U.S. DEPARTMENT OF ENERGY

DELIVERABLES TABLE EXAMPLE

Sept. 1, 2021

A deliverables table is a required part of the submission package for Countdown. This deliverables table is an opportunity for competitors to show they understand the full depth and breadth of technical and business outcomes necessary to create a successful company.

The deliverables table is a list of quantifiable development goals (i.e., milestones) that will be accomplished by the time of your Liftoff submission. It will describe the process you will use and evidence you will provide (i.e., deliverables) to show the goals were accomplished. In addition, appropriate justification should be provided to explain the importance of accomplishing the goals as it relates to your company's development and the wider industry. These goals and your ability to accomplish them are a core criterion of the Liftoff Contest assessment.

Examples of types of technical and business deliverables are listed below. This list of metrics and possible assessment tools is not exhaustive. *Competitors should provide deliverables and assessment tools that are relevant for the technology they propose.* Deliverables proposed should be aggressive, achievable, and SMART (specific, measurable, achievable, relevant, and timely). SMART deliverables should define a metric with a quantifiable success value and have a description of the method by which the metric will be assessed to confirm reaching the goal.

Technical Deliverables Examples: power conversion efficiency, minority carrier lifetime, degradation rates, reliability, precursor work time and shelf life, etc.

Business Deliverables Examples: cost and/or value evaluations, stakeholder engagement, facilities contracts, intellectual property licenses, operational practices (e.g., quality management plan), competitive landscape analysis, etc.

More details can be found in the official rules document.

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A deliverable should contain a metric, the quantitative goal for that metric (success value), and the method by which that metric will be assessed to confirm reaching the goal.

- Metric: the dependent variable, or the item being measured responding to the experimental inputs, or independent variable(s). In the example below, the metric is the temperature of the PV module.
- Success Value: Dependent variable target value. If achieved, this performance addresses the problem statement. In the example below, the success value is the prediction of module temperature within 5ºC.
- Assessment Method: A formal method to confirm that the success value has been met with an acceptable level of certainty. In the example below, the assessment method is the comparison of the irradiance-weighted RMS difference between modeled and measured temperature.
- Metric Justification: Explanation of why the chosen metric and success value is a good choice to address the problem.

Deliverable	Performance Metric	Success Value	Assessment Tool / Method of Measuring Success Value	Metric Justification, Additional Notes
1	PV Module Temperature	Absolute temperature prediction for two modules is demonstrated to be within 5 ºC.	Absolute temperature prediction will be assessed by comparing irradiance-weighted RMS difference between modeled and measured temperature.	Reproducing the absolute operating temperature of two different modules with the improved thermal model demonstrates that the tool can predict effects of module materials choices on operating temperature and is thus useful for evaluating design changes.

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EXAMPLE TECHNICAL DELIVERABLES

Competitors should report their full device design (layer/material/thickness/deposition approach/any post-treatment). The same device stack should be used to meet all technical deliverables.

Deliverable	Performance Metric	Success Value	Assessment Tool / Method of Measuring Success Value	Metric Justification, Additional Notes
1	Device Stability	T80 or T90 ≥ X hrs under accelerated test conditions, Y% yield.	Stability measurements are reported as an average with standard deviation across a statistically relevant sample size (including dependent and independent replicas).[1] Competitors should describe and explain why the single or combined stressor(s), severity/severities, target average, target deviation, and number of samples and replicas were chosen as metrics.	Accelerated tests should demonstrate that the technology has no intrinsic degradation pathways that will prevent long term stability.

[1] The following resource from NIST may be helpful when deciding on sample sizes.

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Deliverable	Performance Metric	Success Value	Assessment Tool / Method of Measuring Success Value	Metric Justification, Additional Notes
2	Power Conversion Efficiency (PCE^2)	≥ X% ± 1σ, cell area ≥ Y cm^2 For mini-modules, consider how many cells there will be, the segment aspect ratio, geometric area efficiency, and total area PCE. Device stack has pathway to a competitive PCE with incumbent photovoltaic technologies.	Efficiency measured using a solar simulator. Efficiency is reported as an average with standard deviation across a statistically relevant sample size with sufficient dependent and independent replicas.[1] Competitors should explain why the average, deviation, and number of samples was chosen as a metric. Cell measurements should be at STC in accordance to IEC 60904-1. Maximum idealized PCE (which is competitive with incumbent technologies) is extrapolated from real data by correcting for losses that can be removed in an optimized cell (ex. series resistance).	Efficiency target demonstrates that the device stack is competitive with the state-of-the-art in the respective technology and has a path to competitiveness with incumbent technologies. Cell area should demonstrate that the deposition of the different layers are deposited using techniques that are scalable (speed, throughput, yield, etc.). The number of cells measured should be statistically relevant and allow for the development of process control.

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Deliverable	Performance Metric	Success Value	Assessment Tool / Method of Measuring Success Value	Metric Justification, Additional Notes
3	Technology Roadmap	Technology roadmap is developed, illustrating pathway to compete with incumbent PV technologies and identifies both commercially available and novel capital equipment that will need to be purchased and/or developed for scale up.	Technology roadmap is reviewed by an independent third party.	Technology roadmap should demonstrate that the competitor has a pathway to develop and scale a competitive PV technology.
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EXAMPLE BUSINESS DELIVERABLES

Deliverable	Performance Metric	Success Value	Assessment Tool / Method of Measuring Success Value	Metric Justification, Additional Notes
4	Intellectual Property Licensing Agreements—if applicable	Licensing agreements of all necessary IP finalized and signed.	Competitors should describe what intellectual property needs to be licensed and why it is relevant for their technology. Copies of the signed agreements delivered to DOE for verification.	Secure relevant IP for development of technology.
5	Quality Management Plan	Develop a preliminary Quality Management Plan. Key systems may include: safety, training, change control, statistical treatment of data including design of experiments standards, cradle to grave tracking of raw materials to formulae to devices, data maintenance, security. Quality Management Plan includes information on how these quality management systems will be deployed.	Quality management plan is reviewed by an independent third-party.	Developing a Quality Management Plan will assist troubleshooting when scaling up the technology.

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Deliverable	Performance Metric	Success Value	Assessment Tool / Method of Measuring Success Value	Metric Justification, Additional Notes
6	Stakeholder Interviews	Conduct ≥ X Stakeholder Interviews	The different types of stakeholders interviewed should be described as well as how those interviews changed/shaped your plans.	Engaging with stakeholders to collect feedback on technology, value proposition, bankability and business model.
7	Business Roadmap	Business roadmap is developed, showing funding pathway for company.	Business roadmap is reviewed by an independent third-party.	Business roadmap should demonstrate that the competitor has a path forward for additional follow-on funding after completion of the Countdown prize.
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