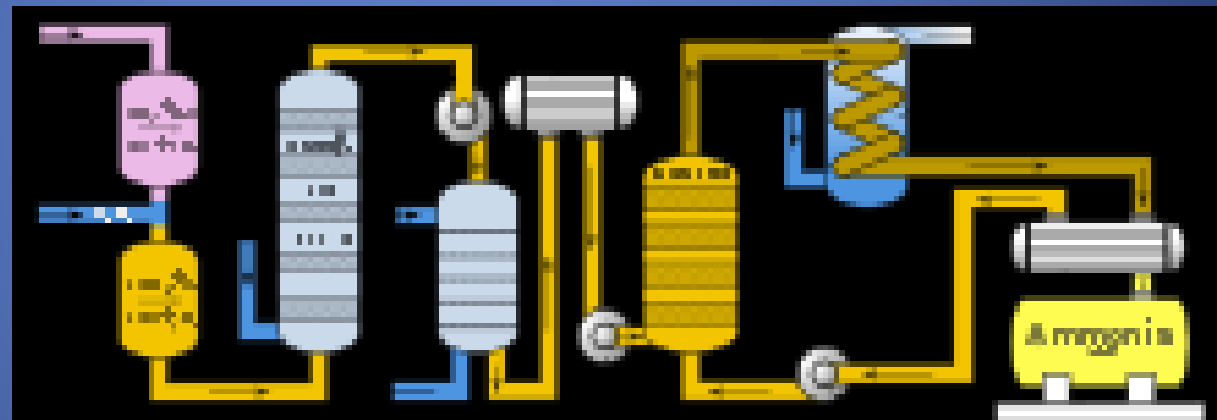


Greening the Nutrient Economy and Reducing Ocean Hypoxia through a Global Cap and Trade Framework on Manufactured Nitrogen Fertilizer

Andrew Hudson
UNDP Water & Ocean
Governance Programme

Haber-Bosch Process 1909

$\text{N}_2 + \text{Natural Gas} \rightarrow \text{N fertilizer}$

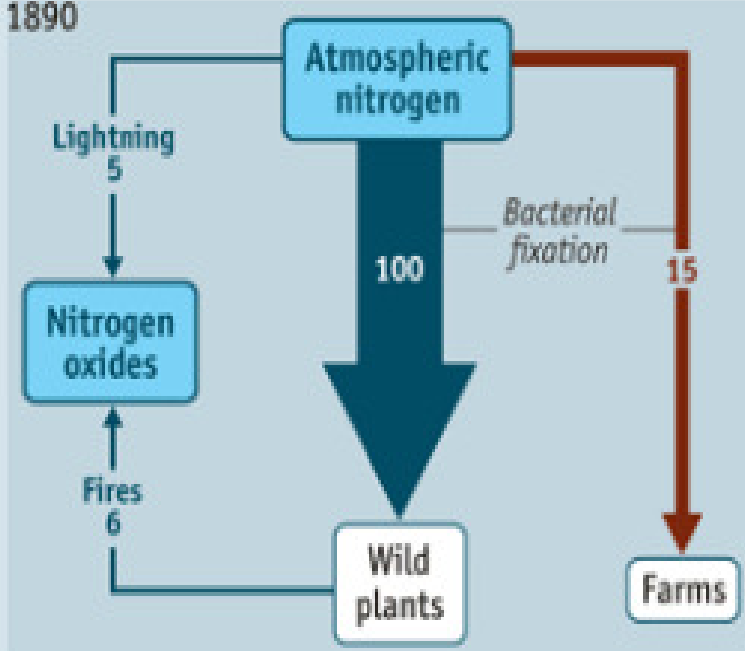


Nitrogen cycle seriously perturbed

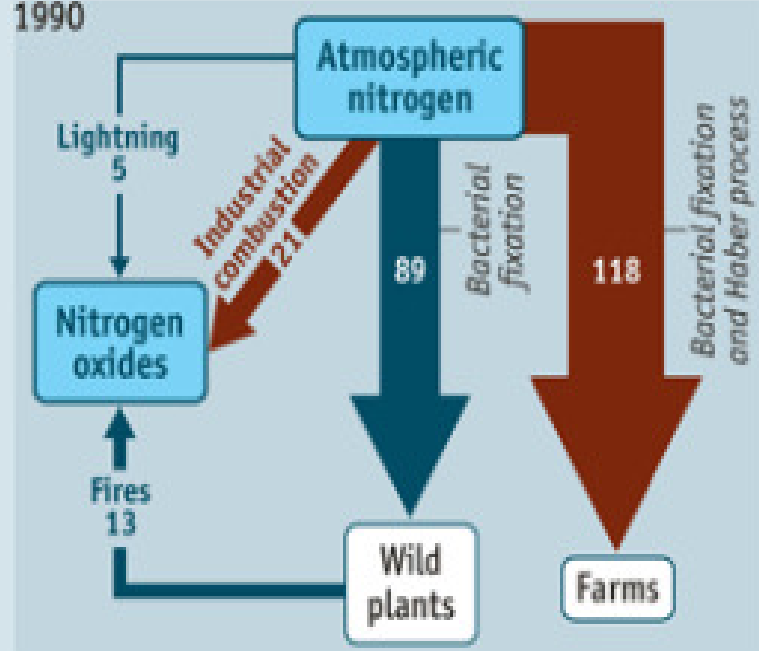
Unbalancing the cycle

Nitrogen flows, megatonnes

1890



1990



Source: Galloway and Cowling, *Ambio*

Population growth tracks Nitrogen production & Green Revolution

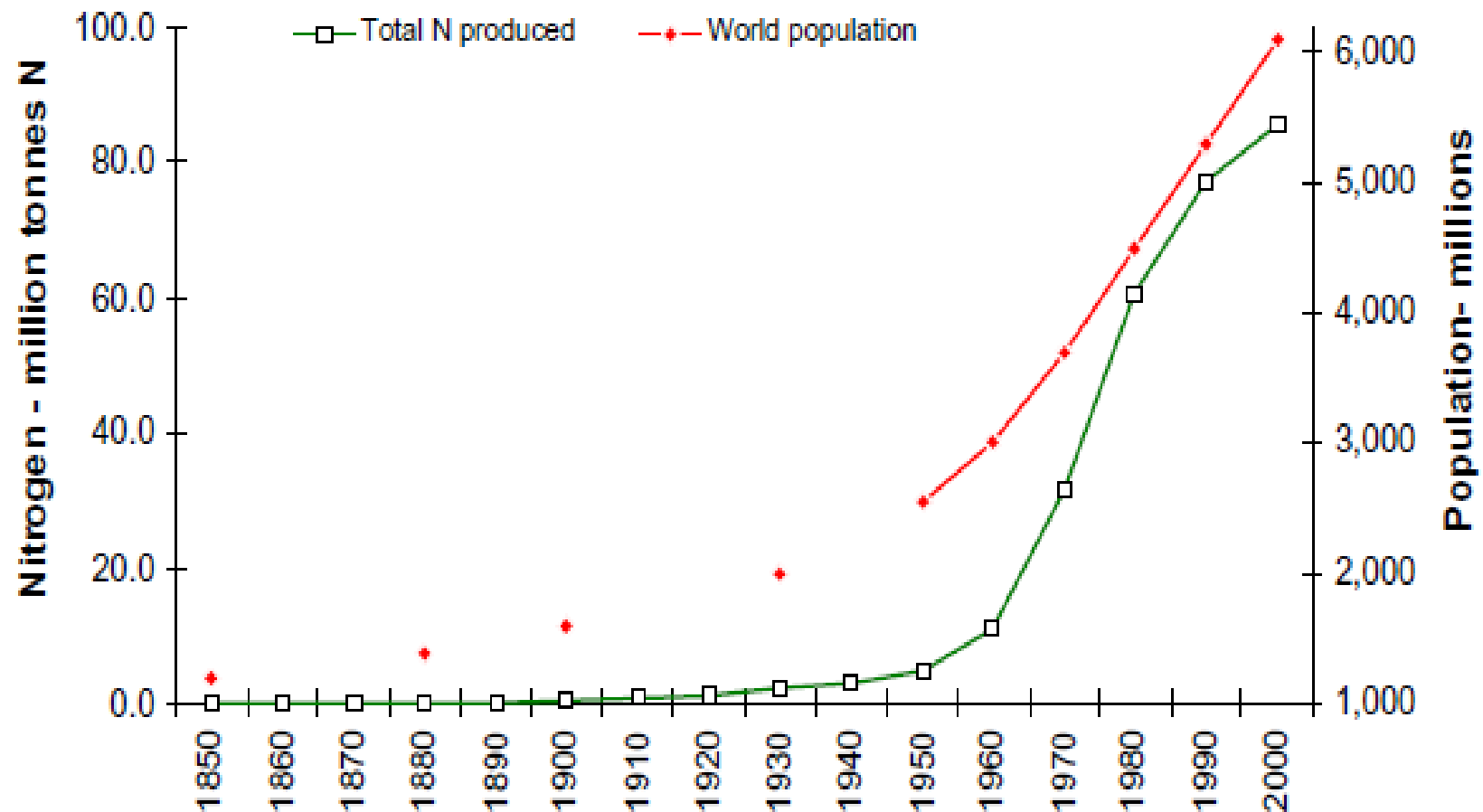


Fig 2. Production of fertiliser nitrogen in relation to world population.

EU Nitrogen Emissions Trends

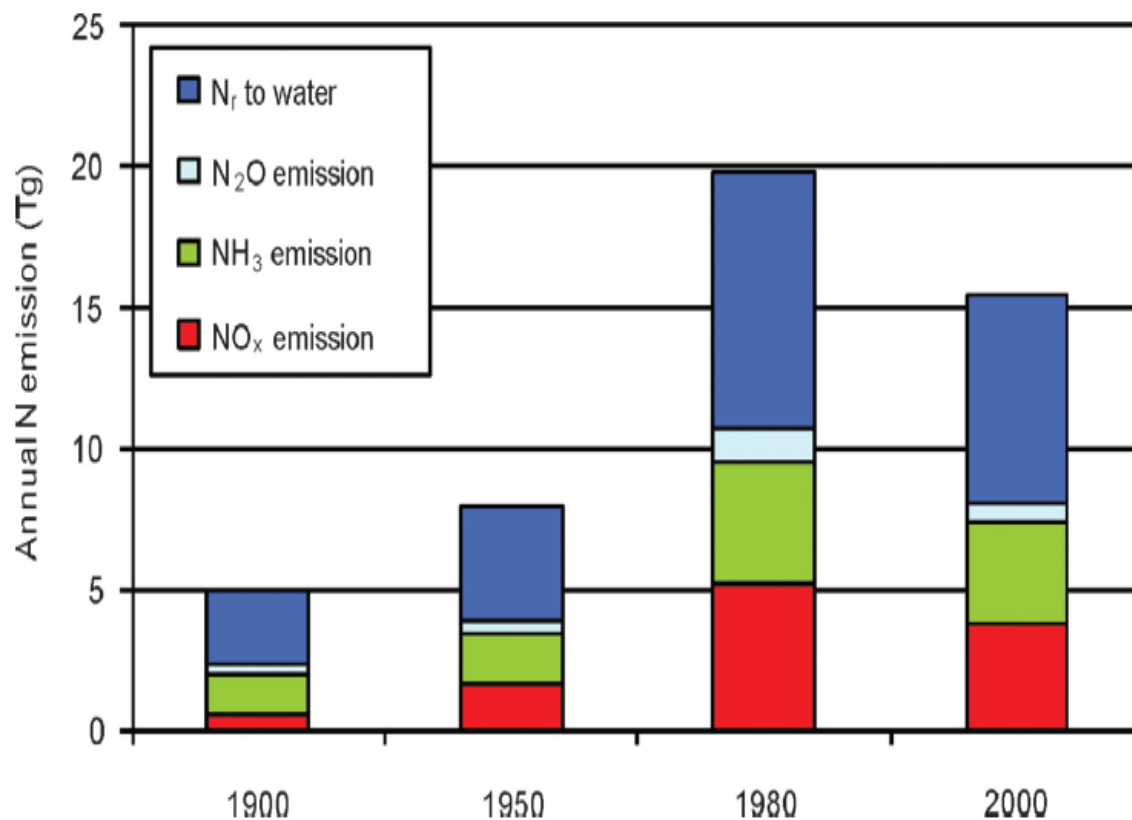
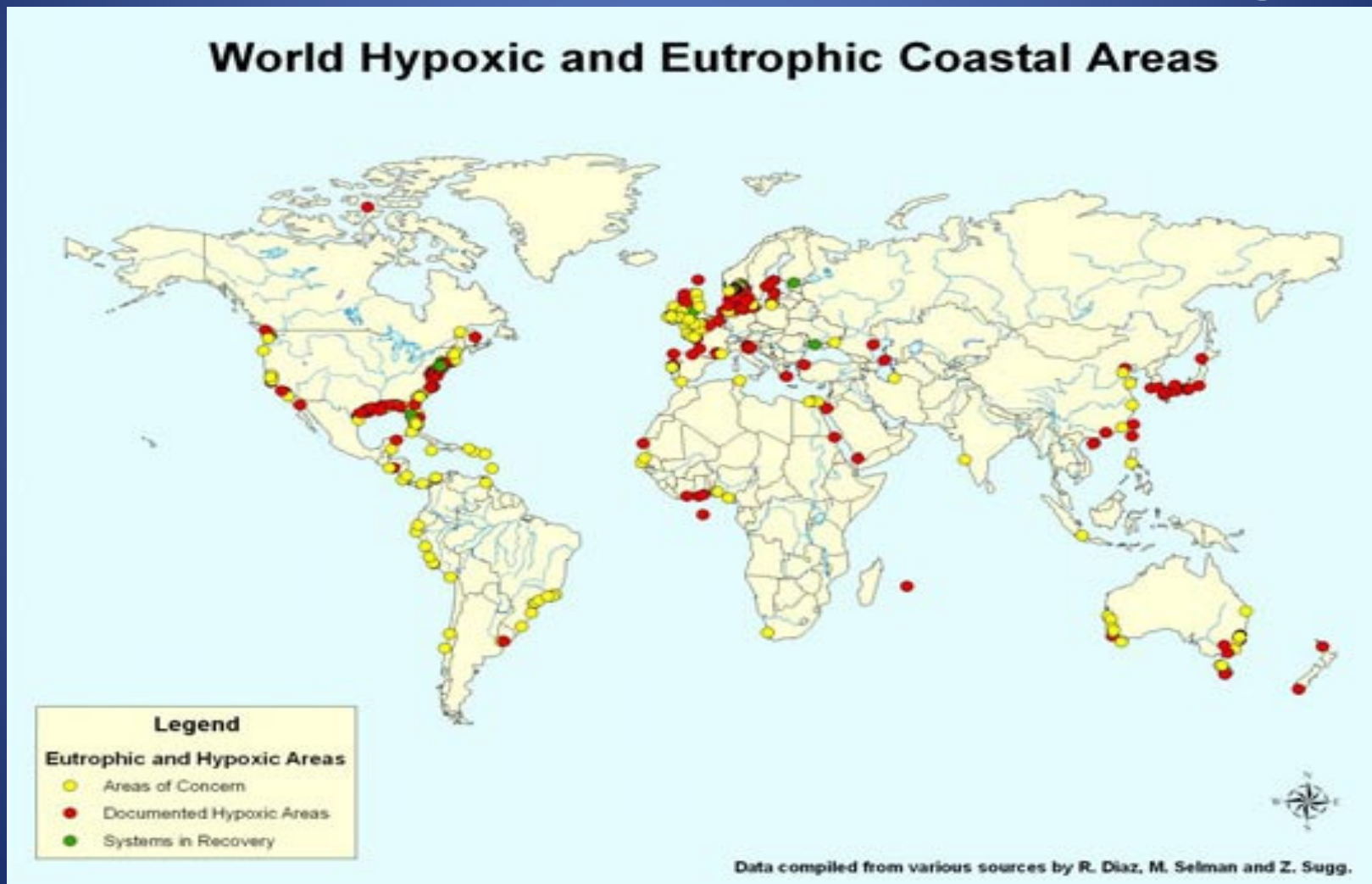


Figure SPM.4 Estimated trends in European reactive nitrogen emissions between 1900 and 2000 (EU-27) [5.1].

Hypoxia increasing geometrically,
\$ 100's billions in economic damage



The future in 'business as usual' scenario

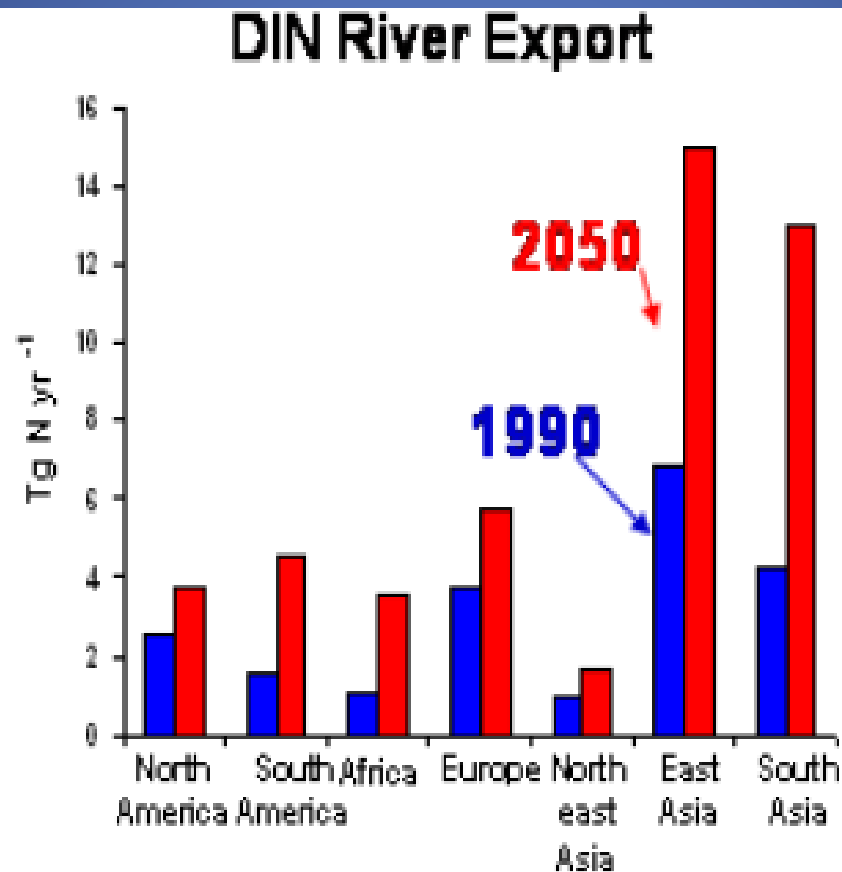
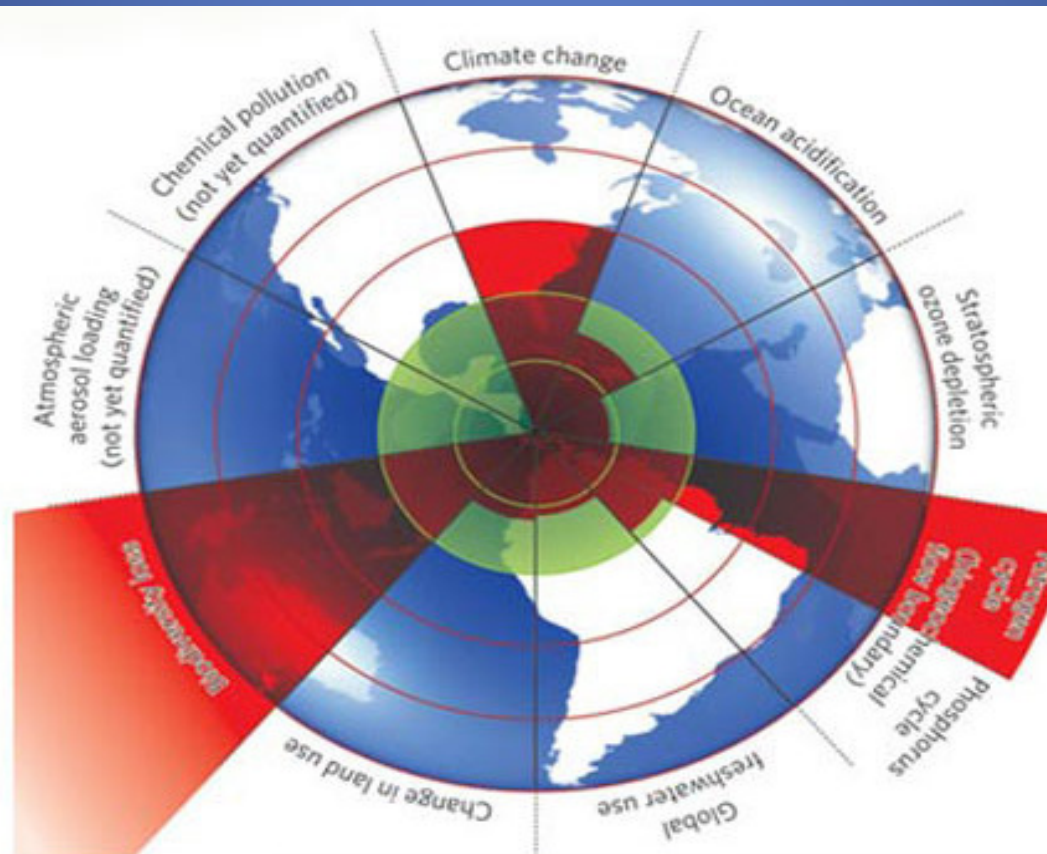


Figure 11. Predicted DIN export to coastal systems in 1990 and 2050 under a business-as-usual (BAU) scenario. Modified from Kroeze and Seitzinger (1998).

Nature 461, 472-475 (24 Sept 2009)

A safe operating space for humanity

Nitrogen among 3 (of 9) boundaries already exceeded
Recommends limiting industrial N fixation to 35 Mt/yr
(60-70% reduction)



The idea is catching on.....



Worldcrunch

A Human-Waste Gold Mine: Bill Gates Looks to Reinvent the Toilet

By [Inga Michler / Die Welt / Worldcrunch](#)

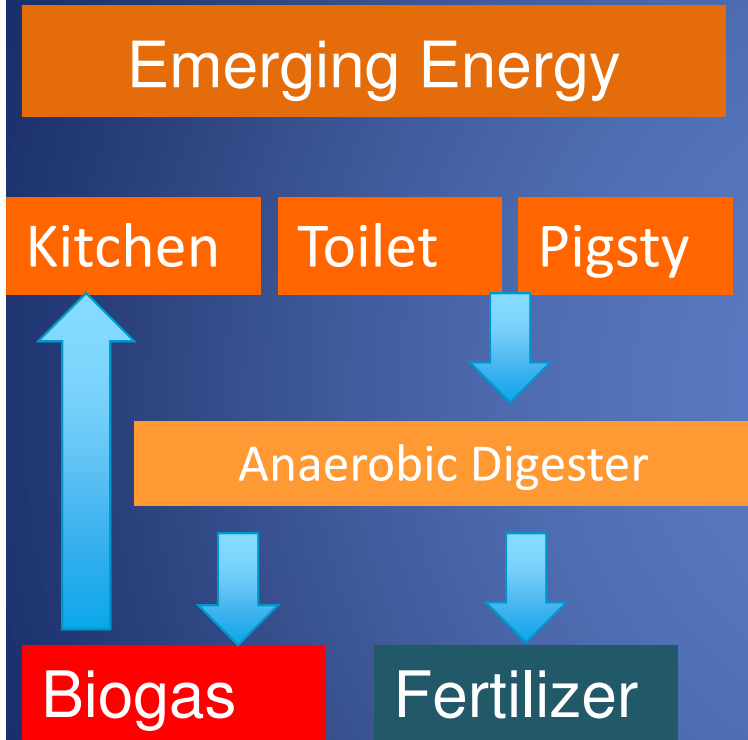
Wednesday, July 13, 2011



Gates Foundation Launches Effort to Reinvent the Toilet

New strategy promotes adoption of safe, affordable sanitation in the developing world
July 19, 2011

China already scaling up....



Year Planned

No. of Households

2005

18 million

2010

39 million

2015

61 million

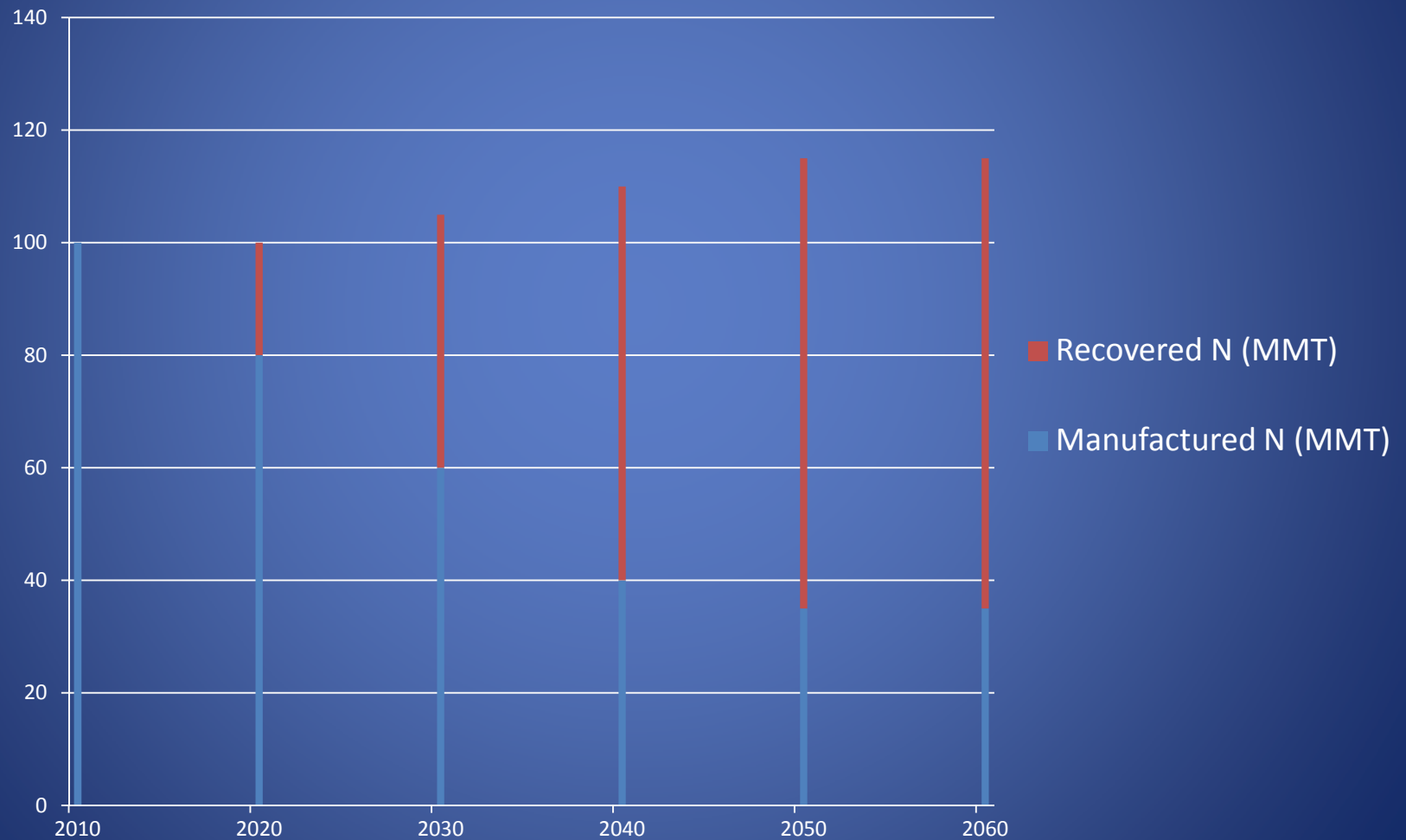
2020

84 million

What's missing?

- A market signal to internalize the nitrogen externality and catalyze broader transition to a 'green nutrient economy'
- **Cap and trade** on manufactured nitrogen production through agreed global framework
- Agreed time frame and amount of incremental reductions to allow sectors to plan and adapt with long-term 'level playing field'
- Catalyze innovative public-private partnerships between fertilizer & wastewater management industries
- Price signals promote BOTH enhanced recovery AND enhanced agricultural use efficiency
- Fertilizer companies in (EU) countries with ETS can sell GHG emission credits for sizeable avoided emissions (H-B energy int.)
- Revenue from initial sales of credits could be used to establish a Global Nitrogen Facility to both manage the cap & trade and support nutrient recycling demonstration projects, technology R&D, and knowledge sharing.

Transition to Nitrogen Recovery



Thank you from the oceans!

