

American Chemical Society

ACS Green Chemistry Institute®



# Making Pharma Greener: *5 Years of the ACS GCI Pharmaceutical Roundtable*

Buzz Cue

ACS Green Chemistry Institute® Governing Board

1155 Sixteenth Street, NW, Washington, DC 20036

[www.acs.org/greenchemistry](http://www.acs.org/greenchemistry)

[www.acs.org/gcipharmaroundtable](http://www.acs.org/gcipharmaroundtable)



# Purpose

- Membership
- Highlights & Impacts



# ACS GCI Pharmaceutical Roundtable

**To catalyze the implementation of green chemistry and engineering in the pharmaceutical industry globally**



## 2005 Membership



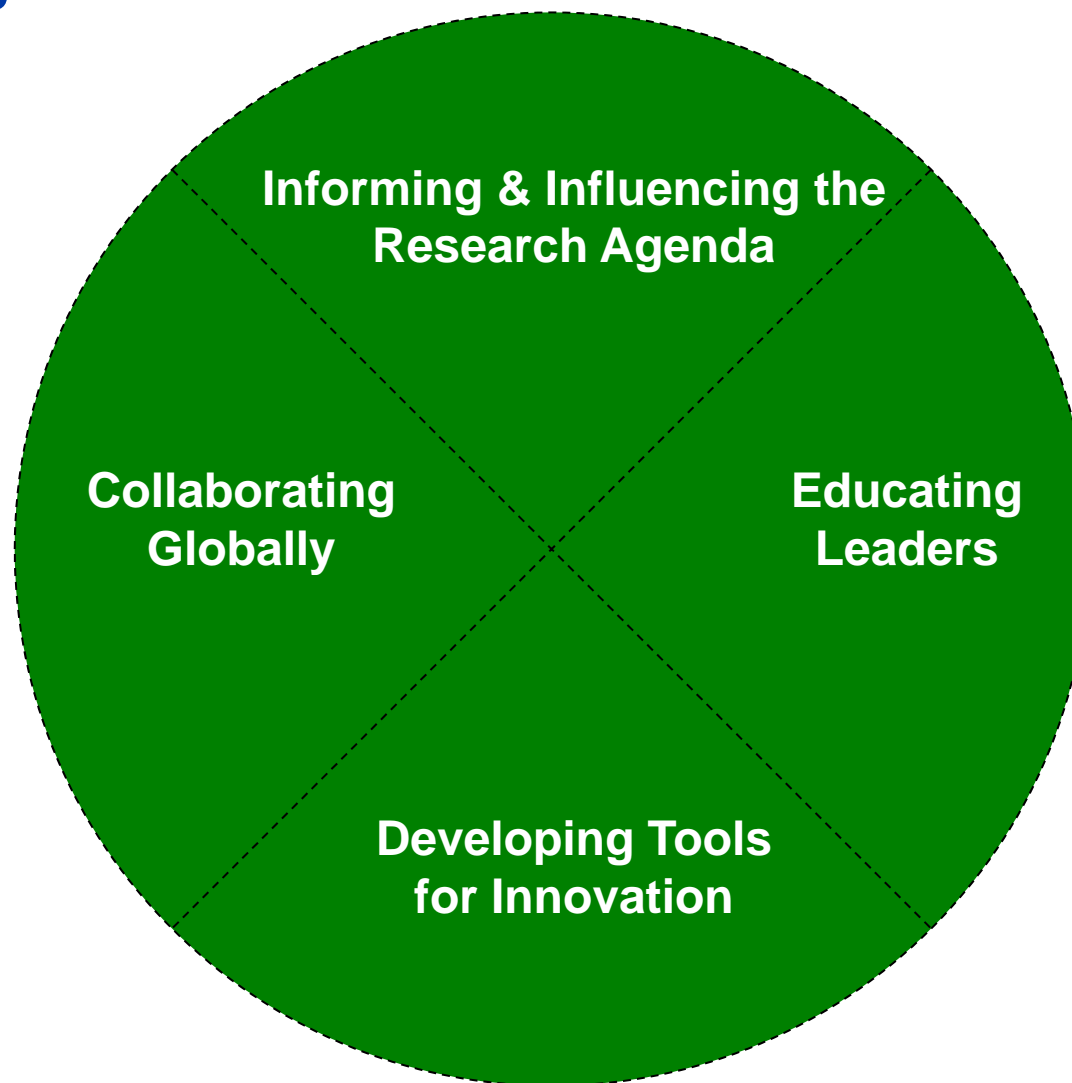


## Current Membership as of April 2010





## Strategic Priorities





# Informing and influencing the research agenda

- Key Green Chemistry Research Areas
  - Our paper published in 2007 has been cited 44 times (ISI Web of Science 03/24/10). Ten unique countries are associated with the authors of the 44 papers. Looking forward 2 generations, the paper has impacted 310 papers in the 3 years since its publication.
  - Identified as Top Ten Most Accessed Papers in the journal on more than 1 occasion in various years.
- Research Grant
  - \$800,000 awarded since 2007
  - GCI Pharmaceutical Roundtable” has been cited as a funding source in 10 papers. Those papers have been cited a total of 125 times. (ISI Web of Science 03/24/2010) However, in a manual exercise, the Roundtable has identified 23 papers associated with the award funding from the grant.
- Collaboration with NIGMS
- Key Green Engineering Research Areas (being publicized in 2010)

# Key Green Chemistry Research Areas



- Current Reactions
  - Amide Formation
  - OH activation
  - Amide Reduction
  - Greener Mitsunobu reactions
  - Oxidation/Epoxidations
- More Aspirational Reactions
  - C-H activation or aromatics
  - Chiral amine synthesis
  - Asymmetric Hydrogenation
  - Greener Fluorination Methods
  - *N*-Centered Chemistry
- Key Ideas outside the Reaction theme
  - Solvent-less Reactor Cleaning
  - Greener alternatives to polar aprotic solvents



# Research Grant Proposals 2007-2009



## Educating Leaders



- Undergraduate workshops
- Articles of Interest (published in *OPRD*)
- Sponsored research lectures at company sites
- Participation in technical conferences



## Developing Tools for Innovation

- Defined Process Mass Intensity (PMI)
- Completed 2 benchmarking studies against PMI
- Reagent selection guide
- Solvent selection guide
- CAS collaboration to integrate green search criteria into Sci-Finder



## Metrics: Process Mass Intensity (PMI)

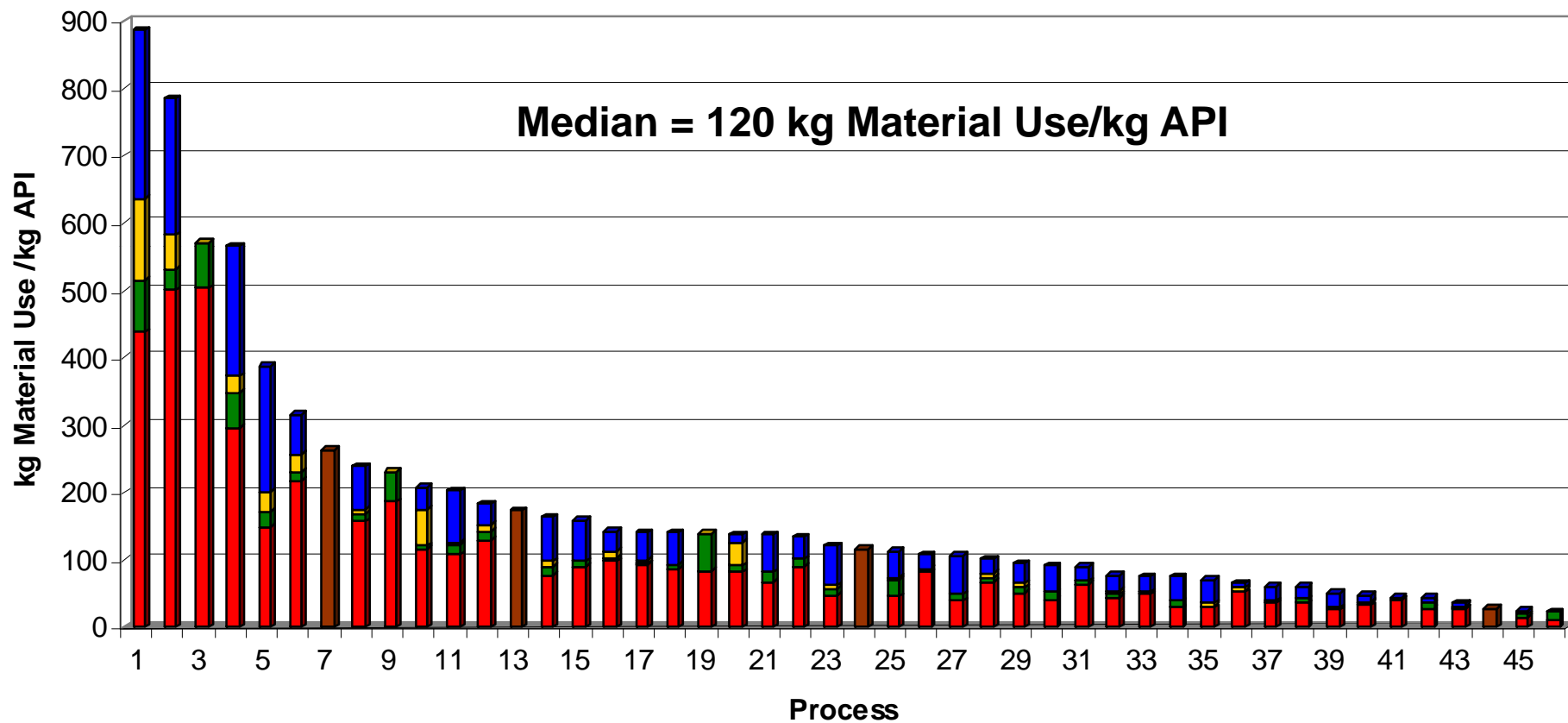
$$\text{Process mass intensity} = \frac{\text{quantity of raw materials input (kg)}}{\text{quantity of bulk API out (kg)}}$$

Collected for compounds in the *development pipelines* at each company

The result is a representative snapshot

***Complete metrics presentation & definitions available at  
[www.acs.org/gcipharmaroundtable](http://www.acs.org/gcipharmaroundtable)***

# Process Mass Intensity



- Total Solvents (excludes water)
- Total Reactants
- Total Other Process Materials
- Total Water
- Total Material Use



## Collaborating Globally

- This was defined as a strategic priority to ensure the Roundtable meets the needs of its members and stays true to the global nature of its mission.
- All activities of the Roundtable are global regarding participation and influence.
- All meetings are online to facilitate global collaboration.
- Commitment to host 1 meeting per year outside of US
  - Switzerland 2010
  - Belgium 2009
  - London 2008
  - London 2007



## Opportunity to Influence & Collaborate

- NIH Challenge grant in Green Chemistry
- Collaborative effort with NIH to communicate green chemistry
- Influence editorial policy



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National Institute of  
General Medical Sciences



## Miscellaneous Activities

- Sponsored an academic tour of US and EU member companies
- Met with editors of journals where green chemistry is published to persuade them to incorporate green metrics and solvents into the publication submissions via editorial policy
  - Note: Green Chemistry: Letters and Reviews does this now.
- Met with solvent producers to persuade them to search for greener solvents
- Met with Chem Abstract Services to discuss incorporation of green tools into the CAS search engines
- Expanding remit into biological drugs, drug discovery, chemical engineering and (hopefully) formulation/drug delivery
- Increasingly frequent discussions with US FDA about green chemistry





## So, What's Next?

- Expand the scope of the Roundtable to the entire lifecycle of a drug
  - basic building blocks from renewable sources to fate and effects of the drugs and their metabolites that are excreted into the environment-any everything in between
- Support training and education
  - Education of the next generation of pharmaceutical employees
  - Education of the scientists and engineers who work in pharma now
  - Education of the decision makers: CEO's, CFO's and senior R&D and manufacturing leaders
- Expand membership to the generic pharma industry, to small and medium pharma companies and to biopharma companies



## Contact Information

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