

# Aluminum Industry and Climate Change :

## Assessment and Responses

**Dr. Subodh Das**  
**Dr. John Green**

TMS Annual Meeting  
San Francisco , CA  
February 17, 2009



# Outline

- Impact of Aluminum Industry on Greenhouse Gases
- Industry Response
  - # 1 Implement Process Improvements
  - # 2 Promote Aluminum Uses in Transportation
  - #3 Develop Recycle - Friendly Aluminum Alloys
  - #4 Increase Recycling Rates
  - #5 Qualify Carbon Trading / Offsets



# Impact of Global Aluminum Industry on Greenhouse Gases

- Aluminum is responsible for 1% of global human induced greenhouse gases (Carbon Dioxide and Perfluoro Carbons)
- 1 kg Perfluoro Carbons (PFC) is equivalent to 6500 kg CO<sub>2</sub>
- About 32 million metric tonnes primary aluminum production worldwide
- Carbon Dioxide (CO<sub>2</sub>)
  - 15.6 kg CO<sub>2</sub> per kg of aluminum production
    - Mining, refining, anode, electrolysis, and electric power generation
  - 453.8 billion metric tonnes CO<sub>2</sub> per year for worldwide production
- Perfluoro Carbons (PFC)
  - 1.0 kg PFC per tonne of aluminum production
  - 32 thousand metric tonnes PFC per year for worldwide production
  - Equivalent to 208 million metric tonnes of CO<sub>2</sub>

## Industry Response #1 Implement Process Improvements

- Produce Electricity Efficiently
  - Use electricity from efficient coal/oil/natural gas power plants
  - Use renewable energy sources
    - Hydro (current world use ~50%), Geothermal, and Nuclear
- Enhance process efficiency in existing plants and develop new technology
  - Replace rotary with fluid bed calciners
  - Reduce electricity needed to make aluminum from 7 to 6 kWh /pound
  - Lower smelting energy consumption
    - Wettable / drained cathode
  - Lower carbon anode effect frequency (reduce PFC)
  - Lower carbon consumption
    - Inert anode
    - More efficient vertical electrode cell
  - Develop non-contact sensors



# Industry Response #2

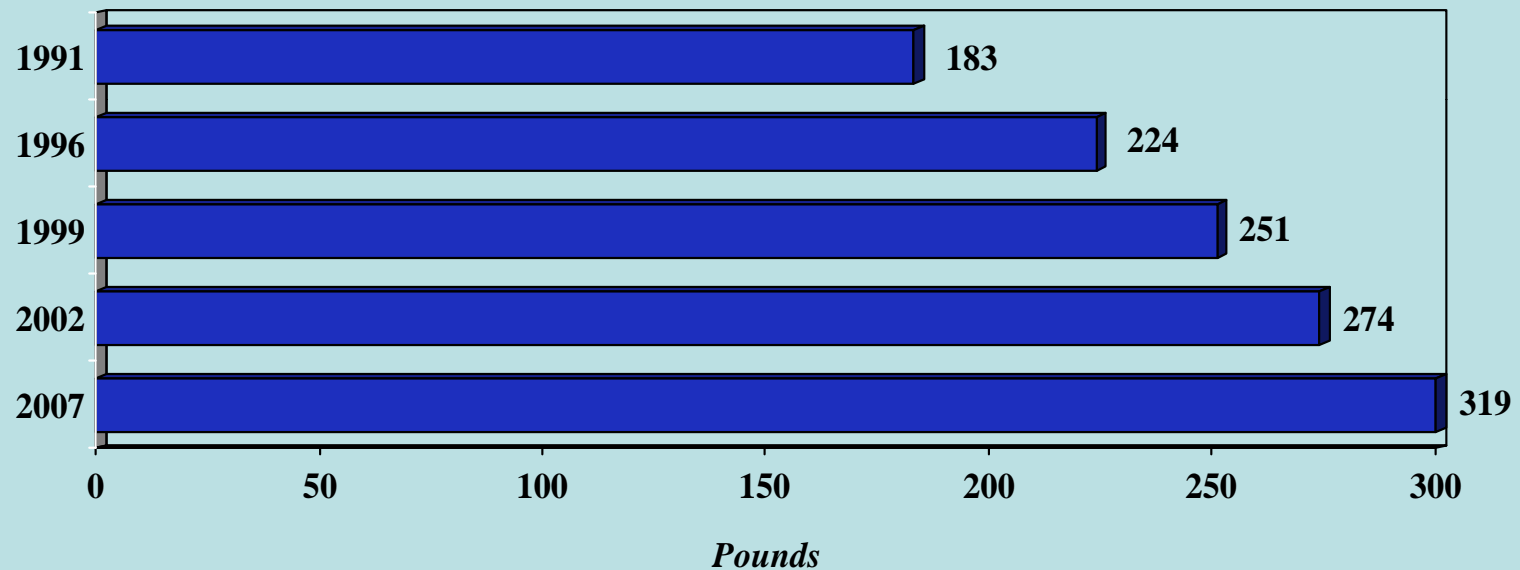
## Promote Aluminum Uses in Transportation

- Light weighting in aircraft, rail, shipping and especially cars and trucks saves fuel, and reduces CO<sub>2</sub> emissions
- Each pound of Al replacing iron or steel saves 20 pounds of CO<sub>2</sub> emissions over an average vehicle lifetime
- Fuel savings of 6-8% can be gained for every 10% weight reduction of a vehicle, resulting in less GHG emissions
- EPA estimates ~90% of automotive aluminum is recovered and recycled



# North American Light Vehicle Aluminum Content Changes

North American Total Aluminum Content  
(Pounds per Vehicle)



# Industry Response #3

## Develop Recycle Friendly Aluminum Alloys

Existing Model

“Primary World”



New Model

“Recycling World”



# Recycling Driving Changes in Alloy Development

- Previous approach to alloy development
  - Driven solely by desired performance
  - Limited considerations of end-of-product-life
  - Less considerations for cost, carbon footprint and availability of alloying elements
- Beginning to recognize impact of recycling
  - How will product be recovered for recycling ?
  - How will composition impact cost & recyclability?
  - What will be it's carbon footprint?



# **New Paradigm for Evaluation of Existing and Designing of New Alloys**

- **For both existing and new alloys --- Recycle to same product**
- **For existing alloys:**
  - **Recognize relative value when recycled**
    - **How big are energy source and carbon footprint?**
  - **Consider how best to group alloys for remelting to maximize value of remelt composition?**
- **For designing new alloys**
  - **Consider how useful composition will be when remelted**
    - **Avoid adding elements that become contaminants**
  - **Consider direct production from recycle remelts**
    - **Avoid tight impurity limits**
    - **Consider alloys from automotive, B&C, packaging or aircraft recycling scrap streams**

# Aluminium Recycle Index ( ARI )

- **Concept Introduction and Definition:**
  - ARI is a measure of the relative ease, value, and desirability of recycling & remelting alloys in end-of-life products
    - Includes potential for recycling back to the same product or to another high-value product with minimal primary additions
  - ARI is a measure of the energy content and carbon footprint

# Industry Response # 4

## Increase Recycling Rates

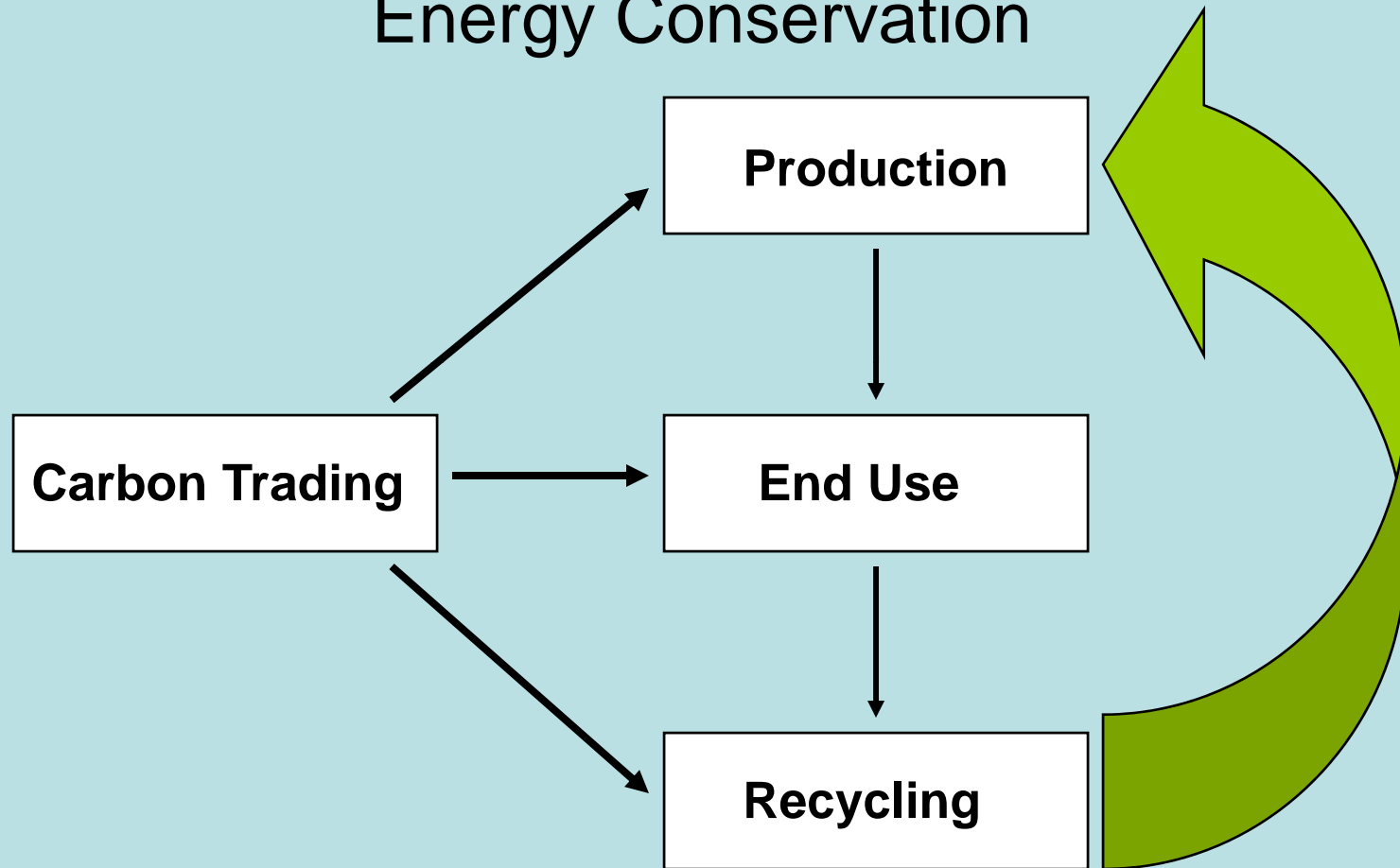
- Enhance aluminum melting efficiency ( average 25 % )
- Implement new recycling/sorting technologies
- Increase UBC recycling rate to new industry goal of 75 % by 2015
- Consider consumer behavior, convenience and economic incentives
- Consider urban mining of Used Beverage Cans (UBCs)
  - US recycling rate ~ 50% (Brazil, Norway ~ 96%)
  - Accumulated landfill totals 20 million tons in the US
  - Total value of “urban mine” is \$50 billion in the US
  - New landfill equals outputs of 3 aluminum smelters (~900,000 tonnes per year in the US)

- **Recycling lowers energy & carbon footprint**

- Requires 5% of energy : 2.3 vs. 45 kWh/kg Al
- Emits 5% of carbon dioxide : 0.6 vs. 12 kg/kg Al
- Alloying Elements Conservation ( Mg, Mn , Cu , Zn, Si )
  - Have high energy and carbon footprints

# Industry Response # 5

## Qualify Carbon Trading / Offsets for Recycling and Energy Conservation



# Thank You

For further discussion, please contact

Dr. Subodh Das

skdas@phinix.net

(859) 619-8386



**TMS**