DRAFT COMPETITION GUIDELINES

Version 1.4

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ADDITIONAL TECHNICAL SPECIFICATIONS WILL BE MADE AVAILABLE IN THE FINAL COMPETITION GUIDELINES PRIOR TO THE END OF REGULAR REGISTRATION (APRIL 2016).

THE XPRIZE FOUNDATION MAY REVISE THESE GUIDELINES DURING THE COURSE OF THE COMPETITION TO PROVIDE ADDITIONAL INFORMATION OR TO IMPROVE THE QUALITY OF THE COMPETITION. THERE MAY ALSO BE UNANTICIPATED ISSUES THAT WILL REQUIRE MODIFICATIONS TO THIS DOCUMENT. THE XPRIZE FOUNDATION RESERVES THE RIGHT TO REVISE THESE GUIDELINES AS IT, IN ITS SOLE DISCRETION, DEEMS NECESSARY OR DESIRABLE. REGISTERED TEAMS WILL BE NOTIFIED OF ANY REVISIONS.

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COMPETITION OVERVIEW

The purpose of the NRG COSIA Carbon XPRIZE (the "PRIZE") is to incentivize innovative approaches to addressing carbon emissions and better understand the potential for converting carbon dioxide (CO_2) into high-value products. An Eligible Entry must be a solution that is originally developed or implemented (e.g. must not violate or infringe on any applicable law or regulation or third-party rights). Eligible Entries must perform all activities necessary to produce one or more end products from a flue gas stream (either an actual flue gas stream from an electric power plant or a simulated flue gas stream) whose economic value will be determined and judged. Activities may include capturing and separating the CO_2 and creating one or more end products, or converting CO_2 from the flue gas stream directly into products.

COMPETITION STRUCTURE

Two Tracks

The competition will operate along two parallel Competition Tracks. In **Competition Track A**, Teams will demonstrate their technologies using a flue gas stream consistent with emissions from coal power generation. In **Competition Track B**, Teams will demonstrate their technologies using a flue gas stream consistent with emissions from natural gas power generation. Competition Tracks A and B will run in parallel, but will be adjudicated completely independently. Progress and success in Competition Track A does not imply commensurate progress or success in Competition Track B, and vice versa.

Registration

Teams are free to submit Entries in either Track A or Track B, or in both Tracks A and B. Teams may submit multiple competition Entries in a single Competition Track, provided that each entry represents a distinct technology approach and CO_2 conversion product.

Three Rounds

The Competition will take place in three (3) rounds over 54 months (4.5 years). After each round only the top teams, as determined by the Judging Panel, will remain eligible to compete in the next round.

- Round 1: Teams will choose a track and submit technical and business information about their technology, process, potential products, and how they plan to achieve the technical requirements and goals of the competition. Teams will be assessed and ranked based on these submissions. *In each track*, up to 15 teams will move onto Round 2.

- Round 2: Teams will demonstrate technologies in a controlled environment (such as a laboratory), using a simulated power plant flue gas stream. Teams must meet minimum

requirements and will be scored on how much CO_2 they convert and the net value of their products. *In each track*, up to five teams will move onto Round 3 and share a $2.5 million milestone purse.

- Round 3: Teams will demonstrate technologies under real world conditions, at a larger scale. Teams will have access to two test centers adjacent to existing power plants, and will prove their technologies using actual power plant flue gas. Teams must meet minimum requirements and will be scored on how much CO_2 they convert and the net value of their products. *In each track*, the winner will be awarded a $7.5 million grand prize.

SCORING CRITERIA AND PERFORMANCE THRESHOLDS

During Round 1, Teams will be evaluated on the two Scoring Criteria and Performance Thresholds (see Tables 1 and 2), as well as on their required submissions of technical and business information (see "Round 1: Technical and Business Viability Assessment"). During Round 2 and Round 3, Teams will be evaluated exclusively using the Scoring Criteria and Performance Thresholds described below (see Tables 1 and 2). Standard technical specifications and economic values that will be used in judging are explained in Addendum A.

Scoring Criteria

Teams will receive a score in each of two categories: CO_2 Converted and Net Value. Each Team's final score will consist of a sum of these two scores, with equal weight. To be eligible to compete and receive points in either category, Teams must present designs that also operate within the Performance Thresholds.

TABLE 1. ***Summary of Scoring Criteria and Performance Thresholds***

Criteria	Performance Threshold to Compete	Judging
CO_2 Converted	Must convert at least 30% of the CO_2 in the flue gas stream	50% of points awarded
Net Value	None	50% of points awarded
Fresh Water Consumed	Must consume less than 4 cubic meters of fresh water per metric ton of CO_2 converted	Pass/Fail
Land Footprint	Must have a total land footprint less than ~2,300 square meters (25,000 square feet) at Round 3 scale.	Pass/Fail

CO_2 Converted is the amount of CO_2 converted from the specified flue gas stream over a fixed test and evaluation period. CO_2 converted will be expressed as a percentage. Teams must convert at least 30% of CO_2 from the specified flue gas stream to be eligible to compete. Teams must convert at least 50% of the CO_2 from the specified flue gas stream to receive points. A Team converting between 30% and 49% of CO_2 in the flue gas stream will not be eliminated, but will receive a CO_2 Converted score of zero.

Teams will receive additional points for performance above 50%. Some examples of CO_2 conversion scores:

- A Team converting 75% of the CO_2 receives a score of 75
- A Team converting 52% of the CO_2 receives a score of 52
- A Team converting 48% of the CO_2 receives a score of 0
- A Team converting 34% of the CO_2 receives a score of 0
- A Team converting 22% of the CO_2 is eliminated

The flue gas stream used in Round 2 will be a simulated flue gas stream; the flue gas stream used in Round 3 will be an actual flue gas stream from a full-scale, operating electric power generating station. The specifications of the flue gas streams used in Round 2 and Round 3 are described in "Competition Timeline" below. (See also example data in Tables 5, 6, 7). The exact duration and

nature of the test and evaluation periods used to determine CO_2 Converted scores will be published and provided to Teams on or before the start of Round 2 testing in October 2016.

Net Value is the economic value of the product(s) made from converted CO_2, minus the cost of inputs and any cost associated with waste disposal, multiplied by a function of market size. Additional detail on the net value formula, and examples of product calculations, are included in Addendum B.

The Net Value score is normalized to 100 (see Addendum B) and added to the CO_2 Converted score to determine a total score. Unlike CO_2 Converted scores, which are calculated and scored directly from chemical conversion data, a Team's Net Value score is calculated relative to the performance of the other Teams in the competition. Table 2 provides hypothetical examples for how CO_2 Converted and Net Value scores can be combined for a total score.

Performance Thresholds

Teams must also meet three Performance Thresholds for fraction of CO_2 Converted (must meet or exceed 30%), for Fresh Water Consumed, and for Land Footprint. Any Team receiving a "fail" on any Performance Threshold will be eliminated from the competition.

Fresh Water Consumed is defined fresh water that meets fresh process water standards at each Round 3 Test Facility (see Addendum A). Fresh Water Consumed refers to evaporated, un-recycled, or un-replaced fresh water used in a Team's process. Teams must not consume more than four (4) cubic meters of fresh water per metric ton of CO_2 converted. XPRIZE will seek to ensure that the specification for water is comparable for both Competition Tracks. Water below this quality standard, including as grey water or other wastewater, salt water, and water in the flue gas stream, will not count toward this maximum. All fresh water consumed, including process water and cooling water (but excluding water that is recycled as part of the process, as in a closed loop system), will count toward this maximum.

Land Footprint is the physical footprint for a Round 3 Demonstration-scale plant that converts CO_2 from a flue gas stream containing at least two (2) metric tons of CO_2 per day. The maximum land footprint will be finalized and published based on available land at each Test Facility, but is expected to be 2,300 square meters (25,000 square feet). This threshold represents the maximum land footprint that will be made available to Teams at Test Facilities in Round 3.

TABLE 2. ***Hypothetical Examples of Combined Final Scores***

Team	Net Value and Market Size Raw Score	Net Value and Market Size Normalized Score	% CO_2 Converted	CO_2 Converted Score	Final Score
A	736	**82.7**	54.4	**54.4**	**137.1**
B	890	**100.0**	49.0	**0**	**100.0**
C	584	**65.6**	65.3	**65.3**	**130.9**
D	-40	**-4.5**	90.0	**90**	**85.5**
E	840	**94.4**	20.0	**Eliminated**	**Eliminated**
F	200	**22.5**	45.0	**0**	**22.5**
G	300	**33.7**	75.0	**75**	**108.7**
H	-250	**-28.1**	85.5	**85.5**	**57.4**
I	870	**97.8**	50.5	**50.5**	**148.3**
J	160	**18.0**	91.0	**91**	**109.0**

PRIZE PURSES

Milestone Prizes

There will be a Milestone Prize Purse in the amount of $5 million. Of this amount, $2.5 million will be for Competition Track A (coal) and $2.5 million will be for Competition Track B (natural gas). In each Competition Track, $2.5 million will be split evenly among up to five (5) Finalists whose performances in Round 2 receive the highest scores in each Competition Track as tabulated according the scoring procedures (see Tables 1 and 2). All prize purses are denominated and will be awarded in United States dollars (USD).

Grand Prizes

There will be a Grand Prize Purse in the amount of $15 million. Of this amount, $7.5 million will be for Competition Track A (coal) and $7.5 million will be for Competition Track B (natural gas). For each Competition Track, $7.5 million will be awarded to the Team whose performance in Round 3

receives the highest score in that Competition Track as tabulated according the scoring procedures (see Tables 1 and 2).

COMPETITION TIMELINE AND ACTIVITIES

The PRIZE Competition will take place over three (3) Rounds over 54 months (4.5 years). Table 3 outlines the anticipated timeline for the Competition.

TABLE 3. *Competition Calendar*

MONTH/YEAR	EVENT
April 2015	Pre-Launch activities begin
30 September 2015	Launch Teams may submit intent to compete Registration begins
ROUND 1: TECHNICAL AND BUSINESS VIABILITY ASSESSMENT (12.5 MONTHS)	
30 April 2016	Regular Registration Deadline
15 July 2016	Late Registration Deadline Round 1 Submission Deadline
16 July 2016 to 30 September 2016	Judging panel reviews Round 1 Submissions
August / September 2016	Judging summit
ROUND 2: PILOT SCALE COMPETITION (14 MONTHS)	
15 October 2016	Semi-finalists announced Round 2 begins
15 August 2017	Round 2 Submission Deadline
16 August 2017 to 31 October 2017	Third party verifies performance data at Team sites
1 November 2017 to 15 December 2017	Judging panel reviews Round 2 Submissions Judging summit
ROUND 3: DEMONSTRATION SCALE COMPETITION (27.5 MONTS)	
15 December 2017	Finalists announced Milestone purses awarded Round 3 begins
1 June 2018	Test Facilities open to Teams for assembly and testing
1 June 2019	Round 3 operational period begins (final competition where Teams operate technologies under competition rules and oversight)
28 February 2020	Round 3 operational period ends
1 March 2020 to 31 March 2020	Judging panel reviews Round 3 operational data Judging summit
31 March 2020	Winner announced and grand prize purse awarded Awards ceremony

Round 1: Technical and Business Viability Assessment

1. Registration. A Team's participation in Round 1 may begin upon Team's submission of the Intent to Compete Form online. The online Portal will be open to all prospective and registered Teams. For details concerning the Intent to Compete form and Registration, see the Competitor Agreement. Teams may choose to register and compete in either Competition Track A (coal) or Competition Track B (natural gas), or to compete in both Tracks A and B simultaneously by registering two (or more) separate Entries. Teams must must indicate their intention to compete in Track A, Track B, or both at registration, and pay a separate registration fee for each Entry.

The registration fee will be $5,000 per Entry for Teams that register before the Regular Registration Deadline (30 April 2016), and $8,000 per Entry for Teams that register before the Late Registration Deadline (15 July 2016).

2. Round 1 Webinar: Prior to the Round 1 submission deadline, XPRIZE will conduct a webinar for registered teams to present instructions and tips and to answer questions regarding the Round 1 submission. Templates and instructions for the Round 1 submission will also be available on the Team Portal. Round 1 submissions may be modified by the team through the Team Portal at any time prior to the Round 1 submission deadline.

3. Round 1 Submission. Three months following the Registration Deadline all registered Teams must complete and submit a Round 1 Submission (see Table 3). The Round 1 Submission and procedures for its submission will be available on the Team Portal. Each Round 1 Submission must provide detailed information to the Judging Panel regarding the Entry and will be used by the Judges to: (i) determine whether not the Entry satisfies the Performance Thresholds; (ii) in the case of multiple Entries by a single Team, determine whether each Entry submitted by a given Team is substantially different from any other Entry or Entries also registered by the same Team, as required by the Competitor Agreement; and (iii) gain a general understanding of the Entry for use in determining and preparing for technical requirements of testing and judging during the Competition. Round 1 Submissions may be modified by the Team through the Team Portal at any time prior to the Round 1 Submission Deadline, as specified in the Competition Calendar (Table 3).

4. Criteria for Evaluation of Round 1 Submission. Any Entry that clearly fails to satisfy the Performance Thresholds based on the evaluation of the Round 1 Submission Form by the Judging Panel will not be eligible to compete. The burden rests entirely on the Team to present a compelling case for its Entry to the Judging Panel within the parameters of the Round 1 Submission. Teams are

encouraged to consider the following principles when completing their Entry. Round 1 Submissions should be:

- **Clear**: Documentation will be needed to prove and validate the feasibility of the Entry. ***Relevance rather than volume of information will be rewarded;***

- **Concise**: Presentation of all information submitted creates a logical, succinct case for the Entry; and

- **Convincing**: The Entry derives a solid, convincing conclusion for its significance in advancing the field of CO_2 conversion.

5. Round 1 Submission Details. Each completed Round 1 Submission must be submitted via the online Team Portal using the entry forms within. Each Submission should include accurate and detailed information regarding the Entry, including in the following areas:

Technical Approach: Teams must provide a technical description of the proposed solution, including any necessary diagrams, supporting photos, and/or video. Content should include any previous testing and evaluation data that validates the success of this technical approach, if available.

Estimated Inputs and Outputs: Teams must identify the end product(s) they plan to produce including the estimated value per unit and estimated market size and market geographic scope of those end product(s). Teams must estimate the amount of each product they plan to produce per unit of CO_2 converted. Teams must also identify the inputs to the process and estimated cost of inputs per unit, including the cost of waste disposal, if any.

Rough Order of Magnitude (ROM) Cost Estimate: Teams must provide a ROM cost estimate consisting of a best estimate of the anticipated capital and operating costs, per unit of CO_2 converted and per unit of end product in Round 2 and Round 3.

Business Plan: Teams must provide a general plan for how the technology can be financed and built for Round 2 and Round 3. XPRIZE will provide a template for the information that must be included in this plan.

Operations Plan: Teams must provide a plan for how the technology will be operated in Round 2 and Round 3.

Measurement and Verification Plan: Teams must provide a plan and detailed schematic for how the CO_2, other inputs, and quantity and composition of end products can be measured in Round 2 and

Round 3, including detail of measurement devices and methodology. The plan will be used, and may be modified, by the third party employed by the competition who will be responsible for measurement and verification.

Scalability Assessment: Teams must submit a description of the current scale of their technology, including the amount of CO_2 the technology has demonstrated converting into a product and the concentration of CO_2 in the flue gas stream or other source of CO_2 used for conversion. Teams should explain in as much detail as possible their plan for achieving the scale required in Round 2 and in Round 3, including by addressing the following questions:

- What are the anticipated timeline, costs, and technical requirements for achieving the scale required in Round 2 and Round 3?
- What percentage of the technological approach uses or could use commercially available components vs. components that will require new or specialized manufacturing?
- What experience (if any) does the Team have in scaling industrial technologies?

Potential Emissions Profile: Teams must submit a description of how their technology has the potential to reduce CO_2 emissions in the future. This should include an order-of-magnitude estimate of net carbon emissions associated with their technology, including those avoided via direct conversion, and those associated with, for instance, the electric power, commodity chemicals, and other major material inputs.

Other Environmental Impact: Teams must provide a description of how the solution minimizes environmental impact and ensures safety during operations, including specific components of the inputs to and the outputs from the solution that could conceivably require further review of possible environmental impact.

Estimates for Judging Criteria and Performance Thresholds: Teams must provide estimates for how the technology will perform according to the following:

- CO_2 Converted: Amount of CO_2 converted from the specified flue gas stream during the fixed test and evaluation period. CO_2 converted will be expressed as a percentage. Teams must convert at least 30% of CO_2 from the specified flue gas stream to be eligible to compete. Teams must convert at least 50% of the CO_2 from the specified flue gas stream to receive points. Teams will receive additional points for performance above 50%.

- Net Value: Value of the product made from CO_2, minus the cost of inputs and any cost associated with waste disposal, multiplied by a function of market size. Net value will be expressed as USD per unit of CO_2 converted.

- Fresh Water Consumed: Teams must detail how their process will consume less than four cubic meters of fresh water per metric ton of CO_2 converted.

- Land Footprint: Teams must provide an estimated land footprint of their technology based on the minimum amount of CO_2 required in the flue gas stream during Round 3 (2 metric tons of CO_2 per day). If a Team's technology footprint exceeds ~2,300 square meters (25,000 square feet) they will be eliminated.

Team Biographies: Teams must provide a short (one paragraph) biographical description of each Team Member and a listing of funding partners, sponsors, suppliers, and formal collaborators connected with the Team.

6. Updates to Round 1 Submission. Teams will have an opportunity to update their Round 1 Submissions prior to the Round 1 Submission Deadline.

7. Judging. Following the Round 1 Submission Deadline, the Judging Panel will review Entries and rank them based on the Judging Criteria. Entries that do not meet the Performance Thresholds will not be eligible to compete. In addition, because data for these performance metrics will be submitted on paper, rather than evaluating the working technologies, the Judging Panel will also take into account other data in the Round 1 Submission in order to determine the final ranking of Entries.

The Judging Panel will determine how scoring will be weighted among various components of the Round 1 Submission. The proposed scoring factors and relative weight, outside of estimates of CO_2 Converted and Net Value, are as follows:

TABLE 4: *Factors and Weight for Elements of Round 1 Submissions*

CRITERION	WEIGHT
The technology readiness of the technology and its likelihood to be successful in Round 2 and Round 3	25%
The estimated capital and operating expenses for Round 2, Round 3, and post-prize commercialization, including the methodology for projecting these costs	25%
The environmental impact, including any additional permitting that would be required in order to demonstrate the technology at the Test Facility in Round 3	35%
The complexity of operations, measurement, and verification of the technology during Round 2 and Round 3	15%

Judges may identify other important criteria, and include them along with updated scoring weights during Round 1. Any revisions to Round 1 Scoring Criteria and/or weighting will be included in the Final Competition Guidelines that are released prior to Round 1 Submission Deadline (15 July 2016).

Round 2: Pilot-Scale Competition

Round 2 will focus on Pilot-scale testing and will last for fourteen (14) months.

1. Announcement of Semi-Finalists. Up to thirty (30) Semi-Finalists will be announced. Up to fifteen (15) Semi-Finalists will be invited to participate from Competition Track A and up to fifteen (15) Semi-Finalists will be invited to participate from Competition Track B. XPRIZE may also choose to make public the rankings of additional top Teams, or "Runners-Up". These Runners-Up may be eligible to participate in Round 2 if any of the 30 Semi-Finalists withdraw or are eliminated before February 2017, the mid-point of Round 2.

2. Round 2 Submission. During Round 2, which will last a total of fourteen (14) months, Semi-Finalists will demonstrate their technology at Pilot scale. Teams may assemble and operate their Round 2 Pilot at a location of their choosing. Teams must procure at their own expense a simulated flue gas stream from an XPRIZE-approved vendor. The simulated flue gas stream used in Round 2 will represent as close as possible the power plant flue gas stream that will be provided in Round 3 at the Test Facility for each Competition Track. Representative specifications for the simulated flue gas stream for each Competition Track are shown below in Tables 5, 6 and 7. The total volume of simulated flue gas must be sufficient to deliver at least 200 kilograms (kg) of CO_2 per day. Teams may choose to use a total volume of simulated flue gas above this minimum, as long as the simulated flue gas conforms to the specifications (see examples in Table 5, 6, 7). Teams will submit Round 2 performance data by the Round 2 Submission Deadline. A Third Party will measure and verify performance data during an in-person visit and laboratory testing of the end product(s). The Judging Panel will review all performance data, award points, and determine up to five (5) Finalists for each Competition Track.

Teams must operate and provide performance data from the Pilot for a total of 72 hours, including a continuous period lasting 24 hours. Teams must submit performance data electronically through the Team Portal before the Round 2 Submission Deadline as specified in the Competition Calendar (Table 3). Teams that fail to submit performance data by the Round 2 Submission Deadline will be eliminated from the competition.

Teams must submit performance data addressing the Judging Criteria and Performance Thresholds (see Table 1).

3. Measurement and Verification. Following the Round 2 Submission Deadline, an XPRIZE-approved third party will visit each Team's Demonstration to measure and verify the performance data. The order of visits will be chosen randomly. XPRIZE will provide Teams with five (5) business days of notice prior to the third party visit, and each visit will last five (5) business days. During each visit, Teams must operate the Pilot for a total of 72 hours, including a continuous period lasting at least 24 hours, during which time the third party will measure and record performance data. In addition to measurement and verification of the technology and process, the third party will also collect three (3) samples of up to one (1) kilogram each of the end product(s). These samples will be evaluated and must meet the minimum specifications for commodity and other products outlined in the Final Competition Guidelines. For example, if Team Alpha is making methanol, their methanol must meet the minimum specifications for methanol outlined in the Final Competition Guidelines.

All Measurement and Verification activities will be completed within eleven (11) weeks . Because not all third party visits to the Team Pilot sites can be conducted simultaneously, the procedure described below will help ensure that no Team benefits from additional time to improve their technology following the Round 2 Submission Deadline. In the case of discrepancies between the performance data in the Round 2 Submission and performance data collected by the third party during Measurement and Verification, the following rules will apply:

- If performance during Measurement and Verification exceeds the performance data in the Round 2 Submission, then the performance data in the Round 2 Submission will be judged.

- If performance during Measurement and Verification is less than the performance data in the Round 2 Submission, then the performance data recorded during Measurement and Verification will be judged.

4. Judging. The Judging Panel will convene a Judging Summit at which they will review Round 2 Submissions and Third-Party Measurement and Verification performance data for each Team. During Round 2, Teams will be evaluated exclusively based on the Judging Criteria in Table 1. The Judging Panel will discuss and determine the final Round 2 rankings and up to ten (10) Finalist Teams, including up to five (5) Finalist Teams for Competition Track A and up to five (5) Finalist Teams for Competition Track B. Participants shall cooperate with the Judging Panel in any verification activities. Application of the Judging Criteria to eligible Competition entries shall be at the Judging Panel's sole discretion.

Round 3: Demonstration-Scale Competition and Test Facilities

1. Announcement of Finalists and Award of Milestone Prize Purse: Following adjudication of Round 2 results, up to ten (10) Finalist Teams will be announced to kick off Round 3. There will be up to five (5) Finalists announced for each Competition Track. Two $2,500,000 (USD) milestone purses will be split evenly among the Finalists in each Track (see "Prize Purses"), and awarded following as soon as possible following Round 2 adjudication. Finalists will then begin to prepare, design, and build or assemble a Demonstration-scale version of their technology at the Test Facility for their Competition Track. XPRIZE may also choose to make public the rankings of additional top Teams, or "Runners-Up". These Runners-Up may be eligible to participate in Round 3 if any of the ten (10) Finalists withdraw or are eliminated before [date TBD].

2. Round 3 Test Facilities: Round 3 will last a total of twenty seven and one half (27.5) months and take place at two centralized Test Facilities in North America that are specifically designed for testing and evaluating carbon conversion technologies. The Competition Track A Test Facility will be adjacent to a coal power generating station. The Competition Track B Test Facility will be adjacent to a natural gas power generating station. The exact location of the Test Facilities will be published online and shared with Teams before the Regular Registration Deadline (30 April 2016).

3. Technology Development, Assembly, and Configuration:
Teams will have access to each Test Facility on or before June 1, 2018. Teams will have a total of eighteen and one half (18.5) months for technology development and assembly of their technologies at the Test Facility. Teams may choose to arrive at the Test Facility any time after the opening date and before operations begin. While at the Test Facility, Teams will have access to the flue gas stream and other standard inputs described above and may conduct testing and modifications necessary to ready their technologies for operation. Finalists must use a supply of flue gas containing between 2 and 5 metric tons of CO_2 per day, allowing Teams to choose a flue gas flow rate within this range.

3. Round 3 Operation: All Demonstration-scale operational testing will begin in May 2019 (see Table 3). Demonstrations will operate for a nine (9) month period to ensure that technologies are proven during multiple seasons, weather patterns, and/or planned and unplanned power plant outages. Data will be collected on a monthly basis by a third party measurement and verification consultant. During the Demonstration, Teams may make modifications in accordance with guidance from the Judging Panel. However, to be eligible for the Grand Prize Purse, Teams must provide to the Judging Panel at least 150 days of data, including 30 days of continuous operation data.

4. Round 3 Judging: Following the end of the operational period, the Judging Panel will convene at a Judging Summit at each Test Facility. The Judging Panel will evaluate the 150 days, including 30

continuous days, of operational data for each Finalist and determine the Winner for each Competition Track. Teams will be evaluated exclusively based on the Judging Criteria described in "Scoring Criteria and Performance Thresholds" of these Competition Guidelines. The winner of the $7,500,000 purse for Competition Track A will be the Finalist Team in that track that meets the Performance Thresholds and performs the best on the Scoring Criteria (see Table 1). The winner of the $7,500,000 purse for Competition Track B will be the Finalist Team in that track that meets the Performance Thresholds and performs the best on the Scoring Criteria (see Table 1). Participants shall cooperate with the Judging Panel in any verification activities. Application of the Judging Criteria to eligible Competition entries shall be at the Judging Panel's sole discretion.

5. Awards Ceremony: One or more awards ceremonies will take place at an appropriate time and venue to be determined and announced by XPRIZE, at which the Winning Team for each Competition Track will be announced. Actual awarding of the Grand Prize Purse will take place as soon as possible after the awards ceremony or ceremonies.

6. Post-Prize Decommissioning: Teams may remain at each Test Facility for [TBD time period] following the end of the Competition. During this time, they may collect additional operational data, show the Demonstration to potential funders, partners, and other stakeholders, and conduct additional testing and modifications of the technology. Teams must remove all equipment from the Test Facility by [date TBD], unless a separate agreement is negotiated between the Team and the owner/operator of the Test Facility.

7. Testing Costs and Travel: Teams will be responsible for paying all costs, travel, and miscellaneous expenses associated with Round 3 testing, including transportation and customs for transporting equipment and Team personnel to the Test Facility. Teams will also be responsible for their own lodging, meals, and other related expenses for Team Members participating in the Competition for the duration of the Competition. Each Finalist will be allowed a limited number of Team Members (operations, technical, designers, mechanics, instrumentation, etc.) present at the Test Facility at any given point in time. This number will be based on space, configuration, and safety considerations at the Test Facility, and will be published online and shared with Teams at or before the start of Round 2 in October 2016.

8. Test Facility Resources: XPRIZE will provide access to each Test Facility, facility operations personnel, and standard inputs. Details on any additional lab and/or office facilities available for use by Finalist Team Members at Test Facilities will be published and shared with Teams at or before the start of Round 2 in October 2016.

XPRIZE will provide the following standard inputs to each Finalist at each Test Facility. While the configuration of the Test Facilities for Competition Track A and Competition Track B may differ, XPRIZE will ensure the following standard inputs are comparable at both Test Facilities:

- A testing bay not exceeding ~2,300 square meters (25,000 square feet)
- Flue gas stream containing between 2 and 5 metric tons of CO_2 per day. (*Note: Relative flue gas composition will remain fixed. Teams may select an input flue gas flow rate within a range commensurate with CO_2 mass flow rates of between 2 and 5 metric tons per day.)*
- Supply of electricity
- Supply of fresh water
- 24/7 on-site security

9. Example Specifications of Flue Gas and Test Facility Standard Inputs:

Tables 5 - 8 provide example specifications for the flue gas streams, and other standard inputs available to be made available at each Test Facility. These Tables show representative quantities and variables only. Final, accurate specifications that reflect flue gas streams and other standard inputs available at each Test Facility will be published and shared with Teams on or before the Regular Registration Deadline in April 2016.

Table 5 [EXAMPLE ONY]: *Flue gas composition and typical plant operating conditions.*

CATEGORY	HOURLY AVG.	HOURLY MAX.	HOURLY MIN.	DAILY TOTAL
Load, Gross MW	373.1	375.1	365.3	
Flue Gas Flow Rate, SCF/Hr	55,683,105	56,451,167	54,976,770	
Temperature, F	201.4	211.2	198.0	
Heat Input, MMBtu/Hr	3,624	3,659	3,559	
CO_2, % Concentration	11.75	11.89	11.62	
CO_2, Tons	380	384	373	9,121
CO, lb/MMBtu	0.031	0.095	0.005	
CO, lb/Hr	114	344	17	2,729
SO2, PPM (1)	49	57	34	
SO2, lb/MMBtu (1)	0.13	0.15	0.09	
SO2, lb/Hr (1)	455	531	313	10,919
NOx, PPM	169	176	163	
NOx, lb/MMBtu	0.316	0.330	0.303	
NOx lb/Hr	1,144	1,188	1,106	27,450

Table 6 [EXAMPLE ONLY]: *Representative emission test data at nominal full load test conditions.*

CATEGORY	VALUE
Filterable Particulate Matter (PM) <10 Microns, Lb/Hr	7.547
Filterable Particulate Matter (PM) <10 Microns, Lb/MMBtu	0.0021
Sulfuric Acid Mist, Lb/Hr	8.73
Sulfuric Acid Mist, Lb/MMBtu	0.0023
Moisture, %	15.0, +/- 2.0
Dry Gas Molecular Wt., lb/lb-mole	30.4, +/- 0.2

Table 7 [EXAMPLE ONLY]: *Maximum levels of pollutants in flue gas per ton of CO_2*

POLLUTANT	MAX. LIMIT PER TON CO_2 (LBS)
Nitrogen Oxides (NOX)	3.12
Carbon Monoxide (CO)	0.91
Sulfur Dioxide (SO2)	1.39
Filterable Particulate Matter (PM) <10 Microns	0.02

Table 8 [EXAMPLE ONLY]: *Specifications for Other Standard Inputs*

INPUT	SPECIFICATION
AC electric power	e.g. 2 MVA, 480 V at each test bay
DC electric power	TBD
Electrical switchgear (e.g. transformers, MCC)	TBD
Process water	TBD
Fresh water	TBD
Water disposal infrastructure (e.g. piping, tanks)	TBD
Waste heat	TBD

TEAM SUMMITS

Teams will be required to participate in one or more Team Summits during the competition. External stakeholders may also be invited to attend. Team Summits will be an opportunity for Teams to interact and collaborate with each other, industry, academic, government, and other stakeholders involved in CO_2 conversion, and potential investors and partners. Team Summits may take place in conjunction with an existing related conference, depending on the exact date and location. Alternatively, the Team Summit may take place at a sponsor facility or site. The specific dates and locations of Team Summits will be determined well in advance of the event.

LEADERBOARDS

XPRIZE may implement interim status reports and/or other information postings describing the progress of the Teams involved in the Competition ("Leaderboards") to help engage key audiences in the Competition and promote Teams by providing public and industry visibility. Rules and Regulations pertaining to Leaderboard programs will be periodically published and Teams will be encouraged to participate. During Round 3, some operational data from Finalists may be shared on a Leaderboard, with Team consent.

SCIENTIFIC ADVISORY BOARD

XPRIZE will form a panel of relevant subject matter and technical experts to serve as the "Scientific Advisory Board" for the Competition. The Scientific Advisory Board (SAB) will remain in place throughout the Competition to advise XPRIZE regarding the scientific and economic elements of the Competition. Each member of the Scientific Advisory Board ("Advisor") will enter into an Agreement with XPRIZE that will: (i) outline Advisor's duties and obligations; (ii) require Advisor to maintain confidentiality of XPRIZE's and Teams' Confidential Information, in accordance with the Agreement; and (iii) require Advisor to acknowledge that he or she shall make no claim to any Team's Intellectual Property.

Composition of Scientific Advisory Board

The total number of SAB members will be determined by XPRIZE and will not exceed ten (10) members. NRG and ConocoPhillips, acting on behalf of COSIA, will each have the right to appoint one (1) member to the SAB. The SAB will be independent of XPRIZE, NRG, COSIA, ConocoPhillips and other COSIA Participating Members, and all Teams and Team Members. No Advisor, nor any member of Advisor's immediate family, shall participate, nor have any financial or other material interest, in any Team or Team Member. All members of the SAB shall promptly disclose to XPRIZE any

such current, former, or expected future conflict of interest with XPRIZE and/or any Team or Team Member.

Role of Scientific Advisory Board

The duties and responsibilities of the Scientific Advisory Board may include, but not be limited to: (i) assisting with the establishment of qualifications for prospective Judges; (ii) recommending members of the Judging Panel; (iii) providing input related to testing protocols and judging criteria, including the standard technical specifications and economic values; (iv) and providing input toward the development of these Competition Guidelines.

JUDGING PANEL

The "Judging Panel" (as defined in the Agreement) will be comprised of highly qualified and impartial Judges. XPRIZE, in its sole and absolute discretion, will recommend Judging Panel candidates to the Scientific Advisory Board for its review and consideration. The Scientific Advisory Board will recommend the candidates it believes are best suited to serve on the Judging Panel. Each Judge will enter into a Judging Agreement with XPRIZE that will: (i) outline the Judge's duties and obligations; (ii) require each Judge to maintain confidentiality of XPRIZE's and Team's Confidential Information in accordance with the Competitor Agreement; and (iii) require each Judge to acknowledge that he or she shall make no claim to any Team's Intellectual Property.

Independence of Judging Panel

The Judging Panel will be independent of XPRIZE, NRG, COSIA, ConocoPhillips and other COSIA Participating Members, and all Teams and Team Members. No Judge, nor any member of Judge's immediate family, shall participate, nor have any financial or other material interest, in any Team or Team Member. All members of the Judging Panel shall promptly disclose to XPRIZE any such current, former, or expected future conflict of interest with XPRIZE, NRG, COSIA, any COSIA Participating Member companies, and/or any Team or Team Member.

Role of Judging Panel

The duties and responsibilities of the Judging Panel will include, but not be limited to: (i) evaluating Teams' compliance with the Agreement, these Guidelines, and the Rules and Regulations for the purposes of the Competition; and (ii) the awarding of points and selection of Teams and Entries that will proceed to each subsequent phase of the Competition.

Grounds for Judging Panel Decisions

Official decisions made by the Judging Panel will be approved by a majority vote of the Judges, following careful consideration of the testing protocols, procedures, guidelines, rules, regulations, criteria, results, and scores set forth in the Agreement, these Competition Guidelines (including the Rules and Regulations to be attached hereto), and all other applicable Exhibits to the Agreement. If any vote of the Judges results in a tie, then the Judging Panel shall determine, in its sole and absolute discretion, the mechanism to settle the tie. Similarly, if one or more Teams or Entries are tied at any stage during the competition, the Judging Panel shall have the sole and absolute discretion to settle the tie. If no Entry meets the criteria for Award, then the Judging Panel will retain sole and absolute discretion to declare or not declare a winner of the Competition and/or otherwise allocate or choose not to allocate one or more of the Awards and/or any other Award associated with the Competition.

Decisions of Judging Panel Are Final

The Judging Panel shall have sole and absolute discretion: (i) to allocate duties among the Judges; (ii) to determine the degree of accuracy and error rate that is acceptable to the Judging Panel for all Competition calculations, measurements, and results, where not specified in the Rules and Regulations; (iii) to determine the methodology used by the Judging Panel to render its decisions; (iv) to declare the winners of the Competition; and (v) to award the Prize Purses and other Awards. Decisions of the Judging Panel shall be binding on XPRIZE, the Team, and each Team Member. XPRIZE and the Team agree not dispute any decision or ruling of the Judging Panel, including decisions regarding the degree of accuracy or error rate of any Competition calculations, measurements, and results. The Team shall have no right to observe other Teams' testing or evaluation, or to be informed of other Teams' calculations, measurements and results, unless such information is made publicly available by XPRIZE.

ADDENDUM A: STANDARD TECHNICAL SPECIFICATIONS AND ECONOMIC VALUES

In order to calculate scores in Round 2 and Round 3, Judges will use standard specifications and values for common products and inputs. XPRIZE will retain one or more technical consultants with expertise in technical and market analysis to make recommendations regarding the technical specifications and economic values listed below. These recommendations will be reviewed by the Scientific Advisory Board and approved by Judges.

Standard technical specifications and economic values will be published in the Final Competition Guidelines prior to the Regular Registration Deadline in April 2016. Teams will be notified during the registration period of any revisions or updates to these values. Judges, with input from the Scientific Advisory Board, will determine whether additional revisions are necessary within 30 days of the beginning of both Round 2 and Round 3.

Teams must request specifications and values for products and inputs not initially included in the Competition Guidelines. Teams will also have the option to submit recommendations and evidence regarding any specifications and values during the public comment period and, if allowed by the Judges, prior to Round 2 and Round 3.

Judges will approve specifications and values for the following (all prices will be expressed in USD):

- Minimum specifications for anticipated products
- Market size of anticipated products
- Price of anticipated products
- Price of electricity
- Price of waste heat
- Specification for water provided at the test facilities
- Specification(s) for other water
- Price of water provided at the test facilities
- Price of other water
- Price of waste disposal provided at the test facility
- Price of common or anticipated chemical inputs
- Price of common or anticipated mineral inputs
- Any other specifications and values for products and inputs requested by teams

ADDENDUM B: NET VALUE METHODOLOGY

The net value calculation proposed here is intended to encourage a diversity of CO_2 conversion technologies and end products while incentivizing solutions that, when commercialized, are likely to have applicability to the massive scale of global CO_2 emissions. In order to be a credible part of a portfolio of technologies to address this problem, CO_2 conversion must create products that can address some reasonable amount of CO_2 when commercialized at scale.

Rather than choosing an arbitrary threshold that might exclude potential technologies and end products from the competition, XPRIZE has developed a market function formula that seeks to incentivize and reward technologies along a curve based on the total market size for the products produced. Under this formula, a Team producing a single product with a very small market size may end up with a net value score of zero. However, most Teams making known products and Teams who can or choose to make multiple products will receive higher net value scores as the total market size for their product(s) increases. Finally, the formula is designed to reward greater market size only to a point; products with very large markets will not automatically score the highest unless their product value and cost of inputs are also much better than other competitors.

Net Value Calculation for a Single Product

The calculation of scoring for net value includes two fundamental components. The first is simply the net value of the product, equal to the value of the product minus the cost of the inputs necessary to make the product. Note that this value could be negative if the cost of inputs is higher than the product's value and this will result in a negative net value score. The cost of disposal of any waste generated will be considered as part of the cost of inputs. The second part is a weighting factor related to market size of the product(s). This weighting factor is referred to mathematically as *f(market size)* because it is a function of the market size. The purpose of this function is to, within a reasonable range, reward processes capable of making products with larger markets and not reward products with smaller markets. The formula for calculating net value for a single product is as follows:

$$score = (product\ value - cost\ of\ inputs)\ f(market\ size)$$

Where:

- Product value = value of the product per metric ton CO_2 embodied in saleable products
- Cost of inputs = cost of inputs per metric ton CO_2 converted
- The market size multiplier is given by the following:

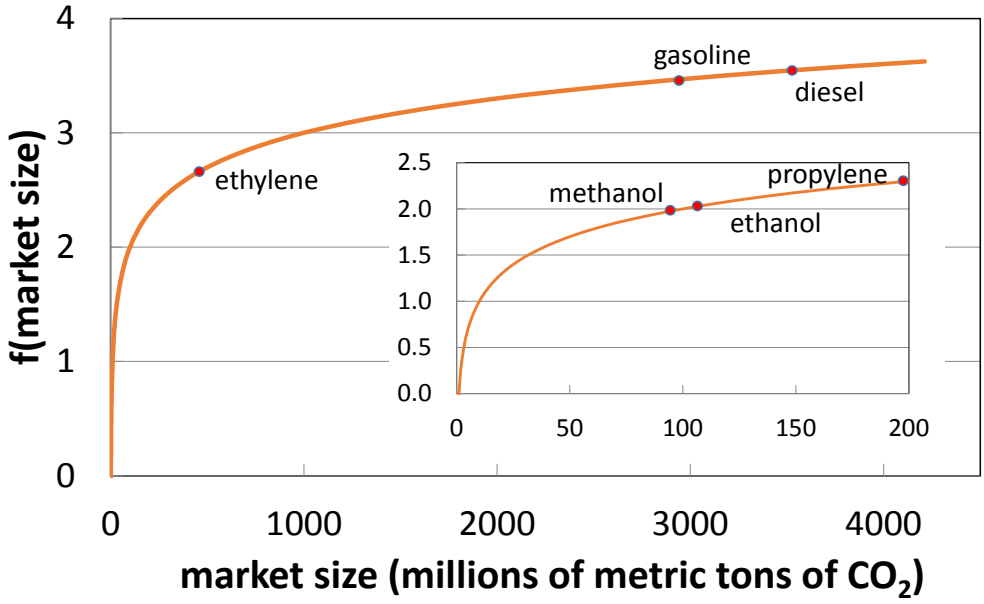
$$f(market\ size) = log_{10}\left(\frac{market\ size}{1x10^6\ metric\ tons\ of\ CO_2}\right)$$

This function of market size was developed to enable the widest possible diversity of products to be competitive. With this function, products with a market size that could consume, in aggregate, between 1-10 million metric tons of CO_2 annually (equivalent to between 100 and 500 MW of coal-based power production) have the potential to achieve a competitive net value score (depending also on the product value and cost of inputs).

This function is also intended to prevent the following scenarios: (i) a Team only capable of making a single product with a very small market but high market value wins; and (ii) *only* Teams making a product with a very large market like gasoline or diesel can win. Products with a market size that would consume, in aggregate, below 1 million metric tons of CO_2 annually will be assigned a net value score of zero. Products with a market size that would consume, in aggregate, more than 10 million metric tons of CO_2 annually will be rewarded by the function, but not in direct proportion to their market size. This is because the value of the multiplier rises from 0 to 1 between 1 and 10 million metric tons but it takes 100 million metric tons for the multiplier to reach a value of 2.

Figure 1 shows the market size multiplier function with several example products. The y-axis represents the value of the market size multiplier and the x-axis represents the potential market size for the product in terms of the aggregate CO_2 that has been converted into the product. The smaller inset shows lower market size values more clearly. It may be useful to consider two hypothetical Teams.

FIGURE 1. Market size multiplier for net value



Team A makes **propylene**, which has a market value of $420 per metric ton of CO_2 converted. Team A has a very good process and their cost of inputs is $100 per metric ton. So, their net value per metric ton of CO_2 converted is $320. The market size for propylene is large enough that 199 million metric tons of CO_2 annually could be converted into propylene. Therefore, the market size multiplier will be log(199/1)=2.30 (also shown in Figure 1). **Team A receives a net value score of 320 x 2.30 = 736.**

Team B has a process that makes **gasoline**, which has a market value of $376 per metric ton of CO_2 converted. Team B has a good process, but their cost of inputs is higher than Team A at $226 per metric ton. So, their net value per metric ton is $150. This is substantially worse than Team A, but gasoline has a much larger market than propylene. Gasoline could consume 2,860 million metric tons of CO_2 annually, giving them a multiplier of log(2860/1)=3.46. **Team B receives a total score of 3.46 x 150 = 519.**

Team A's superior net value more than made up for the market size difference between propylene and gasoline so Team A receives a substantially higher net value score.

Net Value Calculation for Multiple Products

In the event that a Team uses a process that demonstrates capability to make more than one product the net value calculation will consider the value of all of the products made. A market size weighted average of net value will be used and the function of market size will use the sum of all of the product markets to determine the score according to:

$$score = \frac{\sum_i^n market\ size_i (product\ value_i - cost\ of\ inputs_i)}{\sum_i^n market\ size_i} f\left(\sum_i^n market\ size_i\right)$$

To illustrate the use of this method we will consider the already discussed Team A and two new Teams: Team C that can make both formic acid and methanol, and Team D that can make both propylene and ethylene.

Team A makes **propylene**, which has a market value of $420 per metric ton of CO_2 converted. Team A has a very good process and their cost of inputs is $100 per metric ton. So, their net value per metric ton of CO_2 converted is $320. The market size for propylene is large enough that 190 million metric tons of CO_2 annually could be converted into propylene. Therefore, the market size multiplier will be log (199/1)=2.30 (also shown in Figure 1). **Team A receives a net value score of 320 x 2.30 = 736.** Note that there is no difference between this scoring method and the earlier one for Teams that make one product.

When Team C makes **methanol**, which has a market value of $463 per metric ton of CO_2 converted, their cost of inputs is $169 per metric ton of CO_2 converted. When Team C makes **formic acid**, which has a market value of $1150 per metric ton of CO_2 converted, their cost of inputs is $130 per metric ton of CO_2 converted. The market size in terms of CO_2 that could be converted is 89.3 million metric tons for methanol and 0.63 million metric tons for formic acid. Their score is:

$$score = \frac{89.3(463-169)+0.63(1150-130)}{89.3+0.63} log_{10}\left(\frac{89.3+0.63}{1}\right) = \mathbf{584}$$

If Team C they had only made methanol their score would have been 574. The high value of formic acid helps them, but it doesn't help much because its market size is very small.

When Team D makes **propylene**, which has a market value of $420 per metric ton of CO_2 converted, their cost of inputs is $120 per metric ton of CO_2 converted. When they make **ethylene**, which also has a market value of $448 per metric ton of CO_2 converted, their cost of inputs is $125 per metric ton of CO_2 converted. The market size of propylene and ethylene are 199 and 379 million metric tons of CO_2 respectively. Their score is:

$$score = \frac{199(420-120)+379(448-125)}{199+379} log_{10}\left(\frac{199+379}{1}\right) = \mathbf{870}$$

Team A has a lower cost process than Team D for making propylene. But, the flexibility to make two products with significant market size improves Team D's score to the point that they score higher than Team A. When Team C makes formic acid they have the best net value per metric ton of CO_2 converted of the group but this cannot make up for the very limited market size of that product and the low net value of their methanol process.

Another slight variation on multiple product scoring exists when a Team's process makes more than one product simultaneously in ratios that cannot be controlled. We will take for example Team E whose process makes both methanol and formic acid simultaneously. For every 10 metric tons of CO_2 converted their process uses 9 to make methanol and 1 to make formic acid. The process inputs cost $170 per metric ton of CO_2 converted. The market size of methanol is 89.3 million metric tons per year and the market size of formic acid is 0.63 million metric tons per year. Because the Team's process always makes methanol and formic acid in a 9 to 1 ratio and the ratio of market sizes is over 140 to 1 some of the formic acid produced has no market and this makes the real costs of inputs on a per ton basis higher because the same process inputs are required even when some of them are being used to make formic acid that has no market. Only the first 0.63x9=5.7 million metric tons of

CO_2 that go to methanol are co-produced with formic acid that has a market. This can be accounted for as follows:

$$score = \frac{5.7(463-170)+0.63(1150-170)+(89.3-5.7)\left(463-\frac{170}{0.9}\right)}{89.3+0.63} log_{10}\left(\frac{89.3+0.63}{1}\right) = \mathbf{548}$$

This results in a lower score than if the process was capable of making only methanol or if it could make methanol and formic acid in ratios that more closely approximates the ratio of market size for those products.

Normalization of Final Score

The final Net Value score will be determined (normalized) by taking each Team's raw net value score, dividing it by the highest raw net value score in the competition, and multiplying by 100.

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