Non-CO_2 data and methodologies

Casey Delhotal
RTI International

USEPA IMAC Report, 2006

- The Potential Cost of Global Non-CO2 Greenhouse Gas Reduction, USEPA, 2006
  - Peer reviewed, will be published by June, 2006
  - Data tables will be posted on the EPA website
- Data:
  - By sector
  - By major countries and regions
  - MAC curves
  - Technology data
  - Activity data and emission factors (for baselines)

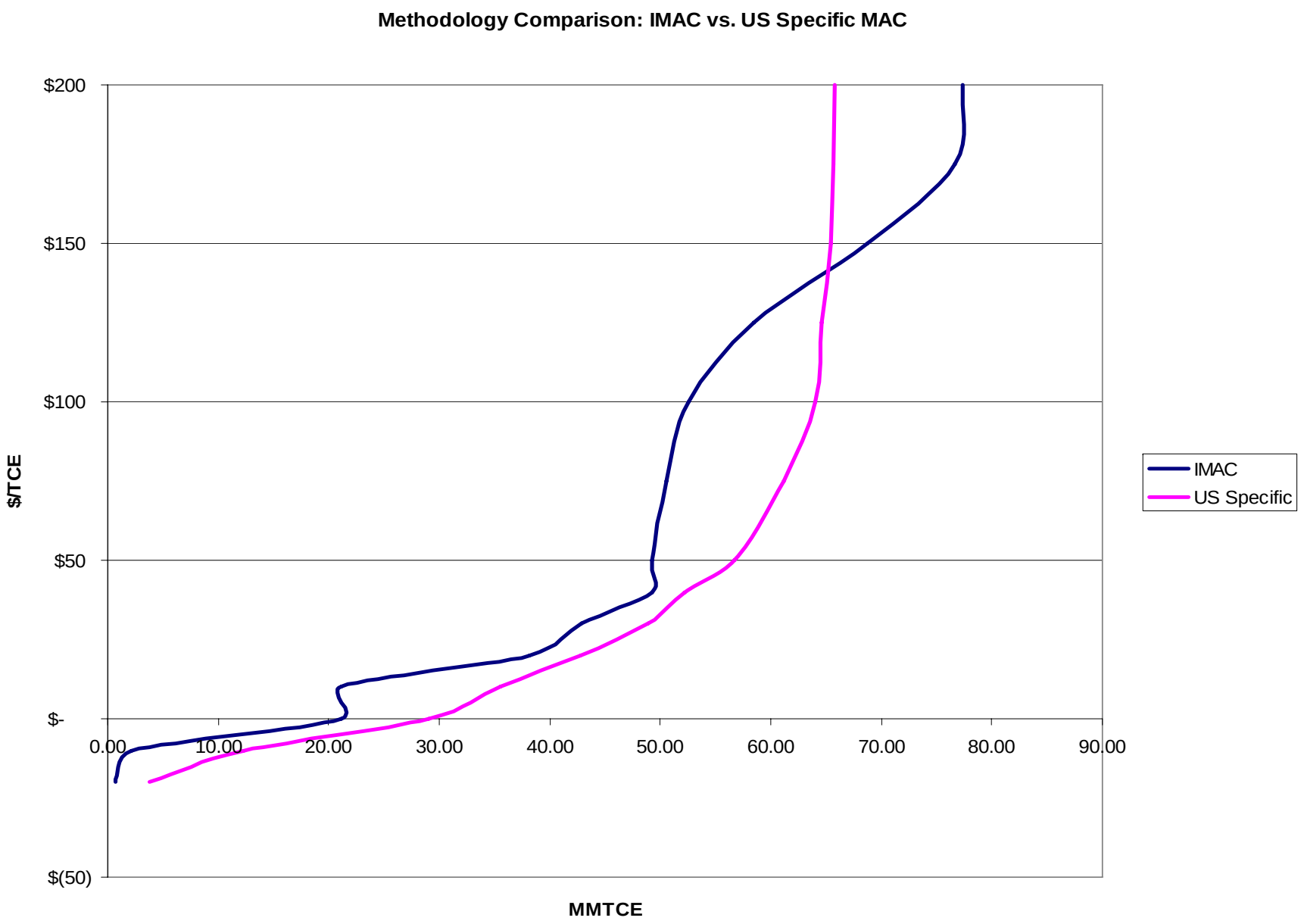
Countries and Sectors

- Regions:
  - Africa
  - Aus/NZ
  - Brazil
  - Canada
  - China
  - CIS
  - Eastern Europe
  - EU-15
  - India
  - Japan
  - Latin America/Carb.
  - Mexico
  - Middle East
  - Non-EU Europe
  - OPEC
  - Russia
  - South and Southeast Asia
  - South Korea
  - Turkey
  - Ukraine
  - United States

- Sectors
  - Coal Mining
  - Natural Gas Sector
  - Oil Sector
  - Landfill Sector
  - Waste Water sector (baselines only)
  - Solvents
  - Foams
  - Aerosols
  - Fire Extinguishing
  - Air-Conditioning
  - Nitric and Adipic Acid production
  - Aluminum
  - HCFC-22 production
  - Semiconductor manufacturing
  - Electric power systems
  - Magnesium production
  - Soil carbon
  - Rice
  - Livestock emissions
  - Manure emissions

Technical Potential Estimates

- Marginal Abatement Cost (MAC) curves
  - Gives the technical potential
  - Does not include transaction costs (information, brokerage fees, etc.)
  - Data is adjusted for labor, materials and energy costs for each region (no consistent domestic technology information available)
  - Step curves (uses average firm or representative firm)


Methodology Comparison: IMAC vs. US Specific MAC
$200
$150
$100
$50
$-
$(50)
$/TCE
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
MMTCE
IMAC
US Specific

Technology Data

- In addition to the MAC curves, data includes technology specific information
  - Relevant to bottom-up analysis
  - Includes capital costs, O&M, assumed energy price, reduction efficiency for each technology

Technology 9: Electricity Generation

Recovered methane is used for electric generation projects.

Energy Offset: electricity Non-Energy Offset: NA **Reduction Efficiency: 75%**

Regions:	Capital Costs ($/TCE in 2000USD)	O&M Costs ($/TCE in 2000USD)	Labor Cost Ratio (Region/US)	Energy Revenue ($/TCE in 2000USD)	Lifetime (years)	Electricity Price ($/kWh - Average 1994-99)	Abatement Potential (% of baseline)	Emission Reduction in 2020 (MMTCE)
China	602.31	0.90	0.03	20.17	20	0.63	11%	5.72
United States	602.31	35.81	1.00	31.92	20	1.00	11%	5.13

Methodologies for using MAC curves

- A recent EMF study asked modeling teams to include non-CO2 GHGs into their models.
- Using an earlier (now out-of-date) version of the USEPA, 2006 data, the following methods were used to incorporate MAC curves:
  - "Read" off the curve (also done for US analyses)
  - Linear extrapolation of curve in model (allows iteration – ex: MERGE, GEMINI-3)
  - Continuous cost functions – estimated by applying exponential function to abatement cost curves (ex: EDGE, FUND)
  - Reduced form making the MAC curve part of the emissions calculation (ex: MiniCAM)
  - Initial cost, maximum cost and maximum reduction rate – reductions implemented over time along a diffusion path (ex: GRAPE)
  - "MIT" approach
  - Bottom up models use technology data (ex: MESSAGE; AIM; also MARKAL)

Examples

- Reduced form
  - *Emissions=EM_factor*Driver*(1-(GDP/Cap))*(1-MAC(C_price)*(1-Eff(t))*
  - *From MiniCam, See Smith, Steven J. and T.M.L. Wigley, 2006. "Multi-Gas Forcing Stabilization with MiniCAM" Energy Journal.*
- MIT Approach
  - Emissions become INPUTS into the CGE production function with constant elasticity of substitution.
  - $(Y/Y_0)=\{a(X/X_0)^{-p} + (1-a)(Z/Z_0)^{-p}\}^{-1/p}$
  - X: non-CO2 GHG emissions; Z: intermediate input; Y: output; a: cost share of non-CO2 GHG reductions
  - See Hyman, R.C., et al, 2002. Modeling Non-CO2 Greenhouse Gas Abatement, MIT Joint Program on the Science and Policy of Global Change, Report No. 94.

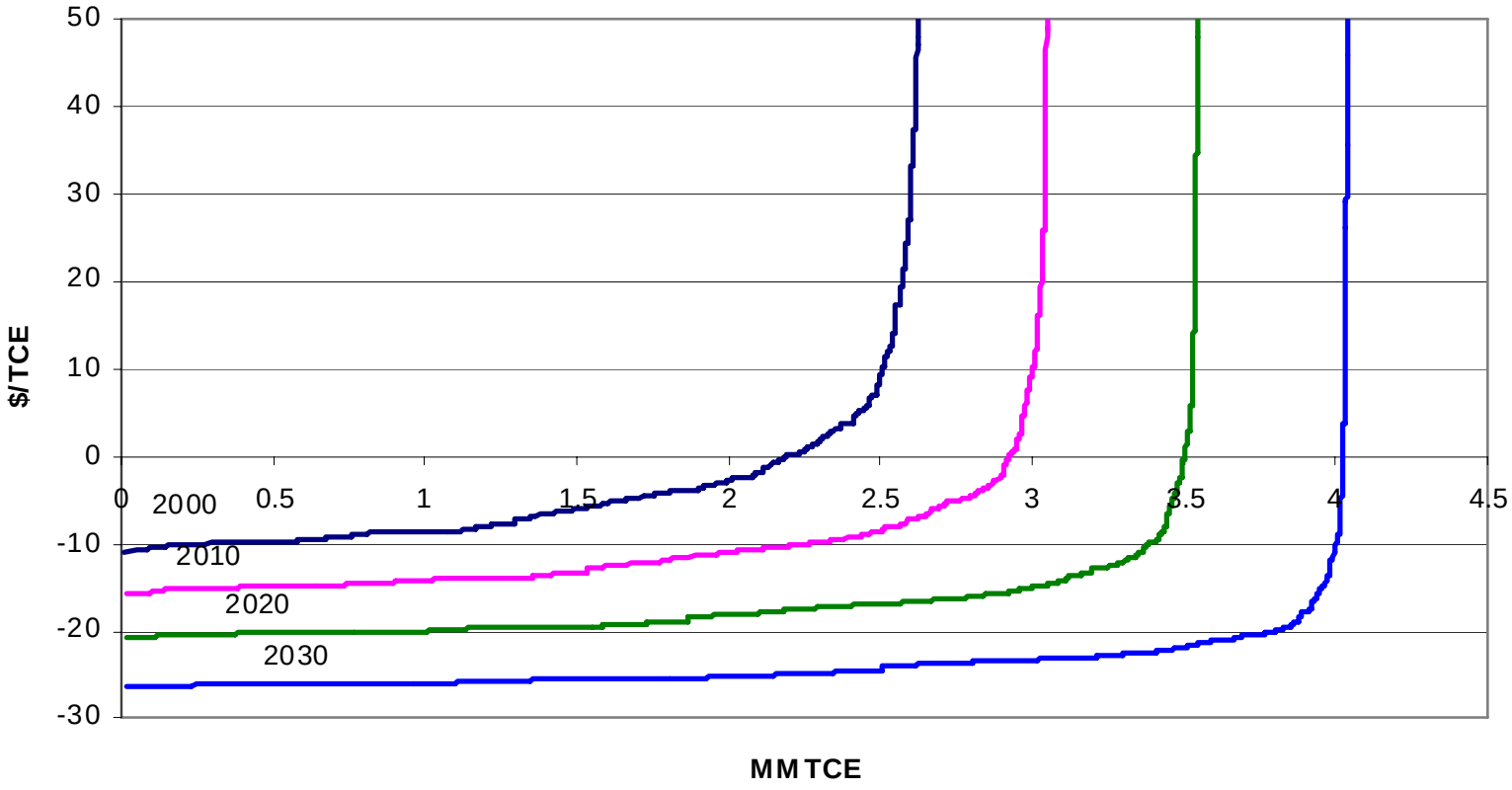
What to consider when using the data…

- Matching the assumptions in the baseline to
  - The baselines in the report
  - The MAC curve information
- Need to understand:
  - What are the drivers of the baseline (GDP, population, industry)?
  - How much mitigation is in the baseline? Does this match the MAC curves?
- Many models must remove “no-regrets” costs in order to solve.

Technical change and lagged response

- Some estimates of technical change for a specific industry exist.
  - Can also shift curves within model to represent technical change or reduction of costs over time.
  - Reduction of cost shifts curve downwards; increased capture efficiencies shift curve outwards.
- Some models use lagged response time.
  - Curves can be applied over a long period of time (instead of instantaneous adoption).
  - Example:

Shift in Mexico's MAC for Landfill Sector Over 30 Years



Who to contact for data and advice?

- Casey Delhotal, RTI International (Overall Report) kcdelhotal@hotmail.com
- Christa Clapp, USEPA, clapp.christa@epa.gov (Methane and overall report)
- Mike Gallaher, RTI International, mpg@rti.org (Technical Change estimates, Methane)
- Debbie Ottinger, USEPA, ottinger.deborah@epa.gov (Fluorinated Gases)