GREENHOUSE GASES EMISSIONS FROM ALUMINIUM PRODUCTION

-INDUSTRY REDUCTION EFFORTS AND THE ROLE OF VOLUNTARY AGREEMENTS IN EMISSION REDUCTIONS

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Presentation Outline

• The aluminium industry and climate change
• Industry’s response to the challenge
• The results to date
• Voluntary agreements
• Current industry actions
• Conclusions
Primary Aluminium is Global

- Total 2000 production = 24.2 million tonnes

- North America: 5.8
- Asia: 4.0
- Europe: 3.8
- Latin America: 2.2
- Oceania: 2.1
- Africa: 1.2

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GHGs from Primary Aluminium Production

Two PFC (perfluorocarbon compounds - CF₄ and C₂F₆) contribute about 48% of primary aluminium GHG emissions.

How to decrease GHG Emissions?

- Increase the recycling rate
- Increase the electrical conversion efficiency and reduce electricity consumption
- Reduce anode effects that produce PFCs
- Change the reduction technology to eliminate carbon
Aluminium Recycling

- Aluminium is not consumed but is used through multiple product life cycles
- “Cradle to next product”  
  Instead of  
  “cradle to grave”
- Aluminium maintains its value in recycling

➢ There is an in-use inventory of aluminium products eventually to be recycled of 400 to 600 million tonnes
Understanding PFC emissions

• PFCs result from anode effects
  – Anode effects result from temporary imbalances in the raw material feed rate with aluminium production rate

• The amount of PFCs produced from anode effects is a function of:
  ➢ Anode effect frequency
  ➢ Duration of anode effects
  ➢ Cell amperage
  ➢ Anode effect voltage

Understanding PFC Emissions

• The specific PFC emissions (kg CF₄/t Al) is primarily a function of anode effect minutes per cell day
• Emissions per anode effect minute strongly dependent on reduction technology
Global Warming Potentials (GWP)

GWP for $\text{CF}_4 = 6500$
GWP for $\text{C}_2\text{F}_6 = 9200$

5700 Revised values proposed
11900 In 3rd assessment report

International Aluminium Institute (IAI)

sponsored PFC initiatives

- Survey member companies on anode effect data
- Conduct workshops for benchmarking and good practices for reduction of anode effects
- Collaborate with national regulatory agencies, regional aluminium associations and member companies in developing better PFC inventories
- Sponsor fundamental atmospheric research to better understand how PFCs affect climate change
- Sponsor measurements of PFCs in historical air samples to establish the relationship with aluminium production
The results

IAI PFC Survey Report for 1990 – 2000

Results
- Specific PFC emissions reduced by 60%
- Total PFC emissions reduced by 46%
- with primary aluminium up by 36%
- Benchmarking data provided comparing individual facility performance

✓ Still room for improvement

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The results

Specific Emissions of PFCs
Current voluntary agreements

- Several types of agreements
- Vary from industry commitments, through signed agreements to negotiated agreements with benefits and penalties
- Negotiated agreements also have third party verification of emissions

### Countries with voluntary agreements

<table>
<thead>
<tr>
<th>Country</th>
<th>Coverage</th>
<th>Start date</th>
<th>End date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>PFC and CO₂</td>
<td>1990</td>
<td>2000/-</td>
</tr>
<tr>
<td>Bahrain</td>
<td>PFC</td>
<td>1995</td>
<td>2000</td>
</tr>
<tr>
<td>Brazil</td>
<td>PFC and CO₂</td>
<td>1994</td>
<td>2000</td>
</tr>
<tr>
<td>Canada</td>
<td>PFC and CO₂</td>
<td>1990</td>
<td>2007</td>
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<tr>
<td>France</td>
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<tr>
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<td>PFC</td>
<td>1990</td>
<td>2005</td>
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<tr>
<td>New Zealand</td>
<td>PFC and CO₂</td>
<td>1990</td>
<td>2000</td>
</tr>
<tr>
<td>Norway</td>
<td>PFC and CO₂</td>
<td>1990</td>
<td>2005</td>
</tr>
<tr>
<td>UK</td>
<td>PFC</td>
<td>1990</td>
<td>2000/2010</td>
</tr>
<tr>
<td>US</td>
<td>PFC</td>
<td>1990</td>
<td>2000/2005</td>
</tr>
</tbody>
</table>
Targets for voluntary agreements

- Gases involved and targets vary from country to country
- Starting point and potential reduction depends on the state of the technology
- The achieved results also depends on change in production volume

### Reductions in Annex I countries (2000)

<table>
<thead>
<tr>
<th>Country</th>
<th>Production</th>
<th>Red Target</th>
<th>Achieved</th>
<th>Gases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>+ 43%</td>
<td>+ 9%</td>
<td>+20%</td>
<td>GHG</td>
</tr>
<tr>
<td>Canada</td>
<td>+ 52</td>
<td>Varies</td>
<td>+7</td>
<td>GHG</td>
</tr>
<tr>
<td>France</td>
<td>+ 35</td>
<td>- 63</td>
<td>- 73</td>
<td>PFC</td>
</tr>
<tr>
<td>Germany</td>
<td>- 11</td>
<td>- 50</td>
<td>- 85</td>
<td>PFC</td>
</tr>
<tr>
<td>Norway</td>
<td>+ 18</td>
<td>- 50</td>
<td>- 53</td>
<td>GHG</td>
</tr>
<tr>
<td>UK</td>
<td>+ 5</td>
<td>- 89</td>
<td>- 87</td>
<td>PFC</td>
</tr>
<tr>
<td>US</td>
<td>- 9</td>
<td>- 45</td>
<td>- 56</td>
<td>PFC</td>
</tr>
</tbody>
</table>
Reductions achieved

- The specific emissions have in all cases been reduced
- Where total emissions targets have not been achieved this is linked to production increases

Current IAI Actions

Improve Quality of PFC Inventory

- Conduct annual surveys of member companies
- Working to increase coverage of survey
- Give member companies benchmark data to evaluate performance
- Have developed global standards for inventory methodology building on WBCSD protocols
- Working with IPCC to improve Tier 2 calculation coefficients
- Moving member companies to Tier 3 reporting
- Working with USEPA to establish a standard PFC measurement protocol globally
Conclusions

• Excellent Progress made by worldwide aluminium industry in reducing greenhouse gas emissions
  – Specific PFC emissions reduced by 50% over the period 1990 – 2000 by worldwide aluminium industry (60% by IAI member companies).
  – Total PFC emissions reduced by 38% by worldwide aluminium industry (46% by IAI member companies) from 1990 to 2000 while primary production increased by 24%.

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Conclusions

• Voluntary programs have been effective in reducing PFC emissions.
• Further reductions in PFC emissions are possible through adoption of best practices, technology improvements and increased recycling.
  – IAI working to facilitate transfer of best practices to reduce the frequency of anode effects and to teach measurement techniques worldwide.

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Conclusions

• Future voluntary programs should be based on:
  – Clearly defined targets and plants/gases included
  – Penalties and benefits – several models used
  – Regular reporting and verification of results