

SF₆ Reductions from Non-Utility and Non-Semiconductor Applications:

Emissions, Reductions, and Costs – An initial assessment

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Draft Staff Analysis

- Survey Overview
- Four Sectors: Magnesium, Tracer Uses, Medical Uses, and Other.
 - Will cover for each:
 - Emissions
 - Reductions
 - Costs
 - Other issues
 - Options
 - Recommended Approach
- Call for comments

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Survey Status

- Sent out to:
 - SF₆ manufacturers and distributors
 - SF₆ users (excluding semiconductor and utility)
- Due July 7th
 - Follow-up being initiated
 - Additional outreach to new sectors will improve estimates

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Overall

- Users:
 - Identified 53 users
 - Response Rate: 38%
- Distributors:
 - Identified 15 distributors
 - Response Rate: 20%
- Manufacturers:
 - Identified 6 potential manufacturers
 - Response rate: 50%
 - 1 no longer manufacturers SF₆

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Magnesium Casting

- 4 magnesium casting plants in CA
 - Two are part of EPA voluntary collaborative and have agreed to eliminate SF₆ use by 2010
 - Two additional casters contacted but no longer cast Mg
 - 1 is die caster, 3 sand casters
 - 2 have responded to survey, results not shared until more responses
- Emissions estimated to be at least 0.1 MMTCO₂E
 - Estimates will likely increase due to the increased number of identified casters
- Alternatives:
 - Alternative gases available: SO₂, HFC-134a, Fluorinated Ketone, Frozen CO₂
 - Sand Casting may be limited to SO₂ and Fluorinated Ketone
- Reductions: 98-99.9%
 - Dependent on alternative cover gas

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Magnesium Casting Option 1: Phase Out SF₆

- Costs:
 - One-time: ~\$570,000 (industry total)
 - Operating: Potential savings of \$4,000 per year
- Reductions: 98-99.9%
- Cost-effectiveness: \$5.80/MTCO₂E
 - Based on non-discounted capital cost only
- International experience
- Does not include costs of recertifying

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Magnesium Casting Option 2: Performance Standard

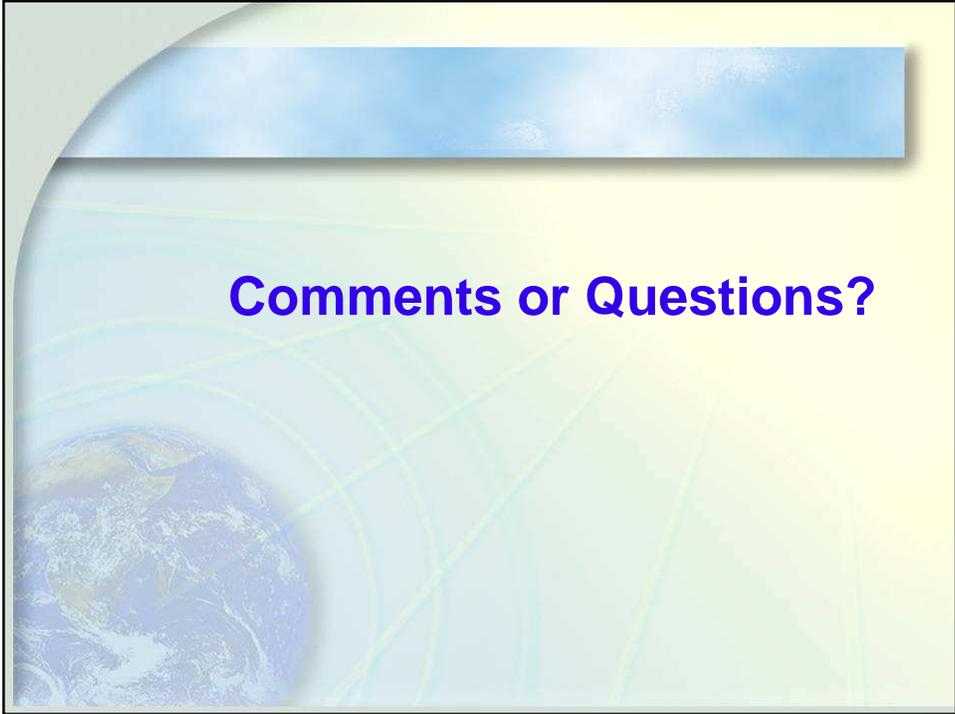
- Good Housekeeping and Process Optimization could be used to set GHG standard
 - Good Housekeeping:
 - Leak detection, calibration, etc.
 - Costs: Savings of >\$20,000
 - Cost-effectiveness: Savings of \$1.90/MTCO₂E
 - Reduction: 0.012 MMTCO₂E
 - Process Optimization:
 - Incremental technology and management practices
 - Costs and reduction potential unknown
 - Capital costs with annual savings likely
- Assumes practices are not already in place

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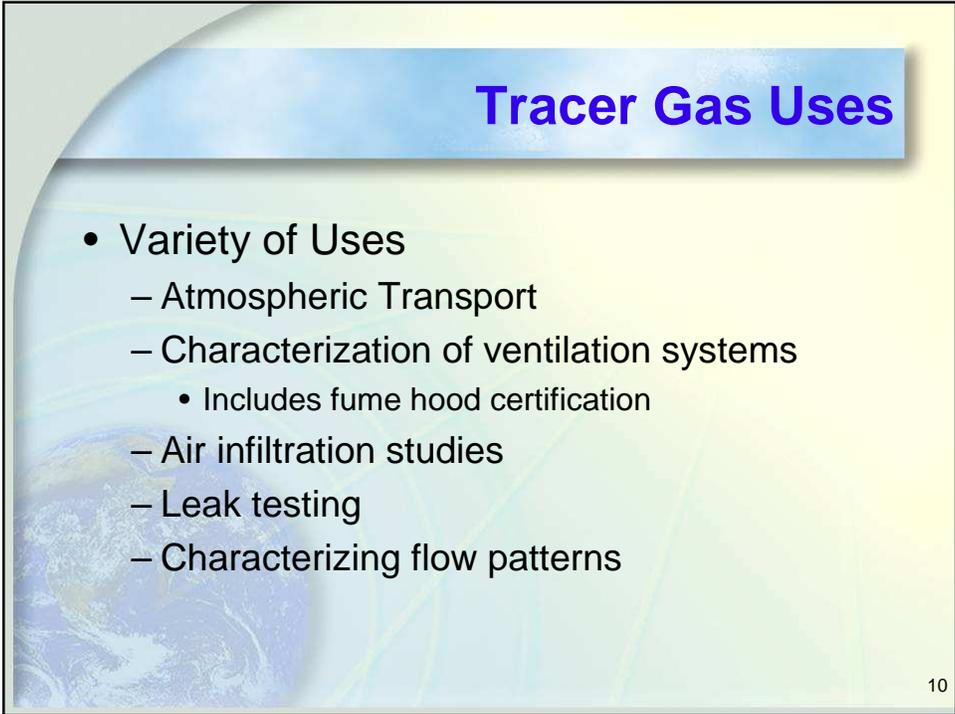
Magnesium Casting: Initial Recommended Approach

- Initial Recommended Approach is a phase out of SF₆ use in magnesium casting in CA
 - Largest reductions
 - Cost-effective
 - Enforceable
- Performance Standard would lead to limited reductions
- Waivers may be an option if no alternative but proof would be necessary

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Comments or Questions?



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 SF₆ use
- ASHRAE 110 specifies actual amount
 - 1.5-1.75 lbs or ~16 MTCO₂E per fume hood test
- Cal/OSHA requirement

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Tracer Gas Uses

- Emission estimates range from 0.03 to 0.15 MMTCO₂E
 - Low survey response rate but has enabled an increase in lower bound
 - Many universities report no usage of SF₆ even for fume hood testing
- Alternative gases or methods
 - PFCs, HFCs
 - N₂O
 - Use less SF₆ with an ECD or alternative methods
- Reductions of 50 - 99% possible

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Tracer Gas Uses

Option 1: Phase Out SF₆

- Reductions:
 - All SF₆ reduced but GHG reductions depend on alternative used
- Cost:
 - Cost is in the difference in price for alternate gas in comparison to SF₆, new equipment
 - Ranges from savings (N₂O) 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/MTCO₂E for most uses
 - Could be higher for some limited uses
- Other:
 - No guarantee of reduced GHG emissions
 - SF₆ may be necessary for some uses

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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
 - ECD costs: \$25,000 – 100,000
- Other
 - Toxicity, Safety
 - Total GHGs considered
 - Developing and implementing regulation would be difficult for wide variety of uses
 - Significant reporting requirements could be necessary

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Tracer Gas Uses: Initial Recommended Approach

- **Initial recommended approach is phase out**
 - SF₆ is a very potent GHG with a long lifetime and tracer uses are emissive
 - Can deal with shortcomings through a combination of exemptions and waivers
 - Exemptions written into regulation
 - Compliance with Cal/OSHA fume hood regulation, identified essential uses
 - Waivers may be use-based but would need to apply for waiver
 - Overall GHG benefit, no alternatives, unidentified essential uses
 - Proof necessary
 - Performance standard for wide variety of uses would be difficult to develop, implement, and enforce. Could include significant reporting requirements.

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Comments or Questions?

Medical Uses

- SF₆ used in two types of eye surgery
 - Retinoplexy and vitrectomy
- Used as contrast agent in ultrasounds
 - Not in US
- Between 35 - 40 MTCO₂E per year in CA
 - Majority is purged

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Medical uses: Initial Recommended Approach

- Exempt medical uses
- 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

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Other Uses: Magic and Consumer Products

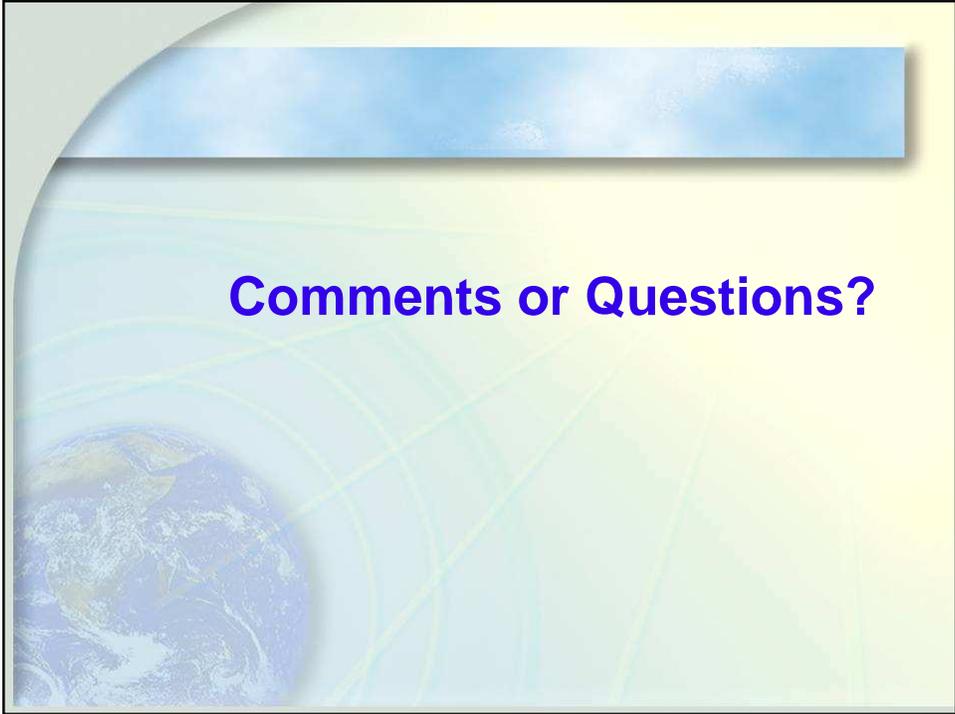
- Historically SF₆ has been used in several products
 - SF₆ remains in rubber insulated products longer than other gases
 - Provides cushion and bounce
 - Previously used in tennis shoes, tires, windows
 - May still be used in tennis balls
 - Preliminary investigation shows no use
- Used in magic tricks
 - Voice deepening
 - Float objects

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Other Uses: Initial Recommended Approach

- Phase out
 - Alternatives available or use is unnecessary
 - Cost savings but potential for reduced revenues

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Comments or Questions?



Summary

- Initial Recommended Approaches (still considering other options):
 - Phase Out of SF₆ use in:
 - Magnesium Casting
 - Tracer Gas Uses
 - Other Uses

Mitigation Fee

- For SF₆:
 - Not practical for one or a few limited uses
 - Leakage and enforcement is a consideration if looking at a limited number of uses of SF₆
 - Not preferred if lower cost options are available
- Mitigation Fee being considered in larger context
 - Leakage and Enforcement issues are lessened
- If High GWP fee goes forward, exempted sectors would be subject to fee

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Contact Information

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<http://www.arb.ca.gov/listserv/listserv.php>

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