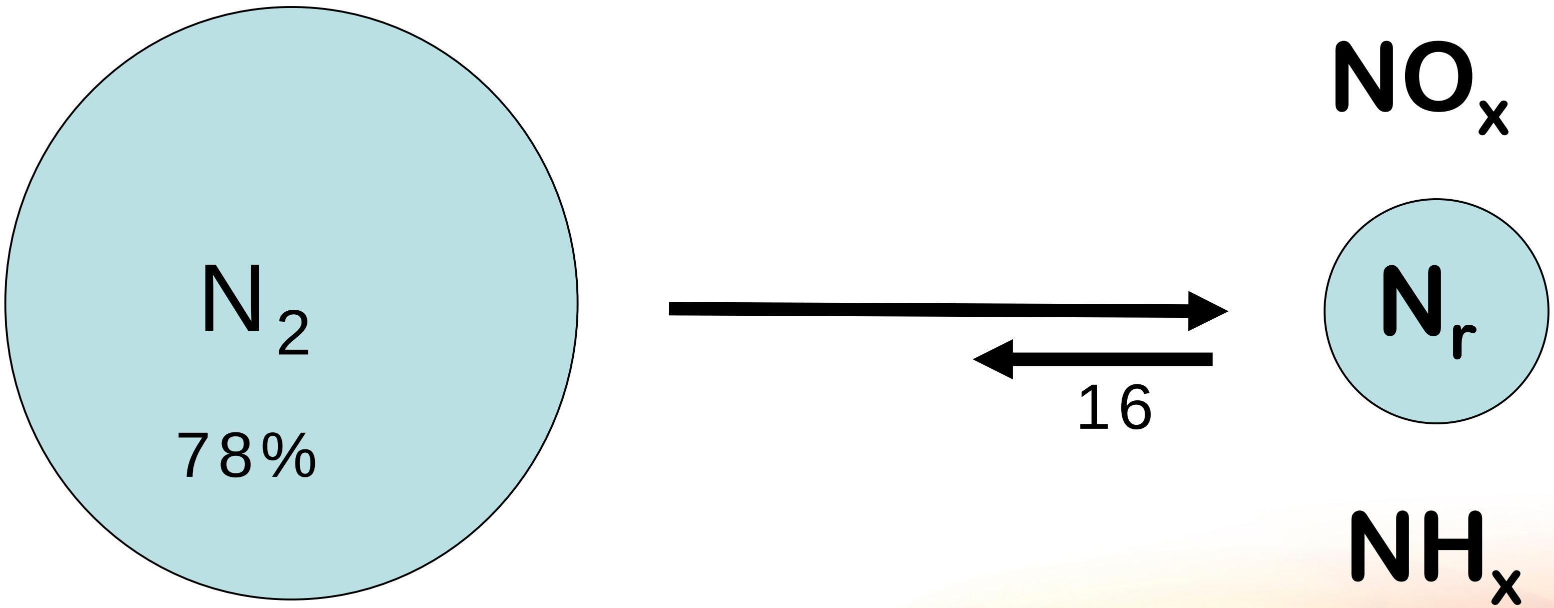


Intervention

- ↑ Efficiency
- Waste treatment
- BMPs
- ↑ Denitrification

Atmospheric Nitrogen

US-Reactive Nitrogen(Tg N/yr)



NO_x Natural

6.4
+
28.5

34.9

NH_x Anthropogenic

Energy production - NO_x

Food/Biofuel production - NH_x

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Implications of different forms of N lost from plant-soil systems

Gaseous losses

N_2

N_2O NO NO_2

NH_3

Runoff & erosion

NO_3 leaching

Negative environmental or health impacts.

- Atmospheric aerosols
- Formation of tropospheric ozone
- Depletion of stratospheric ozone
- Acid rain, acidification of soils
- N deposition
- Impacts on aquatic & terrestrial ecosystems
- Can provide a secondary source for re-emissions
- Contamination of ground & surface water
- Blooms of toxic algae
- Eutrophication & hypoxia in coastal ecosystems
- Increases in disease vectors such as mosquitoes
- Soil acidification

Source: Peoples *et al* (2004) SCOPE 65 *Agriculture & the N Cycle*, (Island Press), pp 53-69;, pp 349-385

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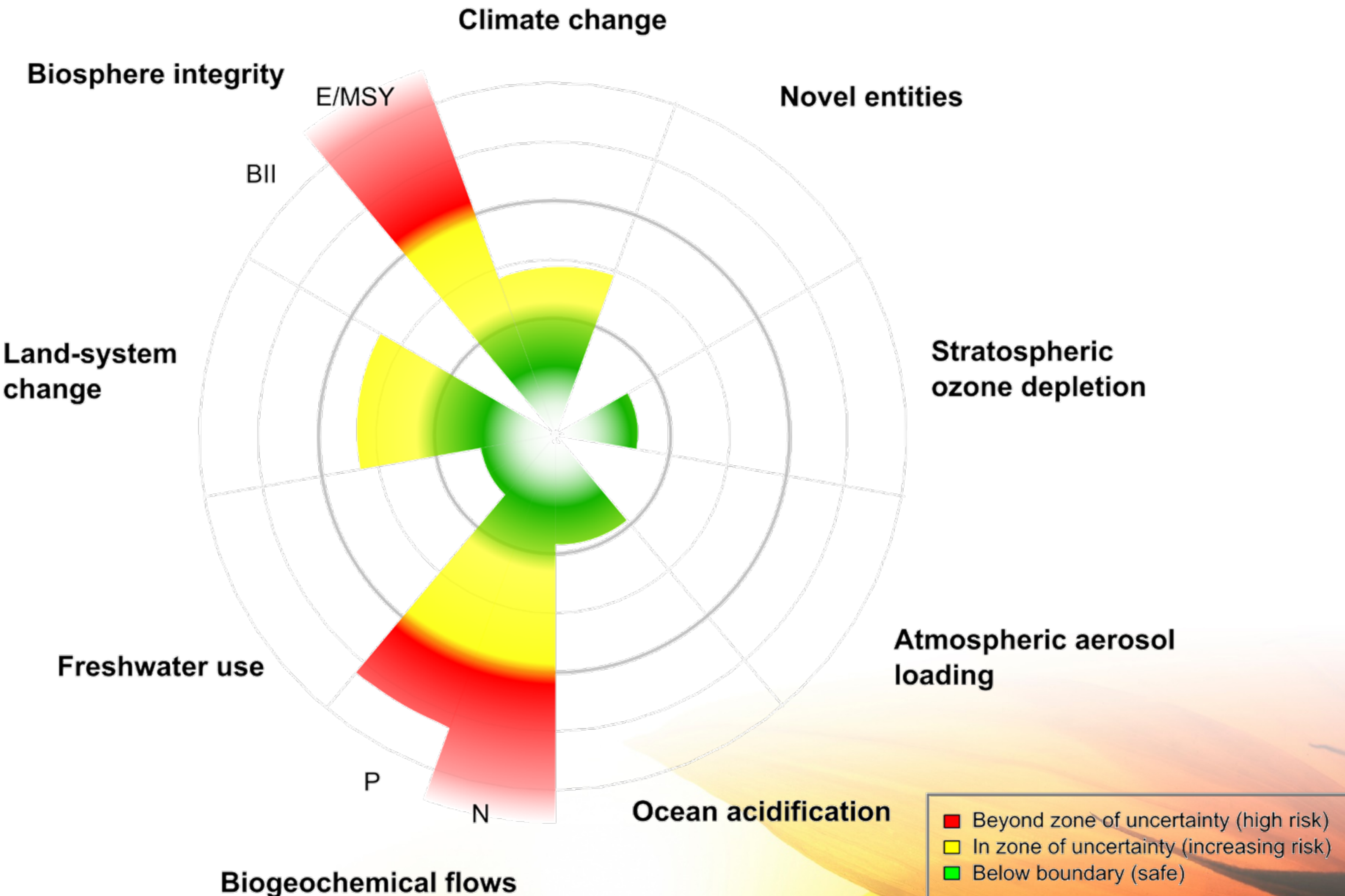

Source: Steffen and others, 16 January 2015, Science

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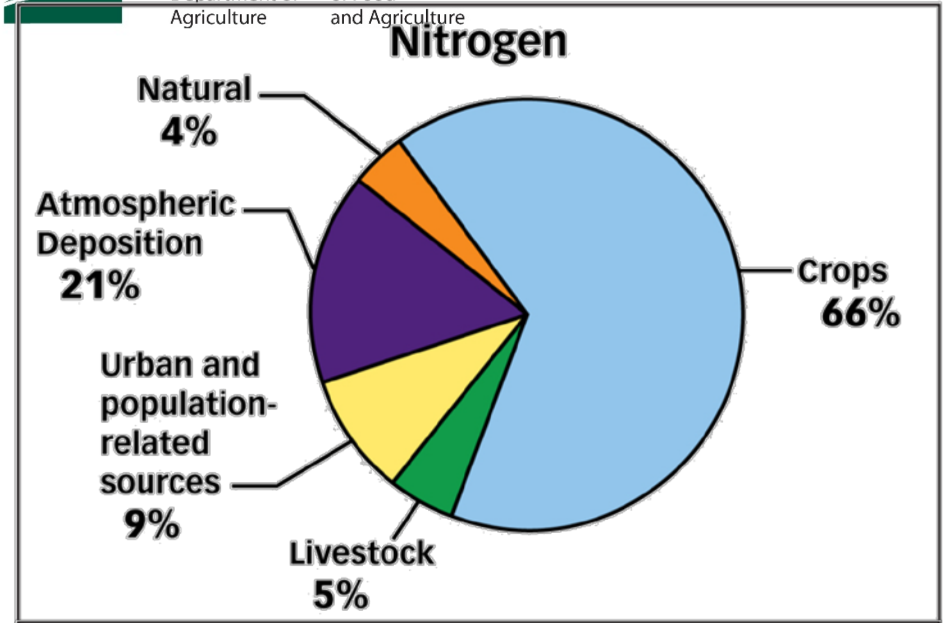
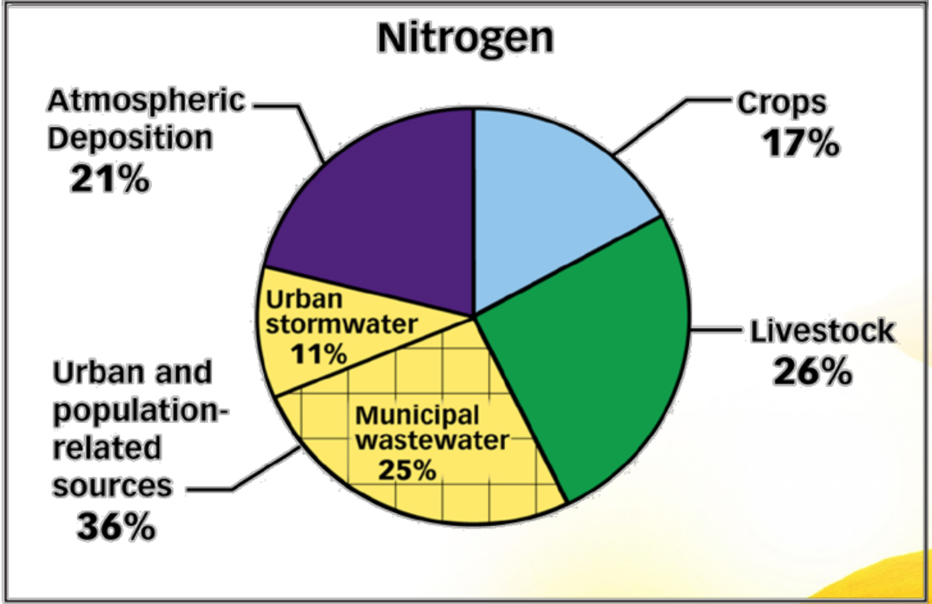
Nitrogen Sources

Gulf of Mexico



Chesapeake Bay

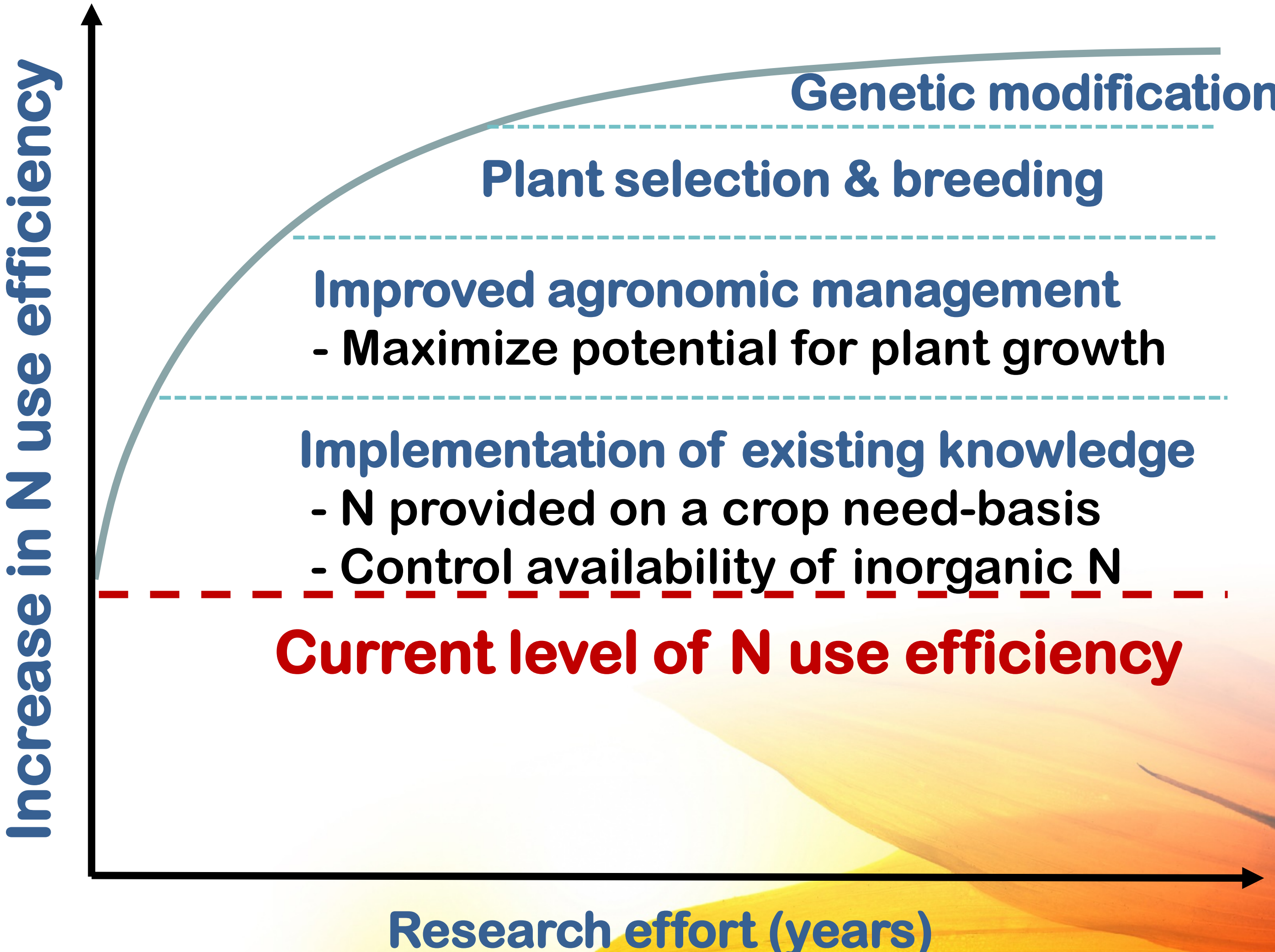


After: EPA (US Environmental Protection Agency). 2010b. Discussion Document: Coming Together for Clean Water, Background Information on Proposed Discussion Topics. US Environmental Protection Agency Forum,April 15, 2010 [online]. Available: http://blog.epa.gov/waterforum/discussion-document

Goal: Reduce the global pool of reactive nitrogen

- Reduce the fixation of reactive nitrogen
  - Improved N use efficiency of plant and animal systems
- Recycle more reactive nitrogen
  - Life-cycle analysis (farm to fork)
  - Cover crops
- Convert reactive nitrogen to dinitrogen gas
  - Edge-of-field treatments

Likely impact of research investment in different areas towards improving N use efficiency (NUE)



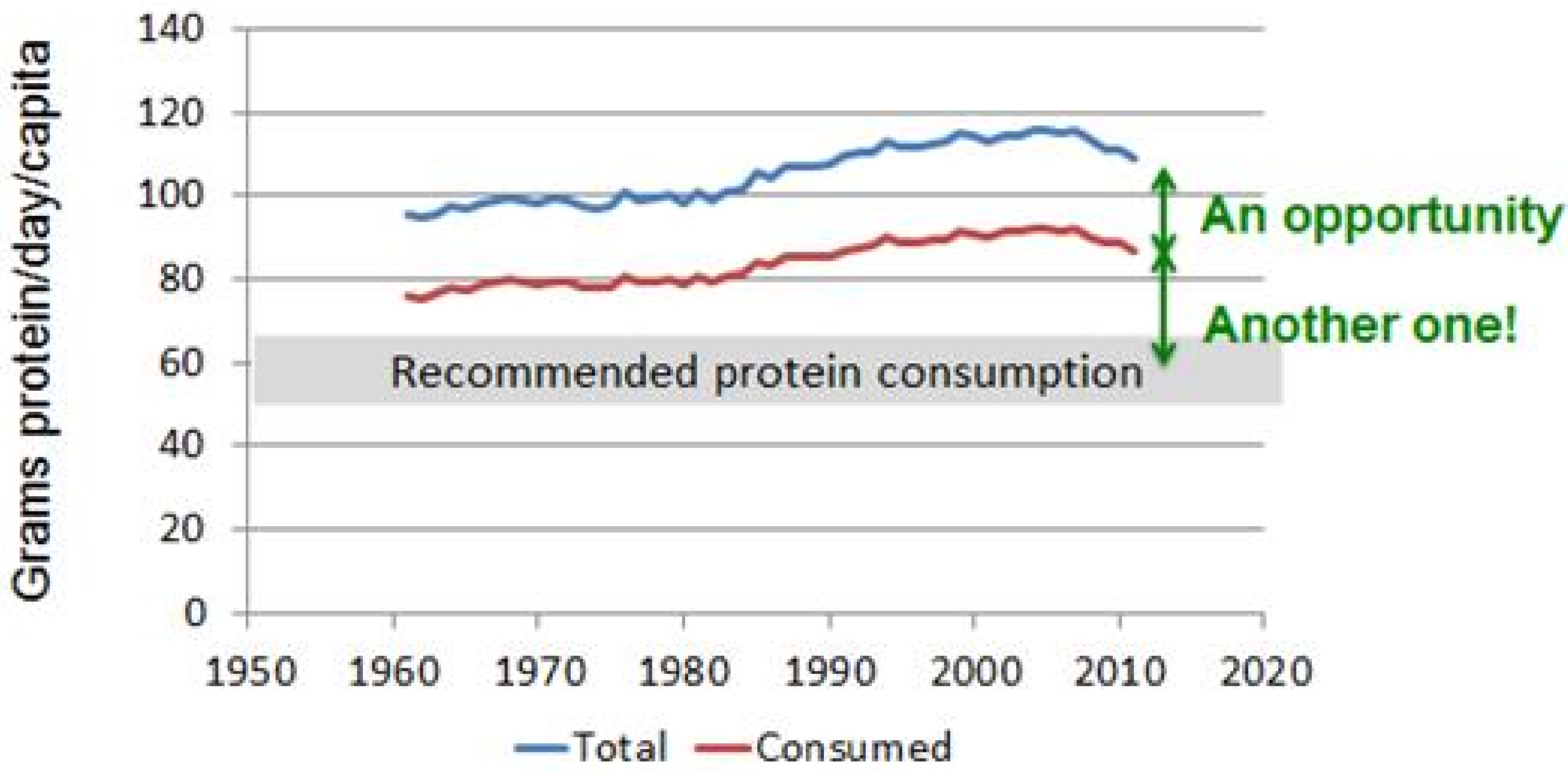
Adapted from: Giller et al. (2004) SCOPE 65 *Agriculture & the N Cycle*, (Island Press), pp 35-52

Transformative vs. Incremental

The trajectory of research discovery should be commensurate with the scope of the problem to be solved:

- Reduce nutrient loading to Gulf of Mexico by 40% in 20 yrs
- Reduce deposition of nitrogen in Rocky Mountain National Park to 3 kg/ha/yr

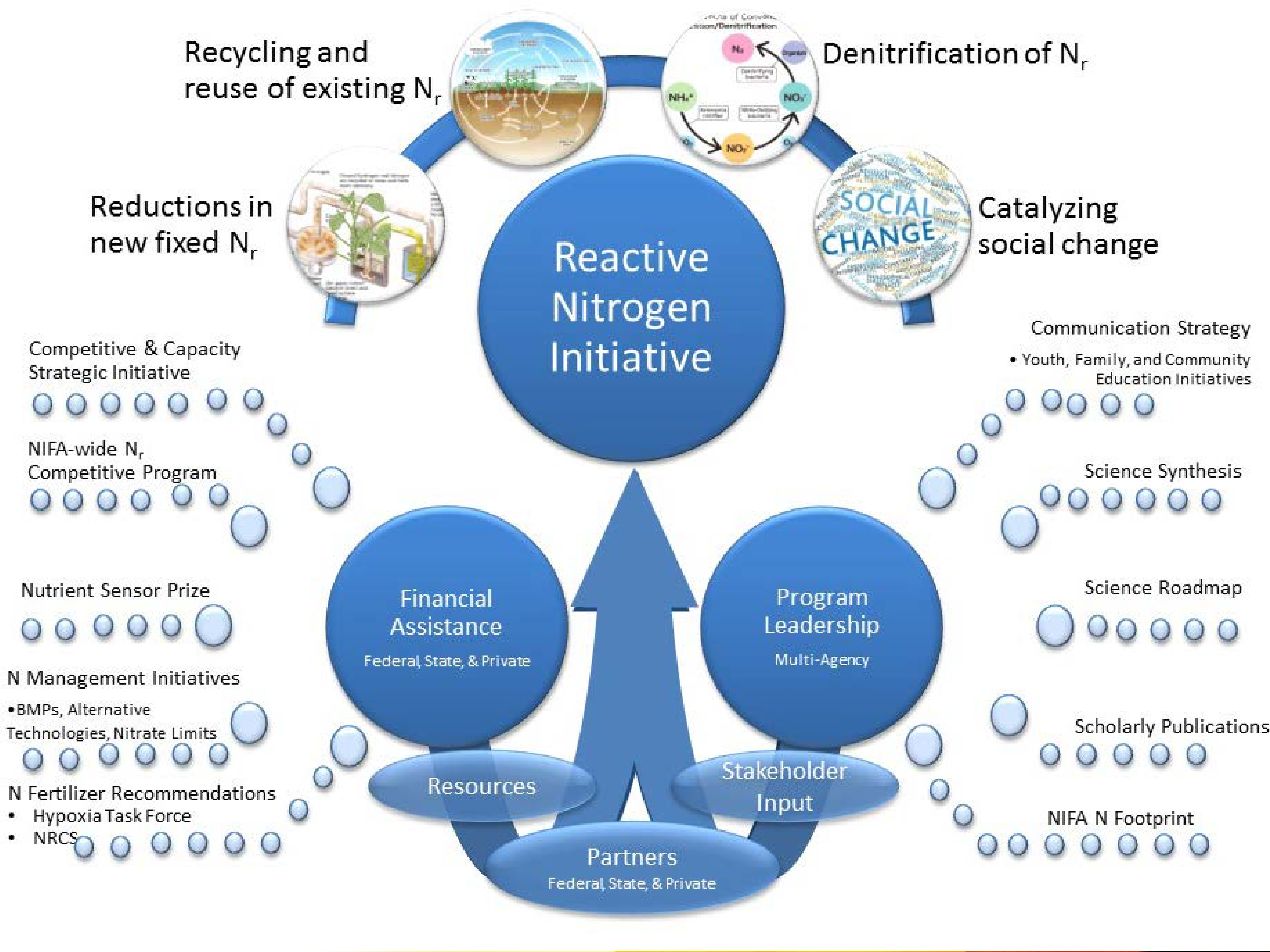
Dietary Protein



Differences in protein production (blue line), consumption (red line), and the impact of eliminating food waste ("An opportunity") and consuming the recommended amount of protein ("Another one"). Source: Dr. Jim Galloway

Biogeochemical vs. Social Science

- Creating markets that reward sustainability
  - Educating consumers
    - Sustainable diet
    - Food waste
- Policy analysis
  - Voluntary vs. regulatory
- NIFA is developing Nr Initiative. This initiative is summarized in the following graphical presentation.


Recycling and reuse of existing N_r
Denitrification of N_r
Reductions in new fixed N_r
Catalyzing social change
SOCIAL CHANGE
Reactive Nitrogen Initiative
Competitive & Capacity Strategic Initiative
NIFA-wide N_r Competitive Program
Nutrient Sensor Prize
N Management Initiatives
•BMPs, Alternative Technologies, Nitrate Limits
N Fertilizer Recommendations
• Hypoxia Task Force
• NRCS
Communication Strategy
• Youth, Family, and Community Education Initiatives
Science Synthesis
Science Roadmap
Scholarly Publications
NIFA N Footprint
Financial Assistance
Federal, State, & Private
Program Leadership
Multi-Agency
Resources
Stakeholder Input
Partners
Federal, State, & Private

Questions

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