JUMP into STEM Technology-to-Market Guidance 2024-2025

Updated: 8/13/2024

The purpose of this document is to provide guidance for the technology-to-market section of a JUMP into STEM submission.

Reminders

- Use the resources provided on the JUMP website. The judges will be able to identify and score your technology-to-market entry more easily.
    - Use the challenge requirements and rules. Specifically, look for technology-to-market guidance in the sections titled "Submission Paper Content Requirements" and "Challenge Evaluation Criteria."
    - Use the JUMP into STEM submission template available on the challenge page for the challenge that your submission will respond to. This submission template gives the same guidance as the challenge requirements and rules.

General Guidance

After reviewing several technology-to-market entries from past submissions, we identified some general guidance for teams to consider when writing their project submissions:

- Clearly **identify** the technology-to-market section of your submission. Make it easy for the reviewers to find this entry.
- Make sure that your technology-to-market entry is **well aligned** with your problem and solution and that your responses make **logical** sense. Proofread your entry to make sure it is complete and understandable.
- Make sure the technology-to-market plan and market adoption barriers are based on an understanding of a **realistic** market.
- Consider the **scope** of the market. Though you may have specific examples for a region or community, make sure that the solution is scalable and applicable to a wider community also.
- Express the **interconnectivity** of stakeholders, cost-benefit analysis, and adoption barriers.

Examples

Below are two high-quality technology-to-market entries from the 2023 challenge competition. We included the abstracts to contextualize the technology-to-market responses. Please consider these examples when writing a technology-to-market entry.

Example 1

Challenge: You and Me, Carbon Free!

Team LGS from the University of Texas at Austin

Reprinted with the permission of the authors: Gabriela Cuevas, Lillian Giraud, and Sergio Flores-Osorio

Advisor: Dr. Zoltan Nagy

This example text was excerpted from the original entry. For simplicity, references are not included.

Abstract
Introducing a widespread recycling program in Brownsville would reduce the carbon impact of existing and new homes and businesses. Recycled materials normally have a lower energy expenditure in order to be converted back to usable materials, as opposed to generating the materials from scratch. According to the US Energy Information Administration (EIA) "One ton of recycled paper saves enough energy to power the average American household for six months." This is about 5,300 kWh, as per the annual energy consumption average sourced from the EIA. For Brownsville, this average is above 1000 kWh higher. Implementing this program could help residents lower their carbon footprint.

Technology-to-Market Plan
The large upfront costs and small immediate economic returns that are associated with implementing a new Municipal Curbside Recycling Program (MCRP) are a significant market adoption barrier that could hinder this proposal's progress. In order to determine total cost, and average yearly cost to Brownsville residents, an analysis was performed using other Texas cities as reference. For comparison, the City of Austin's fleet is made up of 185 collection vehicles (Sanders, 2023). As of 2021, Austin Resource Recovery served 210,000 households. Assuming proportional collection, each vehicle serves approximately 1,135 households. Using this ratio, we can calculate the number of vehicles required for Brownsville. As of 2021, Brownsville had 53,500 households. This means Brownsville would need approximately 47 collection vehicles to serve their population. The cost of a collection vehicle varies significantly, from $150,000 to $300,000. Taking the average, the cost of collection vehicles would total $10,500,000. 65 gallon recycling bins also vary in price from $100 to $300. Assuming one bin per household and taking the average price, the total cost of bins amounts to $10,700,000. These figures are already hefty, and they don't include manpower and planning costs. However, this barrier could be overcome in the immediate future if the funding opportunities from potential stakeholders are effectively utilized.

There would also be a significant upfront capital investment requirement in the planning, design, and implementation process of the necessary infrastructure. The EPA offers resources to help with the planning implementation of environmental programs (EPA, 2023a). The costs for this could also be offset by the cash flow from resident taxes and the community-wide economic benefit of new jobs and increased employment. As shown in the Our Solution section, the local increase in employment would provide both short term and long-term economic improvements. Residents who may not value

recycling or environmental concerns might be more willing to support the program due to its benefits on the local economy and employment rate of the city. These benefits may swing more people towards long term support and involvement despite large initial costs.

While the implementation cost is high, the immediate return would most likely be low in comparison. Recently, the market for recycled materials has been fluctuating. This fluctuation is dependent on multiple factors including world events, foreign market demands, and new consumer habits. Recycled material resale value dropped after "overcapacity in China led to excessive imports into the US, putting downward pressure on domestic prices" (City of Austin, 2015). According to the 2022 financial report from the Bureau of International Recycling, the market has generally improved since 2020, although large fluctuations in cost and demand still persist (Bureau of International Recycling, 2020). For example, at the start of 2022, plastic recyclers were "experiencing not only massive demand but also extremely high prices for their products." However, by October 2022 plastic demand suddenly dropped drastically (Bureau of International Recycling, 2020).

In the long-term future, the market is constantly shifting as the technology and knowledge surrounding recycled materials changes. A new use for these materials is likely to be developed, increasing the sale costs. Changes in consumer lifestyles also have potential to influence the market in a more positive direction, such as the case with how "e-commerce has dramatically increased the use of cardboard boxes and other shipping containers" (City of Austin, 2015). Recycling materials also promotes a circular economy, which aims to keep materials in circulation for as long as possible (EPA, 2023b). If implemented effectively, a circular economy could have positive economic impacts by reducing economic loss from wasted product. In addition to economic benefits, a circular economy also contributes to carbon emission reductions (EPA, 2021).

Example 2

Challenge: Keepin' it Cool (or Hot)

One Grid from Purdue University

Reprinted with the permission of the authors: Aaron Farha, Andreas Hoess, Levi Premer, and Rebecca Lu

Advisor: Dr. Davide Ziviani

This example text was excerpted from the original entry. For simplicity, references are not included.

Abstract
In residential buildings, 32% of the electric energy use is based on space heating and cooling demand. This makes heating and cooling appliances a major contributor of carbon dioxide emissions for the residential sector. To combat climate change and achieve the CO2 reductions targeted by the Paris Agreement, an electrification of the residential building industry is indispensable. The support of low-income households in existing or new built subsidized housing to access weatherization programs and retrofitting their conventional HVAC systems with high-efficient heat pump technology and thermal energy storages will be a key measure to accomplish this task.

Our project "OneGrid" seeks to provide an affordable thermal energy storage-heat pump combination that is optimized for communal use in low-income or subsidized housing. Following the Justice40 program guidelines of the U.S. government, the product will close adoption barriers in underserved

communities while transitioning to an electrified society. With easy installation, retrofit options, a smart control system and the implementation in a Microgrid, not just the users but also the power grid benefits from the installation.

Technology-to-Market Plan

Infrastructure Barriers: Community based microgrids have already been established. The largest barrier to the proposed OneGrid community is the use of DC current between the community and the buildout of a large TES. The concept of a DC Microgrid is widely recognized even though in practice there are only a few examples of such equipment being used; a project in Chicago using a DC grid (Henderson, 2021) and a few off-grid homes. A key barrier to adoption is thus identified as large capital costs associated with DC Microgrid solutions. Although more nuanced, the savings from the DC grid will be substantial within an integrated community as there will be no losses in conversions from AC to DC and will also provide a cost-effective use case for TES. OneGrid will partner with the Indiana Housing & Community Development Authority (IHCDA) to promote the incubation of our concept. Figure 5 details our initial plan to prove out the concept of an integrated DC Microgrid community and evaluate infrastructure costs and scalability.

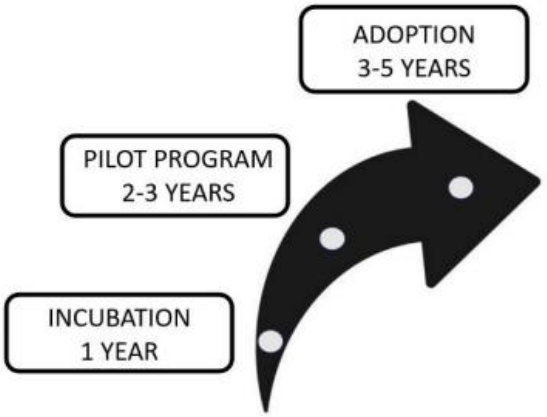

Figure 5: Plan for adoption

1. Finalize concept with sizing guides, suppliers for DC, TES, and DER infrastructure, and cost of build.
2. Pilot Community (Pilot Program): OneGrid will work with the Indiana Housing & Community Development Authority to identify suitable sites to retrofit an existing multi-apartment community with the proposed infrastructure. Ideally, one retrofitted and one ground up site within Indiana will be utilized as incubation sites and to provide a proof-of-concept.
3. Proof of Scalability (Pilot Program): Prove scalability by transferring the infrastructure of the Pilot programs to 10 low-income community sites in Indiana. Here, an evaluation of the time to build and tune models will be quantified, important to prove large scale adoption of OneGrid.
4. Large scale adoption: OneGrid will leverage IHCDA's grant from the EPA Solar for All campaign. This will allow us to expand to all regions within Indiana to promote options for subsidized housing and residential microgrid communities.

Market Adoption Barriers: The cost implications of single residents taking on the financial burden of various Distributed Energy Resources (DERs) is significant. Distributed energy resources are typically smaller-scale, making their cost per unit of energy higher than larger-scale projects. Individual residents generally face higher expenses such as installation and maintenance costs when they invest in solar panels, battery storage, and other DERs for their standalone homes. On a per-kWh basis

installing a DER system for multiple residents is cheaper than installation for a single resident. Adopting a community-based approach is more cost-effective by reducing overall costs while at the same time allowing for the installation of more efficient DER systems. This is especially true for TES in the residential community. To address this barrier, OneGrid will take this burden off the individual resident, increase the size of the TES, and disperse the financial burden across many residents, minimizing the cost per person. This will make the technology more financially feasible, providing a pathway to integrate TES in the residential community. In addition, financing models like Tariff On-Bill Financing (TOBF) could increase the affordability for low-income classes. This financing model avoids loans in the common sense by allowing the installation cost to be paid off as a part of the energy cost savings. That way OneGrid can finance itself with energy cost savings independent of the income level of the installer.

The TES that is added to the OneGrid solution stabilizes the Microgrid at a lower level by reducing the load peaks due to a direct charge of the thermal storage in high production/low consumption times. At the same time the main power grid gets relieved of the usage-based peaks of the whole microgrid community almost completely. With the use of MPC providing an energy management solution, there will also be added protection to the grid and an optimal distribution of energy.

OneGrid will also provide the government with a sustainable solution to house low-income residents that could be supported by actions like the Weatherization Assistance Program (WAP) to increase the accessibility. With low-income households paying substantially more per square foot for their utilities, the necessity for more cost-effective, energy efficient solutions are pressing. OneGrid's proposed a community addresses these inequities with an integrated community that will make these green energy practices more accessible.

<u>OneGrid's Improvements to today's infrastructure:</u>

- Helps stabilize the main power grid by mitigating oscillations.
- Provides a cost-effective solution for DER's.
- Increases efficiencies from current AC grid infrastructure with the use of DC infrastructure.
- Ensures optimal energy management between residents and energy storage with advanced control.
- OneGrid is an excellent choice to support low-income households and minority groups during society's decarbonization efforts.