

First Look West (FLOW 2.0)
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Cleantech University Prize (Cleantech UP)
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Final Technical Report for Grant Closeout

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We formally submit this narrative as the Final Technical Report required to complete the grant requirements for Award Number DE-FOA-0007150. During the period of this grant FLOW put in place resources to achieve the goals set by Cleantech UP: *catalyze early stage development and new company formation* and provided an *enriched academic environment around entrepreneurship principles*.

Background: DOE's Cleantech UP was an annual business plan competition, operating nationally between 2015 and 2018 through eight regional nodes that included Caltech's FLOW. Cleantech UP focused on supporting university students at all levels creating cleantech startups. FLOW operated nationally with a focus on California. In support of the DOE's objectives FLOW developed an immersive five point program that targeted major gaps in the educational support and practical resources available to scientists and engineers starting their first cleantech companies that prevented such young innovators from becoming entrepreneurs.

Specifically, the FLOW program augmented the number of participants entering the energy entrepreneurship pipeline via the Cleantech UP competition; helped the US remain competitive by increasing the viability and financing potential of these cleantech companies started by young academics; and helped build the regional, state and national infrastructure that spurs and supports entrepreneurship.

Each year the FLOW featured two major judging rounds for candidates drawn from as many as 80 applicants annually, providing essential experience and feedback that helped define the direction of these young entrepreneurs. The FLOW winners competed at the DOE's national event, and FLOW companies took the top prize twice in the total history of the DOE program which was started in 2011.

Below you will find a summary of the project details on the project objectives, tasks and outcomes, and lessons learned.

Project Objectives:

FLOW 2.0 aimed to engage university student start-ups at the earliest stages of formation, including conceptualization, with the goal of attracting more top young scientists and engineers to the cleantech industry. With this in view, the program achieved the five objectives outlined in the award:

1. Implemented a best in class competition as the capstone of the program that included a Transformational Idea Award track aimed at scientists and engineers pursuing pre-commercial research and interested in learning about the entrepreneurial process.
2. Implemented BLITZ, the educational module focusing on "customer discovery" through a partnership with Innovation Los Angeles (IN-LA), the National Science Foundation's I-Corps program node based in Los Angeles. BLITZ is tailored to scientists and engineers still immersed in research and completing their graduate degrees and looking at different career options.

3. Implemented a dedicated mentoring initiative that matched the students' business needs with domain experts, as an adjunct to the IN-LA program. This was another key need by this group of inexperienced entrepreneurs
4. Built a bridge to starter funds including FLOW's Rocket Fund, and utility programs
5. Promoted strategic relationships with California's utilities, and with DOE laboratories

In addition: FLOW secured new sponsors for the program: KPPB, a legal IP firm servicing the tech industry; ANSYS, a major company providing engineering design software, Union Bank, providing banking support for early stage tech companies; GUST, developer of Gust Launch, an incorporation and company formation service aimed at first time founders; and Energize California, one of the four tech clusters, sponsored by the California Energy Commission.

Technical Scope Summary: FLOW 2.0 followed the scope of work detailed in the original award, which included the three tasks described in the final FLOW Statement of Proposed Objectives (SOP):

1. Implement a best in class cleantech competition;
2. Provide educational enrichment for student teams and new graduates; and
3. Support competition company formation and viability.

Tasks and Outcomes:

Below we describe the work done in support of these tasks during the period of the grant in more detail.

Task 1. Implement Best in Class Competition

Task Summary: The objective was to host a competitive program, from September to June each year, to include two tracks, the Ready to Commercialize (RTC), and Transformational Idea Award (TIA), and feature approximately 20 ventures in the Regional Final.

To accomplish this, FLOW secured sponsorship from private sector sponsors, including KPPB, a legal firm specializing in advising on intellectual property created by early stage tech companies emerging from academia. This fulfilled FLOW's strategic plan to provide in kind legal support that offers benefits tailored for scientists and engineers starting their first company and unfamiliar with IP issues. FLOW also secured support from ANSYS for the Transformational Idea Award as well as an in kind Start-Up package of software worth over \$100,000. In addition, FLOW secured a sizeable grant from Union Bank, a financial institution providing discounted banking packages for early stage cleantech ventures. Lastly, FLOW partnered with Energize California, a program operated by the Los Angeles Cleantech Incubator, to provide a second prize targeting startups with grid technologies. These partnerships support FLOW's vision of empowering scientists and engineers emerging from academia knowing little about starting a company and needing expertise and financing.

As a part of the Resnick Sustainability Institute at Caltech FLOW took advantage of the Institute's top communication resources and regularly reached more than 3,000 individuals and organizations. In 2016/2017 FLOW took advantage of new relationships with the state-supported Technology Energy Clusters, established and funded by the California Energy Commission. Two

TEC nodes are anchored by the Los Angeles Cleantech Incubator (LACI) and Cleantech San Diego respectively and target Southern California, a major focus for FLOW. In addition to the FLOW network created in California, Oregon, Washington, Nevada, Idaho, Hawaii and Alaska during the first grant period, FLOW continued to reach out to universities in Arizona, Utah, and Texas. Throughout the grant FLOW connected with more than 50 universities in the West and across the country.

During Phase 2, FLOW also adopted a different approach to mentoring, designed to provide more training in customer discovery and value proposition definition. This addressed a particular need for the typical FLOW cohort of companies, to help them gain value and move through the competition process successfully. Each year an IN-LA team of highly skilled facilitators worked with the teams closely over a month and in addition, offered individual office hours.

Also each year FLOW established a set of 19 - 25 judges for the Regional Finals judging panel. Emphasis was placed on recruiting judges from industry or early stage investors, to provide informed guidance and connections to technical resources or funding outside the competition. The judges included representatives of the following organizations: Dow Ventures; Microsoft; Saudi Aramco; Southern California Edison, Pacific Gas & Electric, Southern California Gas, San Diego Gas & Electric, the Los Angeles Department of Water and Power, Sacramento Municipal Utility District; Schneider Electric; Itron; SunPower; Sand Hill Angels; Tech Coast Angels; Pangaea Ventures; Aster Capital; Breakout Lab/Thiel Foundation; Breakout Energy Ventures; Arden Road Investments; and Roda Group; Cyclotron Road; GSV Labs; Hawaii Energy Excelerator; and Idealab.

During that period FLOW hosted two rounds of judging, spaced four weeks apart, which gave companies time to take the learnings and refine their business approach and presentation. Over the three years, FLOW received over 150 applications, and accepted 68 for the competition, representing over 15 universities in 12 states. FLOW's unique contribution was to host and give a \$5,000 award for a pre-commercial Transformational Idea Award (TIA) track for scientists and engineer just starting to explore entrepreneurship. All teams were required to participate in the IN-LA Blitz program and of these 6 – 8 were referred and secured places in the national NSF I-Corps program. As per the FLOW mission this arrangement gave all serious applicants more real world experience and invaluable advice.

In addition, the competition raised \$318,000 in funding support over 2016 – 2018; and FLOW companies have attracted a conservative estimate of \$58,900,000 in further funding (as of November 2018). This represents a significant increase over the \$37,000,000 FLOW alumni raised during the first granting period of the national competition, from 2012 - 2015.

The Regional Finals were all held at the Earl M. Jorgensen Laboratory facility on Caltech campus. The events included the Regional Finals judging, followed by a Reception and Awards Ceremony, with a team of Caltech interns working as coordinators and session recorders. Winners included: 2016: XStream Trucking (Stanford University); 2017 Vescence, University of Houston); and 2018: ETC Solar (Caltech).

Task 2: Provide Additional Educational Enrichment

Task Summary: In 2015/16 FLOW 2.0 established BLITZ, FLOW's educational component. Run by our partner organization, the National Science Foundation Innovation Corps ("I-Corps") initiative in Los Angeles, IN-LA. BLITZ provided on-the-job training featuring real world experience and the opportunity to learn from the marketplace.

IN-LA recruited national I-Corps instructors that helped FLOW teams identify the market and customer base for their technology, determine the commercial readiness, and helped the team develop transition plans to move the technology to market. At least 20 customer interviews had to be completed during the month. In addition, the IN-LA faculty offered additional office hours each week to all for more in-depth exploration on an individualized basis. This mentoring approach was augmented by FLOW connections to industry and business experts that closely matched each company's needs. Particular attention was paid to finding help in understanding techno economic analysis, the manufacturing cycle, and process development for scaling up technology.

FLOW established closer connections to the four TEC clusters established by the California Energy Commission and their mentoring pools and FLOW candidates located in these regions benefitted from this source of guidance. This will continue to be particularly important to foster the emerging SoCal cleantech community.

Finally, FLOW explored building a closer working relationship with the DOE labs, particularly with NREL, through the Wells Fargo-supported IN² program operated in collaboration with NREL. FLOW was an active IN² channel partner and referred FLOW alumni companies to the program and at least one, PowerFlex, received an award.

Task 3: Support Competition Company Formation

Task Summary: Under Cleantech UP, FLOW 2.0 aimed to bridge the gap in private sector funding, and help teams find facilities to build their prototypes and establish their companies.

During the period of the grant FLOW made it a priority to strengthen relationships with incubators such as LACI, and so become a reliable conduit for young companies to suitable commercial space. FLOW occupied a "hot desk" at LACI, and participated in a number of community events. Also, FLOW was a partner in Energize California, the state-funded cluster initiative anchored by LACI which has outreach from Santa Barbara to Orange County. In 2018, Energize California funded a dedicated track providing a \$20k prize that addressed priorities established by the California Energy Commission's grant. In addition, FLOW signed on to host a special track supported by the Department of Defense that addressed that agency's interests, and gave FLOW companies another source of possible funding.

FLOW also established a strong channel relationship with Cleantech San Diego as part of its outreach for competition candidates. FLOW continued building on its multifaceted relationship

with the ETCC utility consortium to bring intense business mentoring and additional funding, technical support and access to field testing through the Rocket Fund grant program*.

Of the Rocket Fund's first year grants in 2015, one company, Axiom Exergy, raised a seed round of \$2.5 million, secured a \$5 million customer order from New York-based Con Edison, launched a field trial with Walmart and secured a follow on funding round of \$7.0 million. The other three have continued to develop their products and work with customers that include Google, the Hilton Inn chain, the Mountainview School District, San Francisco International Airport and the Los Angeles Unified School District. In its second year, the Fund provided grants to five companies, ranging from \$10,000 to \$50,000 for a total of \$120,000.

In Rocket Fund's Year 2 (2016), four FLOW companies Xstream Trucking, Opus 12, PowerFlex and Viper Irrigation received Rocket Fund awards. One awardee, XStream Trucking, has already used the Rocket Fund award to build ten test units for prospective customers and attracted \$2.5 million of investment capital. PowerFlex has now over \$5 million in customer orders. The Fund provided grants of \$20,000 - \$50,000 for a total of approximately \$170,000.

In Rocket Fund's Year 3 (2017), five FLOW companies received awards: Membrion, Inc., South 8 Technologies, Inc., Chai Energy, and ETC Solar. Of these, Membrion closed a seed round of \$2.5 million. In 2018, ETC Solar took the FLOW first prize as well as the DOE's national CUP top award, won CalSEED and SBIR grants, and progressed testing its technology with prospective customers. Close to \$200,000 was awarded in grants ranging from \$20,000 - \$75,000.

Three new private sector companies joined as members: ANSYS (in addition to the FLOW TIA award), the Electric Power Research Institute, the national and international association of utilities and Itron, the energy services giant. In May 2017 FLOW launched a new program with EPRI where FLOW companies were introduced to EPRI members and considered for potential technology validation programs. In all years an invitation was extended to all FLOW competitors to apply to the Rocket Fund and further opportunities were offered through the channel relationships with the four California tech clusters and their incubator networks

FLOW continued to rely on its extended network of incubators for referring FLOW ventures, including Hawaii Elemental Excelsior, Advantage Accelerator (Oregon State University), Prospect SV, and Cyclotron Road.

*FLOW's Rocket Fund continues to operate as a granting pool that helps academic innovators turn their technologies into commercial realities through financial support for building commercial prototypes. The purpose is to help cash-strapped first ventures begin field testing with customers. The goal is to move these companies to fundability faster. As of September 2019 19 awardees have attracted close to \$80 million in follow on funding from investors, customer sales and services and major grants.

Best Practices and Lessons Learned:

Over the course of the grant FLOW 2.0 dealt with close to 1,000 entrepreneurs from over 50 universities in more than 25 states and continually introduced best practices from “in the trenches” lessons learned in operating a successful competitive program. These ground up lessons included:

1. An intense educational element was required, in addition to the experiential learning provided by the competition itself, in order to move these entrepreneurs from their comfort zone in the lab into the commercial world. In addition to the two separate judging rounds intentionally staged months apart to enable the teams to incorporate expert feedback, FLOW introduced BLITZ, an abbreviated NSF I-Corps program overseen by the INLA I-Corps node, that helped these entrepreneurs set the direction for their venture.
2. The FLOW program attracted scientists and engineers with good technology and innovative ideas but with no cultural exposure to business, and so unable to compete with others already further along as entrepreneurs. To meet their needs FLOW established a Transformational Idea Award track, funded by sponsors, that enabled these individuals to gain some experience and guidance that would get them started on the road to applying for the more advanced Ready to Commercialize track the following year. This established a chain of support through the FLOW program from conceptualization (Transformational Idea Award) through the first stages of commercialization (The Road to Commercialize Track) through to prototype funding and customer engagement (The Rocket Fund).
3. Sponsorship was always challenging to raise so FLOW created channel partnerships with government sponsored agencies (e.g. LACI) and private programs (the IN2 Wells Fargo initiatives, NREL Shell Game Changer and the DOE Made in America program.) to provide further funding opportunities and technical support.
4. FLOW recipients were encouraged to incorporate the Lean Launchpad approach to establishing a tech business and connect with customers. However, the important funding gap where technologies were moved from academic lab into real world demonstrations was not being filled. As a consequence, FLOW established the Rocket Fund as an affiliated program providing FLOW companies with vital funding support for building the first commercial prototype to begin demonstrating with customers. This non-equity funding allowed companies to assemble the performance data needed to validate their technology, which attracted later stage grants, potential customers and investors.

5. Successful as it was FLOW needed a program such as the DOE's Cleantech UP to enlarge the arena for these companies by playing a unique and vital role in their future growth. For the participating young companies CUP offered the validation provided by association with the DOE, exposure to potential funding and partners and an unmatched educational experience. CUP also became a vital vehicle for drawing the cleantech community from across the country closer together in support of these young ventures. It has proven impossible for any one region to assemble the resources and expertise to duplicate its impact and value to the community.

