

By Michael Siminovitch and Mauricio Alcocer

In the fall of 2017, the Mexican Ministry of Energy (SENER) awarded funding to the Universidad Autónoma de Guadalajara (UAG) in collaboration with the University of California Davis (UC Davis) to establish a lighting technology and design research center known as the Centro de Tecnología de Iluminación (CTI). This is a multi-year, public-private investment focused on addressing growing climate change concerns through translational research committed to clean energy and sustainability in Mexico.

The purpose of CTI is to accelerate the adoption and development of energy-efficient lighting and daylighting technologies, as well as to build capacity and training programs for Mexico's lighting industry through university and industry collaborations. CTI's research capabilities will help meet Mexico's long-term energy-efficiency and greenhouse gas (GHG) emission reduction goals.

The proposal to establish a lighting technology and design research center in Mexico was driven by SENER's goals of promoting innovation and technology development, as well as capacity building in the energy efficiency sector. Five strategic objectives were developed for CTI through a series of workshops led by SENER, UC Davis and Lawrence Berkeley National Laboratory (LBNL), as well as roundtable discussions with lighting industry, state and municipal partners:

1. Support **market transformation** through translational, evidence-based research;
2. Foster industry **partnerships**;
3. Establish **scientific and experimental capabilities** in lighting and energy efficiency;
4. **Develop students and professionals** in the lighting and energy efficiency field; and
5. Provide high visibility "**showcase demonstrations**" of sustainable energy technologies.

### KEY ACTIVITIES

*Translational, evidence-based research* is the heart of CTI where a laboratory-to-marketplace research center works in collaboration with the lighting industry to develop and incubate best lighting practices (**Figure 1**). The research is evidence-based in the laboratory and confirmed in field demonstrations.

*Demonstration and validation of lab efforts* where real-world data and proof-of-concept evaluations will demonstrate market potential necessary to foster long term commercial interest. The key objectives are to assess market acceptance, technological feasibility and user acceptance.

*Education and training programs* will be established by the CTI. An undergraduate and graduate component will be established within the first two years of operation. In addition, the training and applications laboratory for practitioners, capacity building and workforce training are targeted to be established within the first year of operation with the intention of offering professional development and workforce training classes by the year 2019.

*The development of guidelines and building specifications standards* is fueled by discussions with state and allied institutions including schools, municipalities and retail organizations. These partners strongly suggest the need for guidelines and recommendations that detail best practices for both new construction and major retrofit projects. Additionally, they have identified a growing need for the municipal marketplace to provide high-quality exterior lighting system recommendations based on laboratory and field demonstrations.

Key focus areas for the CTI in the Mexico market include:

1. Municipal lighting, with a focus on lighting quality;
2. School lighting, with a focus on efficiency and learning objectives;
3. Low income residential, with a focus on cost and efficiency;
4. Hospitality applications;
5. Industrial applications; and
6. Retail applications.

## FACILITIES

A series of full-scale development laboratories supporting CTI research activities are being designed to target the six major market applications areas. These full-scale spaces will be constructed with modular ceilings, variable windows and walls and equipped with control systems for testing different lighting conditions and technology. Data acquisition capabilities will provide experimental support to the full-scale laboratories. The laboratories will also be used to support the education and training functions of the center.

Current full-scale laboratory spaces being developed include:

- Large open office configuration
- Two side-by-side small perimeter offices
- Full residential space laboratory
- Retail laboratory and education space
- Hospital patient room
- Industrial high-bay space
- Lamp measurement equipped with integrating spheres, power supplies and analyzers
- Fixtures and optics, equipped with a goniophotometer
- Life testing

Additionally, a 2,000-sq ft education and training space will be built to support workforce development and academic teaching. This space will seat up to 40 occupants and be supported with demonstrations and vignettes

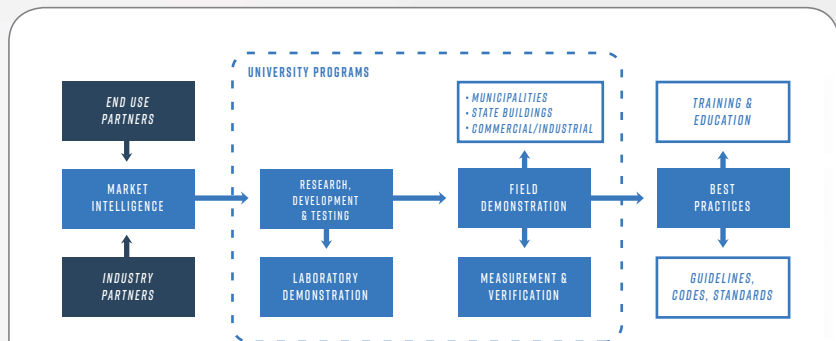


Figure 1. CTI's laboratory-to-marketplace foundation.



A rendering of CTI, which will include lab areas to support the six market sector application areas.

showcasing different lighting technologies and lighting design approaches. The training center will draw from the successful models showcased at Pacific Gas & Electric's Pacific Energy Center (PEC), Community Training and Assistance Center (CTAC), the California Lighting Technology Center (CLTC) at UC Davis and Sacramento Municipal Utility District (SMUD).

The curriculum, demonstrations and vignettes for the education and training space will focus on programs for practitioners and university students at both undergraduate and graduate levels. Practitioners include engineers and architects, lighting design and lighting specifiers. Additionally, a workforce-training program for contractors and installers modeled

after the successful California Advanced Lighting Control Training Program (CALCTP) will be developed. Key curriculum will include single- and multi-day program efforts, as well as longer-term certificate programs. Undergraduate and graduate education offerings will be within the architecture school supporting research, honors projects and a new proposed master's degree in lighting.

### INDUSTRY OPPORTUNITY

The laboratory-to-marketplace foundation of CTI supports new business opportunities for industry partners in the energy-efficiency lighting marketplace in Mexico. These opportunities will encourage Mexican and American industry and government leaders to engage in the research efforts, and will uniquely foster cross-border collaborations as an international engagement. These opportunities will continue to grow as California and Mexico build stronger ties and as mutual interests

materialize in the transition to a low-carbon economy.

Since the announcement of the award in the fall of 2017, UAG and UC Davis faculty have successfully connected with industry partners, public agencies, large end users (retail, healthcare, industrial, municipal), UAG management and related academic programs. CTI will be housed in a 15,000 square foot facility and it is estimated that construction will be completed by January 2019.

CTI will be closely integrated into the mission of UAG, supporting both research and ongoing educational programs. An important program objective in the original CTI proposal was to contribute to the building of workforce development and research capabilities in the sustainability arena. This will be achieved in part through the evolution of new academic programs for teaching and research in lighting energy-efficiency technology and design practice.

Additionally, CTI is closely integrated with UAG School of Architecture, supporting both the educational and research missions of the UAG College of Design, Science and Technology. Collaboration with the UAG Medical School has already been initiated in both the color and circadian design research areas.

An undergraduate program in lighting within the architecture program as well as the complementary graduate degree supporting research interests in lighting for both architecture and engineering students are both in development. These courses will include foundational elements that span the topics of light sources, human factors and design—all with a central theme of efficiency and sustainability. Graduate level courses will include sustainable lighting design, daylighting, controls and human factors issues, such as circadian lighting. □

### THE AUTHORS



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### Acknowledgments:

The authors greatly appreciate the generous support of SENER and the CONACYT-SENER Energy Sustainability Fund and the leadership and vision of its representative in the U.S., Hermann Tribukait, for developing these collaborations, as well as designing and launching the RFP. Sergio Medina, head of the Energy Agency of Jalisco, provided valuable help and guidance throughout this proposal process and in helping with all the industry and institutional partners.