



# **SF<sub>6</sub> Reductions from Non-Utility and Non-Semiconductor Applications:**

## **Emissions, Reductions, and Costs – An initial assessment**

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# Overview

- Regulatory steps
- Overview of Analysis
  - Magnesium
  - Tracer Gas Uses
  - Medical Uses
  - Other
- Summary

# Regulatory Process

- Identify Major Stakeholders
- Establish Working Group
- Stakeholder Consultation Meetings
- Develop Draft Proposal
- Conduct Public Workshops
- Release Staff Report (ISOR)
- Hearing Notice
- Board Hearing and Adoption
- Post Board Adoption Efforts
- Submitted to Office of Administrative Law

# Regulatory Process

- Staff analysis will support staff recommendation to the Board
- Board will approve, disapprove, or approve with request for changes

# Draft Staff Analysis

- Emissions
- Reductions
- Costs
  - To Company
  - Cost-effectiveness
- Other issues
  - E.g. Toxicity
- Options: Phase Out, Mitigation Fee, Performance Standard
- Current Preferred Approach
- Call for comments and submissions

# Mitigation Fee

- Role of fee in overall program under evaluation.
- Mitigation fees have the potential to allow for the continued use of SF<sub>6</sub> in the event that technologically feasible and cost-effective alternative mitigation strategies are unavailable.
- Mitigation fees to could directed at robust alternatives for achieving reductions in GHG emissions that may or may not be related to SF<sub>6</sub> emission sources.
- Mitigation fee could be used as a substitute or a a compliment to a performance-based regulation.
- Will be discussed in general, not by sector

# Magnesium Casting

- 2-3 magnesium casting plants in CA
  - 2 are part of EPA voluntary collaborative and have agreed to eliminate SF<sub>6</sub> use by 2010
  - Third is not in EPA program but use of SF<sub>6</sub> is unclear
- Emissions estimated at 0.1 MMTCO<sub>2</sub>E
- Alternatives:
  - Alternative gases available: SO<sub>2</sub>, HFC-134a, Fluorinated Ketone, Frozen CO<sub>2</sub>
- Reductions: 98-99.9%
  - Dependent on alternative cover gas

# Magnesium Casting

## Option 1: Phase Out SF<sub>6</sub>

- Costs:
  - One-time: ~\$570,000
  - Operating: Potential savings of \$4,000 per year
- Reductions: 98-99.9%
- Cost-effectiveness: \$5.80/tonne CO<sub>2</sub>E
  - Based on non-discounted capital cost only

# Magnesium Casting

## Option 2: Performance Standard

- Good Housekeeping and Process Optimization could be used to set GHG standard
  - Good Housekeeping:
    - Leak detection, calibration, etc.
      - Costs: Savings of >\$20,000
      - Cost-effectiveness: Savings of \$1.90/MTCO<sub>2</sub>E
      - Reduction: 0.012 MMTCO<sub>2</sub>E
    - Process Optimization:
      - Incremental technology and management practices
        - Costs and reduction potential unknown
        - Capital costs with annual savings likely
  - Assumes practices are not already in place

# Magnesium Casting: Preferred Approach

- Preferred Approach is a phase out of SF<sub>6</sub> use in magnesium casting in CA
  - Largest reductions
  - Cost-effective
  - Enforceable
  - Low administrative costs
- Performance Standard would lead to limited reductions and add administrative costs

# Tracer Gas Uses

- Variety of Uses
  - Atmospheric Transport
  - Characterization of ventilation systems
    - Includes fume hood certification
  - Air infiltration studies
  - Leak testing
  - Characterizing flow patterns

# Tracer Gas Use in Standards

- Several standards either require or suggest SF<sub>6</sub> use
- ASHRAE 110 specifies actual amount
  - 1.5-1.75 lbs or ~16 MTCO<sub>2</sub>E per fume hood test

# Tracer Gas Uses

- Emission estimates range from 0.01 to 0.2 MMTCO<sub>2</sub>E
- Alternative gases or methods
  - PFCs
  - N<sub>2</sub>O
  - Use less SF<sub>6</sub> with an ECD
- Reductions of 50 - 99% possible

# Tracer Gas Uses

## Option 1: Phase Out SF<sub>6</sub>

- Reductions:
  - All SF<sub>6</sub> reduced but GHG reductions depend on alternative used, PFC use at same level would provide least reduction
- Cost:
  - Cost is in the difference in price for alternate gas in comparison to SF<sub>6</sub>
  - Ranges from savings (N<sub>2</sub>O) up to a few dollars (PFCs in ventilation tests) to hundreds of dollars (PFCs in fume hood certification) or higher (short range atmospheric transport)
- Cost-effectiveness:
  - PFCs:
    - \$25-90/MTCO<sub>2</sub>E for most uses
    - Could be higher for some uses such as short range transport studies
- Other:
  - No guarantee of reduced GHG emissions
  - SF<sub>6</sub> may be necessary for some uses

# Tracer Gas Uses

## Option 2: Performance Standard

- Reductions:
  - Determine based on costs, cost-effectiveness, etc.
  - Reductions achievable with alternative methodologies, gases, etc will be considered
- Costs
  - Alternative gases costs have wide range: see Phase Out
  - ECD could cost up to \$100,000
- Other
  - Toxicity, Safety
  - Total GHGs considered

# Tracer Gas: Other considerations

- Proven alternatives
- Safety, toxicity
- Total greenhouse gas emissions

# Tracer Gas Uses: Preferred Approach

- Preferred Approach is performance standard
  - Flexible to allow for cost-effective reductions
  - Considers all greenhouse gas emissions, not just SF<sub>6</sub>
- Other Approaches
  - Ban is prescriptive and could result in limited GHG reductions
  - Fee could have large costs

## Medical Uses

- $\text{SF}_6$  used in two types of eye surgery
  - Retinoplexy and vitrectomy
- Used as contrast agent in ultrasounds
  - Not in US
- Between 35 - 40  $\text{MTCO}_2\text{E}$  per year in CA
  - Majority is purged

# Medical Uses

## Option 1: Phase Out SF<sub>6</sub>

- PFCs can be used but do not stay in eye for the same length of time
  - If second surgery is needed, emission reductions are minimal
- PFCs are more expensive and the same volume would be needed
  - Costs expected to be over \$1,000/MTCO<sub>2</sub>E
  - Cost per surgery is low

# Medical Uses

## Option 2: Performance Standard

- Set limit on amount of SF<sub>6</sub> used per surgery
  - Minimize purging
- Options for complying could include smaller syringes or purging into container for recycling
- Costs may be unreasonable and options may not be technically feasible
- Program costs appear to be significant compared to the amount of GHG reductions

## Medical uses: Preferred Approach

- Exempt medical uses
  - Public health
- A phase-out would have limited GHG reductions
- Performance standard would also have administrative costs for few reductions and may have technical and economic limitations

## Other Uses: Magic and Consumer Products

- Historically SF<sub>6</sub> has been used in several products
  - SF<sub>6</sub> remains in rubber insulated products longer than other gases
    - Provides cushion and bounce
  - Previously used in tennis shoes, tires
  - May still be used in tennis balls – uncertain
    - ARB conducting survey and analyzing sample of tennis balls
- Used in magic tricks
  - Voice deepening
  - Float objects

# Other Uses

## Option 1: Phase Out SF<sub>6</sub>

- Reductions: All SF<sub>6</sub> reduced through use of compressed air or nitrogen
- Cost: Alternative gases are generally less expensive
- Other: If alternatives considered inferior, could lead to reduced revenues
- Deters any future SF<sub>6</sub> use in previously phased out uses

## Other Uses

### Option 2: Performance Standard

- No reductions in SF<sub>6</sub> currently identified that would reduce but not eliminate usage

# Other Uses: Preferred Approach

- Preferred Approach: Phase out
  - Alternatives available
  - Cost savings but potential for reduced revenues

# Mitigation Fee

- For SF<sub>6</sub>:
  - Requires further assessment on authority
  - Not practical for certain categories
    - Leakage is a consideration if looking at a limited number of uses of SF<sub>6</sub>
  - Not preferred if lower cost options are available
- Mitigation Fee being considered in larger context
  - Leakage issues are lessened

# Summary

- Sectors are different and will be approached separately
- Preferred approaches developed based on costs, cost-effectiveness, alternative availability, emission reduction, practicality, technical feasibility.
- Considered impact on businesses, safety implications, and multimedia impacts

# Summary

- Preferred Approaches (still considering other options):
  - Phase Out of SF<sub>6</sub> use:
    - Magnesium Casting
    - Other Uses
  - Performance Standard
    - Tracer Gas Uses
  - Exempt (based on current level of information)
    - Medical Uses
- ARB requests comments and submissions, especially for tracer gas performance standard