TECHNOLOGY TRANSFER FOR CALFLEXHUB INNOVATORS

Making a plan to move from the lab to the market

MOMENTUM

INTRODUCTION

THE CALFLEXHUB AND TECHNOLOGY TRANSFER

The CalFlexHub advances and accelerates the functionality and feasibility of flexible demand-side loads as resources integrated with the electricity system. These technologies and techniques promote decarbonization while enabling more affordable, equitable, and reliable energy systems for all Californians in all communities and sectors, underpinning the more dynamic and responsive grid the future demands. They are essential for a zero-carbon future in California and around the world.

CalFlexHub innovators are undertaking sector-transforming research, development, demonstration, and deployment activities to realize this future. Yet, as technology readiness advances in a project, sharing results and ultimately entering the market remains challenging. Research drives progress only when more people and institutions see, understand, and use its outcomes.

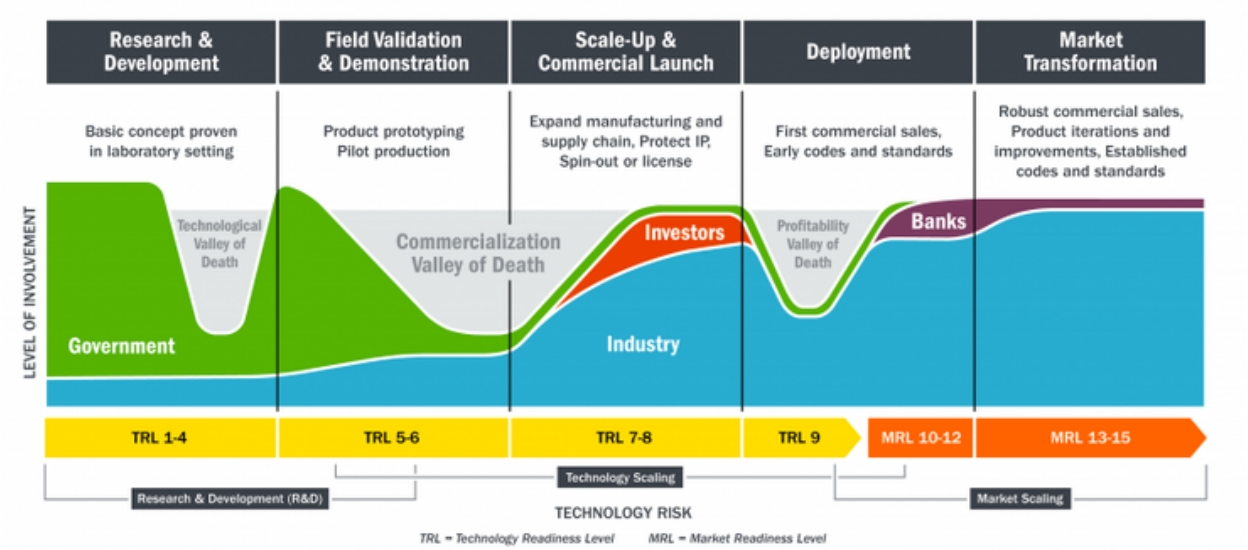
To that end, the CalFlexHub is working to bolster more successful and rapid commercialization of technology solutions with enhanced technology transfer and an improved research environment and sector. Successful, fruitful research is the primary driver of the innovation, and associated systemic change, needed to rapidly transform the energy system. A competitive yet fragmented market coupled with an evolving, complex regulatory and funding environment means that attention to these tasks can give a project an edge – whether for a funding opportunity or landing a commercialization deal.

This manual, created with CalFlexHub innovators in mind, is most applicable for technologies that have achieved a technology readiness level (TRL) of five (5) or greater. It plainly explains what technology transfer is, why it matters to a project; who should undertake it; how it works and when it should happen; explains how to plan for successful technology transfer; and profiles technology transfer successes.

TECHNOLOGY TRANSFER

WHAT IS TECHNOLOGY TRANSFER ?

Technology Transfer (TTx) is the process of transferring the technologies developed through research and development to broader society for practical application and commercialization. It values uniqueness, differentiation, and proprietary knowledge and drives commercialization through sharing knowledge and expertise. In the context of clean energy, technology transfer can play a vital role in accelerating the transition to a low-carbon economy.



Source: The DOE EERE Building Technology Office

There are many examples of successful technology transfer in the clean energy sector. PV cells were first invented in the '50s, but were not considered commercially viable and available until the '80s. Wind turbines were first developed in the 19th century, but weren't given meaningful attention until the '70's energy crisis. These technologies exist due to public interest in energy research investment, de-risking them to drive private investment, commercialization, and improvement.

Today, many technologies are being commercialized or improved through TTx, such as non-lithium battery energy storage, carbon capture and storage, megawatt charging for heavy-duty transportation electrification, innovative grid technologies, V2X, and of course, demand response and load flexibility solutions. Technology transfer is crucial to the clean energy transition. Through shared knowledge and expertise, accelerated development and deployment of new technologies will more rapidly and deeply decarbonize the economy.

WHY DOES TECHNOLOGY TRANSFER MATTER?

TTx is an integral consideration and task for research projects trying to realize their objectives, achieve their goals, make an impact, improve the research arena, and – most importantly – reach the market and commercialize. A thoughtfully created and implemented TTx plan is essential to:

Realizing a return on investment: reaping the financial benefits one can expect to receive from investing in technology transfer.

Maximizing impact: ensure that research findings are disseminated and applied in real-world settings, maximizing their impact and value. This can improve policy, practice, and quality of life for individuals and communities.

Collaboration: facilitate collaboration between researchers and stakeholders, including policymakers, practitioners, and community members. This can lead to co-creating knowledge, shared learning, and improved outcomes.

Capacity building: build the capacity of individuals and organizations to use research findings and best practices in their work. This can lead to improvements in skills, knowledge, and competencies.

WHO DOES TECHNOLOGY TRANSFER?

Generally, there are five stakeholder groups involved and interested in clean energy TTx.

Universities and research institutions: as they develop new technologies and innovations, conduct research, and train scientists and researchers.

Technology transfer offices (TTOs): these organizations, often a part of research outfits and universities, help to manage intellectual property, negotiate licensing agreements, and facilitate TTx.

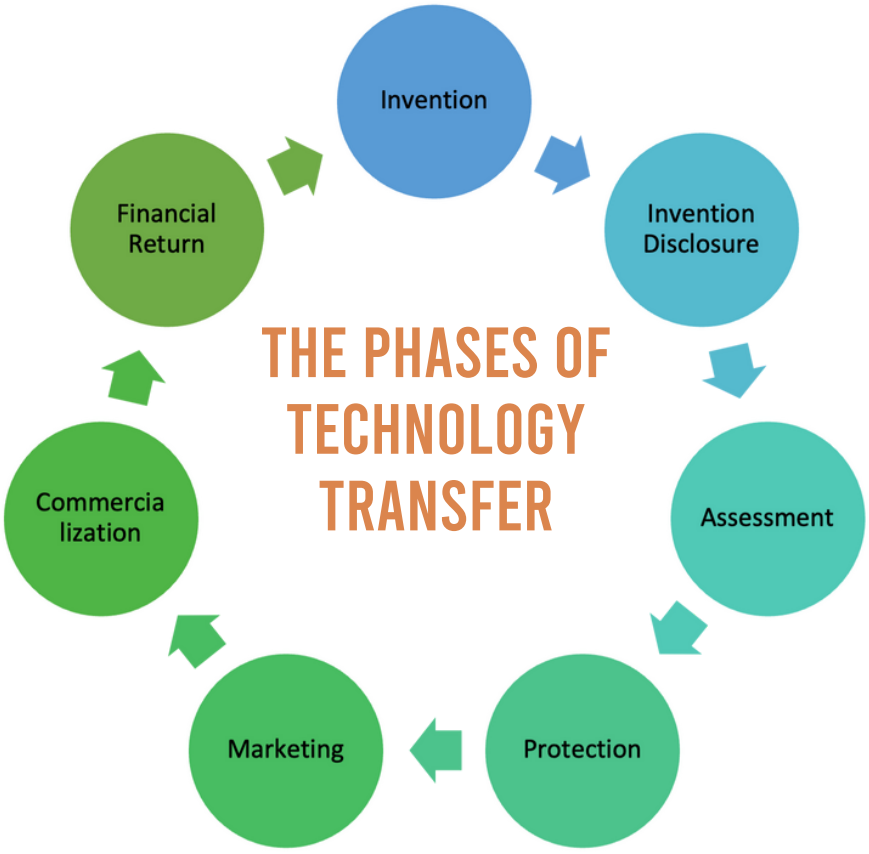
Governments and policymakers: as they develop policies and programs to support innovation and provide funding for research and development.

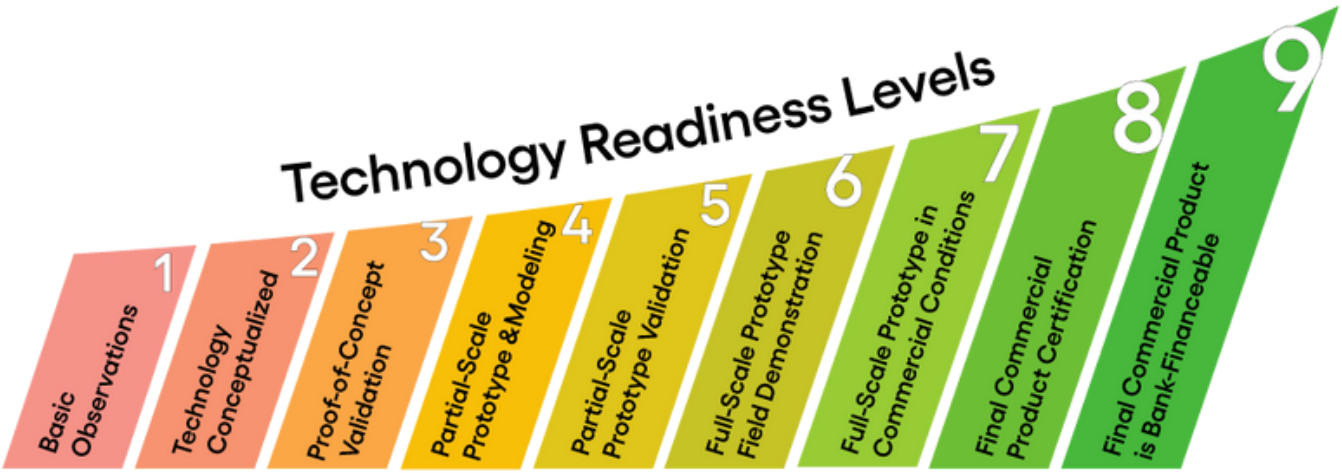
Private sector companies: as they develop new products and technologies and collaborate with universities and research institutions to cultivate new solutions.

Funders: public or private entities who fund start-up companies and entrepreneurs developing new technologies and innovations.

TECHNOLOGY TRANSFER PHASES AND TECHNOLOGY READINESS LEVEL

TTx should occur at every technology readiness level (TRL) from the initial invention to the commercialization of the final product. The next page is a guide of what TRL is generally seen during a given phase of technology transfer.





TECH TRANSFER & TECHNOLOGY READINESS, CONTINUED

Invention

At this stage, the technology is likely at a low TRL level, perhaps in the range of TRL 1 to 3. The technology is still in the early stages of development, and researchers are primarily focused on proving the concept and conducting feasibility studies. The technology transfer process may involve filing patents, publications, and presentations to peers and stakeholders.

Invention Disclosure

The TRL level may increase slightly at this stage, depending on the amount of data and supporting materials available. However, the technology is still likely at a relatively low TRL level, with much development work still to be done.

Assessment

As the technology moves into the assessment phase of TTx, the TRL level may increase significantly. Technology evaluation and market analysis can provide valuable data that can help to advance the technology and increase its TRL level. By the end of this stage, the technology may be in the range of TRL 4 to 6.

Protection

The TRL level may not change significantly during the protection stage, as it primarily involves more fully securing intellectual property rights and establishing a legal framework for licensing or commercialization. However, licensing discussions may occur at this stage if the technology is sufficiently mature, which could lead to an increase in the TRL level.

Marketing

At this stage, the TRL level is likely to be in the range of TRL 5 to 7, as the technology has been evaluated and refined, and a marketing plan is being developed. Market research and strategic partnerships can help to further increase the TRL level by identifying potential applications and customers.

Commercialization

By the time the technology reaches the commercialization stage, its TRL level should be relatively high, perhaps in the range of TRL 7 to 9. The technology should be fully or near-fully matured, with all necessary regulatory approvals in place, and ready for deployment.

Financial Return

The technology has achieved a high TRL level at this stage and is generating profits or revenue. The licensee or new company may continue to develop the technology and bring new products or services to market, which could further increase its TRL level.

DEVELOPING A TECHNOLOGY TRANSFER PLAN

Selecting and customizing the best-fit strategies and practices are crucial to successful TTx. Because TTx can occur between researchers and research organizations, businesses, government agencies, funders, private companies, or even between different countries – plans and activities will differ. Ultimately, a thoughtful TTx will improve the overall competitiveness of organizations and researchers by bringing new or improved products to market; improving on existing standards or introducing the possibility of new ones; improving consumer expectations; and creating or enhancing services and approaches.

HOW TO WRITE AN EXTERNAL TECHNOLOGY TRANSFER PLAN

TTx planning and activities are core steps in commercialization, and having a TTx plan is essential when pursuing funding opportunities. A plan's length, complexity, and sections can vary based on the project team, research goals, alignment with funder needs and goals, need and capacity, technology readiness level, and operating environment. A TTx plan outlines the goals of the project's TTx work, performance metrics, people and organizations involved in the TTx process, the activities undertaken to advance the plan's goals, and the desired outcomes. This simple outline and the knowledge in this guide are a solid foundation for building an effective plan. Note that this outline is best suited for developing an external TTx plan.

Internal TTx plans focus on transferring technology within an organization or company from one department or team to another. The goal is typically to improve efficiency, streamline processes, or share knowledge and expertise among different parts of the organization. External TTx plans involve transferring technology between organizations or from an organization to the broader marketplace. This could include licensing a technology to another company, selling intellectual property to a third party, or collaborating with external partners to bring a new product or service to market.

HOW TO WRITE AN EXTERNAL TECHNOLOGY TRANSFER PLAN

INTRODUCTION

- ☑ This can often be distilled from an executive summary

SECTION 1: THE WHAT AND WHY – Core Project Information

- ☑ Describe the opportunity, problem, or challenge
- ☑ Describe how the project, technology, or innovation and articulate how it is the solution
- ☑ How the project, generally, plans to advance from the current state of the technology to market readiness
  - Barriers to adoption, market challenges, funding challenges, etc.
- ☑ How the final product will be superior to current offerings

BEST PRACTICE HIGHLIGHT

Develop boilerplate: This is a brief, clear, basic description of the technology or innovation's functioning, potential uses, and benefits. As you work with different stakeholders, this boilerplate can be adapted and updated.

SECTION 1.1: EXPANDED PROJECT INFORMATION

- ☑ Define and describe, if desired, more complex project information that could be relevant to some stakeholders, such as:
- ☑ Knowledge objectives and process
- ☑ Technical Research Objectives
- ☑ Project Partners
- ☑ Product specifications
- ☑ Funding situation and needs

SECTION 2: THE WHERE AND WHEN – targeted market identification and analysis; regulatory outlook and analysis

- ☑ Defining target markets
- ☑ Create a schedule, considering the stages of the TTx process and TTx milestones

BEST PRACTICE HIGHLIGHT

Establish Clear and Achievable TTx Metrics and Plan Milestones: To ensure the plan progresses and is effective, establish metrics and milestones early, tying them to TTx phases and tactics in the plan. Some examples of milestones include filing a patent, achieving a number of partnerships, TRL evaluation and movements, or product development milestones.

- ☑ Describing known or anticipated market growth
- ☑ Identifying and analyzing the competitive landscape and competitors
- ☑ Describing the regulatory landscape as well as any opportunities and challenges impacting the projects progress and eventual success

HOW TO WRITE AN EXTERNAL TECHNOLOGY TRANSFER PLAN

SECTION 3: THE WHO – stakeholder, audience, funder identification and analysis

- ☑ As TTx happens in parallel with research, audiences may shift or change in need or priority. Sound analysis and proactive thinking behind a strategy will help address them dynamically at every stage.
- ☑ Identifying critical stakeholders and audiences to be reached
  - Prioritize stakeholders and audiences relative to alignment and interest.
  - Consider: Primary, secondary, and tertiary audiences
- ☑ Describing and analyzing stakeholders' role in the tech transfer and audience needs relative to the opportunity, problem, or challenge and considering barriers to connecting with them
  - Funders – public and private
  - Investors
  - Regulators
  - Government agencies
  - Academic and research institutions
  - Research peers
  - Industry partners
  - Startups and entrepreneurs
  - Workforce and workforce interests
  - Manufacturers
  - Consumers, end users, and the general public

- ☑ Funding and funder identification and analysis
  - Funding and funder identification are critical to TTx. Here are the basic steps in funding and funder identification, scoping, and analysis for a technology transfer plan.
    - $ Identify potential funders: Those who are interested in supporting the technology transfer. This can include government agencies, private foundations, venture capitalists, and corporate partners.
    - $ Conduct a funder analysis: Analyze their funding requirements, application processes, funding limits, and timelines – this will help you determine which funders are the best match for your technology transfer plan.
    - $ Develop a funding strategy: Using funder analysis, develop a funding strategy that outlines how to approach each funder, what funding sources should be sought, and how to leverage networks and resources to secure funding.
    - $ Prepare funding proposals: This includes developing a budget, providing a timeline, outlining the expected outcomes, and showcasing the potential impact of the technology.

HOW TO WRITE AN EXTERNAL TECHNOLOGY TRANSFER PLAN

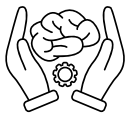
SECTION 4: THE HOW – identifying tactics, channels, and resources

- ☑ Identify what tactics will advance the goals of the TTx plan and how they will be used
- ☑ Identify methods of engagement and available channels for each stakeholder and audience
  - Then outline the tactics and resources to support them
- ☑ Identify what information and materials are needed to support engagement and execution

SECTION 5: EVALUATION – tracking progress and defining success.

- ☑ Craft an evaluation plan that establishes qualitative and quantitative metrics for success for the tactics specifically and the plan overall
- ☑ Some examples include:
  - The number of stakeholders identified compared to those reached to qualify tactic and channel effectiveness
  - Outputs (things created to support and advance the plan) such as workshops, reports, trainings, presentations
  - Outcomes and impacts such as stakeholder collaboration, participation, and feedback
  - Identify and address barriers to adoption and strategies for overcoming obstacles
  - Determine potential pathways to adoption
  - Monitor future adoption

BEST PRACTICES IN TECHNOLOGY TRANSFER



Early Collaboration with Industry Partners

Collaboration with industry partners can help research professionals identify potential commercial applications for their technology and facilitate the transfer process. This tactic should be done with formal NDAs in place. An example of this practice is a startup company focusing on "gap addressing" with a large industry player. That is, the startup works with the industry to understand how their innovation can address a need and tailor development to meet this need and underpin improved future sale or licensing opportunities.

Build an Inclusive and Diverse Team

Building a solid team with the right mix of technical and business acumen and a variety of experiences and perspectives can contribute to TTx in myriad ways.

- ☑ Increased creativity and innovation: more likely to come up with new and innovative ideas because they have different perspectives and experiences to draw from.
- ☑ Improved problem-solving: better able to solve problems because they can bring different approaches and solutions to the table.
- ☑ Enhanced communication: more likely to communicate effectively because of greater awareness and representation of different communication styles and preferences.
- ☑ Improved decision-making: better able to make sound decisions because they have a wider range of information and perspectives to consider.

Ongoing Market Research

Conducting ongoing market research ensures an up-to-date working knowledge of potential technology users and commercial potential. Some examples of market research include market size analysis, competitor analysis, customer analysis and discovery, regulatory analysis, and pricing analysis.

Diversify Funding Sources

Identifying potential funding sources to support the transfer process or fund research into later stages. Researchers should be familiar with funding opportunities in their field and develop strong proposals to secure funding.

BEST PRACTICES IN TECHNOLOGY TRANSFER

Clear Communication Practices

Effective communication between research professionals and industry partners is critical to the successful transfer of technology – this is the core of the reason to do TTx. Research professionals should be able to articulate clearly, and to multiple audiences of varying interest levels and sophistication, their technology's benefits and potential applications.

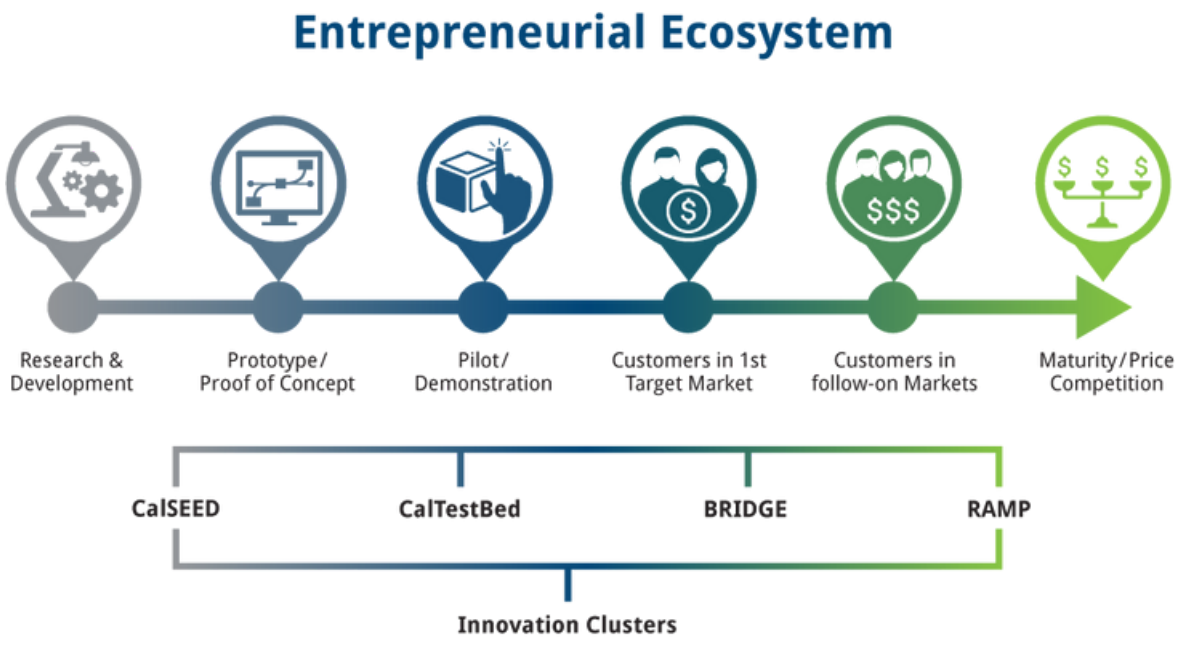
Monitoring and Adjustment

Monitoring the TTx process and making adjustments as needed can help ensure that the process is successful.

RESOURCES FOR TECHNOLOGY TRANSFER

CalFlexHub Innovators are a part of – and have access to – a broad ecosystem of resources to advance load flexible technologies. CalFlexHub is proudly funded by the California Energy Commission (CEC) which invests millions annually in scientific and technological research for energy innovation, including supporting California's entrepreneurs through its Entrepreneurial Ecosystem.

Important to TTx and CalFlexHub Innovators, the Entrepreneurial Ecosystem provides funding opportunities, incubator/accelerator and other programs that support energy technology developers through common barriers or "valleys of death" on the path to commercialization. Mapped for technologies of all TRLs, key program and partners are seen below.



RESOURCES FOR TECHNOLOGY TRANSFER

CalSEED
calseed.fund
The California Sustainable Energy Entrepreneur Development Initiative provides small grant funding for early-stage entrepreneurs to develop their ideas and produce early prototypes.

CalTestBed
caltestbed.com
The California Test Bed Initiative provides clean energy companies with access to testing and certification services needed to refine their prototypes across a network of 60+ University of California facilities and national laboratories.

BRIDGE
energy.ca.gov
The Bridging Rapid Innovation Development to Green Energy initiative competitively awards subsequent funding for technologies previously receiving funding for early-stage development from an eligible federal agency or one of CEC's research programs. BRIDGE helps start-up companies avoid the funding gap between the time a successful project ends and funding for new projects is awarded.

RAMP
energy.ca.gov
The Realizing Accelerated Manufacturing and Production initiative provides technical and financial assistance to help clean energy entrepreneurs advance their emerging technologies to the low-rate initial production stage, the first step to a mass-produced product.

Innovation Clusters
Four local hubs offering energy innovators a suite of support technical and non-technical services and expanded networks across the state through founding partner organizations.

- **Bay Area** Regional Energy Innovation Cluster, activate.org
- **BlueTechValley** Regional Energy Innovation Cluster, wetcenter.org
- **Los Angeles** Regional Energy Innovation Cluster, laincubator.org
- **San Diego** Regional Energy Innovation Cluster, cleantechsandiego.org/scein

Empower Innovation is the Entrepreneurial Ecosystem's central network of information, in partnership with the above organizations, accelerating the cleantech innovation journey. Visit empowerinnovation.net to learn more, become a network member and unlock more curated resources.

RESOURCES FOR TECHNOLOGY TRANSFER

A US Department of Energy sponsored national laboratory, Berkeley Lab also boasts programs and resources that can support the CalFlexHub Innovator's path to commercialization.

Cradle 2 Commerce

c2c.lbl.gov

Cradle to Commerce connects inventors and entrepreneurs with curated climate technologies from four national labs, and with critical resources such as state-of-the-art test beds, prototyping facilities, and scientific resources for technology advancement. This includes entrepreneurship training and access to early commercialization partners, mentors, and investors.

IMPEL

impel.lbl.gov

The Incubating Market-Propelled Entrepreneurial-mindset at the Labs and Beyond, or IMPEL program is a tech-to-market program focused on building technologies, funded by the DOE Building Technologies Office and implemented by Berkeley Lab. The program helps early-stage individuals from business, academia, and DOE's national labs translate the premise and promise of their technology into the language of business, boosting their chances of bringing it to market.

TECHNOLOGY TRANSFER SUCCESSES

Through the programs above and many more across the energy innovation landscape, there are successful TTx stories to tell.

ALD TECHNICAL SOLUTIONS LLC, IMPEL COHORT 2022, CALTESTBED COHORT 1, CALSEED COHORT 4

Davoud Zamani
CEO & Co-Founder
ALD Technical Solutions

ALD Technical Solutions' composite Wire Wrap Technology is a lightweight, high-strength, long-lasting, cost-effective composite reinforcement system that withstands high temperatures. The product can be installed quickly and easily with an innovative robotic technology system and secured in place around existing power lines. ALD Technical Solutions LLC received $450,000 from the California Energy Commission through the CalSEED and CalTestBed programs, supporting the continued development of their structural composite reinforcement system that will increase power capacity, extend lifespan, decrease sag, and improve reliability and resiliency of grid infrastructure with no downtime and minimal capital investment.

TECHNOLOGY TRANSFER SUCCESSES

COMMUNITY ENERGY LABS, IMPEL COHORT 2021, CALSEED COHORT 6, CALTESTBED COHORT 2

Tanya Barham
CEO & Founder
Community Energy Labs

Community Energy Labs' (CEL) Automated Grid-Smart Building Energy Controls is an automated building control platform that minimizes burdens on controls professionals and operators of K-12, municipal, and small to mid-sized buildings. CEL received multiple awards and grants in the summer of 2022, including a grant from Rocket Fund (a program of the Resnick Sustainability Institute at Caltech). They received a $206k SBIR grant from the Department of Energy, to develop scalable, novel interface design and workflow automation that improves the quality of model predictive control outputs, enabling small users with lean staffing to be able to achieve dramatic energy savings. They also won a USDA grant, and won a CRADA award with LBNL and ActiveBAS for a 'Low-cost, Scalable Control Solution for Grid-Interactive Small and Medium Sized Commercial Buildings.' In May 2022, CalSEED awarded $3.45 million to 23 early-stage clean energy innovation companies, including CEL.

FLORRENT, IMPEL COHORT 2022

Jose LaSalle
Founder & CEO
florrent

florrent is an MA-based, minority-owned climate tech company innovating to design and build the next generation of high energy density ultracapacitors to stabilize electrical grids and address critical bottlenecks for the adoption of renewable energies, electric vehicles, and net-zero buildings. Their Bio-Based Ultracapacitors for Electric Grid Stability are manufactured from abundant and regenerative hemp biomass, grown domestically in the U.S. by Black and Indigenous farmers. florrent was recently accepted into the Advancing Climatetech and Clean Energy Leaders Program (ACCEL)'s inaugural cohort—a new accelerator from Greentown Labs and Browning the Green Space designed to bolster BIPOC-led climate tech startups by offering access to funding, networking connections, resources, and opportunities that structural inequities put out of reach. florrent was a recipient of $75,000 of non-dilutive funding from the MassCEC Diversity in Cleantech Early Stage (DICES) grant. florrent is also poised to close a successful pre-seed round within the coming months. They pitched in August 2022 at the IMPEL Investor Forum and Pitch Competition hosted by Cleantech Future and won the Audience's Choice Award.

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