Evaluating Social Costs of Emissions to Reflect their Full Environmental Impact

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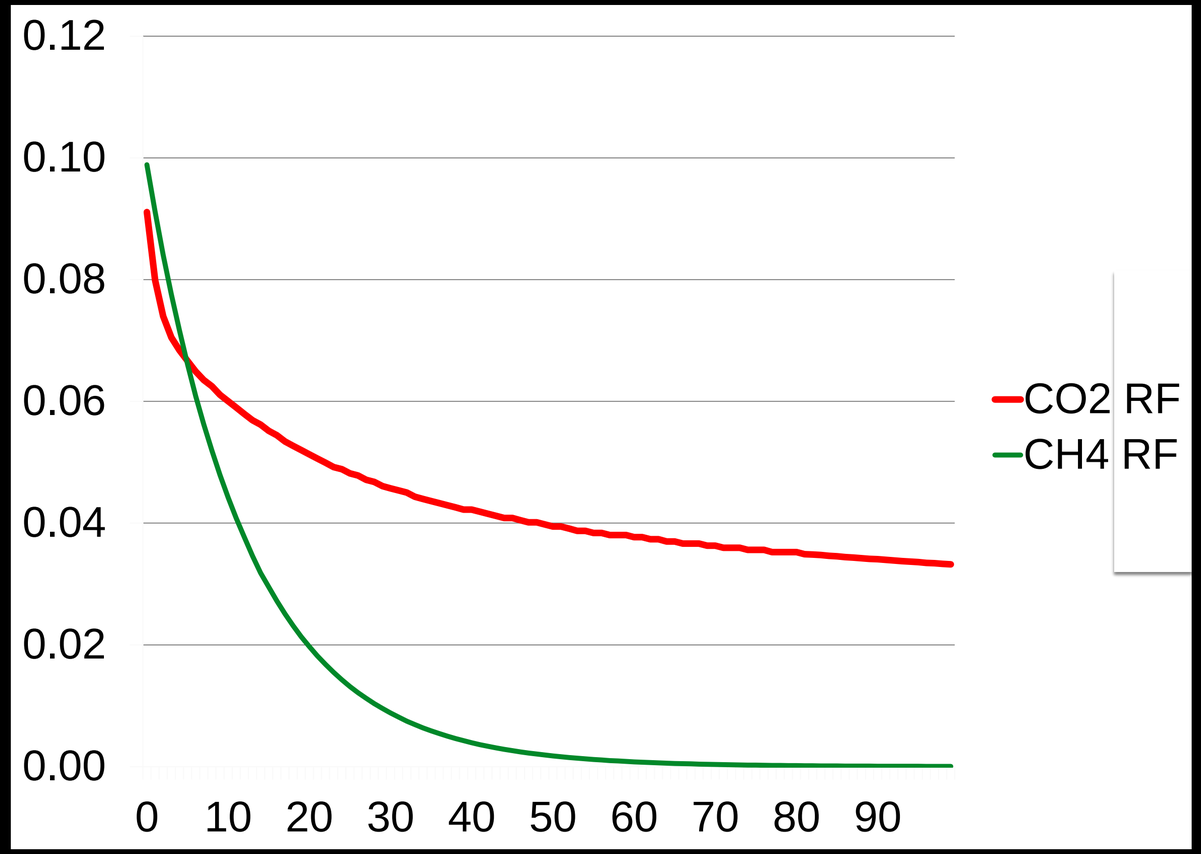
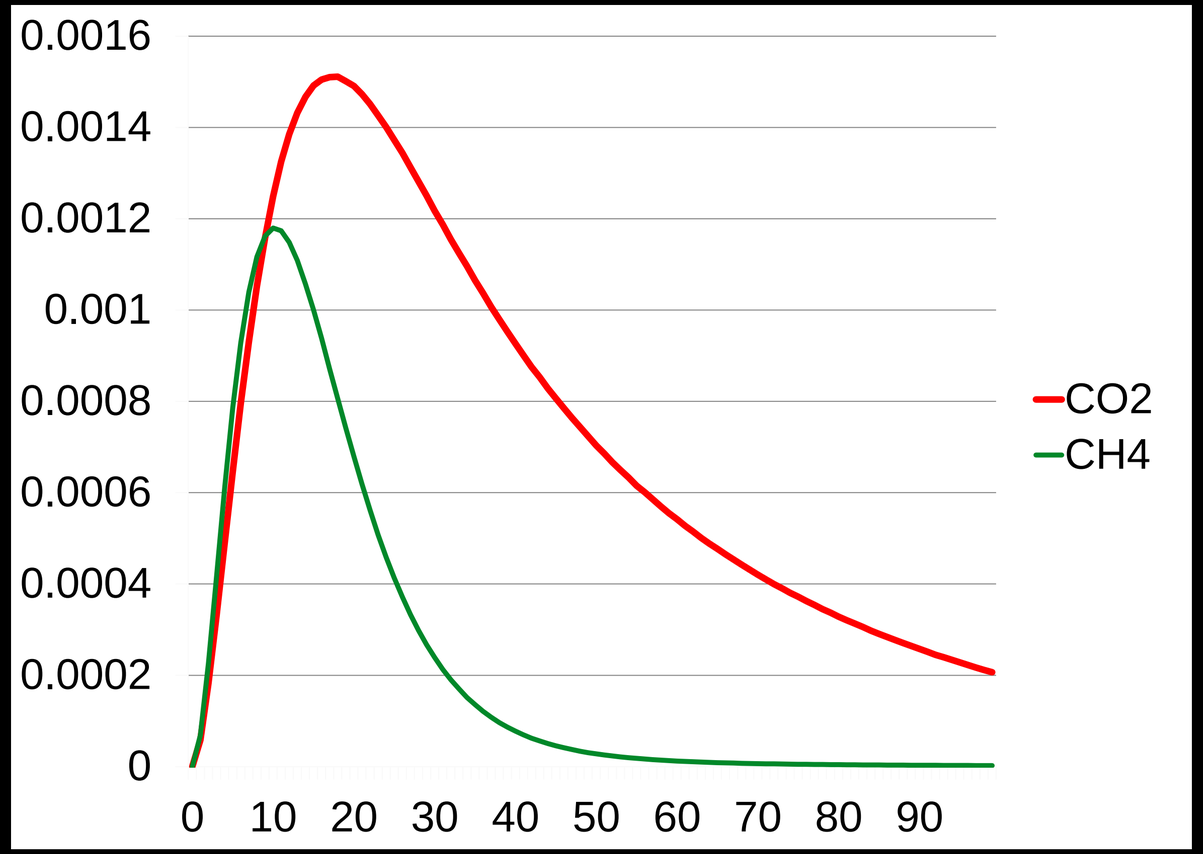
Thanks to J. Fuglestvedt & W. Collins

Consistency of time dependence



Radiative Forcing



Discounted Damages (dT^2)

What's being done?

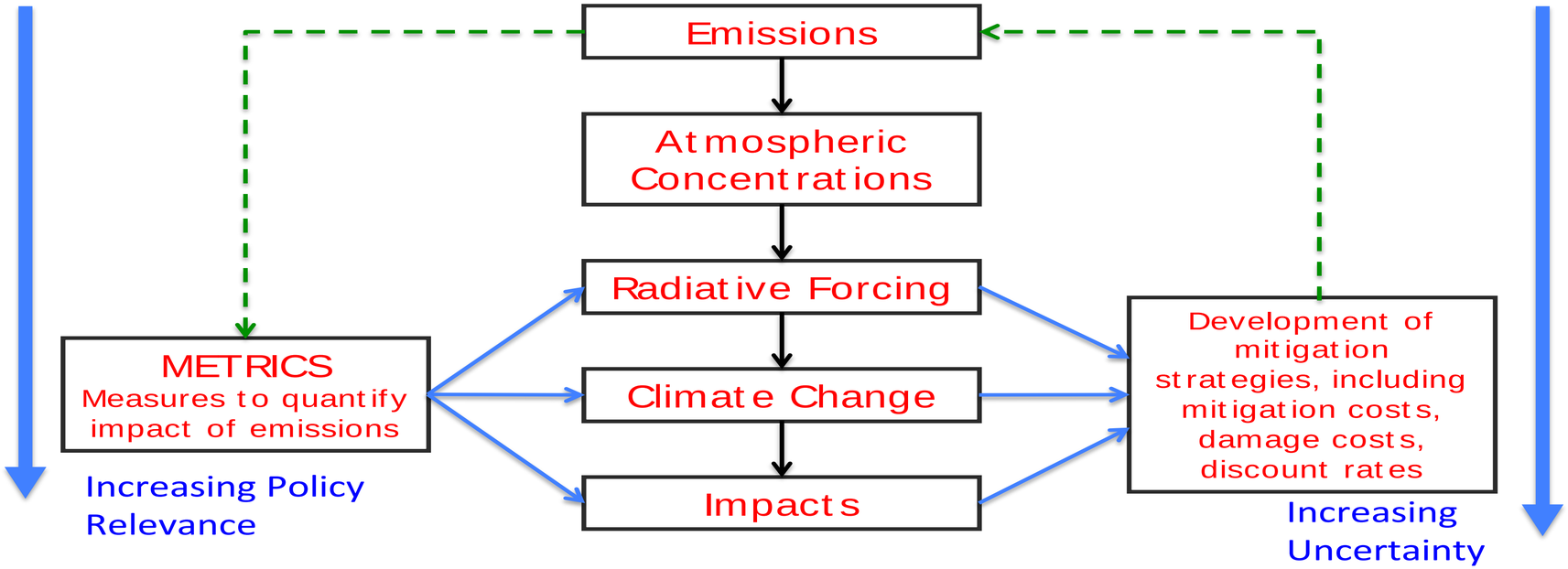
Long awareness (e.g. early 1990s papers; Manne & Richels, Kandlikar) and development of Global Damage Potential

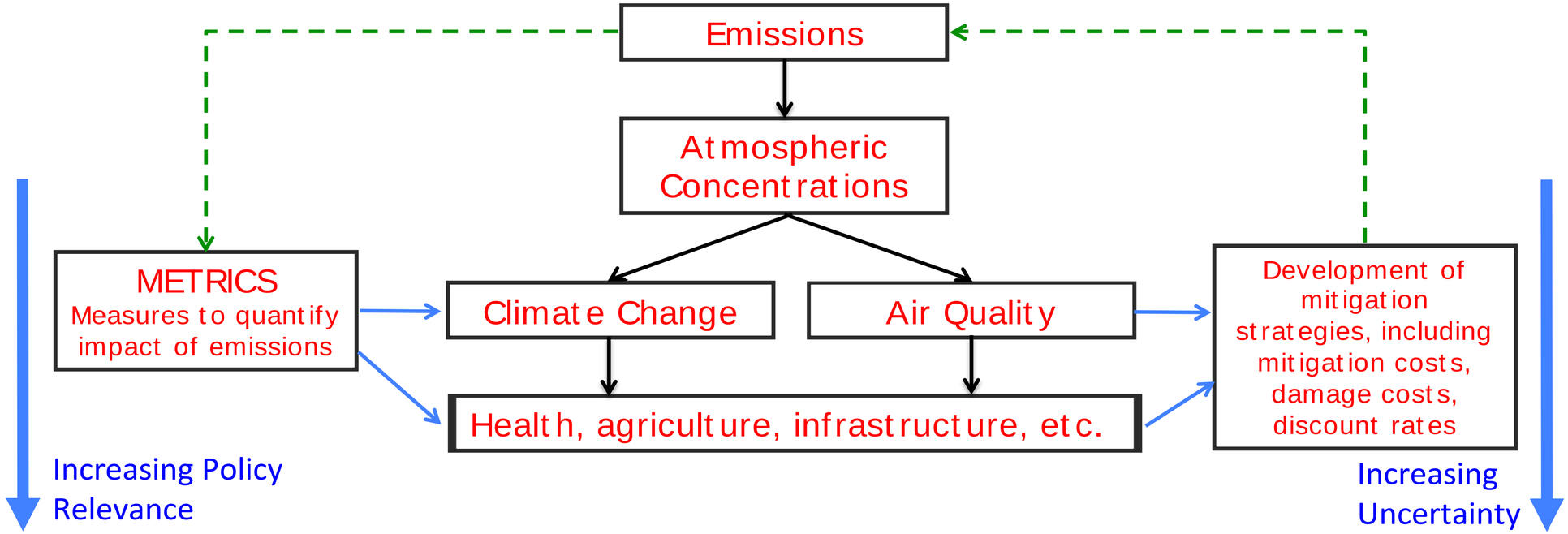
Policy analyses typically use CO2eq based on GWP100, e.g.

- Springmann et al., Dietary Choice, PNAS, 2013
- DEFRA, The Social Cost of Carbon and the Shadow Price of Carbon: What They Are, and How to Use Them in Economic Appraisal in the UK, 2007
- Shindell et al., SLCF Mitigation, Science, 2012

US EPA analysis for CH4 and N2O (Marten & Newbold) included time-varying temperature (but no air quality)

Consist-ency of impacts

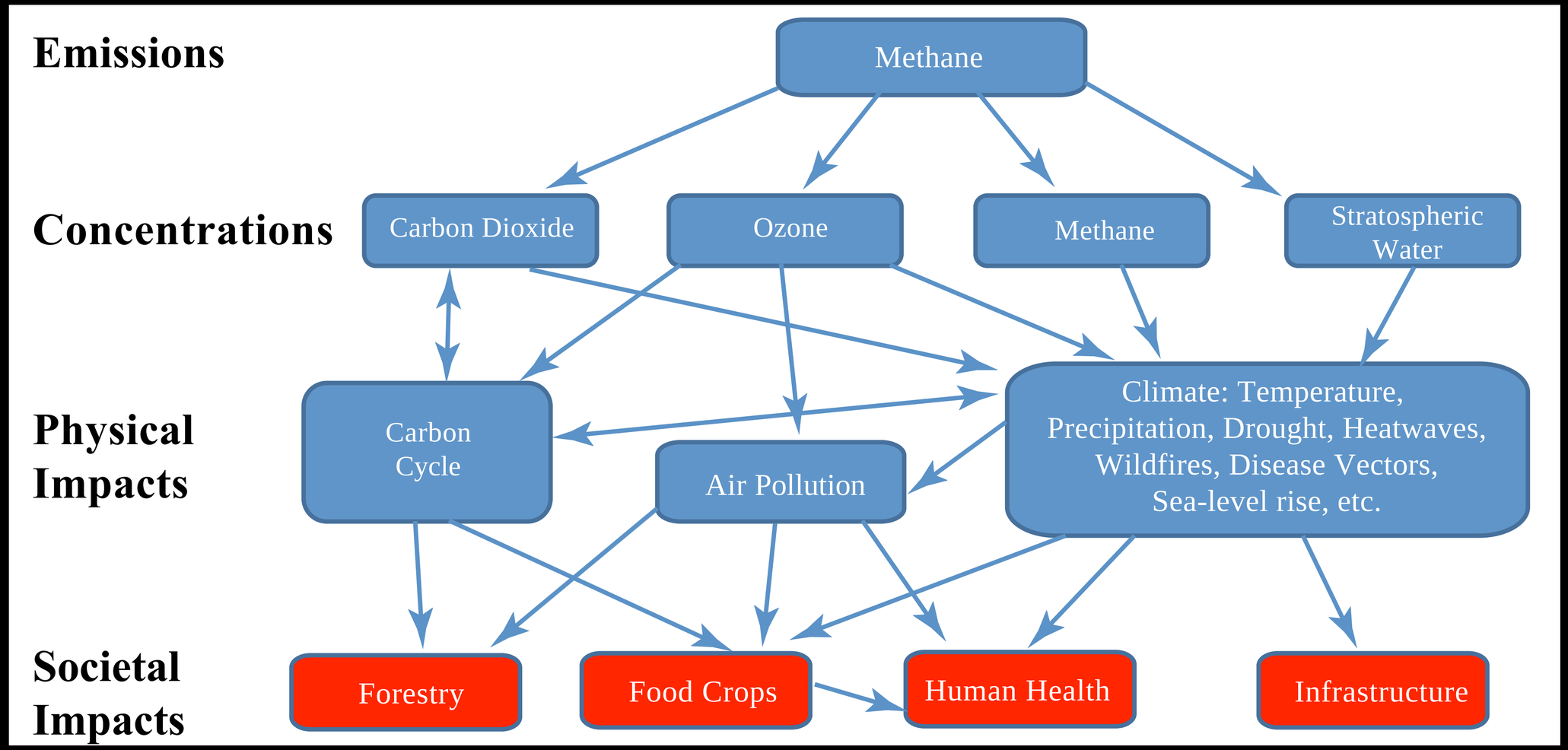




Shindell et al, Faraday Disc, 2017

Valuing Emissions:

Develop a broad Social Cost of Methane that includes impacts on human health, agriculture, etc., via climate & air quality



Shindell et al, Faraday Disc, 2017

Valuing Emissions

Social Cost of Methane including climate change & air quality impacts with consistent methodology

Updated to reflect:

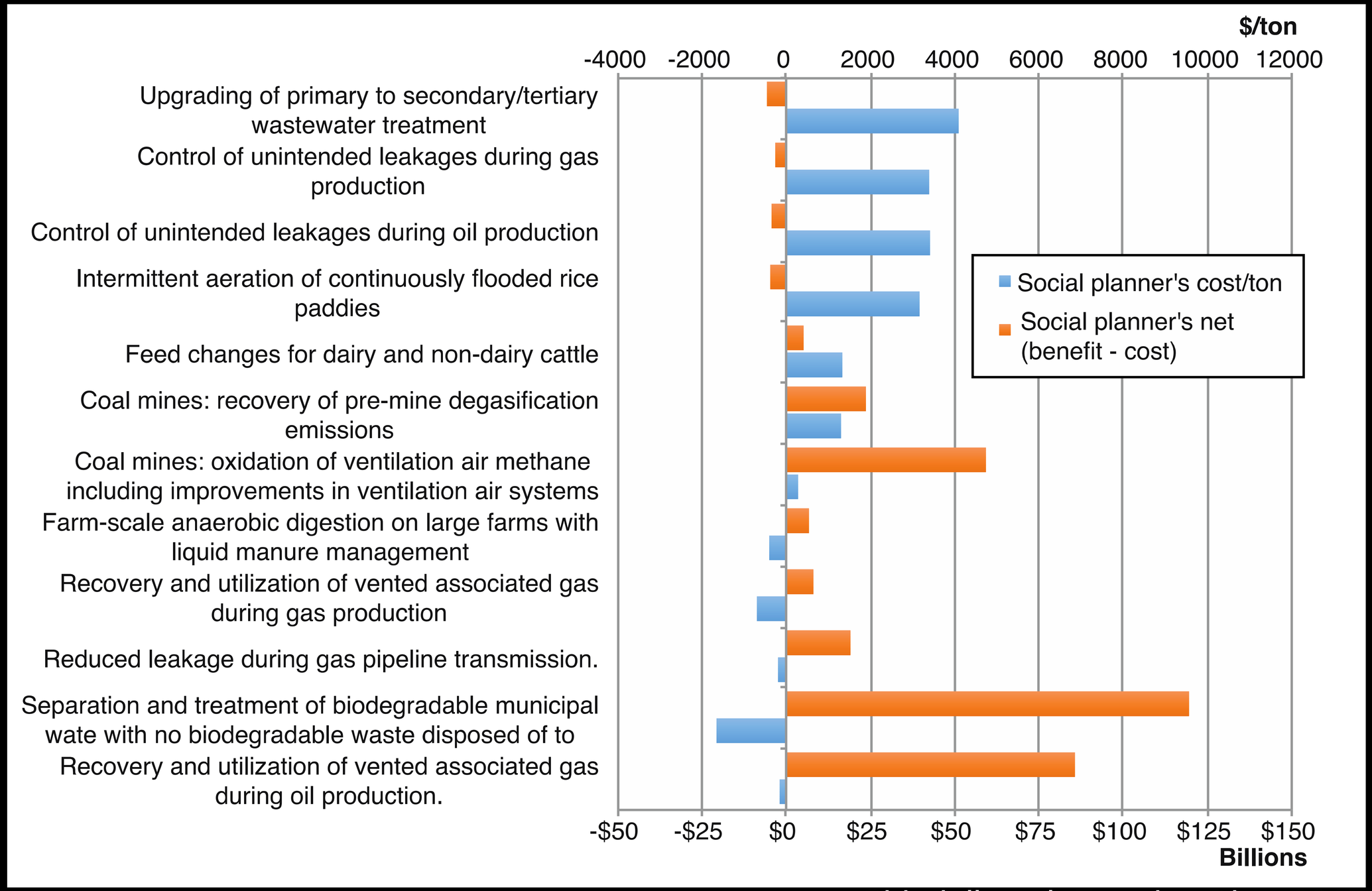
- New IRFs (Geoffroy et al, J Clim)
- New carbon-cycle feedback to dT (Gasser et al, ESD)
- Impact of ozone on carbon-uptake (Collins et al, JGR)
- Pollutant specific impacts on agriculture (Shindell, EF)
- Impact of climate change on air quality (Silva et al; ACCMIP)
- Valuation of energy offset due to methane capture

Valuing Emissions:

Methane (3% discounting, CO_2 total $67/ton)

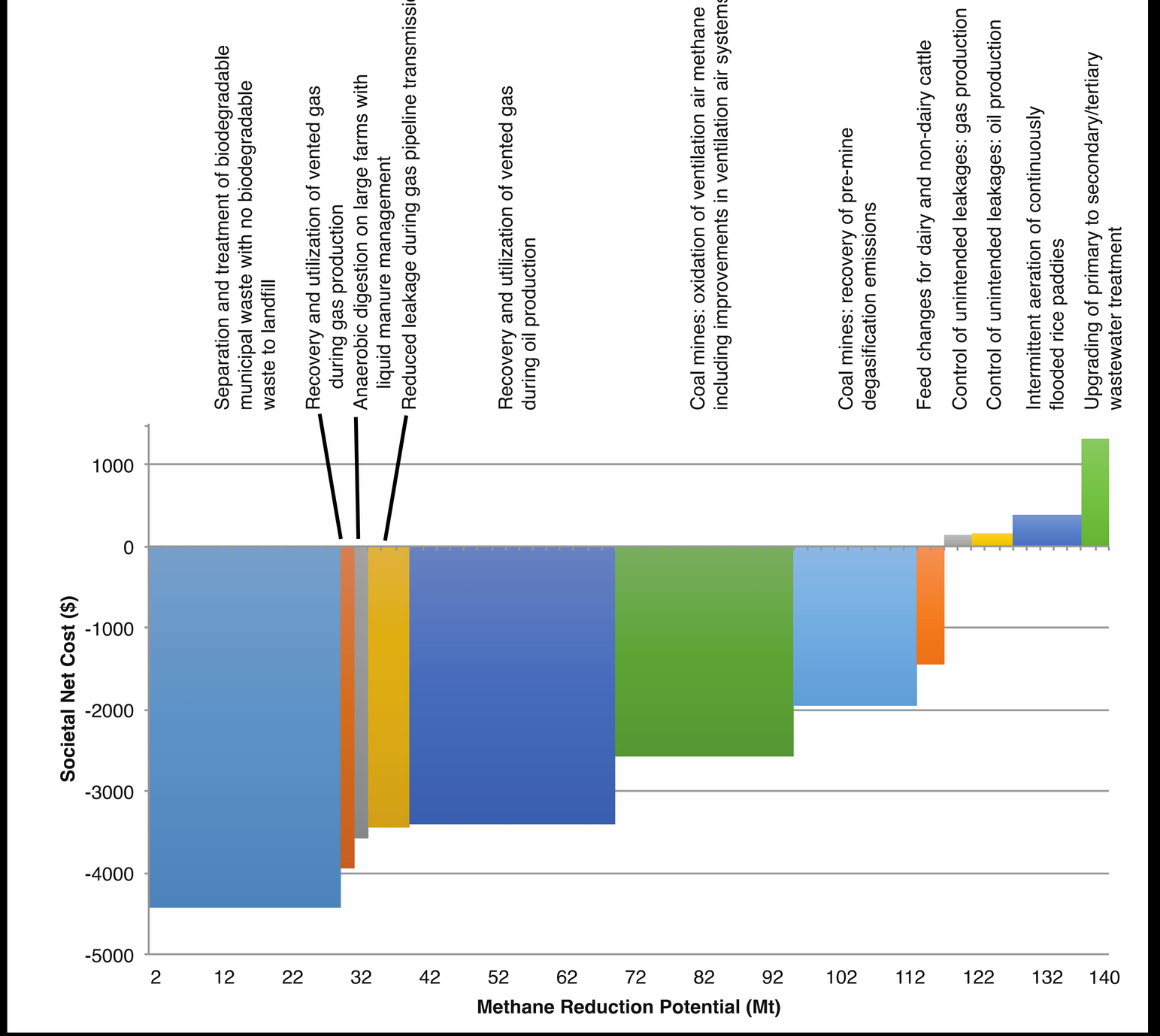
Basic Climate	$780
Climate/health (malnutrition $460)	$1500
Composition/health	$670
Agriculture	$370
Total	$3320 (1490-5510)
Ratio vs CO_2	50 (76 and180 with 4% and 10% discounting, respectively)

Control measures & costs from UNEP, 2011



Shindell et al, Faraday Disc, 2017

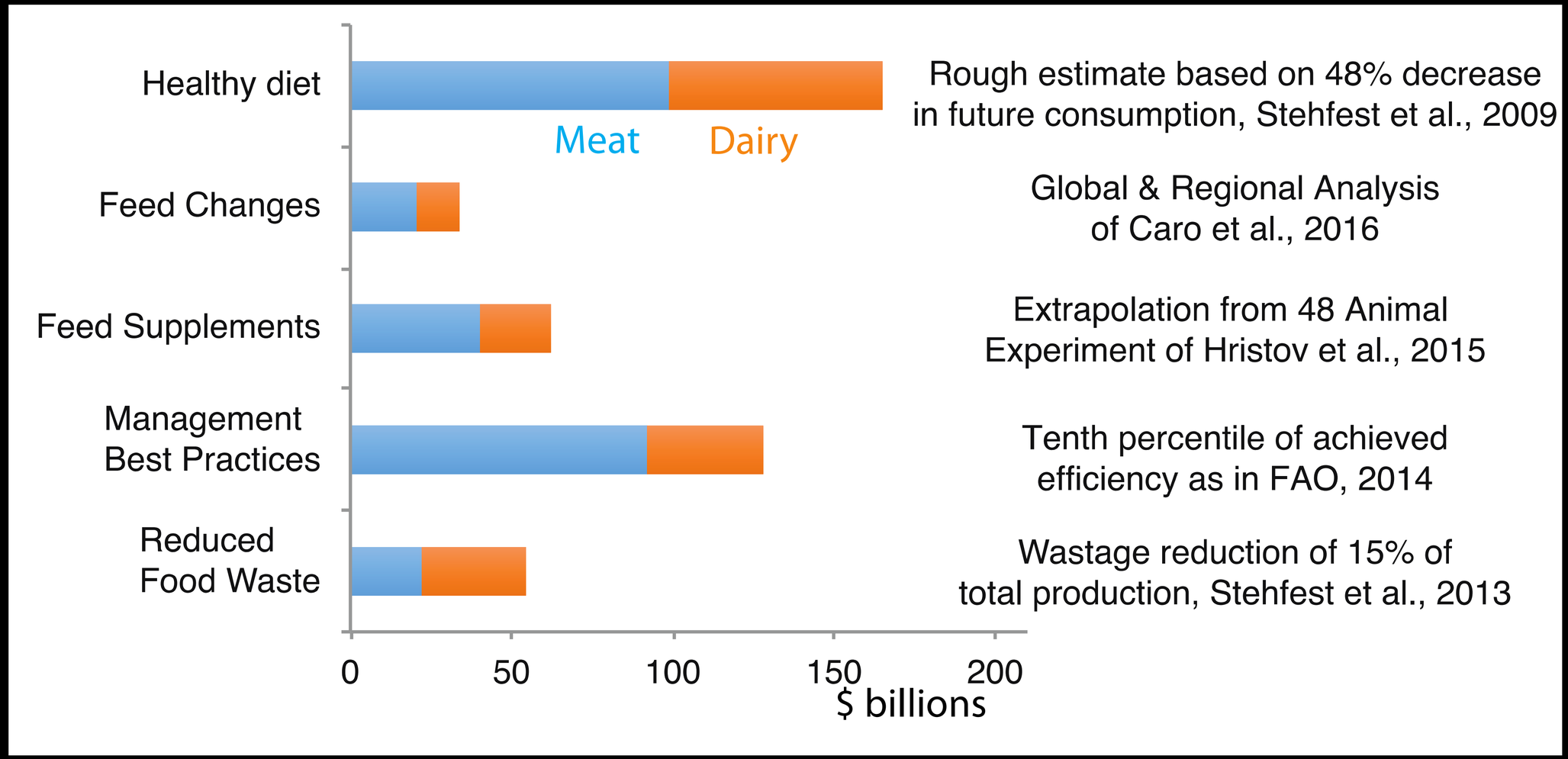
Cost curves for in-use methane abatement measures



Shindell et al, Faraday Disc, 2017

Livestock-related emissions

Benefit Valuation due to Emissions Reductions

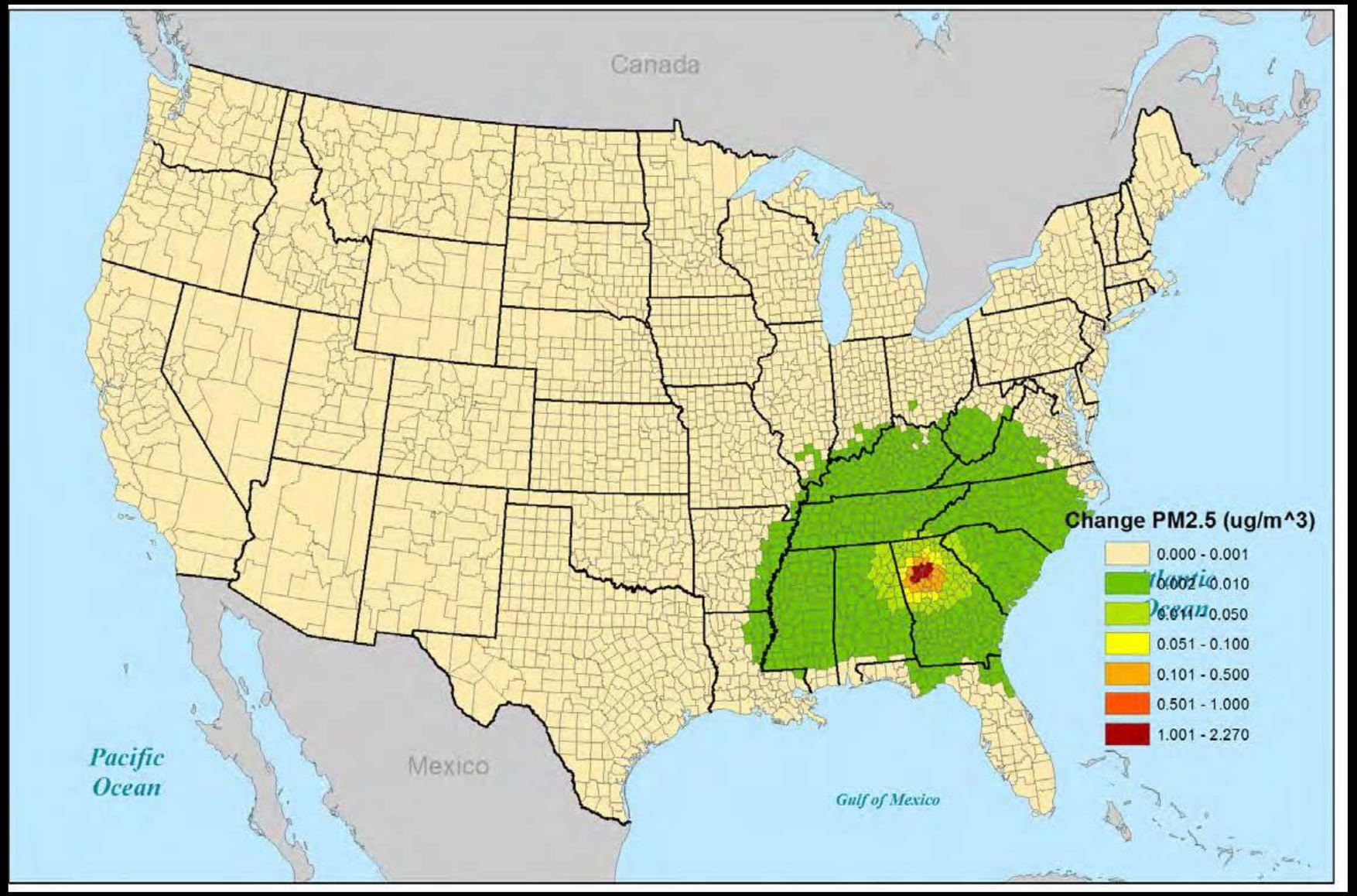


~$270 billion for healthy diet due to reduced health care cost + lost work days (Springmann et al., PNAS, 2016)

Shindell et al, Faraday Disc, 2017

Analysis for shorter-lived optimally would have spatial detail

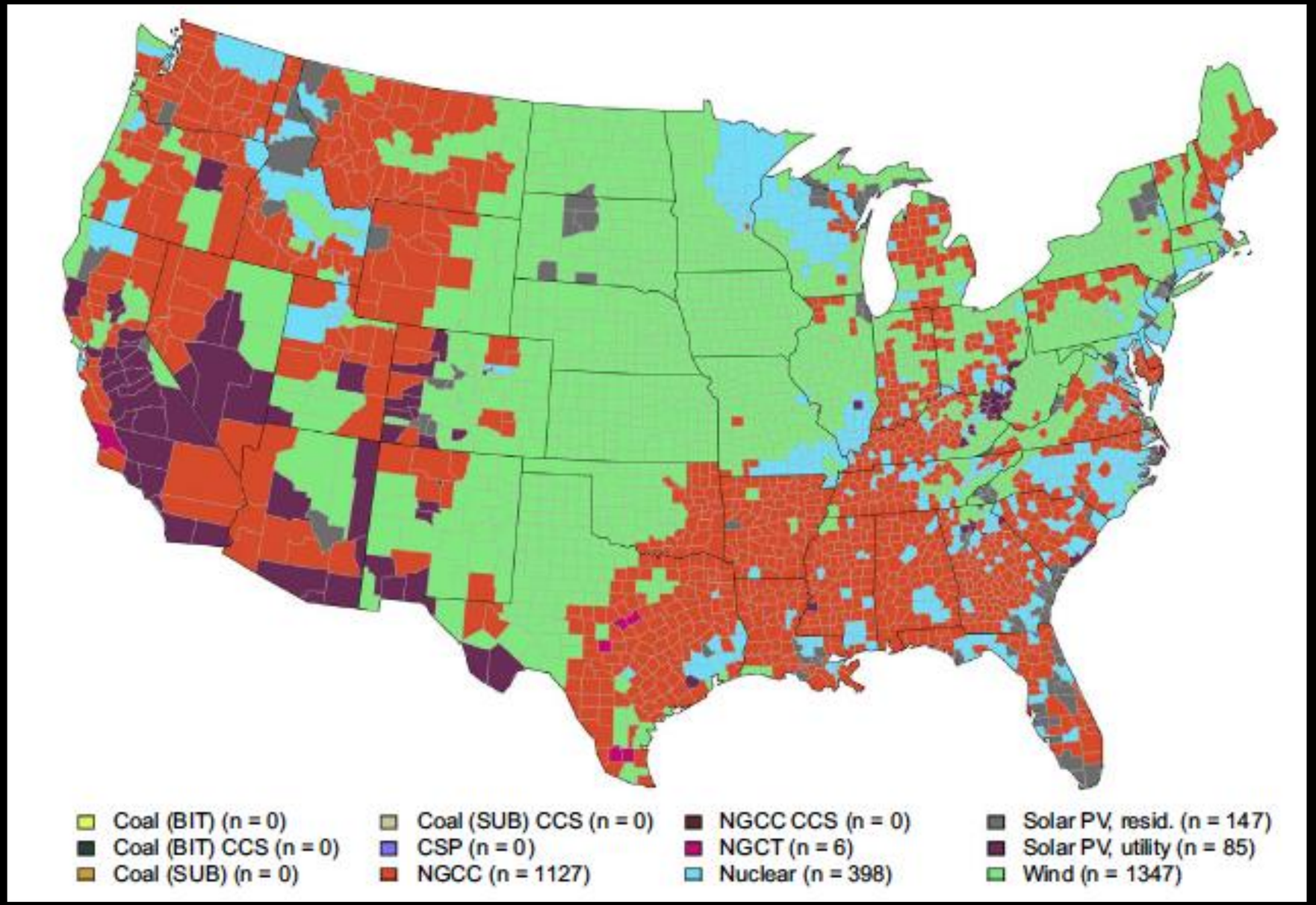
$PM_{2.5}$ as a result of emissions from a single county (Fulton)



Holland et al, NBER, 2015

Analysis for shorter-lived optimally would have spatial detail

Minimum cost electricity technologies by county including climate and air quality externalities



Rhodes et al, Energy Policy, 2017

Using broad impact analyses to maximize societal benefits

Methane is well enough understood to calculate values well & provide simple metrics

Given recent trends and need to deal with agriculture and natural gas important to get right

For other health-related emissions, need detailed analyses (SNAP tool)

Clear that maximizing societal welfare not the same as maximizing either climate or air quality benefits alone (e.g. public health depends on both)