WILLIAM DAVIDSON INSTITUTE
AT THE UNIVERSITY OF MICHIGAN

Lab to Market: Commercializing Energy and Mobility Technologies in Chihuahua

Phase 1 Deliverable: Mapping of Commercialization Activity

CHIHUAHUA GOBIERNO DEL ESTADO
SECRETARÍA DE INNOVACIÓN Y DESARROLLO ECONÓMICO

Frente Norte.

January 2025

About WDI

WDI is a solutions-driven non-profit affiliated with the University of Michigan that operates at the intersection of education, entrepreneurship, and impact across emerging markets. We are dedicated to unlocking the power of business to tackle critical global challenges and drive inclusive economic growth.

Working with entrepreneurs, investors, governments, and academia, we catalyze action to drive pioneering solutions in energy, climate health, and health. We are a:

Learning and insights hub

Enterprise accelerator

Ecosystem catalyst

About the Lab to Market project

Developing the know-how to commercialize technologies related to energy and mobility that are developed at academic institutions in Chihuahua has been identified as a need and priority by various stakeholders in the state. Building on multiple years of collaboration, the William Davidson Institute at the University of Michigan (WDI) is partnering with the Secretaría de Innovación y Desarrollo Económico (SIDE) and Frente Norte on a project in 2024-2025, **From Lab to Market: Commercializing Energy and Mobility Technologies in Chihuahua**.

Project goals:

- Build capacity at an institutional level for universities and research centers in Chihuahua to bring the innovations they develop related to energy & mobility to market
- Apply lessons learned and resources from WDI and U-M to Chihuahua context
- Support commercialization of specific prototypes already under development
- Involve students and researchers in the commercialization process to advance learning and pedagogical goals
- Strengthen relationships and engagement with institutions that have been engaged in other e-mobility efforts in the state

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Phased approach

This project involves three phases, taking place between October 2024 and May 2025.

Phase 1 **Phase 2** **Phase 3**

Phase 1 goal

The goal of the first phase of this project is to understand current activity related to commercialization in Chihuahua, including assets and gaps to support academic commercialization.

To achieve this goal, the WDI team interviewed key stakeholders in Chihuahua and gathered data via desk research. We worked with six academic institutions in the state, and engaged with many individuals who have participated in and supported this project to-date (see Appendix for full list). These institutions were selected based on a number of factors, including expressed interest and activity in this topic, established interactions through recent e-mobility projects, and balanced representation between the cities of Chihuahua and Juárez.

The six institutions that participated in the first phase are:

cimav Centro de Investigación en Materiales Avanzados, S.C.

TEC DE JUÁREZ Forjando el futuro, transformando vidas.

Tecnológico de Monterrey Chihuahua

Tecnológico de Monterrey Ciudad Juárez

Universidad Autónoma de Chihuahua

UACJ

Report overview

In the following slides, we present context about academic commercialization and relevant history and policies in Mexico. We then show a mapping of key activity, resources, and gaps related to academic commercialization, both within and external to academic institutions. Next, we elaborate with more detailed findings from six academic institutions and relevant prototypes identified thus far. We conclude with recommendations for phase 2 of this project and suggested next steps.

Report sections

1. Background

2. Mexico and Chihuahua context

3. Chihuahua commercialization ecosystem

4. Overall institutional findings

5. Detailed institutional view

6. Prototypes

7. Recommendations for phase 2

8. Appendix

1. Background

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What is commercialization and why should we care

Academic institutions play many roles in society, one of which is serving as engines of innovation. They drive innovation through 1) teaching and promoting innovation among students; 2) publishing innovative research; and 3) bringing innovative products or services to market. The latter can be accomplished through work with existing companies via licensing, or through the creation of new companies (spinoffs or startups). Strengthening the role of academic institutions in bringing innovations to markets is the focus of this project. This report is focused on understanding the current commercialization capabilities and roles of academic institutions in the state of Chihuahua.

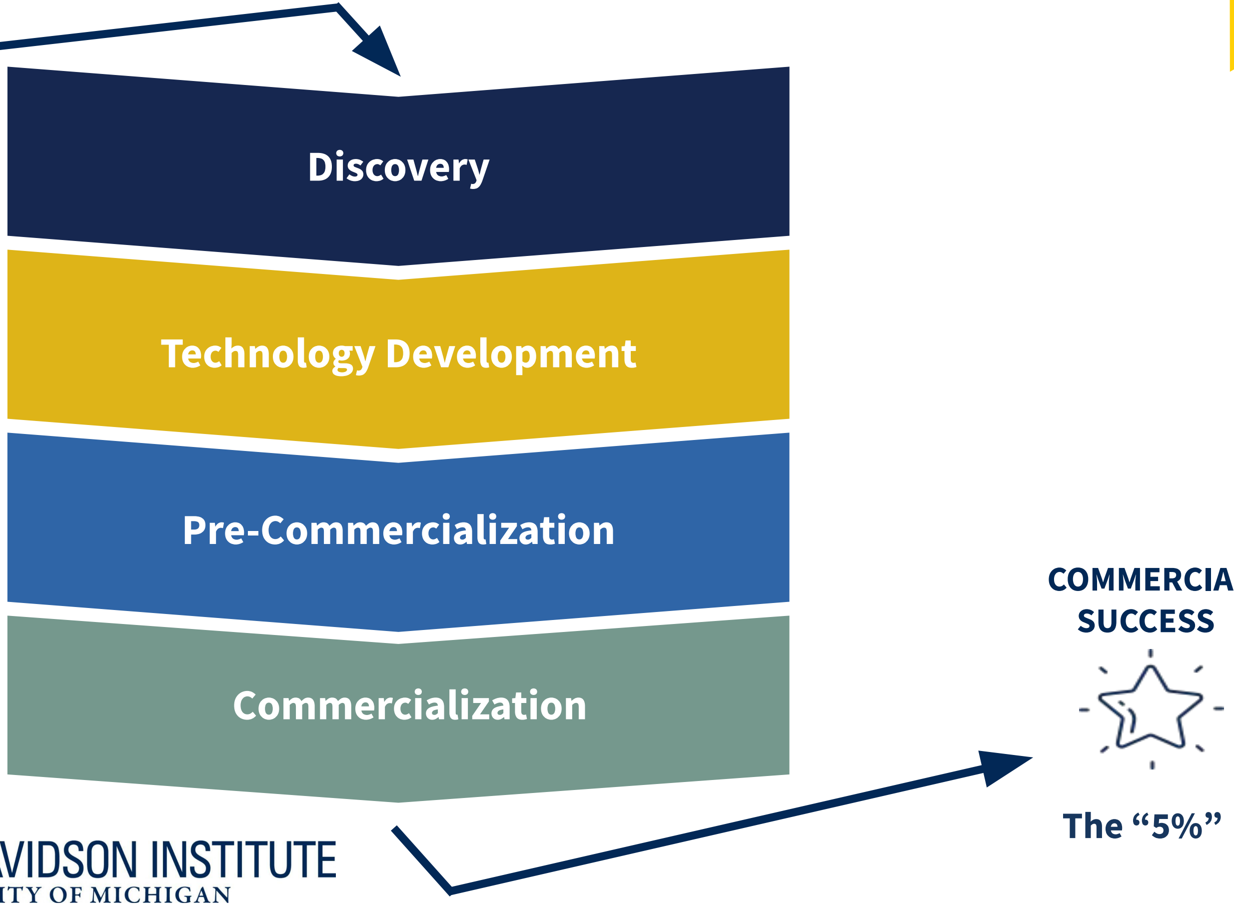
At WDI we support commercialization of products or services originating from academic research in LMICs and/or for application in LMIC markets. We have developed a roadmap for how to bring innovations from the lab to market, which we describe in the following slides. It is important to note that there is nuance in the process and it is not necessarily linear, as it depends on the context and product.

Our approach is also based on the following principles:

- Capitalize on educational opportunities
- Leverage/complement other resources at the University of Michigan (U-M)
- Staged process with lots of small goals and opportunities for feedback
- Balance ambition with reality
- Fit with LMIC markets

High-level commercialization process

- Faculty/student ideas
- Industry-sponsored ideas
- Other calls for proposals



Overview of process and key steps for product and business

Discovery

Product

Defining problem, hypothesis, why it's of interest

Business

N/A

Technology Development

Product

Develop technology, subcomponents, develop lab scale prototype and test

Business

Define market needs and comparable solutions, understand value proposition and competition

Pre-Commercialization

Product

Run proof of concept testing in customer setting at scale

Business

Complete high-level market analysis and business case for specific markets, including product costing

Commercialization

Product

Produce the product

Business

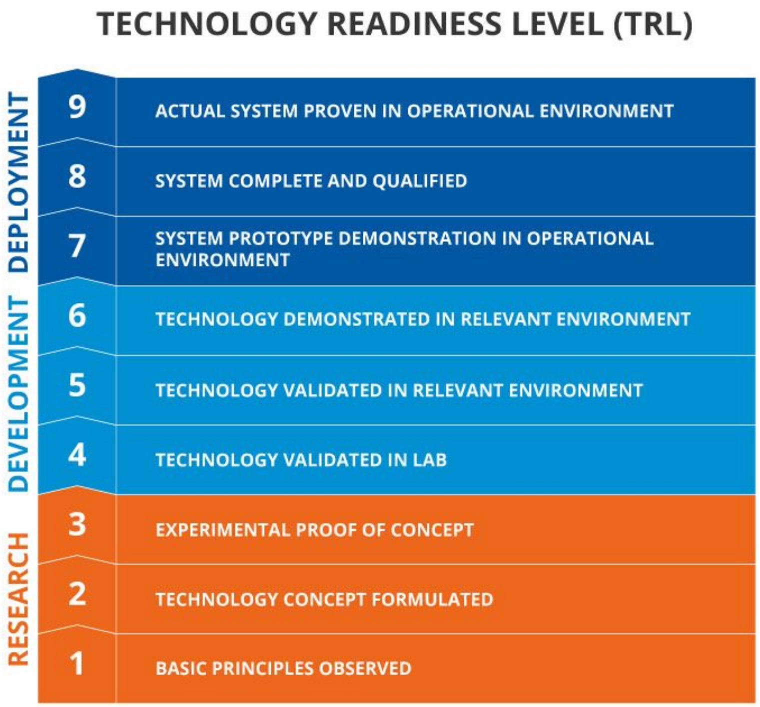
Identify production partners, develop funding models and placement and promotion strategy, execute the business model, monitor and evaluate

Feedback and iteration

Source: Developed by WDI

Technology readiness levels

An innovation may also be assigned a technology readiness level (TRL) to indicate its technological maturity, which corresponds to its commercialization journey. As several prototypes from Chihuahua are presented in later slides with their corresponding TRL, we include a visual explanation of TRLs using an example from the U.S. Department of Energy here.



Source: https://www.twi-global.com/technical-knowledge/faqs/technology-readiness-levels

Key players

Inventor/researcher: Technical faculty member, researcher or student who develops an idea for a product or service; usually owns rights to part of the intellectual property depending on their institution's policies.

Commercial lead: Advances the business milestones to bring the product/service to market. May be the inventor/researcher or may be someone else.

Academic institution: Where the inventor/researcher is based, usually owns rights to part of the intellectual property and provides resources such as facilities, equipment, expertise.

Government: Manages the patent, may provide other types of resources such as funding.

Customer: The institution or individual that pays for the product or service. May also be the end user, or may be different.

To commercialize or not?

The commercialization process can be long, complicated, and require a lot of different types of resources and expertise. A commitment is needed on behalf of the inventor/researcher and their institution to pursue commercialization in an effective way. What are the potential benefits and reasons to pursue commercialization, and what are the potential challenges and pitfalls?

Opportunities	Challenges
• Generate social and economic benefit through access to innovations in real world • Speed time to implement innovations through strengthened connections between industry and academia (licensing or start-ups) • New source of revenue for person/institution with IP • Reputational boost • Positive feedback loops - success begets success • Presents pedagogical opportunities for multiple disciplines, especially science, engineering, business, law	• Need the driver – who makes sure everything gets done and never says “that’s not my job” • Incentives within a university, particularly faculty, are not typically aligned with commercialization objectives • Requires (often substantial) resources and different kinds of expertise • Progress can be slow because relying on academic programs and calendar • Success in commercialization is a long shot even for great ideas

What does success look like?

For those interested in working to overcome these challenges to reap the benefits of commercialization, how can they be set up for success? This first requires an agreed-upon definition of success, as well as the alignment of key enablers at the institutional and ecosystem level.

Depending on the institution, success might encompass any of the following, or other metrics:

- More patent applications
- More prototypes developed by faculty and students
- Better understanding among faculty and students about business, legal, and technical concepts related to commercialization
- Enhanced entrepreneurial mindset among students and faculty
- More licenses sold to companies
- More spin-off or startup companies formed

Success enablers

Key enablers at the institutional and ecosystem level also need to be aligned to facilitate success.

Institutional level enablers

- Management commitment
- Strong research engine
- Blending technical, business, legal minds and resources
- Involving students
- Aligned incentives
- Entrepreneurial culture - awareness, incentives, opportunities (time, resources, mindset) to test and fail and test again
    - Entrepreneur scientist - researchers
    - Entrepreneurial champions - integration of entrepreneurial training throughout curriculum, determined pursuit of interdisciplinary research
- Interactions with industry to know needs of market

Ecosystem level enablers

- Legal and regulatory environment
- Business and economic environment
- Access to funding

2. Mexico and Chihuahua context

Higher Education Context in Mexico & Chihuahua

Increasing enrollment in higher education was a priority of the previous federal administration, and public and private universities have been growing fast. This academic year, there are 3.9 million students enrolled in higher education programs in Mexico (WENR). The number of students enrolling in higher education in Mexico has doubled since 2000, now representing 38% of the college-aged population (Forbes).

The state of Chihuahua has 137 universities, with over 145,000 students enrolled in higher education. 938 researchers work at these institutions across several disciplines, with 15% in engineering and technology development. (Source: CIES, CONAHCYT, SEECH data 2023-2024)

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Policies for academic commercialization in Mexico

Several key laws and governmental programs in Mexico in the past few decades have aimed to spur innovation, industry-academic connections, and commercialization:

- Starting in 2001, public policies aimed at promoting technology transfer and innovation, systemic strategies to support innovative companies - these resulted in mechanisms such as national incubator system, technology parks, OTTs, business accelerator networks, and more
- 2008 CONACYT AVANCE program and 2012 Ministry of the Economy FINNOVA - initiatives to create patenting centers in universities and research institutions around the country - have contributed to more IP protection, increased interactions between public research institutions and industry
- 2013 creation of National Institute of the Entrepreneur (INADEM)
- COMIMSA transformed into InnovaBienestar in 2023, a state-owned, semi-public company for technology transfer, consolidating and/or replacing many OTTs at different institutions

While some of these policies and programs have helped to advance commercialization, not all of them are still in existence. There are still challenges at national and institutional levels, which we will explore further.

State of academic commercialization in Mexico

Within this broader context, there has been research on ecosystem and institutional factors affecting the success of academic commercialization in Mexico. These are relevant to different degrees in Chihuahua as well, as we will explore in the next section.

Four major challenges in Mexico with generation of university spin-off companies include: (source)

1. Lack of clear and effective process and management surrounding intellectual property
2. Lack of dedicated tech transfer professionals/capabilities at higher education institutions
3. Lack of business training and entrepreneurship education focused on commercialization, which is inherently difficult
4. Lack of enabling environment within higher education institutions in terms of governance, processes, etc.

Relevance to Chihuahua

Increasing the activity and success of commercialization of innovations at academic institutions in Chihuahua is a priority for several players across the state – especially state government agencies and the academic institutions themselves. Priorities include increasing the number of patent applications filed, prototypes developed, IP licensed to companies, and new companies created.

In this context, we will next describe the current state of the ecosystem in Chihuahua related to commercialization, highlighting key players, current activity, assets to be leveraged, and gaps to be addressed.

3. Chihuahua commercialization ecosystem

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Methodology and limitations

The following findings and assessment are primarily based on key informant interviews at six academic institutions and select state government offices as well as desk research and online literature review. The interviews took place in November and December 2024.

For key informant interviews, we generally spoke with institutional leadership, those involved in technology transfer, innovation, or similar functions, faculty members with relevant prototypes or research, and some students. Our findings are therefore influenced by the individuals we spoke with, and are meant to be more representative than comprehensive. We recognize that there may be nuances or examples that aren't represented, given limitations due to the set up of each institution, the way communication flows among schools or between schools and central offices, and in some cases leadership transitions, etc.

Even with these limitations, these findings serve as a solid basis for the goals of this phase of the Lab to Market project.

Current commercialization processes at Chihuahua institutions

How are academic institutions in Chihuahua supporting commercialization of energy and mobility technologies today?

Next, we present several visuals for the general processes they are following, where they are focusing efforts, and where they are progressing vs. hitting roadblocks.

Academic institutions' commercialization process today

The six academic institutions involved in this research are active in the discovery and technology development phases of the commercialization process, but rarely progress to the following stages, with a few exceptions. Within the first two phases, activity is mostly on the "product" side, with some "business" activity for example through student projects or OTT staff.

	Discovery	Technology Development	Pre-Commercialization	Commercialization
Product	Defining problem, hypothesis, why it's of interest	Develop technology, subcomponents, develop lab scale prototype and test	Run proof of concept testing in customer setting at scale	Produce the product
Business	N/A	Define market needs and comparable solutions, understand value proposition and competition	Complete high-level market analysis and business case for specific markets, including product costing	Identify production partners, develop funding models and placement and promotion strategy, execute the business model, monitor and evaluate

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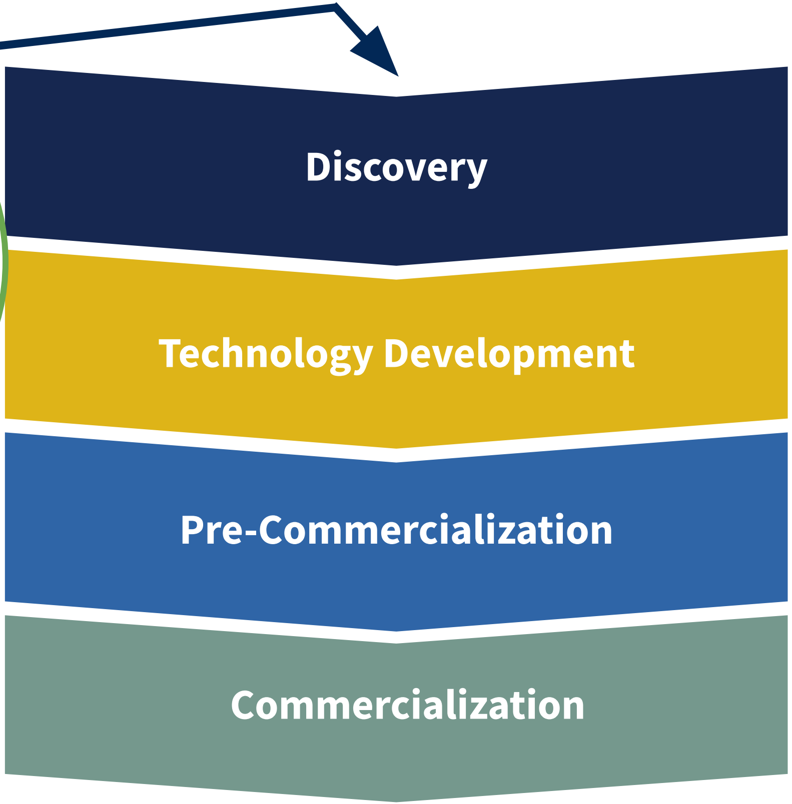
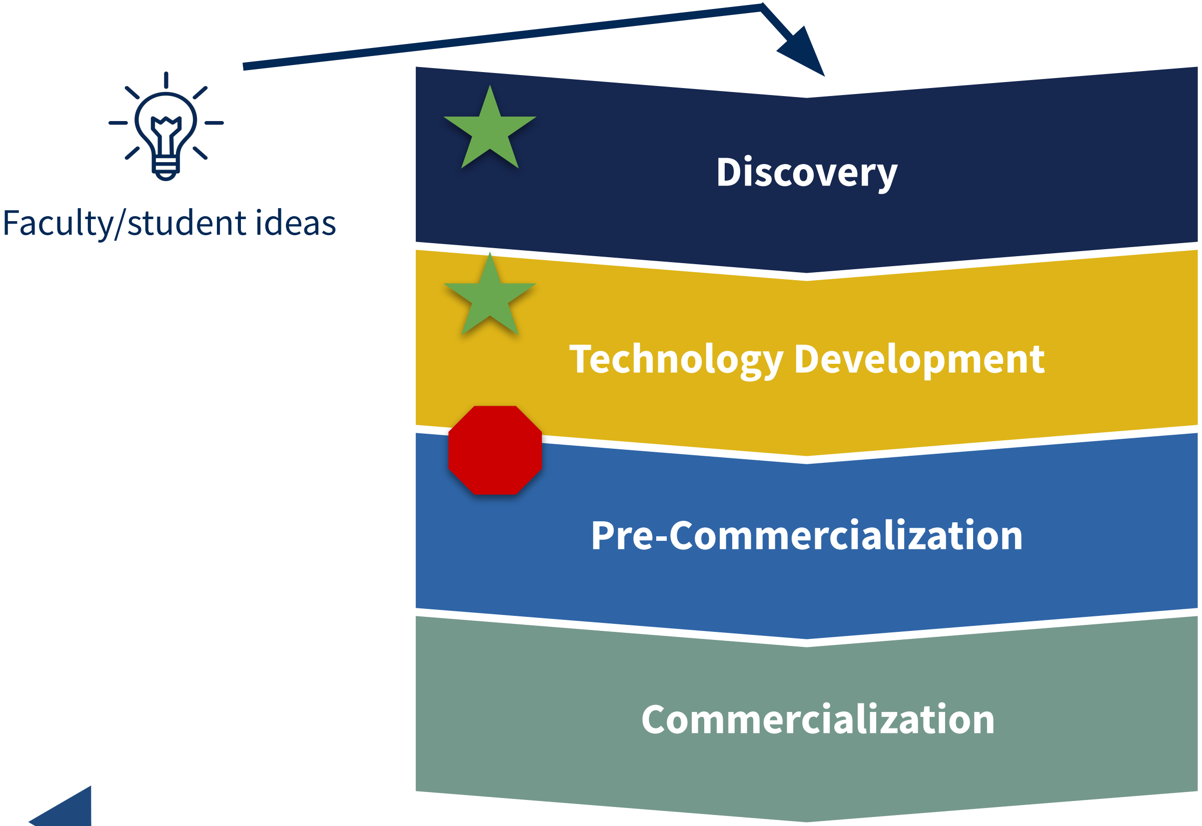
Where do these innovations originate?

- Faculty/student ideas
- Industry-sponsored ideas
- Other calls for proposals



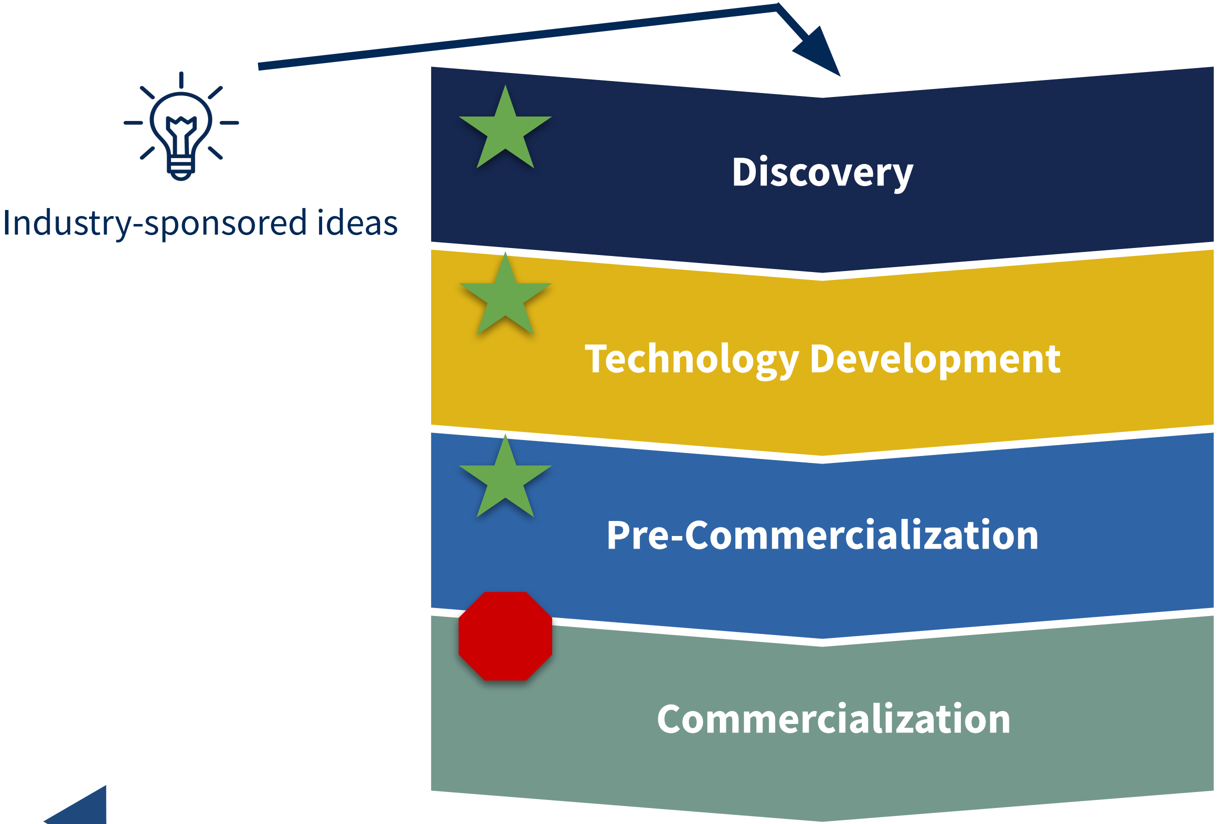
The commercialization-related activities and roadblocks within academic institutions differ based on where the ideas originate. We will describe each of these scenarios in the following slides.

Faculty/student initiated ideas



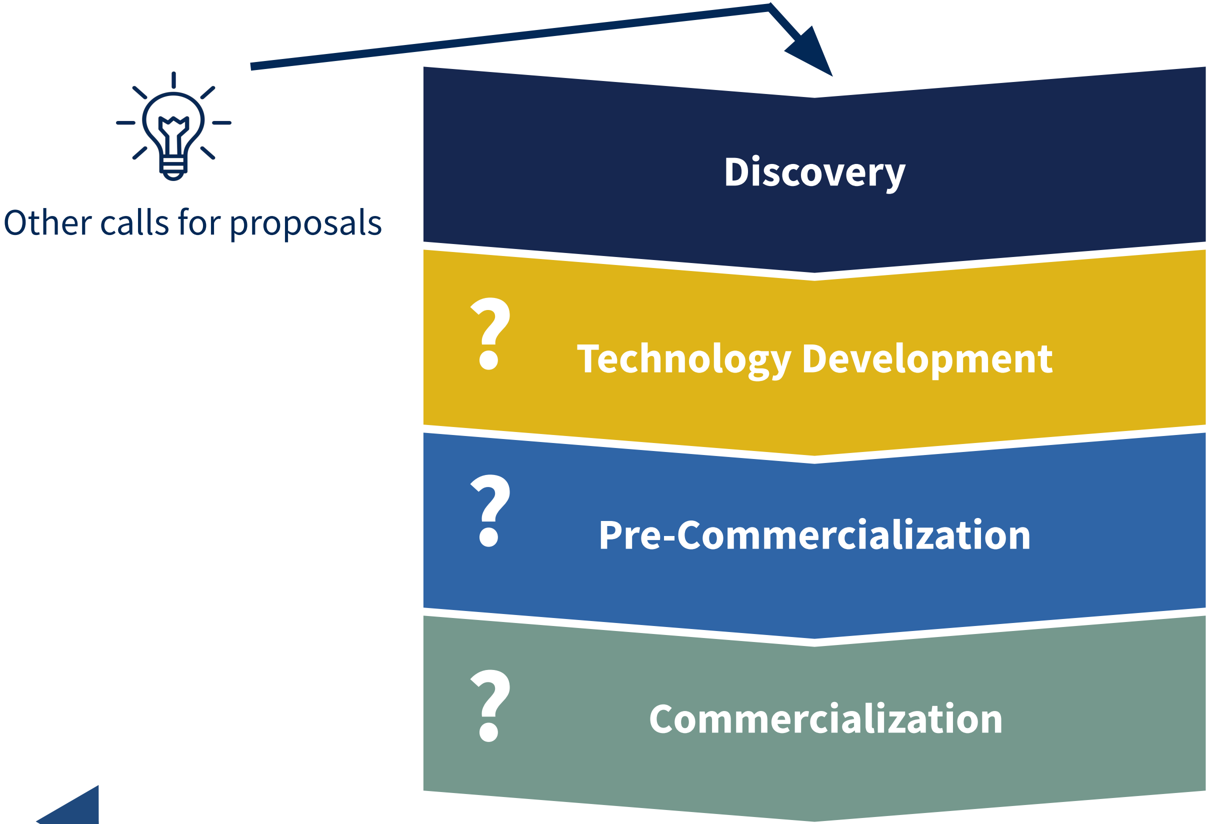
Faculty and students are often generating novel ideas from their research or studies. In these cases, the focus tends to be on creating and testing the feasibility of a solution for a technical problem rather than considering the market opportunity in the discovery phase. Faculty and students will then leverage academic institution resources to protect IP (or forego this for a variety of reasons described elsewhere) and develop and iterate prototypes in the technology development phase. This is typically where the commercialization process stalls.

Industry-sponsored ideas



In some cases, industry comes to researchers at academic institutions with a problem identified, to co-develop or have the academic researchers develop a solution. In the discovery and technology development phases the academic researchers tend to still focus on the technical aspects of the idea and prototype, and the company will consider the market opportunity and perhaps competitor analysis and more depending on the situation. In these cases, there is negotiation between the company and academic institution regarding IP (which often stays with the company). The company is then often able to support more advanced testing of the prototype and business development in the pre-commercialization and commercialization stages. Not every development in these scenarios is a commercial success, but these tend to advance farther than student/faculty generated ideas.

Other calls for proposals



It is harder to generalize the path and roadblocks for ideas that originate from other calls for proposals. We heard that there are a lot of differences based on the each call and who issues it (e.g. federal government, state government, company), the scope, and terms specific to the call. We did not learn about any commercialization success stories from this path.

Where do these innovations typically get stuck?

Overall, academic institutions in Chihuahua excel at the discovery phase, and early parts of the technology development phase (creating bench scale prototypes). Depending on the idea and resources needed to continue advancing the development of the technology, the process may stall at this point. Where there are available external resources (such as from a company with a vested interest), the idea has a greater chance of advancing to further testing and refinement, as well as pre-commercialization activity to understand potential fit with market.

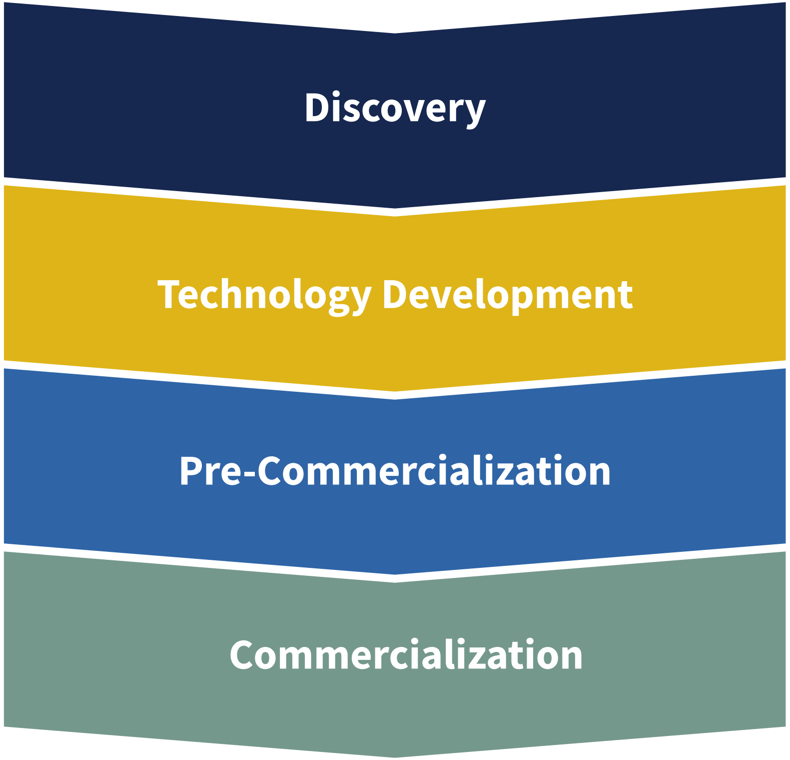
We did not learn of any success stories so far with an academic innovation being commercialized.

What type of support exists outside of these institutions?

Next we highlight assets and resources for supporting academic commercialization that are based outside of academic institutions (external) and are accessible by stakeholders across the state.

In later slides, we present more detailed views of findings from within academic institutions as well as statewide gaps and challenges.

External commercialization assets and resources



Outside of the resources within academic institutions in the state, there are other assets that can support bringing academic innovations to market. Here we map where those identified can play a role in the commercialization process, with further explanation on the following slide. Note that there may be additional assets in the state; here we aim to highlight those specifically referenced by interviewees as playing a direct, rather than tangential, role in the academic commercialization process in the state.

External commercialization asset organization details

State government

State funding program launched in 2024 focused on science, technology and innovation supporting research, equipment, testing, facilities for piloting and more. Funding has gone to universities and research centers, companies, and other entities that are working to drive forward research and realize impact from innovations.

The Centro de Patentamiento (CEPAT, launched in 2024) is part of the Chihuahua Instituto de Innovación y Competitividad (I2C). CEPAT is focused on building capacity in the patenting process throughout the state through workshops, awareness building, working directly with university offices to complement what they do, tracking and sharing data about patents, and more.

CENALTEC, part of INADET in the state government, establishes and manages a number of laboratories and workshops throughout the state. These provide equipment, space and training that can be valuable for developing, testing, and advancing prototypes and other technologies.

National government

Local actors work with the federal IMPI (Instituto Mexicano de la Propiedad Industrial) to register, manage, and protect intellectual property generated by research and prototype development.

Non-profit

Part of Desarrollo Económico del Estado de Chihuahua (DESEC), Startup Chihuahua promotes an innovation ecosystem in Chihuahua. They have various programs, including incubation and support to seed and scale technological innovations.

Operating under Frente Norte, Startup Juarez connects and supports startups in all stages with a focus on data-driven innovation and ecosystem support.

Overall commercialization assets and resources

Both within and external to academic institutions in the state, various resources exist to seed new ideas, develop initial concepts or bench-scale prototypes, and define and register intellectual property. There exists expertise, facilities, and processes internal and external to academic institutions to bring ideas this far. Additionally, there is more limited expertise to undertake some market analysis and help researchers, at least at a very preliminary stage, to understand the commercial feasibility of their innovations.

Next we summarize the challenges we encountered to greater success in this area.

Overall commercialization gaps and challenges

These are general challenges to commercialization that were identified within and outside of the academic institutions in the state.

Within academic institutions

- Lacking internal capacity and know-how to take tech transfer steps beyond patent filing
- Little to nothing by way of incentives for faculty to commercialize – incentives are aligned with other activities
- Legal structures/policies may prevent engaging with industry in ways needed for commercialization
- Lack of clarity/standardization on institutional rules related to IP rights

Fit with industry

- Lack of facilities, equipment to do testing, validation and get necessary certifications for prototypes to be industry-ready
- Many technologies developed at academic institutions are TRL 4 or earlier - either not a good fit for industry or requires additional development by industry, limiting opportunities for researchers and academic institutions
- General lack of connections and experience working between academic institutions and companies

Broader context

- Patenting process in Mexico can take years
- By law, IP belongs to institution (not researcher) unless institutional agreement specifies otherwise
- Legal restrictions over what can be done with research undertaken with federal funding

Summary

While there are clear challenges and gaps to overcome to advance academic commercialization in the state, a number of organizations, processes, and other assets are already in place – as well as clear interest and motivation from various actors at different institutions to advance this type of work.

4. Overall institutional findings

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Academic institutions findings

Academic institutions are a key aspect of the broader state ecosystem for bringing energy and mobility innovations to market, so we look at them next.

For each of the institutions included in this phase of the project, we gathered information via interviews and desk research. We organize the findings by eight key areas. Each area represents an aspect within the institution that can enable commercialization.

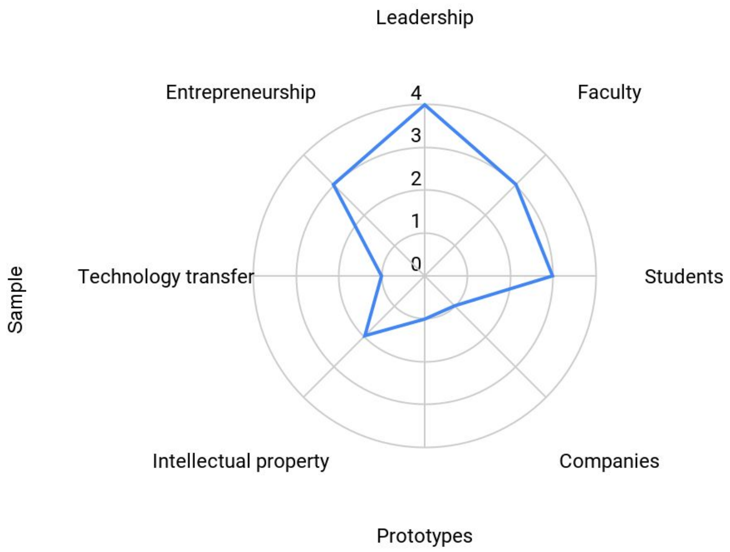
Descriptions of institutional enablers

Here we describe each area for which we will provide descriptive findings from the academic institutions in the coming slides.

Leadership	Indication that commercialization is a priority for institutional leadership, either through expressing it during interviews, history of success, commitment of resources, alignment of incentives for researchers, etc.
Faculty	Relevance of faculty activities and interests to commercialization.
Students	Any student activities or roles relevant to commercialization.
Companies	Current programs or other mechanisms to engage with companies.
Prototypes	Existence of prototypes developed by researchers, faculty, students (for the purposes of this project, prioritizing those relevant to energy and mobility).
Intellectual property	Institutional capabilities to identify and protect intellectual property.
Technology transfer	Institutional capabilities to advance ideas beyond the patent stage.
Entrepreneurship	Classes, programs, or other aspects of institutional culture that promote learning and doing related to entrepreneurship for students and faculty.

Explanation of visual representations

For each institution included in this analysis, we present a visual representation of the findings across the eight areas of analysis. These visuals are meant to help identify areas of strength vs. opportunity for growth overall and at each institution. The numbers shown in the chart were assigned by WDI based on qualitative findings.



This sample radar chart indicates that the hypothetical institution has strong leadership commitment, faculty and student interest in commercialization, and existence of entrepreneurial culture and programs. It is currently lacking mechanisms for working with companies as well as IP and tech transfer capabilities.

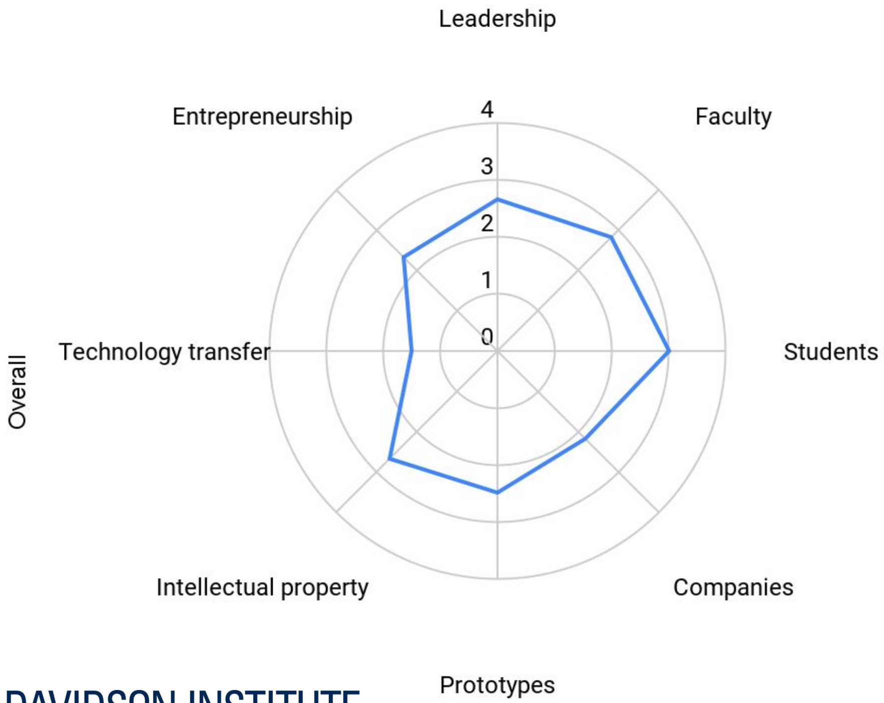
Overall institutional findings: descriptive summary

This chart summarizes the findings from the six academic institutions that were involved in the first phase of this project. It is important to note that this is not meant as a comprehensive evaluation of these areas within the academic institutions, but rather an evaluation of how aligned each area is with commercialization.

Leadership	• Most institutions indicated leadership interest in doing more related to commercialization. Some expressed openness to reviewing how resources are allocated, incentives aligned, etc.
Faculty	• Interviewees indicated that many faculty are interested in the real-world impact of their research, including through commercialization. However incentives are typically focused on teaching, publication, and in some cases patenting – but not bringing ideas to market.
Students	• Many institutions have programs to engage students in research, connecting their studies to companies' needs – and are interested in doing more along these lines.
Companies	• Few institutions have established and successful models for engaging companies - all expressed interest in doing more in this area.
Prototypes	• Existence of prototypes is uneven across institutions - some have many, but most have few.
Intellectual property	• Many have expertise and capacity to apply for patents, but could use more to avoid bottlenecks in the process.
Technology transfer	• Few institutions have dedicated technology transfer staff or offices, and largely do not provide support after the patenting phase.
Entrepreneurship	• Some institutions have very established entrepreneurial culture and programs – but more often programs are more limited, with interest in doing more.

Overall institutional findings: visual

This visual summary illustrates the areas of strength vs. opportunities for improvement related to commercialization across the six institutions included in this analysis. The numbers are average scores of the detailed findings provided in the next section.



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5. Detailed institutional view

Findings by institution

To complement the statewide view of the commercialization support ecosystem, we now present more detailed findings from the six institutions included in this phase of the project.

We organize these findings by the eight areas introduced in the previous section, first presenting a description and then a visualization of the findings.

First, we provide context about each of the institutions.

Overview of institutions included in this analysis

Institution	Overview
cimav	Centro de Investigación en Materiales Avanzados (CIMAV) is a research center in Chihuahua capital focused on the areas of materials, energy and the environment. It is one of 27 institutions coordinated by CONACYT. In addition to research, CIMAV runs graduate (masters and doctoral) programs and works with industry.
TEC DE JUÁREZ Forjando el futuro, transformando vidas.	Instituto Tecnológico de Ciudad Juárez is a public university and part of the National Technological System of Mexico. With approximately 6,000 students (predominantly undergraduates), ITCJ has pre-bachelor's programs (such as certificates and diplomas), undergraduate, and a small number of masters and doctoral programs.
Tecnológico de Monterrey Chihuahua	Tecnológico de Monterrey, Chihuahua campus is a private university, one of 31 campuses located across 25 cities in Mexico, serving 90,000 total students as part of the ITESM network, founded in Monterrey. The Chihuahua campus was established in 1976 and primarily offers programs in administration and engineering.
Tecnológico de Monterrey Ciudad Juárez	Tecnológico de Monterrey Ciudad Juárez campus is also part of the ITESM network. The campus was closed for several years and recently re-started 2 years ago. It currently serves approximately 150 students in a business and two engineering programs.
Universidad Autónoma de Chihuahua	Universidad Autónoma de Chihuahua is a public university in Chihuahua capital with several campuses and 25,000 students, offering many undergraduate and graduate degrees in different fields.
UACJ	Universidad Autónoma de Ciudad Juárez is a public university serving 40,000 students, offering bachelor, masters and doctoral programs in many different disciplines.

CIMAV - descriptive findings

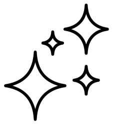
Centro de Investigación en Materiales Avanzados, S.C.

Leadership	• Strong interest in expanding their commercialization activity and strengthening connections with companies • Have strong networks, looking to do even more collaboratively with other institutions • Currently no incentives for faculty to focus on commercializing technologies post-patent; priority areas are research, teaching, patenting
Faculty	• Strong research activity and interest in commercialization
Students	• Approximately 200 students at CIMAV, closely involved in research projects and in opportunities to work with companies
Companies	• Strong existing mechanisms for working with companies and office dedicated to this. Collaboration with companies involves sponsored research, providing lab or other technical services, co-applying for funding • Have explored licensing CIMAV IP to companies but haven't been able to negotiate mutually agreeable terms. In other cases company owns IP developed at CIMAV when sponsoring project
Prototypes	• A lot of prototypes have been developed or are under development, including in energy and mobility • Many are TRL 4 or lower, but some are higher (TRL 6-9)
Intellectual property	• Lots of experience applying for patents - mainly in Mexico but also through partners in the US and Canada as relevant • Ownership of rights between institution and researcher/inventor is not entirely clear or standardized
Technology transfer	• Not much experience or success with the steps post-patenting, but very interested in doing more of this • Does some market research related to their prototypes
Entrepreneurship	• Entrepreneurship class offered to Masters students

CIMAV - visual representation

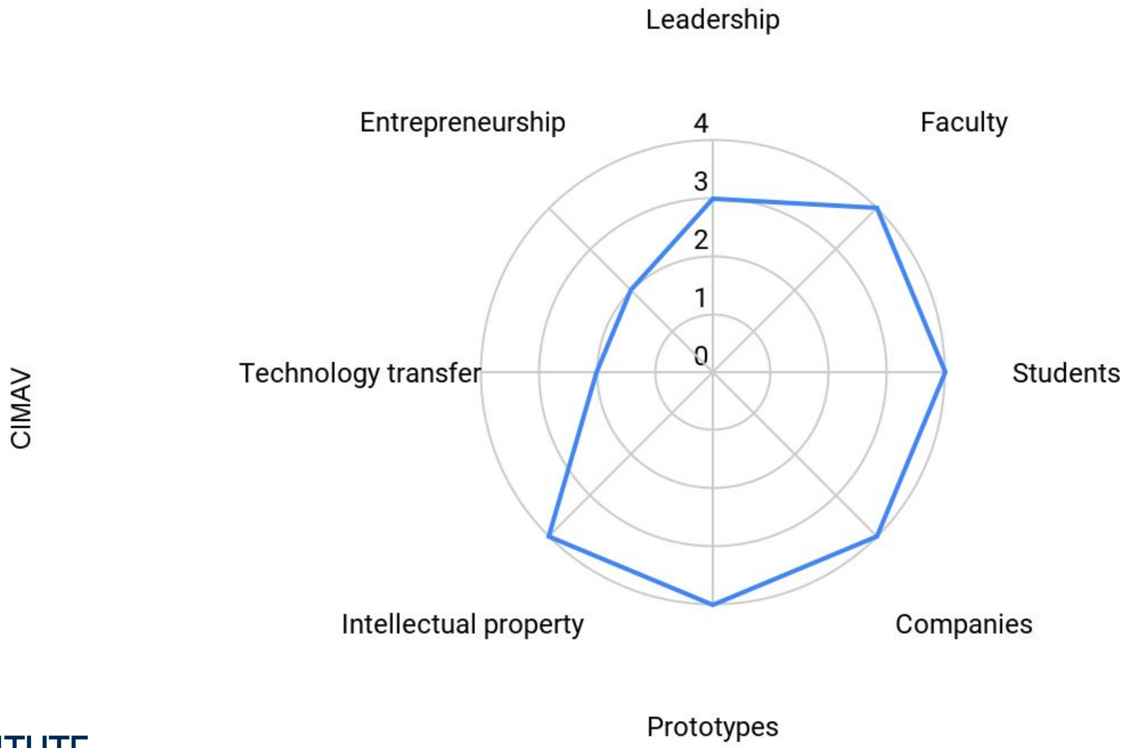
Centro de Investigación en Materiales Avanzados, S.C.

Spotlight



Advanced materials services for industry

CIMAV has a long history of working with industry, and has a strong offering of services for companies. They have specialized expertise in advanced materials with many applications for the manufacturing industry across the state. Their cutting edge infrastructure includes labs for materials characterization, nanotechnology, and more.



ITCJ - descriptive findings

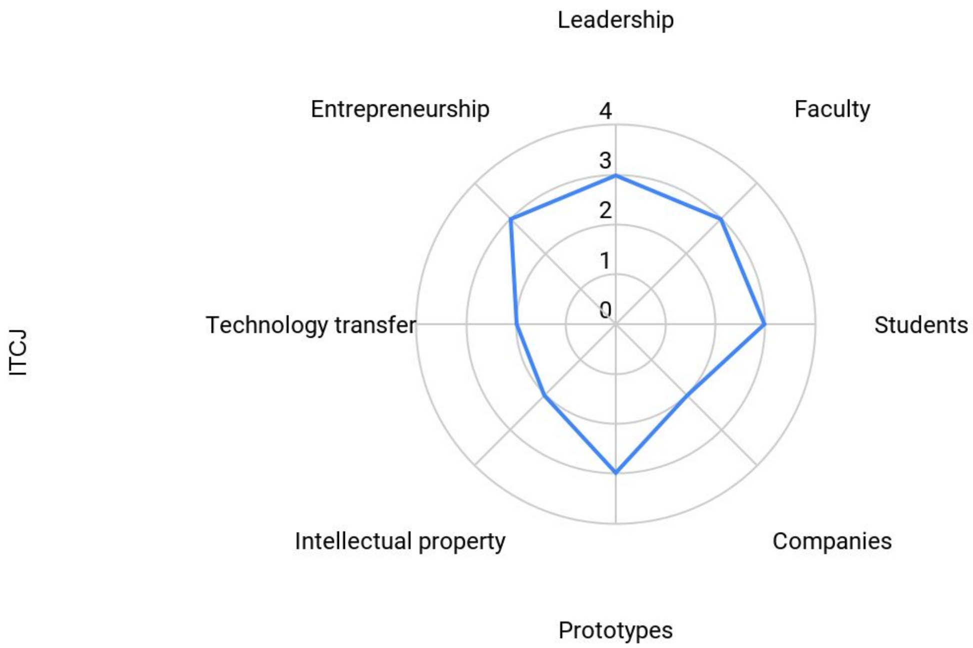
Leadership	• There is interest in doing more related to commercialization and support for prototype development, but this is not an institutional priority
Faculty	• There is a research group in engineering that is quite focused on prototype development and technological advancement in areas related to energy and mobility
Students	• Students are encouraged through classes, clubs, and other activities to develop products, prototypes, and work directly with companies
Companies	• Companies primarily engage with ITCJ through the Nodo-TEC (the Node), a center focused on creativity, entrepreneurship and technological innovation. ITCJ can sign NDAs and assign students or faculty to work on projects with companies
Prototypes	• There are multiple relevant prototypes related to energy and mobility involving faculty and students
Intellectual property	• Researchers can seek support from a Regional Center for Equipment Optimization and Development (CRODE) in Chihuahua to file patents with IMPI
Technology transfer	• In the past there was a tech transfer office at ITCJ to help with applying for patents, but not currently
Entrepreneurship	• There is an incubator that serves students, faculty, and the public, providing business support services. Through the incubator, the Nodo-TEC, and other programs at ITCJ, for example in the business program, students and researchers are exposed to entrepreneurial thinking and business concepts

ITCJ - visual representation

Spotlight

Node of Creativity, Technological Innovation and Entrepreneurship

The Node is a development center for "real-life" projects, promoting collaboration between academia and industry – collaborative learning for students and researchers, and targeted support with technological products and services for industry. In the Node, ITCJ has built makerspaces, acquired equipment, and organized programming to build design, development and research skills and build a culture of creativity, innovation and entrepreneurship among multidisciplinary groups. Technical focus areas include 3D printing, AI, Manufacturing, and Internet of Things.



Tec Chihuahua - descriptive findings

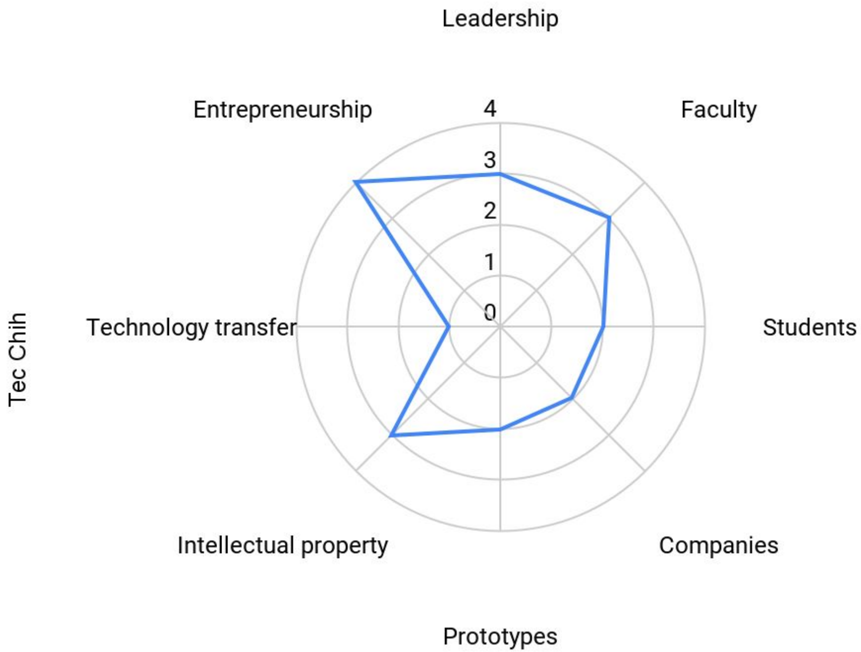
Leadership	• Commercialization is an increasing priority for the institution, to generate revenue and support more related activities at the school • Implementing the Tec21 Educational model, centered on competency-based and challenge-based learning - integrates real-world problems from partner organizations into the curriculum, modular calendar for students • Current incentives for faculty focus on publication and teaching, not commercialization
Faculty	• Individual faculty have driven efforts to make prototypes, patent, think about commercialization to-date - it has been organic and often more focused on the prototype as teaching and research tool than on getting it to market
Students	• There are relevant student clubs, including one aiming to compete at Shell Eco-marathon • All students work on a capstone project, some involved in research and product design beyond that
Companies	• Some work with companies, for example through small-scale class projects for credit, no fees - hoping to do more
Prototypes	• Small number exist that are relevant to energy and mobility
Intellectual property	• They work with inventors to apply for patents - this is the focus in terms of commercialization in Chihuahua
Technology transfer	• Technology Industrial Park on campus can support projects that have reached validation phase to seek funds • In Tec national network there are other resources to help with commercialization, but not in Chihuahua
Entrepreneurship	• Have science and technology entrepreneurship program at national level through ITESM • Testing venture builder program and adapting a model from Jalisco focused on bringing technologies to market • Have makerspaces, mechanisms to connect technical with business, but more focus on this is needed

Tec Chihuahua - visual representation

Spotlight

PIT2 and PIT3

In 2009, Tec campus Chihuahua created PIT2 (Parque de Innovación y Transferencia de Tecnología) in 2013, PIT3 was created. These are spaces and associated programs dedicated to consulting, training and services for the development, incubation and formation of companies. They work with Tec faculty and students, as well as external companies.



Tec CDJ - descriptive findings

Tecnológico de Monterrey

Leadership	• Leadership team is very small and focused on ramping back up operations of the campus, starting with two core engineering and business programs and expanding from there
Faculty	• Very small group of faculty at present, focused on teaching
Students	• Curriculum has focus on application of knowledge - practical, flexible, rapid • International business challenge - companies define a challenge and students solve in teams • Also programs where students develop rapid prototypes in specific topic • Aiming to start students clubs and teams, could be aligned with energy & mobility
Companies	• Working to align curriculum very closely with industry needs
Prototypes	• No activity here now but developing a makerspace
Intellectual property	• No activity here now but they can use centralized ITESM resources if needed, and they also teach about patenting process in some classes
Technology transfer	• No activity here now
Entrepreneurship	• No activity here now, outside of business focus in classes

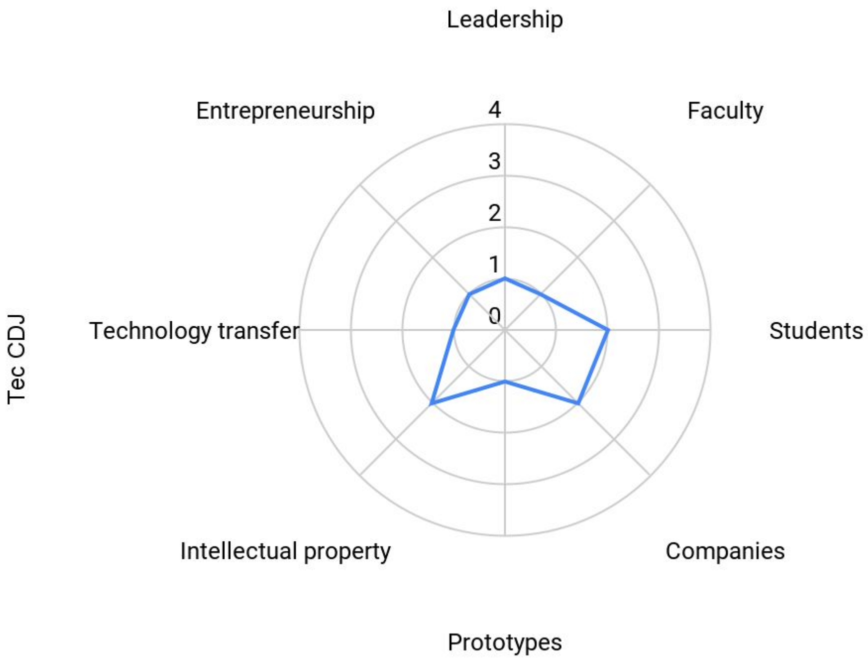
Tec CDJ - visual representation

Tecnológico de Monterrey

Spotlight

International business challenge

In the school's international business program, students are presented with a challenge related to positioning a new product in a new market under certain constraints. Students work in teams to present their positioning and compete with other teams. They learn through the process of working with real companies with real challenges, and this challenge aligns with Tec's new educational model Tec21 that emphasizes practice over theory.



UACH - descriptive findings

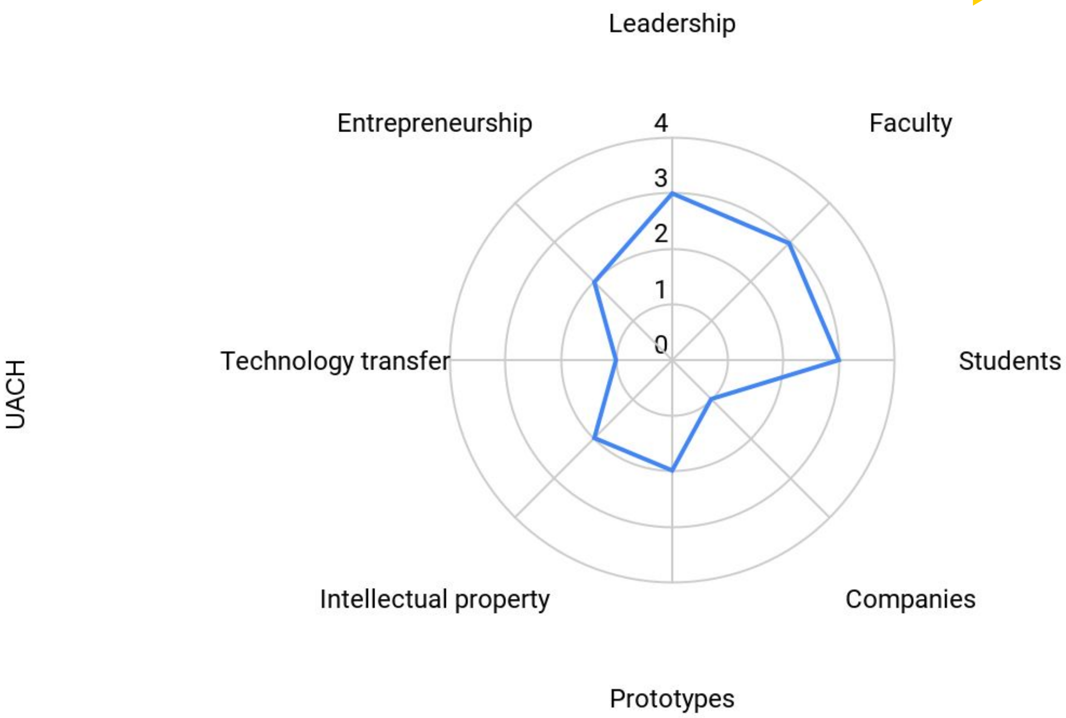
Leadership	• UACH is creating a new institute as a separate entity that will focus on research, training, and development/incubation of new technologies and ideas; will allow them to work with new organizations and access different types of resources • Clean energy and mobility will be among the focus areas • Will also create six new lab spaces connected to the institute focused on advancing research
Faculty	• Faculty have demonstrated interest in working more with industry, commercializing research
Students	• Institutional interest in engaging students more in research, commercialization, work with industry • Many students get involved now with companies or research via capstone projects
Companies	• Have been limited in the ways in which they can work with industry - new institute will help address some of these limitations • Interested in better understanding the needs of industry
Prototypes	• In general, many prototypes are developed at UACH - not many related to energy and mobility at present
Intellectual property	• Centralized legal team that works with IMPI to apply for patents, but many faculty members will apply on their own • Working with CEPAT and I2C to build capacity in this area
Technology transfer	• Do not have an office of technology transfer • Researcher/inventor typically retains 30-40% of rights of IP developed while working at UACH
Entrepreneurship	• Have multidisciplinary entrepreneurship program and technological innovation and entrepreneurship center

UACH - visual representation

Spotlight

New institute

UACH is in the process of creating a new institute that will be a separate but related entity with UACH, to facilitate new ways of working internally and with external entities that are currently restricted by UACH's structure. The new entity, which aims to be up and running by 2025, will focus on research, training and the development of prototypes in the areas of clean energy, e-mobility, software development, ecology, and water management. There will be an emphasis on working more and in new ways with industry, and bringing innovations from UACH research to market.



UACJ - descriptive findings

Leadership	• New university administration is prioritizing research, technology transfer and making investments in new offices, policies • Working on strategy specific to commercialization, open to restructuring incentives
Faculty	• Lots of research activity, split between basic and applied - often focused on publishing over commercialization
Students	• Some programs specifically designed to involve students in developing prototypes, designing products, etc. • Students are often included in patent applications with faculty
Companies	• Some company engagement is happening at researcher level, want to do more to create and offer services for companies based on what's already happening
Prototypes	• There are many prototypes in TRL 3-4, not all related to energy & mobility • No known success stories advancing prototypes beyond this, including in energy & mobility
Intellectual property	• Researcher/inventors can apply for patents through UACJ or directly with IMPI - in the past there wasn't much support or incentive for them to go through UACJ, which is seen as a missed opportunity • Working to streamline and standardize process of determining IP rights between UACJ and researcher/inventor - aiming for 50/50
Technology transfer	• New office of technology transfer, aiming to provide more resources and streamline processes • At present, not much activity or support after applying for patent
Entrepreneurship	• Have entrepreneurship incubator with mentors and other services - open to the public, not specifically geared towards researchers

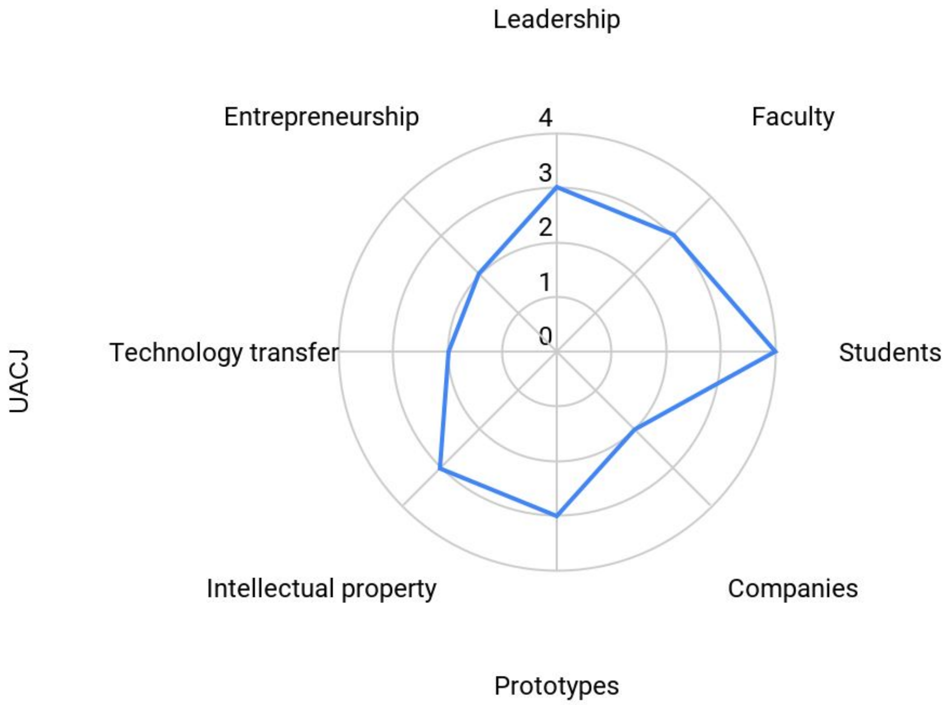
UACJ - visual representation

UACJ

Spotlight

Overhaul of OTT policies and programs

With the new university leadership, the administration is considering how to enhance technology transfer. They recently created an office of technology transfer, are revisiting policies to promote consistency and transparency, are signaling interest in redesigning programs and committing resources to make it easier for UACJ faculty and students to protect their intellectual property and bring it to market.



6. Prototypes

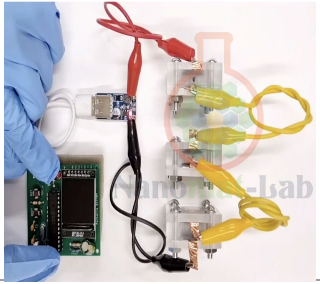
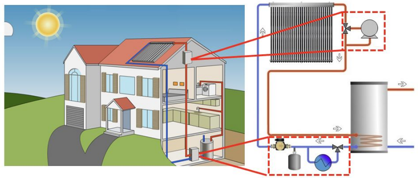
Energy and mobility prototypes

One of the areas highlighted in the findings is the existence of energy and mobility prototypes. We have started gathering information about relevant prototypes at each institution, both to understand the level of activity and how those prototypes have progressed at each institution, and also to prepare for the next phases of this project where we will assess commercial feasibility of prototypes and provide more targeted support to a select number.

In the following slides we present energy and mobility prototypes identified so far at each institution.

Initial energy & mobility prototypes identified

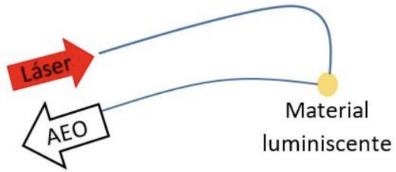
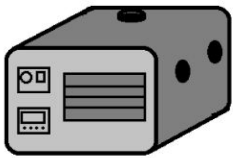
Centro de Investigación en Materiales Avanzados, S.C.

Zinc-air battery	Solar power from solar thermal collectors	Defrosting system for refrigeration
TRL 4, currently applying for patent	TRL 4, patented	TRL 9, developing demonstration facility for prototype
		

Additional relevant technologies:

- Automated cleaning system for solar panels
- Mixed solar drying chamber
- Cylindrical channel solar concentrator with trapezoidal secondary reflector
- Method for preparing photoactive layer of semi-transparent organic solar cell
- Mobile removable platform for thermosolar equipment

Initial energy & mobility prototypes identified

Temperature optic sensor for li-ion batteries	Stirling engine generator to extend EV range	Electric power converter
Concept	Concept	Simulation created
		

Additional relevant technologies and research:

- Optimal planning for EV battery recycling and disposal in US-Mexico binational context
- Vision laboratory and data analysis with AI
- Hydrogen generation by electrolysis using optical Schlieren technique

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Initial energy & mobility prototypes identified

TEC DE JUÁREZ
Forjando el futuro, transformando vidas.

Green hydrogen generation	E-bike frame	Electric motor for 2W	E-motor control system
Initial prototype developed	In development	Three prototypes at different stages of development	In development

WILLIAM DAVIDSON INSTITUTE
AT THE UNIVERSITY OF MICHIGAN

Initial energy & mobility prototypes identified

Tecnológico de Monterrey
Chihuahua

Agri-robot	Heliocentric life support system
Prototype undergoing testing and development	Theoretical feasibility of concept outlined
	

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7. Recommendations for phase 2

Preparing for Lab to Market phase 2

In addition to understanding the ecosystem, assets, and gaps related to academic commercialization at the state level, a goal of this phase of the project is to recommend which two academic institutions will receive more targeted support in the coming months to strengthen their ability to support commercialization of energy and mobility innovations.

In the following slides we provide our recommendations and rationale for two institutions.

We also describe other planned activities for phase 2 and 3 of the project.

Recommended institutions for phase 2

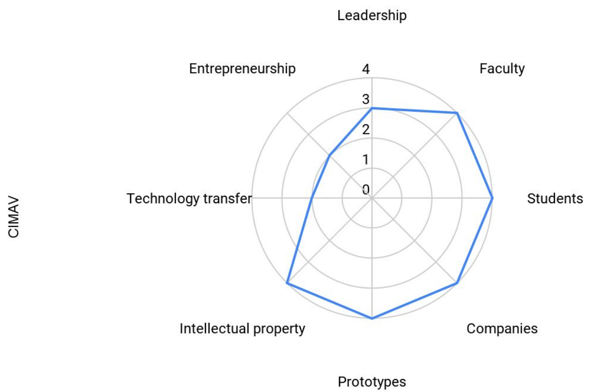
We base our following recommendations on a number of factors, including:

- Demonstrated interest and activity related to commercialization, providing a stronger base on which to build - as illustrated through institutional findings presented previously
- Distinct institutional approaches to commercialization, so that support provided in phases 2 and 3 can be in turn relevant to different types of institutions throughout the state
- One institution from each of the two cities of Chihuahua and Juárez
- Existence of relevant prototypes so we can complete commercial feasibility analysis

Recommended institutions for phase 2

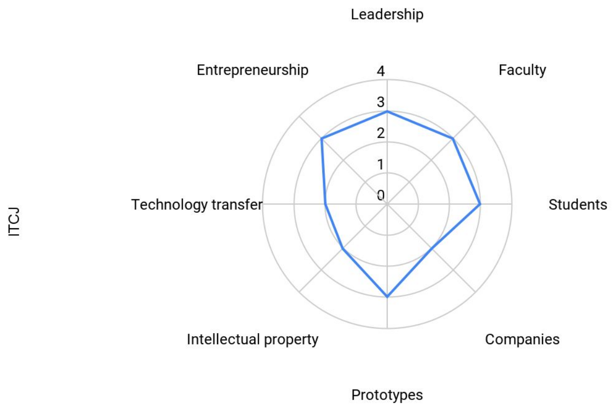
Chihuahua Centro de Investigación en Materiales Avanzados, S.C.

- Stated priority for leadership
- Existence of several relevant prototypes
- Strong capabilities for patenting process and interest in developing more technology transfer capabilities
- Strong existing mechanisms for working with companies



Juárez TEC DE JUÁREZ Forjando el futuro, transformando vidas.

- Relevant group of faculty driving research and prototype development on energy & mobility topics
- Existing infrastructure and programs for involving students in innovation projects
- Mechanisms for working with companies
- Existence of relevant prototypes



8. Appendix

List of interviewees

We extend our gratitude to the following individuals for taking the time to meet and speak with us about this project. We also corresponded with additional individuals that aren't named here.

Institution	Interviewees
Tec Chihuahua	• Claudia Ortega • Alberto Aguilar • Oscar Salinas • Luis Orona • Camilo Lozoya
Tec Ciudad Juárez	• Judith Soto • Reyes Angulo • Omar Saucedo
CIMAV	• Leticia Torres • Marcos • Pedro Martinez • Alfredo Aguilar • Daniel Leal • Alejandro Lopez • Armando Reyes • Fernando Figueroa • Ricardo Beltran • Lorena Alvarez Contreras

Institution	Interviewees
UACJ	• Amanda Carrillo • Flor Rocio Ramirez Martinez • Ramon Ribera • Alejandra Lugo • Jose Mireles
UACH	• Fabian Martinez • Fernando Martinez • Alejandro Leal Almeida • Graciela Ramirez Alonso • Cornelio Alvarez-Herrera • Marco Sanchez • Carlos Molina • Roberto Nado • Javier Facio
ITCJ	• Jeovany Rodriguez • Tomas Limones • Jorge Adolfo • Denise Salcido • Rafael Rodriguez
CEPAT, I2C, SIDE	• Carlos Piedra • Jose Rodriguez • Luciano Fernandez • Sonia Carrasco

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