CLIMATE ACTION RESERVE

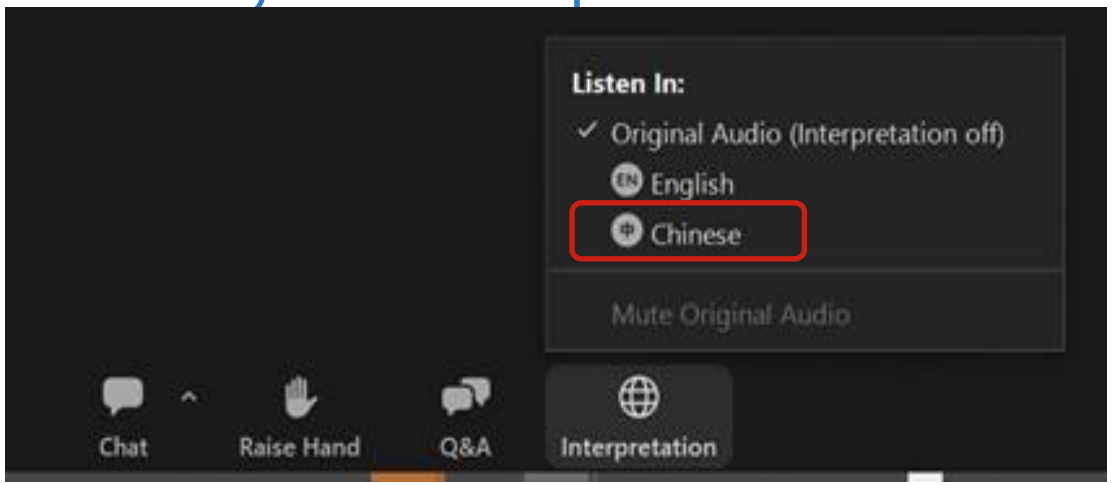
China Adipic Acid Production Protocol Version 1.0

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

CLIMATE ACTION RESERVE

- Adipic Acid
- Forest
- Forest (ARB)
- Grassland
- Landfill
- Livestock
- Livestock (ARB)
- Mine Methane
- Mine Methane (ARB)
- Nitric Acid Production
- Nitrogen Management
- Organic Waste Composting
- Organic Waste Digestion
- Ozone Depleting Substances
- Ozone Depleting Substances (ARB)
- Soil Enrichment

978 Listed, New, Registered & Completed Projects as of August 28, 2023

Climate Action Reserve

Voluntary & Compliance

>600 Projects

190M+ Credits Issued

Industrial Protocols

US Adipic Acid Production

Nitric Acid Production

Ozone Depleting Substances

DEVELOPMENT PROCESS & TIMELINE

Background: Why Reduce Emissions From Adipic Acid Production in China?

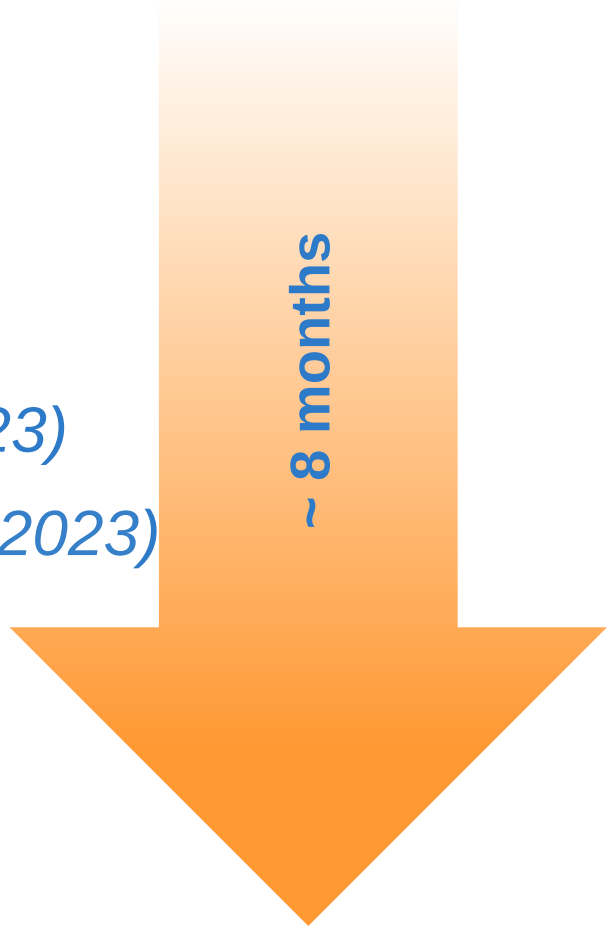
- Adipic acid's primary use is in the manufacturing of nylon 6,6-polyamide
- Nitrous Oxide (N_2O) is a by-product of adipic acid production (AAP)
  - Global warming potential 265 times that of CO2 (IPCC AR5)
- Over 3 million metric tonnes of global production in 2015
  - US and China are two of the largest sources
- Production in China is expected to increase 5.5%
- Climate Action Reserve developed an US Adipic Acid Protocol in September 2020
- Installing N_2O abatement technology is an important step in reducing global emissions

Workgroup Participants

Organization	Individual
Ascend Performance Materials	Chris Johnson
Ascend Performance Materials	Brian Clancy-Jundt (Alternate)
China National Chemical Energy Conservation Center	Hanna Zhang
ClimeCo Corporation LLC	Lauren Mechak
Futurepast, Inc	John Shideler
GHD Pty Ltd	Yusi Li
Invista	Yuwen Wang
Ruby Canyon Environmental, Inc	Phillip Cunningham
Ruby Canyon Environmental, Inc	Issai Medellin (Alternate)
Shenma Nylon Chemical Company	Liu Wei
Shenma Nylon Chemical Company	Li Xiaoye (Alternate)
SinoCarbon Innovation and Investment Co. ltd	Tang Jin

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

ELIGIBILITY REQUIREMENTS

Project Definition (Section 2.2)

- Defined as: the installation and operation of a new, previously uninstalled N_2O abatement technology AND/OR the enhancement of an existing control technology at a single plant that results in the reduction of N_2O 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

Project Definition (Section 2.2)

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Approved N_2O Control Technologies for Adipic Acid Projects

Abatement Type	Description	Example
Catalytic Destruction	Destroy N_2O using a catalyst – selective catalytic reduction (SCR) or non-selective catalytic reduction (NSCR)	Noble or precious metal catalysts
Thermal Destruction	Destroy N_2O using flame burners with pre-mixed CH_4 or natural gas	Thermal Reduction Units (TRUs)
Recycle to Nitric Acid	Recycle N_2O to create nitric acid by burning the gas at high temperatures with steam	Nitrogen recycling adiabatic reactor
Recycling / Utilization Technologies	Utilize N_2O as a reactant or input to produce other products	Using N_2O off gas as an oxidant to produce phenol from benzene

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 N_2O 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 N_2O 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 N_2O 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 N_2O abatement technology
    - Projects required to abate N_2O 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

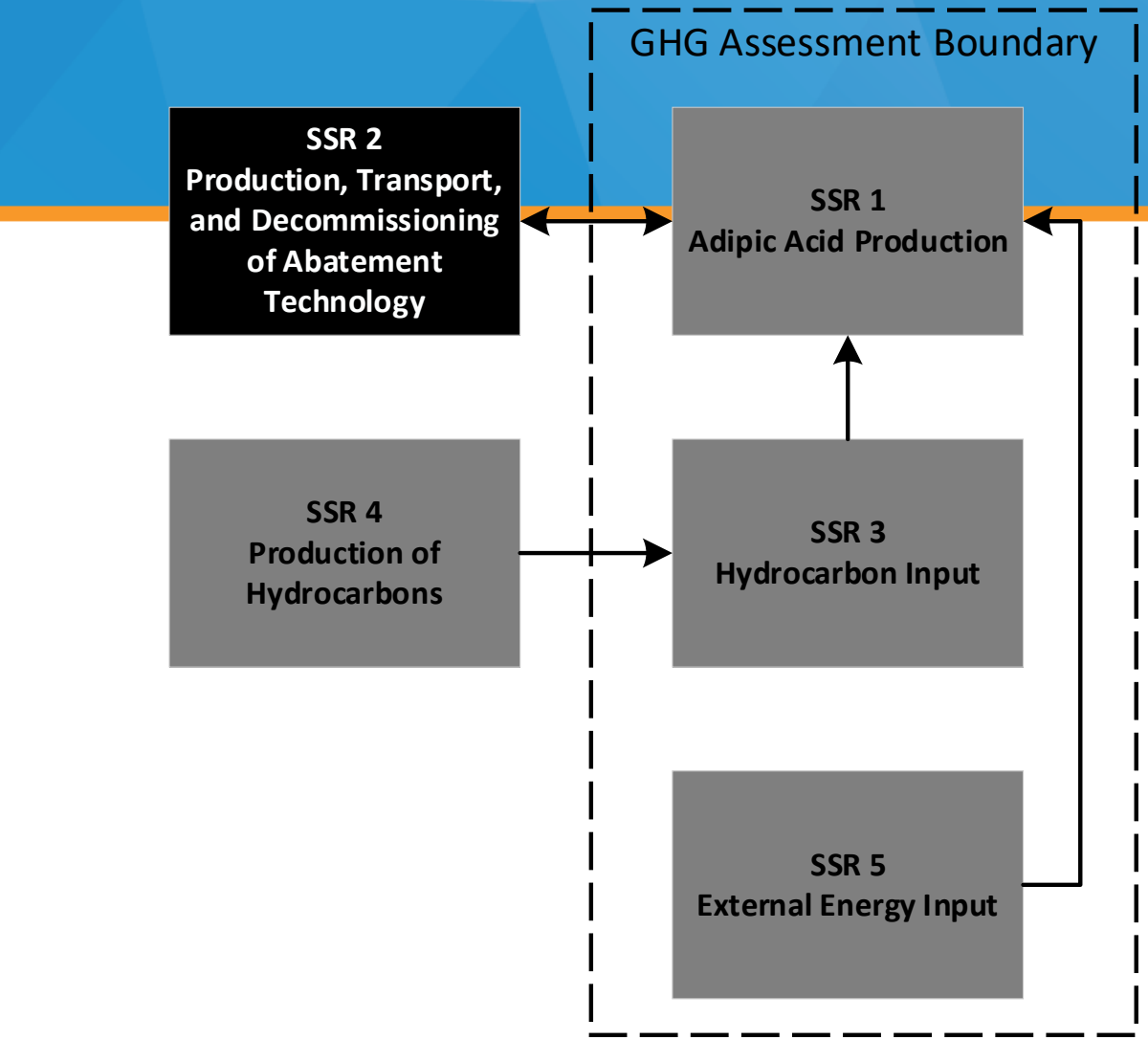
1. Establishes a 90% baseline abatement efficiency or historical, maximum abatement efficiency of previous 5 years.
   - No credit issuance for days that fall below the baseline abatement efficiency
2. Production cap on credit issuance based on an AAPs nameplate capacity
   - Specified to avoid non-additional 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_2O

ER
Equation 5.1

Emission Reductions = Baseline Emissions – Project Emissions

Baseline Emissions

BE
Equation 5.2
Baseline Emissions

- $TE_{y,N2O}$ **Equation 5.3** Total Annual N_2O Emissions Before any Emissions Control Treatment
- $HNO_{3,Ratio}$ **Equation 5.4** Nitric Acid Use Ratio

Project Emissions

PE
Equation 5.5
Project Emissions

- PE_{N2O} **Equation 5.6** Project N_2O Emissions in the Off Gas Routed from Emissions Control Units
- PE_{HC} **Equation 5.7** Project Emissions from Hydrocarbon Use
  - $CO_{2,HC}$ **Equation 5.8** Project CO_2 Emissions from Hydrocarbon Use
  - $CH_{4,HC}$ **Equation 5.9** Project CH_4 Emissions from Hydrocarbon Use
- PE_{EE} **Equation 5.10** Project Emissions from Increased External Energy 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
  - $CO_{2,net}$ **Equation 5.14** Project Emissions from Fossil Fuel and Electricity Use

Quantification (Section 5)

Equation 5.1. Calculating GHG Emission Reductions

$$\boldsymbol{ER = BE - PE}$$

Where,			Units
ER	=	Total emission reductions for the reporting period	tCO_2e
BE	=	Total baseline emissions for the reporting period, from all SSRs in the GHG Assessment Boundary, see Equation 5.2	tCO_2e
PE	=	Total project emissions for the reporting period, from all SSRs in the GHG Assessment Boundary, see Equation 5.5	tCO_2e

Baseline Emission (Section 5.1)

Equation 5.2. Baseline Emissions

$$BE = \left[\left(TE_{RP,N_2O} \times (1 - AE_{BL}) \right) + (HNO_{3\,Ratio} \times AA_{RP} \times 0.0025) \right] \times GWP_{N_2O}$$

Where,

			Units
BE	=	Baseline emissions during the reporting period	tCO_2e
$TE_{RP,N2O}$	=	Measured total N_2O emissions in off gas during the reporting period '*RP*' before any emissions control treatment (e.g., abatement), see Equation 5.3	tN_2O
AE_{BL}	=	Baseline N_2O 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 N_2O abatement or previous abatement was below 90%. See Section 5.1.2 for details.	%, as a decimal
HNO_{3Ratio}	=	Ratio of HNO_3 to AA, see Equation 5.4.	$tHNO_3/tAA$
AA_{RP}	=	Measured adipic acid production in the project reporting period '*RP*'	tAA
0.0025	=	IPCC emission factor for N_2O emissions per HNO_3 production	$tN_2O/tHNO_3$
GWP_{N2O}	=	Global warming potential of N_2O	tCO_2e/tN_2O

Baseline Abatement Efficiency Based on the Pre-Project Scenario (Section 5.1.2)

Pre-Project Scenario	90% Baseline	Maximum AE_{BL} in 5-year lookback period
No Abatement	X	
Abatement below 90% with enhancement and not previously listed under a carbon offset program	X	
Current abatement below 90% with enhancement, previously listed under a carbon offset program but not actively reporting	X	
Abatement above 90% with enhancement and not previously listed under a carbon offset program		X
Current abatement above 90% with enhancement, previously listed under a carbon offset program but not actively reporting		X

Project Emissions (Section 5.2)

Equation 5.5. Project Emissions

$$PE = PE_{N_2O} + PE_{HC} + PE_{EE}$$

Where,			Units
PE	=	Total project emissions during the reporting period	tCO_2e
PE_{N2O}	=	Measured N_2O emissions in the off gas from project N_2O control units during the reporting period (Equation 5.6)	tCO_2e
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)	tCO_2e
PE_{EE}	=	GHG emissions from external energy used to reheat the off gas during the reporting period (Equation 5.10)	tCO_2e

N_2O Emissions in the Off Gas (Section 5.2.1)

Equation 5.6. Project N_2O Emissions in the Off Gas Routed from Emissions Control Units

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

Where,			Units
PE_{N2O}	=	Measured N_2O emissions in the off gas from project control units during the reporting period	tCO_2e
$F_{RP,cu}$	=	Volume flow rate in the off gas during the reporting period '*RP*' from the N_2O control unit	m^3/hour
$F_{RP,ncu}$	=	Volume flow rate in the off gas during the reporting period '*RP*' from the non-N_2O control unit	m^3/hour
$N_2O_{RP,conc,cu}$	=	N_2O concentration in the off gas during the reporting period '*RP*' from the N_2O control unit *'cu'*	tN_2O/m^3
$N_2O_{RP,conc,ncu}$	=	N_2O concentration in the off gas during the reporting period '*RP*' from non-N_2O control unit *'ncu'*	tN_2O/m^3
$OH_{RP,cu}$	=	Operating hours in reporting period '*RP*' by N_2O control unit *'cu'*	hours
$OH_{RP,ncu}$	=	Operating hours in reporting period '*RP*' by non-N_2O control unit *'ncu'*	hours
GWP_{N2O}	=	Global warming potential of N_2O	tCO_2e/tN_2O
cu	=	Each installed N_2O emissions control unit (e.g., thermal reduction unit, adiabatic reactor, absorption media, or other N_2O abatement device)	
ncu	=	Each installed non-N_2O emissions control unit (e.g., selective catalytic reduction unit or other non-N_2O abating device), inclusive of any N_2O emissions bypassed or directly vented to the atmosphere	

Project Emissions from Hydrocarbon Use (Section 5.2.2)

Equation 5.7. Project Emissions from Hydrocarbon Use

$$PE_{HC} = CO_{2_{HC}} + CH_{4_{HC}}$$

Where,

			Units
PE_{HC}	=	Net GHG emissions from the use of hydrocarbons as a reducing agent or to reheat off gas during the reporting period	tCO_2e
CO_{2HC}	=	Net GHG emissions as CO_2 from hydrocarbon use during the reporting period (Equation 5.8)	tCO_2e
CH_{4HC}	=	Net GHG emissions as CH_4 from hydrocarbon use during the reporting period (Equation 5.9)	tCO_2e

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,			Units
PE_{EE}	=	Project emissions from external energy during the reporting period. If result is < 0, use a value of 0	tCO_2e
SE	=	Emissions from net change in steam export during the reporting period (Equation 5.11)	tCO_2e
OGU	=	Emissions from net change in off gas utilization during the reporting period (Equation 5.12)	tCO_2e
OGH	=	Emissions from net change in off gas heating during the reporting period (Equation 5.13)	tCO_2e
$CO_{2,net}$	=	Net increase in CO_2 emissions from increased fossil fuel and/or electricity use due to project activity (Equation 5.14)	tCO_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 SO_2, NO_x, 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 NO_X emission measurements, which is also applicable to N_2O 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_2O 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.

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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

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THANK YOU!