



Commercialisation Pathways Program

NSW Quantum Computing Commercialisation Fund

Guidelines for Applicants

December 2022



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Commercialisation Pathways Program

NSW Quantum Computing Commercialisation Fund

1. Overview

1.1 Background

The Quantum Computing Commercialisation Fund (QCCF) is a \$7 million, single round, competitive technology development and commercialisation program funded by the NSW Government through the Future Economy Fund's Commercialisation Pathways Program (CPP). The QCCF is administered by the Office of the NSW Chief Scientist & Engineer (OCSE) in Investment NSW within the NSW Department of Enterprise, Investment and Trade (DEIT).

The NSW Government recognises the importance of capturing potential commercial applications of NSW research. The CPP addresses gaps in the product life cycle between early-stage research and mature investment opportunities, to target market failures preventing NSW businesses from capitalising on innovation. The CPP delivers grants to drive the commercialisation of highly innovative ideas into new products, processes or services.

The CPP will have the flexibility to meet the needs of diverse industries and firms with potential to commercialise innovations aligned with the [NSW Industry Development Framework](#) (Framework) and the [NSW 20-Year R&D Roadmap](#) (Roadmap) priority industries or technologies.

The QCCF is targeted towards quantum computing as identified in the Roadmap and under the 'Digital systems and software' identified as an emerging industry in the Framework.

The QCCF will be used to support the development and commercialisation of quantum computing hardware and/or software as part of the NSW Government's Quantum Technologies Action Plan being developed under the Roadmap.

Grant funding under the QCCF will be provided for projects ranging between \$200,000 to \$4 million.

1.2 Program Purpose

The objective of the QCCF is to progress quantum computing hardware and/or software towards commercialisation within NSW.

The QCCF targets innovative quantum computing hardware and/or software within Technology Readiness Level (TRL) 3 – 7 and aims to help companies move along the TRL scale (Figure 1, Appendix A), increase the technical maturity of their technology and enable them to attract large-scale private investment.

Figure 1 Technology readiness levels

Technology Readiness Levels (TRLs) are used to represent the development of an innovation. TRLs will help to define eligibility and support under the QCCF.

It is expected that requests for support will reflect the different industries, levels of complexity or costs across the priority sectors, and indicative grant amounts are provided below.

At the application stage, applicants will provide an estimated TRL (ranging from TRL 3 to TRL 7) for the project at the commencement date and at the completion date.

Technology Readiness Levels (TRL)								
1	2	3	4	5	6	7	8	9
Basic principles observed	Technology concept formulated	Experimental proof of concept	Technology validation in lab	Technology valid in relevant environment	Demonstration in relevant environment	Demonstration in operational environment	System complete and qualified	Successful mission operations
Not eligible		Eligible					Not eligible	

2. Timing

Timeline

Application

Opening **22 December 2022** and closing **10:00AM (AEDT) Thursday 2 February 2023**

Applicants will have at least four (4) weeks to complete and submit an application once the round is open. The Expert Panel will have at least two (2) weeks to assess applications.

Note: dates may be subject to change.

3. Eligibility

3.1 Eligible Applicants

To be eligible for the QCCF, applicants must be based and headquartered in NSW¹ and be one of the following:

- a company incorporated under the *Corporations Act 2001* (Cth) (including a company limited by guarantee) that has an Australian Business Number (ABN);
- an Aboriginal and/or Torres Strait Islander Corporation registered under the *Corporations (Aboriginal and /or Torres Strait Islander) Act 2006* (Cth);
- an individual or partnership who agrees to form a company under the *Corporations Act 2001* (Cth) so that DEIT can enter into a legally binding Deed of Agreement; or
- a NSW public research organisation applying through its appropriate technology transfer office or the Chief Executive Officer (or equivalent) of the research organisation that will become a separate entity before entering into a legally binding Deed of Agreement with DEIT.

¹ See Glossary for definitions of key terms.

Applicants must hold the Intellectual Property or the rights to commercialise the innovative quantum computing hardware and/or software.

Ineligible applicants include:

- Australian or NSW Government agencies, local government, State Owned Corporations or statutory authorities, Australian subsidiaries of international companies
- businesses that are insolvent
- an individual, unincorporated association or partnership that will not form a company under the *Corporations Act 2001* (Cth).

Joint applications between a business entity and research-based organisations (including universities) are encouraged. However, the business entity must lead the project and submit the grant application. The lead applicant (the business) must outline clearly in their application who the project partners are and how each partner will contribute to achieving the objectives of the project proposal. If a joint application is successful, the Deed of Agreement will be between the lead applicant and the NSW Government.

DEIT, at its sole discretion, can take publicly available information about an applicant into account that may cause a business to be ineligible for support, such as any personnel or business activities that could cause reputational damage or other risk to the NSW Government. DEIT may seek clarification from applicants in relation to its application, including seeking further information on the eligibility or assessment criteria.

DEIT reserves the right to assess the applicant's management, its Directors, Officers and entities or individuals that exercise control over an applicant against a fit and proper persons eligibility criterion.

3.2 Eligible Projects

The project must:

- have a maximum project period of three years (unless there are exceptional circumstances). Projects will require clear and achievable milestones (e.g., moving from TRL 3 to TRL 4) to support appropriate staging and monitoring.
- seek to progress an innovation along the commercialisation pathway.
- have an existing prototype/proof-of-concept.
- be TRL 3-7 on the TRL Scale (Figure 1).
- demonstrate why sufficient funding for the entire project cannot be accessed from alternative sources and that the project would not proceed at the proposed scale in NSW without government support.

Ineligible projects include:

- activities that are deemed to be in the very early stages of project development, where only basic principles have been observed and reported and no practical applications of the basic principles of the invention have been achieved (TRL 1-2).
- activities where the basic performance of the technology hasn't yet been demonstrated in a laboratory setting or equivalent testing.

DEIT may seek clarification from any applicant in relation to its application, including seeking further information on the eligibility or assessment criteria.

At any time during the assessment process, if falsified or incorrect declarations are identified, the application will be deemed ineligible by DEIT and denied progress in the QCCF process.

Applicants eligible for funding from any other NSW Government grant program for the same outputs and/or outcomes are not eligible for the QCCF.

3.3 Eligible Support

QCCF funding can be used for:

- prototyping and piloting studies
- manufacturing and/or scaling
- conducting market and product assessments
- salaries and access to external expertise that is directly related to delivery of the project
- commercialisation strategies and commercial feasibility studies
- specialist equipment and/or infrastructure necessary to progress the project
- intellectual property protection or advice

Examples of ineligible activities for funding:

- solutions designed to improve internal business processes
- general business costs including sales, marketing, rent and travel
- project costs that are already the subject of another government grant, subsidy or financial assistance
- project costs incurred prior to an application being submitted (no retrospective funding will be awarded)

The support considered for successful projects under the QCCF will be in the form of a grant to be provided in accordance with a Deed of Agreement entered into with DEIT.

The applicant must repay the grant if the organisation achieves a specified level of economic success. The specific terms of this repayment such as time period and other factors will be agreed to as part of the Deed of Agreement negotiations.

Grants provided for projects would be:

- a minimum of \$200,000
- a maximum of \$4,000,000
- paid over a maximum of 36 months.

Applications can include co-funding proposals and potential leveraging opportunities. If other in-kind assistance is sought, these should be included in proposals where feasible, and will be considered during the assessment process.

4. Applications

Applications must include:

- a brief overview of the proposal and how it meets the eligibility criteria.
- details of the applicant/partners involved (including any existing collaborative partnerships with industry organisations) and the impact/rationale for the grant sought
- schedule of the estimated costs of commercialisation of the innovative quantum computing hardware and/or software
- why sufficient funding for the entire project cannot be accessed from alternative sources

- project/product development stage, the value and type of support requested, estimated total cost of the project
- details of whether the applicant has other income streams (e.g., other active businesses) and why they cannot be used to fund the proposal
- details of any other co-contributions to the project, including from the applicant and other sources
- a short description of the project's expected benefits, including how it will facilitate commercialisation
- the intended location of the project in NSW
- how the project aligns to the Roadmap and Framework and builds the NSW Quantum Ecosystem
- details of how the proposal will be implemented, the requirements for successful implementation and identified risks and their mitigants and/or controls
- details of the project governance structure (e.g., project board, advisory boards, stakeholders, etc.)
- details of the market structure (e.g., supply chain logistics, end customers, distribution stream)
- demonstrated capability and capacity to deliver the project.

Details about the assessment process are in Section 5 – Assessment.

Important information when submitting:

Applicants need to:

- submit the online application form through SmartyGrants, ensuring all questions are answered or indicated not applicable
- clearly identify in their application (including attachments) any information that the applicant requests be treated as confidential
- authorise their application. The application must be authorised by at least one of the core participants (i.e. by the head of the organisation or their authorised delegate). If applying as a consortium, the lead applicant must authorise the application.

Late proposals will not be considered except where DEIT is satisfied that the integrity and competitiveness of the program has not been compromised.

5. Assessment

The assessment of applications will be led by the independent Expert Panel, and DEIT - OCSE as Secretariat to the QCCF.

An independent probity advisor will be present to provide guidance to DEIT and the Expert Panel on integrity, fairness, and accountability to ensure transparency of the Program's administration. Further information about probity controls is at Section 9.

During the assessment process, DEIT – OCSE may ask applicants to provide additional information to assist in the assessment process. Advice may be sought from other NSW Government agencies or other sources to assist in the assessment of projects, as required. DEIT – OCSE may seek to negotiate amendments to the application to maximise the public benefits from the project.

5.1 Application

Once the application stage has closed, DEIT – OCSE will review applications for eligibility and provide a report to the independent Expert Panel on the eligible and ineligible applications. The role of the DEIT – OCSE and the Expert Panel are described below.

The Expert Panel will assess eligible applications against the assessment criteria listed in Table 1.

If required, the Expert Panel may conduct interviews with all shortlisted applicants, after their assessment against the assessment criteria.

Table 1. QCCF Assessment Criteria

Criteria	Description
Applications will be assessed according to the criteria outlined below:	
Innovation (35%)	<ul style="list-style-type: none"> ● A highly innovative new product, idea, process or service. Consideration includes evidence of each of the following: <ul style="list-style-type: none"> ○ value proposition of the innovation and project including competitive advantages, value creation, and extent to which it addresses the identified problem ○ uniqueness in market / disruption potential ○ how the product or service is functionally or technically viable ○ expected progress from the estimated TRL at the project commencement date to the objective TRL at the completion date ○ economic, health, environmental and/or social benefits to NSW
Commercialisation (35%)	<ul style="list-style-type: none"> ● Progression of the innovation to deliver future commercial outcomes and revenue generation. Consideration includes evidence of: <ul style="list-style-type: none"> ○ potential for application, demand, or market adoption ○ a clear path to commercialisation including <ul style="list-style-type: none"> ▪ the size of the problem, market or demand addressed by the product, process or service ▪ export potential of the innovation ▪ intellectual property strategy, current and expected registration of patents, trademarks etc
Deliverability (30%)	<ul style="list-style-type: none"> ● Consideration includes evidence of: <ul style="list-style-type: none"> ○ the applicant’s past performance in delivering similar projects ○ the applicant’s financial viability ○ the suitability of the staff and/or arrangements in place to deliver the project ○ the suitability of the detailed business plan, technical plans and/or cost estimates supporting the project ○ feasibility of the project plan. Projects will have a maximum project period of two to three years (unless there are exceptional circumstances). Projects will require clear and achievable milestones (e.g., TRL 4 to TRL 5) to support appropriate staging and monitoring ● Whether the total funding sought and provided through the grant, partners, participants and other funding sources is sufficient to undertake the initiative ● why sufficient funding for the entire project cannot be accessed from alternative sources and why the project would not proceed in its current scale in NSW without government support ● sustainability in operation; how future funding will be accessed, such that it can be scaled over time

DEIT – OCSE

The DEIT-OCSE Secretariat have experience in developing and delivering competitive grant programs. Members of the Secretariat will identify any conflicts of interest in relation to any eligible applications and sign a confidentiality agreement before conducting its eligibility assessment. DEIT – OCSE, on behalf of the Expert Panel, may seek further information on individual applications in relation to eligibility.

Independent Expert Panel

The Expert Panel:

- will be chaired by an independent person with experience in research commercialisation and expertise in the quantum or related sectors and grant programs;
- will comprise members with research, industry, entrepreneurial and venture capital expertise relevant to delivering the QCCF program purpose; and
- will draw on advice or expertise as required. Expertise could include individuals with significant subject-matter expertise specific to the nature of shortlisted projects, but who are not conflicted. These experts will provide advice only and will not participate in the assessment of applications.

When making their recommendations, the Expert Panel may take the following into consideration:

- the total funding available
- a competitive assessment of applications based on the extent to which each application meets the Assessment Criteria
- the requested amount against the scope of the project i.e., could the applicant effectively deliver the proposed project with less funding
- whether the requested funding amount is too large compared to the project as a whole
- whether a reduction could pose significant risks to the success of a project. Advice may be sought from applicants to understand the potential impact if a decision was made to award less funding than was applied for
- whether applicants have sufficient or additional resources or avenues available to raise additional capital other than the QCCF funding, that could assist with the success of their project
- whether a decrease of funding will impact the acceleration of commercialisation.

5.3 Financial Assessment

An independent financial advisor will undertake financial assessments of applications. They will report to the Expert Panel on organisational and/or project-specific risks.

Once successful applicants have been determined, the independent financial advisor will undertake a return-on-investment assessment with each funding recipient as part of contract negotiations. The independent financial advisor will be engaged to conduct annual financial audits and risk assessments during the term of the Deed of Agreement, as per the reporting requirements for successful funding recipients detailed in the Deed of Agreement.

5.4 Decision Making

The Expert Panel will provide its recommendations to the Minister for Enterprise, Investment and Trade Technology. The Minister for Enterprise, Investment and Trade makes final decisions on whether to fund projects.

The final decision by the Minister will be recorded in writing and any departure from the Expert Panel's recommendation will be documented with reasons for the variation and published. Records relating to the decision will be managed in accordance with the requirements of the *State Records Act 1998*.

The Expert Panel recommendations will include what proposals to fund, the amount and type of funding, and any specific funding conditions. Assessment will be merit based against the assessment criteria and competitive, and the NSW Government may choose not to award or recommend funding under this program.

6. Reporting and Data

6.1 Monitoring

Reporting of successful projects will be outlined in the Deed of Agreement and will involve 6-monthly and/or annual reporting, dependent on the size of the grant and the nature of the proposed activity. Templates will be provided for these reports and will require information such as:

- progress against agreed project milestones and outcomes
- project costs
- contributions of participants directly related to the grant
- performance measures, including, but not limited to:
 - revenue from sales or other grants
 - number of jobs established or supported by the grant
 - research, industry or government engagement
 - IP progress
 - regulatory progress

Activity Progress Reporting

During the term of the Deed of Agreement, successful applicants must provide a written Activity Progress Report to document progress on the Project to date and include:

- financial reporting as set out in the Deed of Agreement;
- audited accounts for the preceding financial year reporting period;
- progress and expenditure against the project plan;
- current and prospective partners for collaborations/engagement;
- any difficulties impacting the project, or which are anticipated to impact the project;
- an updated Project Budget for the following 12 months;
- a definitive statement as to whether:
 - the financial information for the project represents the financial transactions fairly and is based on proper accounts and records;

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- if the Grant was expended in accordance with the Deed of Agreement; and
- the amount of interest earned on the investment of the Grant.

An Executive Member or equivalent that DEIT approves in writing must sign the Activity Progress Report.

Activity Final Reporting

The Final Report is to document completion of the Project and is to include:

- all activities undertaken during the reporting period;
- evaluation of the project and how successful the project was in achieving its objectives;
- the status of results achieved to date from the project;
- the results of research and collaborations with other organisations;
- details about any Residual Funds which, unless authorisation has been sought, must be returned to DEIT;
- any other information deemed to be relevant to the project that will assist the promotion of the Future Economy Fund or QCCF;
- a complete financial acquittal of how the funds were spent during the grant period and include a definitive statement as to whether:
 - the financial information for the Project represents the financial transactions fairly and is based on proper accounts and records; and
 - if the Grant was expended in accordance with the Deed of Agreement.

During the term of the project, DEIT, the successful applicant and financial advisor will meet to conduct an annual performance review and discuss the 6-monthly or annual activity progress report.

6.2 Evaluation

DEIT will evaluate the QCCF to measure the extent to which the Program's objectives have been achieved and may use information from applications and reports for this purpose. DEIT may also interview applicants or related consortia and ask for more information to understand how the Program impacted projects and to evaluate how effective the program was in achieving its outcomes. This could include information about revenues, costs, employment, and other matters. DEIT may contact applicants up to three years after receipt of final grant payments associated with the Program for more information to assist with this evaluation.

7. Important Terms and Conditions

Applicants should note:

- Successful applicants must repay the grant if the organisation achieves a specified level of economic success. The specific terms of this repayment such as time period and other factors will be agreed to as part of the Deed of Agreement negotiations.
- The grant will be payable upon the execution of the Deed of Agreement. Invoices for grant payments will be submitted and paid in a single tranche, or as dictated by the Deed of Agreement.
- Successful applicants will be required to provide financial information to an external financial advisor who will undertake 6-monthly and/or annual financial monitoring of the organisation. This will monitor how the grant is expended against agreed milestones, identify any financial risks to the project or organisation and determine if the applicant is required to begin repayment to DEIT upon the specified level of economic success.
- The NSW Government will publicly announce funding for individual applications and provide information on the [NSW Government Grants and Funding Finder](#). It may also use information provided to create case studies.
- Requests for variations or changes to the project may be considered with regard to probity principles being upheld.
- Successful applicants will be required to pay back grant funds where the corresponding spending was not in accordance with the Deed of Agreement.
- Successful applicants will be required to participate in program evaluation after the project has commenced.
- In accordance with the Deed of Agreement, the successful applicant will be required to provide evidence of how projects have resulted in measurable benefits consistent with the Program's objectives and outcomes, particularly on research and development outcomes.
- All successful applicants of NSW Government funding should acknowledge this financial support in accordance with the Funding Acknowledgement Guidelines for Recipients of NSW Government Grants available at nsw.gov.au/branding/sponsorship-and-funding-acknowledgment-guidelines.
- All successful applicants must seek DEIT's written consent prior to any significant public announcement, marketing, press announcements, or official launch in relation to the Program.
- Payments will be GST inclusive. Applicants must be registered under the GST Law at the time of making any supply under this Deed on which GST is imposed. Grants are assessable income for taxation purposes, unless exempted by a taxation law. It is recommended applicants seek independent professional advice about taxation obligations or seek assistance from the Australian Taxation Office. The NSW Government does not provide advice on individual taxation circumstances.
- DEIT reserves the right to undertake an audit of QCCF funding and support within seven years from date of the Deed of Agreement. Tracking and reporting will be a requirement of the deed of agreement, which will include regular performance reporting.

8. Communication

8.1 Successful Applicants

Applicants will be notified via email and/or letter of the outcome of their Preliminary or Full application within 30 days of the determination. All unsuccessful applicants will be offered a feedback information session.

Successful applicants who will be offered grant funding will be notified via email and/or letter within 30 days of the final determination. If you are successful, we will advise you of any specific conditions attached to the grant including a request to keep the grant confidential for a period of time, if an announcement is likely to be made by the NSW Government.

8.2 Deed of Agreement

Successful applicants who accept the offer of a grant will be required to enter into a formal Deed of Agreement with the NSW Government relating to the grant. The Deed of Agreement will specify obligations that relate primarily to the recipient's accountability for the grant, including using the grant for activities occurring in NSW, the return of unspent grant funds and reporting on the use of the grant for the duration of the term. The NSW Government makes no binding funding or support commitment to an applicant unless and until both parties sign the Deed of Agreement, including the lead applicant identified in the proposal.

While successful applicants are required to be compliant with all relevant laws and regulations, they will be specifically requested to comply with the *Work Health and Safety Act 2011 (NSW)*.

8.3 Complaints

Any enquiry you have about the assessment process or the outcome of your application for the Program should be submitted in writing to <https://www.investment.nsw.gov.au/contact-us/> or by calling 02 4908 4800.

If you do not agree with the way DEIT has handled your enquiry or complaint, you may wish to contact the NSW Ombudsman. The NSW Ombudsman will not usually look into a complaint unless the matter has been first raised directly with DEIT.

NSW Ombudsman
Level 24, 580 George Street,
Sydney NSW 2000

9. Controls

9.1 Probity Advice

DEIT will make sure that the grant opportunity process is fair according to the published guidelines and incorporates appropriate safeguards against fraud, unlawful activities, and other inappropriate conduct.

An independent probity advisor will be engaged as part of this Program to provide guidance to DEIT – OCSE on any issues concerning integrity, fairness and accountability that may arise throughout the application, assessment, and decision-making process. The probity advisor will observe the conduct of meetings and the assessment process to which funding recommendations are made. The probity advisor will review meeting minutes and final funding recommendations and is required to endorse or oppose actions and/or recommendations arising from meetings. At the conclusion of the assessment process, the

probity advisor will provide a report to DEIT – OCSE about its observations of the process. This will ensure decisions are made with integrity, fairness, and accountability, while delivering value for money for NSW.

9.2 Government Information (Public Access) Act 2009 (NSW)

Applicants should be aware that information submitted in applications and all related correspondence, attachments and other documents may be made publicly available under the Government Information (Public Access) Act 2009 (NSW) and included on the [NSW Government Grants and Funding Finder](#). Information that is deemed to be commercially sensitive may be withheld. The Government Information (Public Access) Act 2009 (NSW) makes government information accessible to the public by:

- requiring government agencies to make certain sorts of information freely available,
- encouraging government agencies to release as much other information as possible,
- giving the public an enforceable right to make access applications for government information, and
- restricting access to information only when there is an overriding public interest against disclosure.

9.3 Conflicts of Interest

Conflicts of interest for DEIT will be handled as set out in the DEIT NSW Code of Ethics and Conduct.

9.4 Privacy

DEIT will treat applicants' personal information according to the DEIT Privacy Management Plan available at investment.nsw.gov.au/privacy/ and the *Privacy and Personal Information Protection Act 1998 (NSW)*.

This includes letting applicants know:

- what personal information we collect
- why we collect your personal information
- who we give your personal information to

An applicant's personal information can only be disclosed to someone for the primary purpose for which it was collected unless an exemption applies.

9.5 Disclaimer

DEIT does not guarantee or warrant, and accepts no legal liability whatsoever arising from or connected to, the accuracy, reliability, currency or completeness of any material contained in this publication. Information in this publication is provided as general information only and is not intended as a substitute for advice from a qualified professional.

DEIT recommends that users exercise care and use their own skill and judgment in using information from this publication and that users carefully evaluate the accuracy, currency, completeness and relevance of such information. Users should take steps to independently verify the information in this publication and, where appropriate, seek professional advice.

The Guidelines are subject to change at any time at the sole discretion of DEIT.

10. Contact Details

Any enquiry about the applications form, assessment process or the outcome of an application for the QCCF should be submitted through: www.investment.nsw.gov.au/contact-us/

11. Glossary

Based and headquartered in NSW (Section 2.1):

In relation to **Commercialisation Grants**: means at the time of execution of the agreement corporate headquarters, (where a company's management and key staff who operate and oversee overall business activities), are located within the state of NSW for the period of the Deed of Agreement.

Innovative refers to creating more effective products and ideas. It may also refer to new ways to do things and changes to existing processes.²

TRL or Technological Readiness Levels (TRL) are a commonly accepted measurement system, originally developed by NASA, which are used to assess the maturity level of a particular technology. Each technology project is evaluated against the parameters for each technology level and is then assigned a TRL rating based on the projects progress. There are nine technology readiness levels. TRL 1 is the lowest and TRL 9 is the highest.³

System refers to an interconnected set of elements or parts that is coherently organised and interconnected in a pattern or structure, that produces a characteristic set of behaviours, often classified as its 'function' or 'purpose'.⁴

² Australian Government (2021), [Innovation in your business](#).

³ NASA (2012), [Technology Readiness Level](#)

⁴ Meadows, D. (2008), Thinking in Systems, Sustainability Institute.

Appendix A

TRL	TRL definition	TRL description/evidence of achievement
1	Basic Research. Initial scientific research begins.	Basic principles are observed. Focus is on fundamental understanding of a material or process.
2	Applied Research. Initial practical applications are identified. Potential of material or process to satisfy a technology need is confirmed.	Once basic principles are observed, practical applications can be identified. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions. Examples are still limited to analytic studies. Supporting information includes publications or other references that outline the application being considered and that provide analysis to support the concept.
3	Critical Function, i.e., Proof of Concept Established. Applied research continues and early-stage development begins. Includes studies and initial laboratory measurements to validate analytical predictions of separate elements of the technology.	Analytical studies and laboratory-scale studies are designed to physically validate the predictions of separate elements of the technology. At TRL 3 experimental work is intended to verify that the concept works as expected. Components of the technology are validated, but there is no strong attempt to integrate the components into a complete system. Modelling and simulation may be used to complement physical experiments. Examples include research on materials, components, or processes that are not yet integrated.
4	Laboratory Testing/Validation of Alpha Prototype Component/Process. Design, development and lab testing of technological components are performed. Results provide evidence that applicable component/process performance targets may be attainable based on projected or modelled systems.	The basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared with the eventual system. Supporting information includes the results of the integrated experiments and estimates of how the experimental components and experimental test results differ from the expected system performance goals. TRL 4-6 represent the bridge from scientific research to engineering, from development to demonstration. TRL 4 is the first step in determining whether the individual components will work together as a system. The goal of TRL 4 should be the narrowing of possible options in the complete system.
5	Testing of Integrated/Semi-Integrated System. Component and/or process validation in relevant environment- (Beta prototype component level)	The basic technological components are integrated so that the system configuration is similar to (matches) the final application in almost all respects. Supporting information includes results from the laboratory scale testing, analysis of the differences between the laboratory and eventual operating system/environment, and analysis of what the experimental results mean for the eventual operating system/environment. The major difference between TRL 4 and 5 is the increase in the fidelity of the system and environment to the actual application. The system tested is almost prototypical. Scientific risk should be retired at the end of TRL 5. Results presented should be statistically relevant.

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TRL	TRL definition	TRL description/evidence of achievement
6	<p>Prototype System Verified. System/process prototype demonstration in an operational environment (Beta prototype system level).</p>	<p>Engineering-scale models or prototypes are tested in a relevant environment. This represents a major step up in a technology's demonstrated readiness. The major difference between TRL 5 and 6 is the step up from laboratory scale to engineering scale and the determination of scaling factors that will enable design of the final system. The operating environment for the testing should closely represent the actual operating environment. Refinement of the cost model is expected at this stage based on new learning from the pilot line. The goal while in TRL 6 is to reduce engineering risk. Results presented should be statistically relevant.</p>
7	<p>Integrated Pilot System Demonstrated. System/process prototype demonstration in an operational environment (integrated pilot system level).</p>	<p>This represents a major step up from TRL 6, requiring demonstration of an actual system prototype in a relevant environment. Final design is virtually complete. The goal of this stage is to retire engineering and manufacturing risk. To credibly achieve this goal and exit TRL 7, scale is required as many significant engineering and manufacturing issues can surface during the transition between TRL 6 and 7.</p>
8	<p>System Incorporated in Commercial Design. Actual system/process completed and qualified through test and demonstration (pre-commercial demonstration).</p>	<p>The technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include full scale volume manufacturing of commercial end product.</p>
9	<p>System Proven and Ready for Full Commercial Deployment.</p>	<p>The actual system is proven through successful operations in operating environment, and ready for full commercial deployment. The technology is in its final form.</p>