Integrated Nitrogen Committee

October 20-21, 2008 Workshop

Breakout Groups

Overall Goals of the Workshop

- To evaluate INC's assessment of Nr problems, consequences, and remedies with emphasis on risk reduction
- To react to INC's quantitative suggestions for Nr reduction targets
- To suggest mechanisms whereby the Nr strategy might be enacted

Risk Assessment Paradigm

- Measurement of Assessment
- Management of the Risk
- Communication of the Risk

Risk Assessment Measurement

Identify the nature and end point (e.g. death from hazardous chemicals, disability from accidents, loss of diversity from habitat encroachment, impairment of ecosystem services, etc.)

Develop quantitative methods of analysis (perturbation-effect, loading-failure, dose-response)

Determine extent of impact (i.e. fate, transport, and transformation to an exposed population)

Calculate risk (e.g. 95% confidence of 1/1000 occurrence over a human lifetime, etc.)

Risk Management

Integration of risk assessment with other considerations, such as economic or legal concerns, to reach decisions regarding the need for and practicability of implementing various risk reduction activities

Risk Communication

- The formal and informal processes of communication among various parties who are potentially at risk from or are otherwise interested in the threatening agent
- Human perception matters! (e.g. Is the problem on the radar? Are decisions perceived to be in our best interests? Are tradeoffs sufficiently understood?…)

Overarching questions

(from the SAB perspective)

What is the potential for applying new science to integrated nitrogen management?

How could application of science strengthen the design and implementation of programs to address integrated nitrogen control?

What are the barriers to applying science to integrated nitrogen management and how might they be overcome?

What opportunities are available to strengthen EPA research and applied science to address integrated nitrogen management?

What steps should the SAB and SAB members take to provide science advice on this topic more effectively?

Control Strategies for Nr

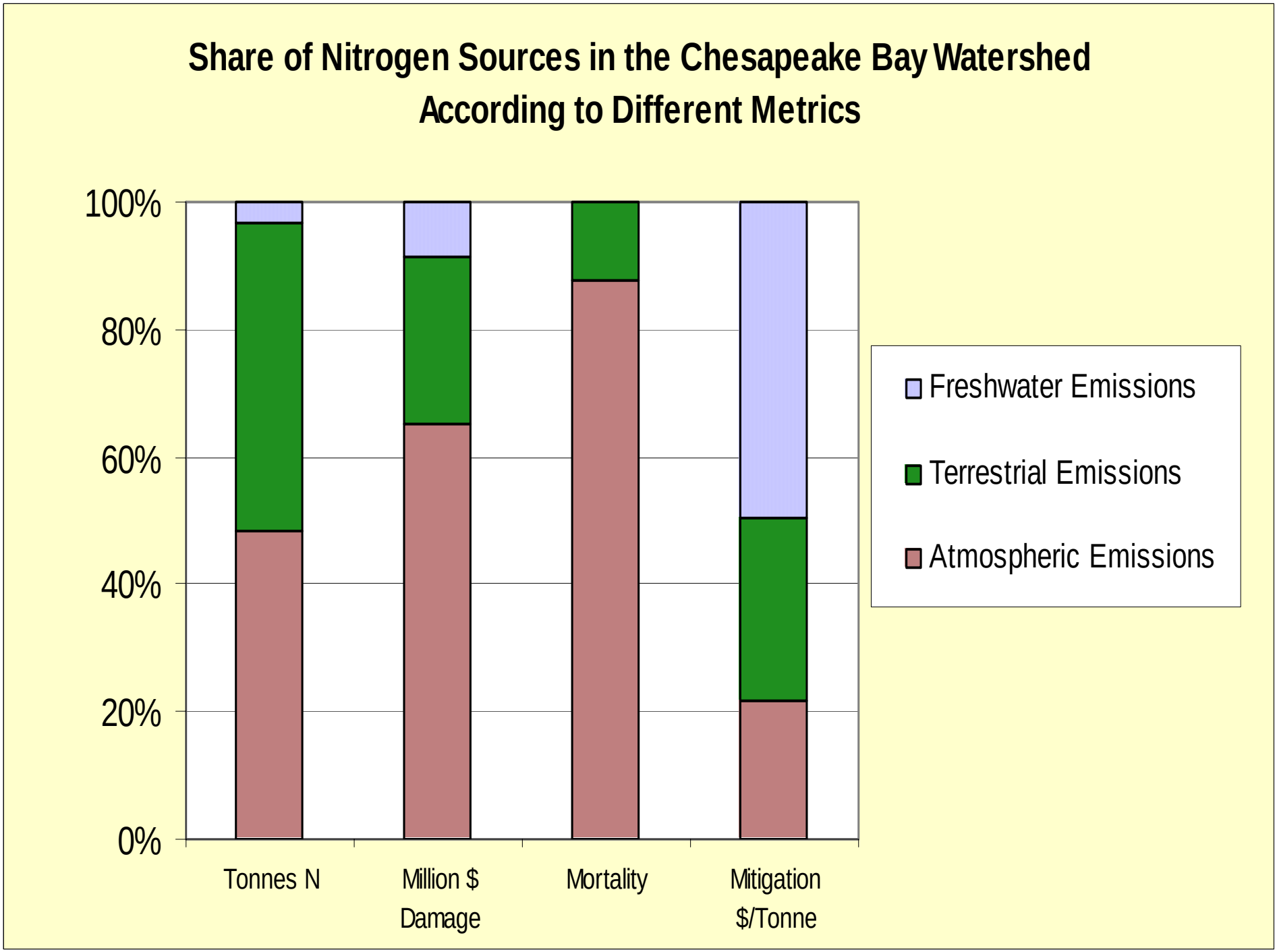
- **Transformation**—in which one form of nitrogen is converted to another form (e.g. nitrification, denitrification)
- **Removal**—in which Nr is sequestered from impacting a particular resource (e.g. ion exchange, denitrification)
- **Source limitation**— in which the amount of Nr introduced into the environment is lowered (e.g. lower fertilizer application rates, controls on NOx generation)
- **Improved use efficiency**— in which the efficiency of production that is dependent on Nr is improved (e.g. increased grain yields for lower Nr applied)
- **Improved practices**— in which the flux of Nr that creates an impact is lowered through better management practices (e.g. on-field agricultural practices, regulation of urban runoff, controlled combustion conditions)
- **Product substitution**— in which a product is developed or promoted which has a lower dependency on Nr (e.g. switchgrass instead of corn grain as a feedstock for ethanol)

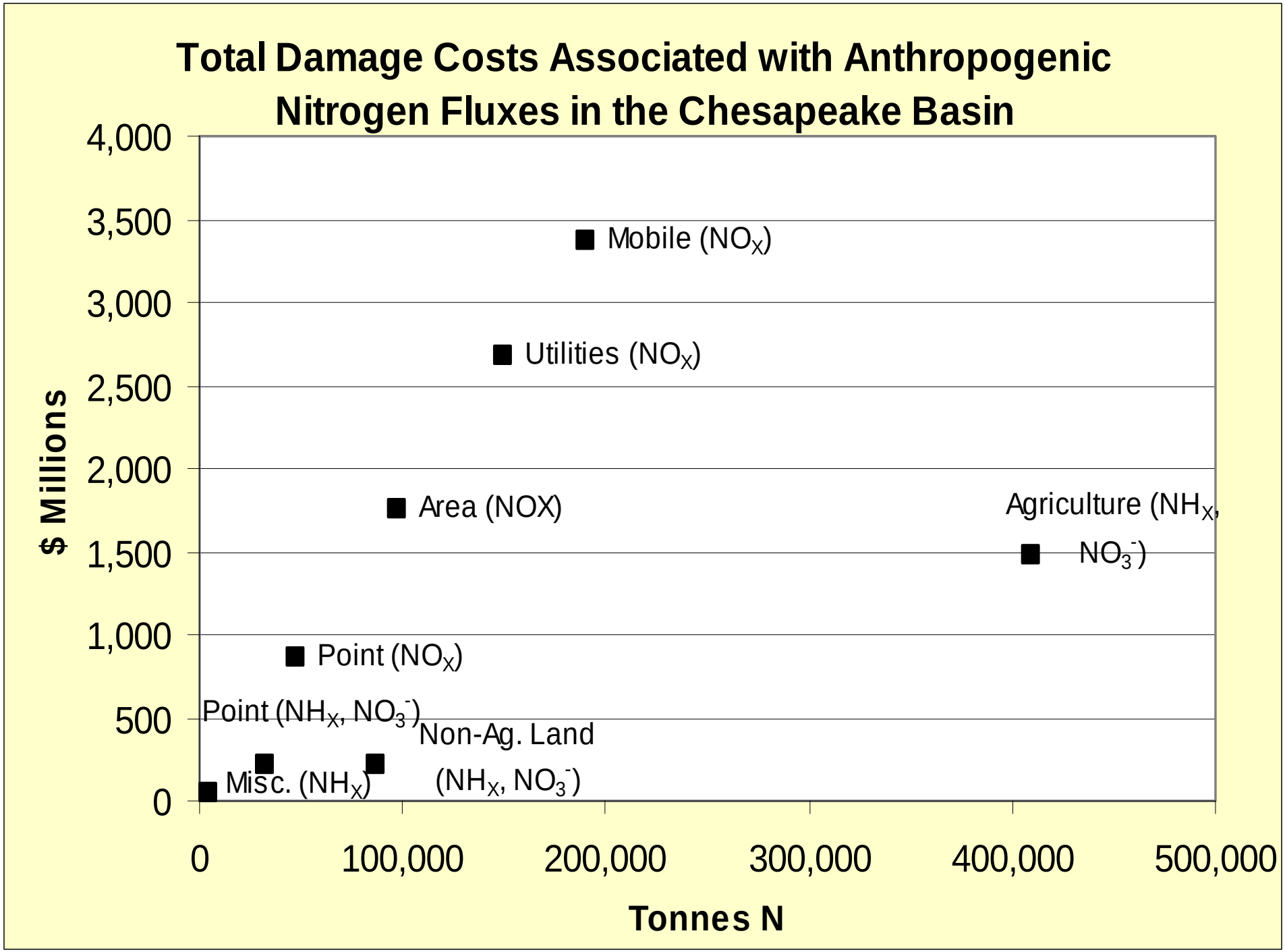
Management of Nr in the Environment

- Command-and-Control—in which permitted limitations on emissions, as promulgated under various statutes, are issued. Violations may result in the assessment of penalties and/or fines.
- Government-based programs for effecting a policy, such as directed taxes, price supports for a given commodity, subsidies to bring about a particular end, and grants for capital expansion, improvement, and research.
- Market-based instruments for pollution control in which cap and trade markets are used to bring about a desired policy end, often at reduced overall cost.
- Voluntary programs in which desired ends are achieved using private or government-initiated agreements or through outreach and education.

Cascading costs of Nr

- Economic costs reflect one way in which society values diverse ecosystem goods and services and human health within a common metric
- Damage costs track the cascading tons of Nr as chemical forms change and move through multiple ecosystems with related impacts
- Not all damage costs can be monetized, e.g. biodiversity loss by eutrophication

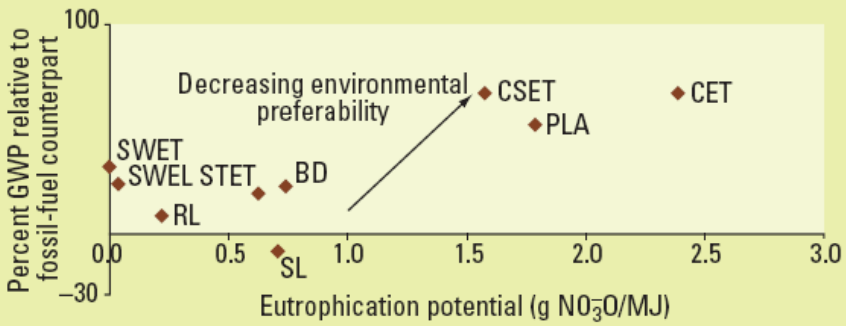

Share of Nitrogen Sources in the Chesapeake Bay Watershed
According to Different Metrics
100%
80%
60%
40%
20%
0%
Tonnes N
Million $ Damage
Mortality
Mitigation $/Tonne
Freshwater Emissions
Terrestrial Emissions
Atmospheric Emissions


Total Damage Costs Associated with Anthropogenic Nitrogen Fluxes in the Chesapeake Basin
$ Millions
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Mobile (NO_X)
Utilities (NO_X)
Area (NOX)
Agriculture (NH_X, NO_3^-)
Point (NO_X)
Point (NH_X, NO_3^-)
Non-Ag. Land (NH_X, NO_3^-)
Misc. (NH_X)
0
100,000
200,000
300,000
400,000
500,000
Tonnes N

Interactions of Nr and Carbon

Eutrophication potential vs relative global-warming potential (GWP) for various biobased products

Bioproducts increase in environmental preferability as relative GWP and eutrophication potential decrease. Bioproduct abbreviations (analogous fossil-fuel products are given in parentheses): BD, biodiesel (diesel); CET, corn ethanol (gasoline); CSET, corn and stover ethanol (gasoline); PLA, polylactic acid [from corn] (polystyrene [general]); RL, rapeseed lubricant (petroleum lubricant); SL, soybean lubricant (petroleum lubricant); STET, stover ethanol (gasoline); SWEL, switchgrass electricity (coal electricity); and SWET, switchgrass ethanol (gasoline).



As shown in Figure 1, reactive nitrogen com-

have on yields. Switchgrass has much greater yields than most row crops; this results in low nitrate emissions per mass of crop (0.01 kg NO_3^-/t switchgrass).

Trade-offs of carbon and nitrogen impacts

Climate change is an important and critical issue, but the environmental impacts resulting from emissions of reactive nitrogen are also significant. Biobased products are clearly an improvement over petroleum products with respect to climate change; however, agricultural systems are largely responsible for the increase in global fluxes of reactive nitrogen and declines in regional water quality. For future policy initiatives, it is important to determine the extent to which regional water quality is compromised to realize benefits from carbon emissions reduction. For bioproducts, fundamental trade-offs exist between global climate change and nitrogen-related impacts.

Figure 2 shows the trade-offs of improved climate-change potential and water-quality degradation resulting from bioproduct adoption. Representative life-cycle studies were collected to show the impacts of bioproduct adoption. The data used to construct the figure are contained within the supporting in-

Breakout Groups I

October 20 Pollutant/Media Specific

#1: NOx emissions from combustion/ Dickerson & Lighty

#2: Managing ammonia emissions/ Aneja & Mosier

#3: Urban and aquatic Nr discharge/ Hey & Stacey

#4: Agricultural aquatic discharge/ Cassman & Paerl

Breakout Groups II

<u>October 21 Crosscutting</u>

#5: Impacts of land use on accumulation and effects of Nr in the environment/ Boyer & Cowling

#6: Integrated Nr policies/ Mosier & Stacey

#7: Agroecosystems, food security, and bioproducts/ Cassman & Kohn

#8: Energy and the cascading costs of Nr/ Doering & Moomaw

How Our Groups Will Work

Group-specific charges as distributed in workshop materials

Led by members of INC

Notes/ rapporteurs

Report out to the workshop of the whole after each set of BG sessions

INC meets Tuesday afternoon to incorporate changes into draft report (due November 14)