What is the Climate Action Reserve?

- Non-profit national GHG offsets registry
  - Develop high-quality projects standards and register/track offset credits in public online system
  - Ensure environmental integrity and quality of offset credits
  - Intended to be the premier place to register carbon offset projects for North America

- Also houses the **California Climate Action Registry**
  - Non-profit GHG inventory registry created by state legislation in 2001
  - Encourage voluntary entity-wide reporting and reductions
  - Over 350 members and 730 million metric tons CO₂e registered for years 2000 - 2007
Today’s Agenda

Morning
- Reserve protocol development process
- ODS project typologies

break for lunch

Afternoon
- Nitric acid N\textsubscript{2}O project typologies
- Other potential industrial gas project typologies
Scoping Meeting Purpose

- Engage stakeholders in process
- Help shape direction and scope of protocols
- Gather information and input on key issues
- Assess project types for future development
Protocol Development Process

- Internal protocol scoping
- Form multi-stakeholder workgroup
- Discussion paper and/or draft protocol:
  - Maintain consistency with other high quality emission reduction standards
- Send draft through workgroup process
  - Workgroup provides feedback, consensus is built
  - Can be iterative process
- Draft protocol released for public review
- Public comments incorporated
- Protocol submitted to Reserve board for adoption
Timeline – ODS and/or N_2O

Scoping meeting: May 19, 2009
Drafting of protocol: June - July 2009
Adoption by Reserve Board: December 2009
Principles of Reserve Project Accounting

- **Real**: Reductions have actually occurred, and are quantified using complete, accurate, transparent, and conservative methodologies.
- **Additional**: Reductions result from activities that would not happen in the absence of a GHG market.
- **Permanent**: Reductions verified ex-post, risk of reversals mitigated.
- **Verified**: Emission reports must be verifiably free of material misstatements.
- **Owned unambiguously**: Ownership of GHG reductions must be clear.
- **Not harmful**: Negative externalities must be avoided.
- **Practicality**: Project implementation barriers should be minimized.
Project Accounting Frameworks

- Top-down (standardized) approach
  - Criteria developed by GHG program (Reserve)
  - Applicable to multiple projects within sector

- Bottom-up (project-specific) approach
  - Developed on case-by-case basis by project developer
  - Represent conditions for a single project
  - CDM style approach to project accounting
The Standardized Approach

Benefits to a top-down approach:

- Low up-front costs to project developers
- Efficient review and approval of projects
- Transparency and consistency
- Same approach applies across projects
- Prescriptive guidance to eliminate judgment calls

But...high initial resource investment to program
Project Protocol Components

- Define the GHG reduction project
- Define eligibility (incl. “additionality”)
- Establish assessment boundary
- Calculate GHG reductions
  - Baseline emissions
  - Project emissions
- Verify project performance
Define GHG Reduction Project

- GHG project is a specific activity or set of activities intended to:
  - Reduce GHG emissions
  - Increase carbon storage or
  - Enhance GHG removals from atmosphere

- Project definition will delineate what activities are “creditable” under protocol
  - i.e., what baseline and project scenarios are accepted
Define Eligibility

**Additionality criteria**

- **Regulatory test**
  - Is it required by law?

- **Project start date**
  - As early as Jan 1, 2001 for 12 month period after protocol is adopted
  - Only new projects after initial 12 months

- **Performance threshold, technology standard and/or other conditions**
  - Standard of performance applicable to all industrial gas projects, as defined in the individual protocol
Define Eligibility (cont.)

Other eligibility criteria

- Project location
  - Must be based in the United States

- Regulatory compliance
  - Project activity must comply with all air & water quality regulations
Establish Assessment Boundary

- Delineates the sources and gases required to be assessed to determine net change in emissions from project activity
  - Primary effects
    - For industrial gas, destruction of substance or reduction of fugitive emissions
  - Secondary effects
    - Must be identified and assessed
    - Large, negative secondary effects can render project activity unviable
Calculate GHG Reductions

- Develop standardized measurement and monitoring to:
  - Estimate baseline emissions and
  - Calculate project emissions
- Procedures for collecting necessary data
- Frequency of monitoring
- Standardized calculation methodologies and default emission factors, where necessary
Verify Project Performance

- Reserve requires annual third-party verification by an accredited verification body
- Develop companion verification project protocol to guide verifiers
- Risk assessment and data sampling exercise
  - Site visits and desktop review of data to ensure no material misstatements (+/- 5%)
Ozone Depleting Substances
Background – Montreal Protocol

- Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol):
  - Phased out worldwide production and consumption of most Ozone Depleting Substances (ODS)

- Led to an amendment of the U.S. Clean Air Act (CAA) in 1990
  - Title VI Stratospheric Ozone Protection: authorizes the U.S. Environmental Protection Agency (EPA) to manage the phase out of ODS
  - ODS include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons, carbon tetrachloride, methyl chloroform, methyl bromide, and hydrobromofluorocarbons (HBFCs)
  - Some, like HCFCs and methyl bromide are still in the process of being phased out

- Montreal Protocol and Title VI of the CAA do not forbid the use of existing or recycled controlled substances beyond the phase out dates
Background – Kyoto Protocol

- Continued use and disposal of ODS contribute to both ozone depletion and climate change

- Global warming potentials (GWPs) for common ODS range from ~ 1,000 to 10,000

- Because production was already regulated by the Montreal Protocol, ODS were not included in the Kyoto Protocol
  - ODS emission reduction projects are not eligible for offsets under the Clean Development Mechanism (CDM)
Background – Common uses

- CFCs and HCFCs are commonly used in:
  - Refrigeration and air conditioning applications
  - Blowing agents for foam manufacturing
  - Propellants in spray cans

- Halons and carbon tetrachloride are used in fire suppression applications

- Accessible banks in the U.S. are estimated at over 1,400 MMTCO$_2$e (EPA, 2007)
Organization of Presentation

- Presentation of each class of ODS separately
- Discussion of cross-cutting issues (regulation, ownership, tracking, verification) together at the end

<table>
<thead>
<tr>
<th>Refrigerants</th>
<th>Foams</th>
<th>Fire Suppressants</th>
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<tr>
<td>commercial/industrial</td>
<td>building/construction</td>
<td>stockpiled</td>
</tr>
<tr>
<td>consumer appliances</td>
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<td>equipment</td>
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<tr>
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Project – Refrigerants

- Refrigerants used in commercial and industrial refrigeration and A/C systems, and residential appliances
  - Recovered from industrial equipment when upgrades, decommissioning, or servicing occurs
  - Removed from residential appliances at end-of-life

- Assumption: eventual fate is 100% fugitive release from leaky equipment (10-90%/year leak rates)

- Project: collection and destruction by incineration at a qualifying facility

- CFC 11: 4,750
- CFC-12: 10,900 GWP
- HCFC-22: 1,810 GWP
- HCFC-123: 77 GWP
- R-502: 4,700 GWP
Project – Fire Suppressants

- Used in fire suppression equipment
  - Released through leaks and discharge of equipment
- Storage tanks, cylinders, etc. being stockpiled for future use
  - Average annual leak rates of 4.5 – 5%, eventually recharges equipment

- Halon 1301: 7,140 GWP (for “flooding” fire suppression)
- Halon 1211: 1,890 GWP (portable fire extinguishers)
- Halon 2402: 1,620 GWP

- Assumption: eventual fate is 100% release through use
- Project: collection and destruction by incineration at a qualifying facility
Project – Foams

- ODS used as a blowing agent for certain foams:
  - appliance insulation (refrigerators, A/C, etc.)
  - insulation in building materials
- ODS is released during shredding, and in landfill

  - CFC-11: 4,750 GWP (appliance insulation)
  - HCFC-141b: 725 GWP (building insulation)

- **Assumption**: 50-65% will be released
- **Project**: collection, extraction, and destruction at a qualifying facility
Discussion – Regulatory Status

- What is the regulatory framework for ODS?
  - Refrigerants?
  - Fire suppressants?
  - Foams?

- Certain HCFCs will not be completely phased out of production until 2030 in developed countries and 2040 in developing countries
  - Should there be any provisions for allowing reductions to be claimed for these ODS?
Discussion – Performance Standard

- What are the current incentives and common practice for 1) recycling ODS and 2) destroying ODS?
  - Refrigerants?
  - Fire suppressants?
  - Foams?

- For refrigerants and fire suppressants, replacements must be considered
  - Can the replacements, some with higher GWP, be adequately accounted for?
Discussion – Additionality

- Are imports available either legally or illegally?
  - i.e., will destroyed ODS simply be replaced by a new source, with no or diminished net reduction?

- Can chain of custody and origin of ODS be tracked and verified?
  - What might such a data management system look like?
  - What verification challenges will this entail?
Discussion – Destruction Facility

- How many RCRA-approved hazardous waste combustors exist in the U.S.?
  - Are there further requirements of an ODS destruction facility?

- Can adequate chemical analysis of destroyed materials be conducted at destruction facilities?

- Is this information verifiable?
Discussion – Ownership

- Who is the project proponent?
  - Recovery operation, aggregator, or destruction facility?
  - For each, what are the implications for verification?

- What defines a project?
  - An on-going operation or a discrete action?
  - Will one provide greater verification challenges?
Discussion – Prioritization

- The Reserve may not be able to pursue all project types simultaneously
  - Which of the project types on the previous slides should the Reserve prioritize?
Issues for Future Discussion

- Issues to be discussed in stakeholder workgroup process
  - Given that emissions would accrue on a rolling basis, should the Reserve consider forward-crediting?
  - Are assumptions of 100% eventual fugitive emissions valid?
References

1. EOS Climate, Methodology for Ozone Depleting Substances Destruction Projects (2008)
2. EPA, Destruction of Ozone Depleting Substances, prepared by ICF International (Draft 2008)
LUNCH
N$_2$O at Nitric Acid Plants
Background – Industry

- Nitric acid is a primary input in the production of fertilizer and certain explosives
- Produced in approximately 40 plants in the U.S.
- Estimated 2007 GHG emissions of 21.7 Tg CO$_2$e in U.S.
Background – Process

- 2 step process:
  - Ammonia is first oxidized over a precious metal gauze catalyst to form NO and NO₂
  - Absorption in water creates HNO₃

- Bi-products of these reactions are NO, NO₂, and N₂O

- Pollution control technology targets NOₓ
Background – Abatement

- 2 NOx abatement technologies in the U.S.
  - Non-selective catalytic reduction (NSCR)
    • Catalysts include platinum, rhodium, palladium
    • Controls up to 80% of N₂O in addition to NOx
    • Installed until late-1970s
    • Requires high temperature and energy inputs
  - Selective catalytic reduction (SCR)
    • Catalysts include petoxide, platinum, iron/chromium oxides
    • Does not control N₂O, only NOx
    • Lower cost of operation, lower temperature requirements
    • Employed in 80% of U.S. nitric acid plants
Opportunity

- 80% of U.S. nitric acid plants employ SCR, releasing N₂O untreated to the atmosphere
  - Emissions range up to 12 kg N₂O / t HNO₃

- Two proven CDM methodologies exist:
  - AM 0028: *Catalytic N₂O destruction in the tail gas of Nitric Acid or Caprolactum Production Plants*
    - 15 projects, estimated 7,415,849 tCO₂e/yr*
  - AM 0034: *Catalytic reduction of N₂O inside the ammonia burner of nitric acid plants*
    - 42 projects, estimated 9,942,836 tCO₂e/yr*

*6 projects and 1,049,696 tCO₂e/yr are under both AM 0028 and AM 0034
Project – Secondary Abatement (AM 0034)

- Places a secondary catalyst inside the reactor vessel, beneath primary gauze, and destroys N$_2$O almost instantaneously

- Advantages:
  - Low capital cost
  - Can be employed at most plants

- Disadvantages
  - Lower destruction efficiencies
  - Monitoring difficulties (must rely on EFs)
Project – Tertiary Abatement (AM 0028)

- Involves treatment of the $N_2O$ in the tailgas, within a separate chamber
  - Can be situated in a number of places, depending on the engineering of the plant

- Advantages:
  - High destruction efficiency
  - Ability to monitor $N_2O$ destruction directly

- Disadvantages:
  - High capital cost, extensive engineering
  - Not suitable for all acid plants
  - Requires high temperatures and fuel inputs (e.g., $CH_4$)
Discussion – Additionality

- Regulatory
  - What is the status of potential regulation of N\textsubscript{2}O at nitric acid plants?
    - How will this effect the availability of projects?
    - What might N\textsubscript{2}O regulation look like?
    - Emissions intensity or part of cap?

- Performance Threshold
  - What is the U.S. market penetration of N\textsubscript{2}O abatement technology at pre-existing plants?
  - What is common practice for new nitric acid plants?
  - Do current carbon costs justify the necessary investment?
  - Are there sufficient technical/technological resources and expertise to support projects?
Discussion – Definition

- Should the protocol pursue secondary and/or tertiary abatement?
  - Should both be included in a single protocol?
  - What is the uncertainty associated with emission factors used for secondary treatment?
  - What is the uncertainty associated with CEMS used for tertiary treatment?
  - Are there significant data management challenges with either/both?
  - Are there specific verification challenges with either/both?
Discussion – Other Issues

- Ownership of credits?

- Should the protocol allow for projects at NSCR facilities?
  - If NSCR removes 80% of N$_2$O, is there opportunity?

- Can SCR facilities be retrofitted to NSCR?
  - Could this be a viable project type?

- Are there resources or approaches other than CDM methodologies?
References

1. AM0028: Catalytic N\textsubscript{2}O destruction in the tail gas of Nitric Acid or Caprolactam Production Plants
2. AM0034: Catalytic reduction of N\textsubscript{2}O inside the ammonia burner of nitric acid plants
3. AM0051: Secondary catalytic N\textsubscript{2}O destruction in nitric acid plants
4. EFMA, Production of Nitric Acid (2000)
Potential Project Types for Industrial Gases
Purpose

- Explore project activities that reduce/avoid release of high GWP gases
- Present what we know and our ideas
- Discuss what you know and your ideas
- Not making decisions today on what protocols to develop, but

you are the experts and we want your input!
 Agenda

- Evaluating project types for protocol development
- Potential project types
  - HFCs from commercial refrigeration systems
  - HFCs from foam blowing agents
  - SF$_6$
  - NF$_3$
  - PFCs
  - Others?
- Discussion
Evaluating Project Types

- What is the likelihood that the sector will be part of a GHG cap?
- Are there existing methodologies or protocols that could serve as a starting point?
- What are the potential total GHG reductions from this type of project activity?
- Are there high quality datasets related to the sector?
- Are there positive or negative environmental impacts from this type of project activity?
- Is the project type amenable to standardization?
- Does the project type create direct or indirect emission reductions?
ODS Substitutes

- Use and emissions of HFCs and PFCs significantly increased since 1990; will likely accelerate over next decade

Emissions of HFCs and PFCs from ODS Substitutes by Sector (TgCO₂e)

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<tr>
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<tr>
<td>Fire protection</td>
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<td>+</td>
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</tr>
</tbody>
</table>

+ Does not exceed 0.5 Mg

HFCs -
Commercial Refrigeration Systems

- Commercial refrigeration systems using HFCs
- Project: Reducing HFC leak rates through leak detection management systems OR equipment replacement

Issues/Questions

- Pending and future regulation?
- Potential quantity of projects?
- Data available to set performance standards?

Equipment replacement:
  - How do you establish baseline?
  - When do you credit reductions?
HFCs - Foam Blowing Agents

- Project: Avoid release of HFCs used as blowing agent during production of rigid polyurethane foam
  - Replace HFCs with low- or no- GWP blowing agents

Issues/Questions

- Potential for regulation?
- Potential size and quantity of projects?
- Major release at end of life, not at manufacturing - when do you credit reduction?
- Length of crediting period
- Other environmental impacts of replacements?
**PFCs**

- Used in semiconductor manufacturing and created as a byproduct in aluminum production
- Semiconductor project: Management improvements to minimize release of PFCs
- Aluminum project: Process improvements to minimize creation of PFCs

**Issues/Questions**

- Strong voluntary commitments (and measured reductions) with industries already in place
- Pending and future regulation?
- What are specific opportunities in semiconductor industry?
**SF$_6$**

- Used in electricity generation, magnesium production and semiconductor manufacturing sectors
- Project: SF$_6$ leak reduction from existing applications OR replacement with alternative gas

**Issues/Questions**
- Strong voluntary commitments (and measured reductions) with industries already in place
- Pending and future regulation?
- Expense of SF$_6$ - financial incentive to manage?
- Substitutes available?
NF$_3$

- Introduced as a substitute for PFCs; primarily for semiconductor manufacture
- Estimated emissions have ↑ as plasma product sales ↑
- Project: NF$_3$ leak reduction from existing applications through increased destruction efficiency OR replacement with alternative gas

Issues/Questions
- Not a Kyoto gas, but high GWP - being grouped into “fluorinated gases”
- Pending and future regulation?
- Very high expected destruction efficiency, but no reporting requirements
Discussion

Let’s hear from you!
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