China Adipic Acid Production Protocol Version 1.0

Public Comment Webinar

September 6 (USA) / September 7 (Beijing)
Simultaneous Translation

• Meeting will utilize simultaneous translation provided by Speed Asia
• To switch languages from English to Mandarin, select “Chinese” as highlighted below from your Zoom panel

• Attendees that are listening under the interpretation setting will be able to hear the translation at a higher volume, and English will be present at a lower volume
• Attendees that prefer Mandarin may follow along using the Mandarin slides provided in the chat
Housekeeping

• All attendees are in listen-only mode
• Please submit your questions in the Zoom question box and we’ll try to answer them at the end, time permitting
• We will follow up via email to answer any questions not addressed during the meeting
• The slides and a recording of the presentation will be posted online on the Climate Action Reserve website
AGENDA

➢ Climate Action Reserve

➢ Background on adipic acid production industry

➢ Protocol development process/timeline
  • REMINDER:
    • Public Comments are due by September 18 (USA)

➢ Protocol Overview
  • Project definition
  • Project ownership
  • Additionality
  • Permanence
  • Quantification
  • Monitoring / reporting / verification

➢ Next steps
Climate Action Reserve

• Mission: to develop, promote and support innovative, credible market-based climate change solutions that benefit economies, ecosystems and society

• Develop high-quality, stakeholder-driven, standardized carbon offset project protocols for global carbon credit markets

• Accredited Offset Project Registry under the California cap-and-trade program, Washington cap-and-invest program, and CORSIA

• Serve compliance and voluntary carbon markets

• Reputation for integrity and experience in providing best-in-class registry services for offset markets
DEVELOPMENT PROCESS & TIMELINE
Background: Why Reduce Emissions From Adipic Acid Production in China?

• Adipic acid’s primary use is in the manufacturing of nylon 6,6-polyamide
• Nitrous Oxide (N\textsubscript{2}O) is a by-product of adipic acid production (AAP)
  – Global warming potential 265 times that of CO2 (IPCC AR5)
• Over 3 million metric tonnes of global production in 2015
  – US and China are two of the largest sources
• Production in China is expected to increase 5.5%
• Climate Action Reserve developed an US Adipic Acid Protocol in September 2020
• Installing N\textsubscript{2}O abatement technology is an important step in reducing global emissions
<table>
<thead>
<tr>
<th>Organization</th>
<th>Individual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascend Performance Materials</td>
<td>Chris Johnson</td>
</tr>
<tr>
<td>Ascend Performance Materials</td>
<td>Brian Clancy-Jundt (Alternate)</td>
</tr>
<tr>
<td>China National Chemical Energy Conservation Center</td>
<td>Hanna Zhang</td>
</tr>
<tr>
<td>ClimeCo Corporation LLC</td>
<td>Lauren Mechak</td>
</tr>
<tr>
<td>Futurepast, Inc</td>
<td>John Shideler</td>
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<tr>
<td>GHD Pty Ltd</td>
<td>Yusi Li</td>
</tr>
<tr>
<td>Invista</td>
<td>Yuwen Wang</td>
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<tr>
<td>Ruby Canyon Environmental, Inc</td>
<td>Phillip Cunningham</td>
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<tr>
<td>Ruby Canyon Environmental, Inc</td>
<td>Issai Medellin (Alternate)</td>
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<tr>
<td>Shenma Nylon Chemical Company</td>
<td>Liu Wei</td>
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<tr>
<td>Shenma Nylon Chemical Company</td>
<td>Li Xiaoye (Alternate)</td>
</tr>
<tr>
<td>SinoCarbon Innovation and Investment Co. ltd</td>
<td>Tang Jin</td>
</tr>
</tbody>
</table>
Protocol Development Timeline

1. Kick-off meeting (March 2023)
2. Workgroup process (May – June 2023)
   - Meeting 1 (May 24 / 25, 2023)
   - Meeting 2 (June 15 / 16, 2023)
3. Revisions based on workgroup feedback (May – August 2023)
4. 30-day public comment period (August 18 – September 18, 2023)
5. Revisions based on public comments (September 2023)
6. Propose to Board adoption (October 2023)
PROTOCOL OVERVIEW
Protocol Overview

- Project definition
- Project ownership
- Additionality
- Quantification
- Monitoring
- Reporting & Verification
• Defined as: the installation and operation of a new, previously uninstalled N\textsubscript{2}O abatement technology AND/OR the enhancement of an existing control technology at a single plant that results in the reduction of N\textsubscript{2}O emissions

• “Enhancement” constitutes the implementation of a capital investment expenditure to improve abatement efficiency of existing controls compared to historical efficiency levels

• It is possible to register multiple projects at one facility, each with its own start date, crediting period, registration, and verification
## Approved N₂O Control Technologies for Adipic Acid Projects

<table>
<thead>
<tr>
<th>Abatement Type</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catalytic Destruction</td>
<td>Destroy N₂O using a catalyst – selective catalytic reduction (SCR) or non-selective catalytic reduction (NSCR)</td>
<td>Noble or precious metal catalysts</td>
</tr>
<tr>
<td>Thermal Destruction</td>
<td>Destroy N₂O using flame burners with pre-mixed CH₄ or natural gas</td>
<td>Thermal Reduction Units (TRUs)</td>
</tr>
<tr>
<td>Recycle to Nitric Acid</td>
<td>Recycle N₂O to create nitric acid by burning the gas at high temperatures with steam</td>
<td>Nitrogen recycling adiabatic reactor</td>
</tr>
<tr>
<td>Recycling / Utilization Technologies</td>
<td>Utilize N₂O as a reactant or input to produce other products</td>
<td>Using N₂O off gas as an oxidant to produce phenol from benzene</td>
</tr>
</tbody>
</table>
Project Ownership (Section 2.3)

• “Project developer” is the entity with an active account with the Reserve and is responsible for project reporting and verification
  – May be facility owners, entities that specialize in project development, abatement technology suppliers, or other entities
• Must demonstrate clear ownership of the GHG reductions
• Ownership must be established by clear and explicit title and the Project Developer must sign the Reserve’s Attestation of Title form
Eligibility Rules (Section 3)

• Only projects located at AAPs in China are eligible
  – Regions subject to China’s Emissions Trading Scheme (ETS) that cover N₂O abatement at adipic acid plants are excluded

• Start date is defined as the completion of the initial startup testing of the abatement technology but must be no more than 9 months after the date on which production first commences after the installation or enhancement of specific N₂O control technology
  – Must be submitted to the Reserve within 12 months of the start date for listing

• Crediting period is 10 years from the start date unless it becomes legally required

• May be eligible for a second crediting period for a project lifespan of 20 years
  – Must meet eligibility requirements of the most recent protocol when applying for second CP
  – Begins the day following the end of the first crediting period
Additionality Requirements (Section 3.4)

• Must be additional – yield a surplus of GHG reductions that are additional to what would have occurred in the absence of the value of the carbon credits

• Must satisfy the following two tests:
  – Performance Standard Test
    • Installing one of the four approved N₂O control technologies and/or enhancing an existing one
  – Legal Requirements Test
    • Passes when there are no laws, regulations, or other legally binding mandates requiring the installation of N₂O abatement technology
    • Projects required to abate N₂O emissions under China’s Emissions Trading Scheme or China’s Certified Emissions Reduction Scheme are not eligible
Defining Additionality (Section 3.4.3)

• Other measures taken in the protocol to ensure additionality

1. Establishes a 90% baseline abatement efficiency or historical, maximum abatement efficiency of previous 5 years.
   - No credit issuance for days that fall below the baseline abatement efficiency

2. Production cap on credit issuance based on an AAPs nameplate capacity
   - Specified to avoid non-additional crediting simply for the purpose of creating credits, i.e., the market is not demanding the increased adipic acid supply
   - Must notify the Reserve if increasing production capacity over 10%
   - If over 10%, project developer must demonstrate market demand
Regulatory Compliance (Section 3.5)

• Project developers must attest that project activities do not cause material violations of applicable laws (e.g., air, water quality, safety, etc.)
• Must sign the Attestation of Regulatory Compliance at each verification
• Must disclose in writing all instances of legal violations caused by project activities
• If the verifier and the Reserve determine that project activities have caused a material violation, then CRTs will not be issued for GHG reductions that occurred during the period(s) when the violation occurred
• Administrative violations and “acts of nature” do not impact crediting
  – Re-occurring administrative violations related to project activities may affect crediting
GHG QUANTIFICATION
Section 4

SSR: Sources, Sinks, and Reservoirs
Relevant gases: CO$_2$, CH$_4$, N$_2$O
Emission Reductions = Baseline Emissions – Project Emissions

Baseline Emissions

BE
Equation 5.2
Baseline Emissions

TE\textsubscript{N2O}
Equation 5.3
Total Annual N\textsubscript{2}O Emissions Before any Emissions Control Treatment

HNO\textsubscript{3}\textsubscript{Ratio}
Equation 5.4
Nitric Acid Use Ratio

Project Emissions

PE
Equation 5.5
Project Emissions

PE\textsubscript{N2O}
Equation 5.6
Project N\textsubscript{2}O Emissions in the Off Gas Routed from Emissions Control Units

PE\textsubscript{HC}
Equation 5.7
Project Emissions from Hydrocarbon Use

PE\textsubscript{EE}
Equation 5.10
Project Emissions from Increased External Energy Use

CO\textsubscript{2,HC}
Equation 5.8
Project CO\textsubscript{2} Emissions from Hydrocarbon Use

CH\textsubscript{4,HC}
Equation 5.9
Project CH\textsubscript{4} Emissions from Hydrocarbon Use

SE
Equation 5.11
Project Emissions from Steam Export

OGU
Equation 5.12
Project Emissions from Off Gas Utilization

OGH
Equation 5.13
Project Emissions from Off Gas Heating

CO\textsubscript{2,FF}
Equation 5.14
Project Emissions from Fossil Fuel and Electricity Use
Quantification (Section 5)

**Equation 5.1. Calculating GHG Emission Reductions**

\[ ER = BE - PE \]

Where,

<table>
<thead>
<tr>
<th>( ER )</th>
<th>Total emission reductions for the reporting period</th>
<th>( tCO_2e )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( BE )</td>
<td>Total baseline emissions for the reporting period, from all SSRs in the GHG Assessment Boundary, see Equation 5.2</td>
<td>( tCO_2e )</td>
</tr>
<tr>
<td>( PE )</td>
<td>Total project emissions for the reporting period, from all SSRs in the GHG Assessment Boundary, see Equation 5.5</td>
<td>( tCO_2e )</td>
</tr>
</tbody>
</table>
Baseline Emission (Section 5.1)

**Equation 5.2. Baseline Emissions**

\[
BE = \left[ (TE_{RP,N_2O} \times (1 - AE_{BL})) + (HNO_3_{Ratio} \times AA_{RP} \times 0.0025) \right] \times GWP_{N_2O}
\]

Where,

- **BE** = Baseline emissions during the reporting period (tCO₂e)
- **TE\textsubscript{RP,N₂O}** = Measured total N₂O emissions in off gas during the reporting period ‘RP’ before any emissions control treatment (e.g., abatement), see Equation 5.3 (tN₂O)
- **AE\textsubscript{BL}** = Baseline N₂O abatement efficiency; equal to the maximum abatement achieved in the 5-year lookback period if abatement was ever greater than 90%, or equal to 90% if there is no previous N₂O abatement or previous abatement was below 90%. See Section 5.1.2 for details. (%, as a decimal)
- **HNO\textsubscript{3Ratio}** = Ratio of HNO₃ to AA, see Equation 5.4. (tHNO₃/tAA)
- **AA\textsubscript{RP}** = Measured adipic acid production in the project reporting period ‘RP’ (tAA)
- **0.0025** = IPCC emission factor for N₂O emissions per HNO₃ production (tN₂O/tHNO₃)
- **GWP\textsubscript{N₂O}** = Global warming potential of N₂O (tCO₂e/tN₂O)
## Baseline Abatement Efficiency Based on the Pre-Project Scenario (Section 5.1.2)

<table>
<thead>
<tr>
<th>Pre-Project Scenario</th>
<th>90% Baseline</th>
<th>Maximum $A_{E, BL}$ in 5-year lookback period</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Abatement</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Abatement below 90% with enhancement and not previously listed under a carbon offset program</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Current abatement below 90% with enhancement, previously listed under a carbon offset program but not actively reporting</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Abatement above 90% with enhancement and not previously listed under a carbon offset program</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Current abatement above 90% with enhancement, previously listed under a carbon offset program but not actively reporting</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Project Emissions (Section 5.2)

**Equation 5.5. Project Emissions**

\[ PE = PE_{N_2O} + PE_{HC} + PE_{EE} \]

*Where,

\[ PE \] = Total project emissions during the reporting period \[ \text{tCO}_2\text{e} \]

\[ PE_{N_2O} \] = Measured \( N_2O \) emissions in the off gas from project \( N_2O \) control units during the reporting period (Equation 5.6) \[ \text{tCO}_2\text{e} \]

\[ PE_{HC} \] = GHG emissions from the use of hydrocarbons as a reducing agent or to reheat off gas during the reporting period (Equation 5.7) \[ \text{tCO}_2\text{e} \]

\[ PE_{EE} \] = GHG emissions from external energy used to reheat the off gas during the reporting period (Equation 5.10) \[ \text{tCO}_2\text{e} \]
Equation 5.6. Project N₂O Emissions in the Off Gas Routed from Emissions Control Units

\[ \text{PE}_{N_2O} = \left[ \sum_{cu} (F_{RP,cu} \times N_2O_{RP,conc,cu} \times OH_{RP,cu}) + \sum_{ncu} (F_{RP,ncu} \times N_2O_{RP,conc,ncu} \times OH_{RP,ncu}) \right] \times GWP_{N_2O} \]

Where,

- \( PE_{N_2O} \): Measured N₂O emissions in the off gas from project control units during the reporting period (tCO₂e)
- \( F_{RP,cu} \): Volume flow rate in the off gas during the reporting period ‘RP’ from the N₂O control unit (m³/hour)
- \( F_{RP,ncu} \): Volume flow rate in the off gas during the reporting period ‘RP’ from the non-N₂O control unit (m³/hour)
- \( N_2O_{RP,conc,cu} \): N₂O concentration in the off gas during the reporting period ‘RP’ from the N₂O control unit ‘cu’ (tN₂O/m³)
- \( N_2O_{RP,conc,ncu} \): N₂O concentration in the off gas during the reporting period ‘RP’ from non-N₂O control unit ‘ncu’ (tN₂O/m³)
- \( OH_{RP,cu} \): Operating hours in reporting period ‘RP’ by N₂O control unit ‘cu’ (hours)
- \( OH_{RP,ncu} \): Operating hours in reporting period ‘RP’ by non-N₂O control unit ‘ncu’ (hours)
- \( GWP_{N_2O} \): Global warming potential of N₂O (tCO₂e/tN₂O)
- \( cu \): Each installed N₂O emissions control unit (e.g., thermal reduction unit, adiabatic reactor, absorption media, or other N₂O abatement device)
- \( ncu \): Each installed non-N₂O emissions control unit (e.g., selective catalytic reduction unit or other non-N₂O abating device), inclusive of any N₂O emissions bypassed or directly vented to the atmosphere
### Equation 5.7. Project Emissions from Hydrocarbon Use

\[
PE_{HC} = CO_{2HC} + CH_{4HC}
\]

Where,

- \( PE_{HC} \) = Net GHG emissions from the use of hydrocarbons as a reducing agent or to reheat off gas during the reporting period [tCO\(_2\)e]
- \( CO_{2HC} \) = Net GHG emissions as CO\(_2\) from hydrocarbon use during the reporting period [tCO\(_2\)e]
- \( CH_{4HC} \) = Net GHG emissions as CH\(_4\) from hydrocarbon use during the reporting period [tCO\(_2\)e]

(Equation 5.8)
Project Emissions from Increased External Energy Use (Section 5.2.3)

Equation 5.10. Project Emissions from Increased External Energy Use

\[ PE_{EE} = SE + OGU + OGH + CO_{2,net} \]

Where,

- **\( PE_{EE} \)** = Project emissions from external energy during the reporting period. If result is < 0, use a value of 0
- **\( SE \)** = Emissions from net change in steam export during the reporting period (Equation 5.11) t\( \text{CO}_2\text{e} \)
- **\( OGU \)** = Emissions from net change in off gas utilization during the reporting period (Equation 5.12) t\( \text{CO}_2\text{e} \)
- **\( OGH \)** = Emissions from net change in off gas heating during the reporting period (Equation 5.13) t\( \text{CO}_2\text{e} \)
- **\( CO_{2,net} \)** = Net increase in CO\(_2\) emissions from increased fossil fuel and/or electricity use due to project activity (Equation 5.14) t\( \text{CO}_2 \)
MONITORING AND QA/QC REQUIREMENTS
Project Monitoring (Section 6)

• A monitoring plan must be established for all monitoring and reporting activities associated with the project to ensure all requirements of the protocol are met.

• Must follow relevant sections of the Professional Standard of the People’s Republic of China, HJ 75-2017, Specifications for Continuous Emissions Monitoring of SO₂, NOₓ, and Particulate Matter in the Flue Gas Emitted from Stationary Sources – as indicated in protocol Sections 6.1 - 6.3.

• HJ 75-2017 provides guidance on the standards of performance for continuous emission monitoring systems (CEMS) for NOₓ emission measurements, which is also applicable to N₂O emission testing at AAPs.

• Initial Monitoring Requirements:
  – System installation and certification
  – Calibration
  – Accuracy testing
Project Monitoring (Section 6)

• Ongoing Monitoring Requirements:
  – Daily monitoring to ensure quality hourly data recorded by the CEMS
  – Weekly inspections of CEMS components
  – Monthly monitoring system inspections of N\textsubscript{2}O CEMS and flow velocity of continuous monitoring systems (CMS)
  – Quarterly CEMS total system calibration assessments
  – Semiannual CEMS accuracy assessments
REPORTING AND VERIFICATION CYCLES
Reporting Period and Verification Cycle (Section 7.3)

• Reporting period: length of time that GHG emission reductions from project activities are quantified
  – Maximum 12 months, but may be sub-annual (e.g., monthly, quarterly, semi-annually)
  – Each reporting period must be verified by a third-party verification service
  – Must be continuous

• Verification cycle: length of time over which GHG emission reductions from project activities are verified
  – Site visits are required for every 24 months of data
  – After the initial reporting period, two reporting periods may be verified at once

• Verification documents are required to be submitted to the Reserve no more than 12 months after the end of the reporting period.
Questions?
NEXT STEPS
Next steps

• **For interested stakeholders:**
  – Public Comment Draft available on the Protocol webpage
  – Submit comments by **September 18 (USA)**

• **For Reserve:**
  – Review and respond to comments
  – Incorporate feedback into the final draft
  – Bring the protocol to the Board of Directors for adoption on October 4
Key contacts

• *Climate Action Reserve:*
  – Rachel Mooney, Senior Associate
  Email: rmooney@climateactionreserve.org
THANK YOU!