

ELECTRI  INTERNATIONAL



Street Lighting for Xalostoc, State of Mexico

**ELECTRI Student Passport Project 2017
Final Report 2019-01-25**



CECA/NECA University of Toronto
Student Chapter



"Alone we can do so little;
Together we can do so much."

– Helen Keller



The Project Team

ELECTRI International Student Passport Initiative

The University of Toronto Team

Ernesto Diaz Lozano Patiño *

Alejandro Sarellano Acevedo

Greg Peniuk

Mackenzie de CARLE *

Noah Cassidy *

Sneha Adhikari

Syed Imam

Brenda McCabe, Faculty Advisor *

* Visiting Team

TECHO: Jose Roberto Velazquez Alvarado

Special Thanks to

Larry Tricinci, President, Beacon Utility Contractors Limited

Paul Cadario, Distinguished Fellow in Global Innovation at University of Toronto

Ing. Jose Luis Lacer Lara, General Director, Wassertec

Nataliya Pekar, Alumnae and former CECA/NECA Student Chapter member

Patrick Minardi, Alumnus and former CECA/NECA Student Chapter member

The families living in this Xalostoc Community

and

The Canadian Electrical Contractors Association

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1 Introduction

San Miguel Xalostoc, a community established in the State of Mexico, faces crippling infrastructure challenges. Xalostoc is in an area known for informal settlements where inhabitants live in extreme poverty without access to basic city services. A major issue in this community is violence.

Within Xalostoc is a small neighborhood of approximately 140 families. They live on land owned by Ferrovial, a private railway operator, adjacent to an open triangular lot about 300m long. The community has an agreement with Ferrovial that allows them to settle there as long as they do not interfere with the railway infrastructure and keep the right of way clean. Although each household has an average income about one fifth of the city average of \$740 USD/month, they are strong and actively seek a stable and safe community for their families.

PERSONAL STORY

“There is no light after sunset - it is all dark. It is very dangerous because people come back from work late, and kids leave early in the morning to school.”



Figure 1: Visiting Team and TECHO Staff and Volunteers

The community has been working with TECHO México to improve the safety and security in their small neighborhood. TECHO (meaning ceiling or roof) is a non-profit organization that works throughout Latin America to achieve sustainable communities by developing partnerships with volunteers and communities. By engaging the community in the needs assessment,

planning, and fundraising, their success empowers the communities to tackle future projects on their own.

Residents of this community identified public lighting as the most effective way to improve security and trust. However, the community does not have access to formal electrical service nor the means to pay the fees demanded by the local electric utility. An off-grid solar powered system could provide an alternative to traditional street lighting. The NECA/CECA University of Toronto student chapter partnered with TECHO and the community to address their safety problem (Figure 1 and Figure 2).



Figure 2: Visiting Team with one of the community leaders

With contributions from the ELECTRI International Student Passport Initiative, TECHO, University of Toronto, the Student Chapter, and the community, they now have those lights (Figure 3)!

The Student Chapter is very proud of this project and the contribution that it has made to the community. We thank all of our supporters without whom this could not have happened. The next few pages provide a pictorial record of the project from community identification, footing construction, light assembly and installation, impact of lights on community, and project review with community leaders.

This report provides insight to the history of the people of Mexico City, the street light project, the installation, lessons learned, and next steps.



Figure 3: The first streetlight coming on...

Xalostoc: A Community with a defined need



This community lacks reliable utilities that are taken for granted in most large cities.



Community members prepare foundations



It takes several weeks and many neighbors to hand dig the footings. Precast footings are installed.



Learning to assemble and install the lighting system



Once the footings are approved, the lighting system is delivered. Everyone helps install.



LIGHT and SAFETY for the Community



The lights have dramatically improved safety and security in the community.



Follow up with the Community



The community gathers to talk about the project with TECHO and CECA/NECA members.



2 Location

With 8.85 million residents (2010), Mexico City is North America's most populous city and second only to Sao Paulo in the Americas. During our trip, we had the opportunity to explore the city and its surroundings to gain a better understanding of the city's history and to appreciate why communities like Xalostoc have come to exist within the city's metropolitan area.

The city's history is a blend of legendary tales and a prime example of the new and old world coming together (Figure 5). It is said that the Aztecs left Aztlan (the location of which is still under debate) to establish a city where they saw a sign of their gods: an eagle, standing on a cactus, devouring the snake. In 1325, they found their sign in a small island in Lake Texcoco, so they established Tenochtitlan in the heart of what is now Mexico City. Their empire flourished through the 14th and 15th century, at its peak controlling the whole central region of Mexico. However, the arrival of Spanish conquistadors in 1521 turned the fate of the region when they defeated the Aztecs in a bloody war. The Spanish demolished most of the buildings in Tenochtitlan to make way for European buildings and impose Catholicism (Figure 4).



Figure 4: Visit to Templo Mayor, the main ceremonial temple of the Aztecs. Archeologists uncovered several buildings downtown and continue today to explore the remnants of the old Aztec capital.

While buildings were replaced, the Aztec culture did not disappear but rather merged with the Spanish, setting the foundations of the Mexican culture. However, the Spanish oppression of the indigenous communities in Mexican territories set the stage for several of the social issues that the country still faces.

Following Mexico's independence in 1821, the country experienced a tumultuous series of external conflicts that decimated the economy. Coupled with the tension between social classes that was present since the Spanish conquest, this resulted in a revolution that started in 1910. The rest of the twentieth century was characterized by a party dictatorship, which brought periods of apparent stability and growth, and others of economic uncertainty and enormous inflation. Through this process, Mexico City established itself as the political and economic center of the country, which led to the migration of millions of Mexicans into the metropolitan areas in search of job opportunities.



Figure 5: Learning about local history

The plateauing of the City's population led to exponential growth in the neighboring State of Mexico as shown in Figure 6. This growth reduced housing affordability and resulted in the establishment of informal settlements along the perimeter of urban areas.

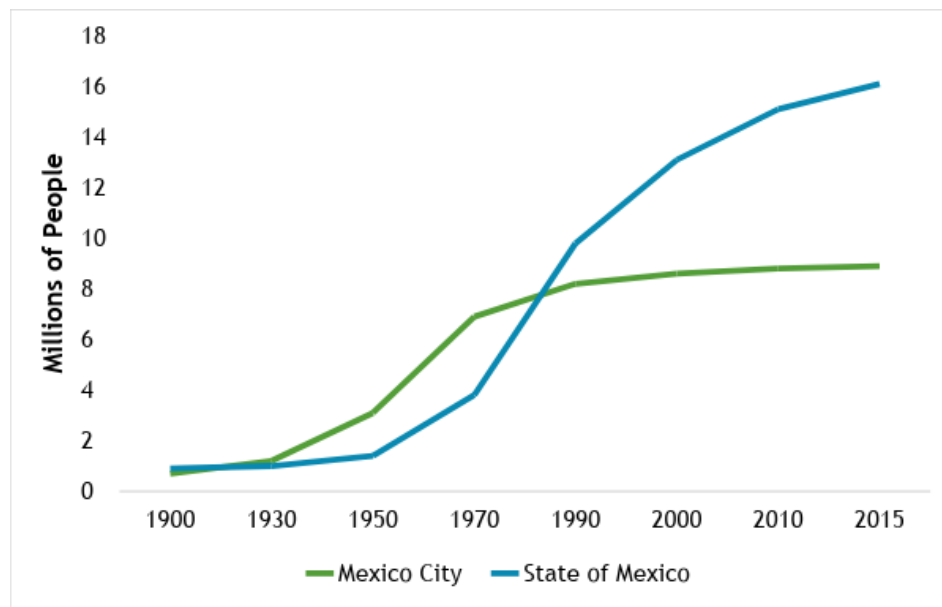


Figure 6: Historic population of Mexico City and State of Mexico (1900-2015)

One example of these communities is San Miguel Xalostoc, which is located just north of Mexico City in the Ecatepec municipality in the State of Mexico (Figure 7). This community has several

settlements where its inhabitants live in extreme poverty without access to basic city services. Within San Miguel Xalostoc is a small neighborhood of approximately 140 families. They live on a narrow 300m long piece of land owned by a private railway operator (Figure 8). The community has an agreement with the private operator that allows them to settle there as long as they do not interfere with the railway infrastructure. Before the project proceeded, the community approached the operator to get their approval, which was granted.

Each household has an average income of \$150 US per month - about one fifth of the city average, but they are strong and actively seek a stable and safe community for their families. Given the high crime rates of the Ecatepec municipality, the community prioritized safety as a key success factor toward a sustainable community. The residents have been working with TECHO México to improve the safety and security in their small neighborhood. TECHO (meaning ceiling or roof) is a non-profit organization that works throughout Latin America to achieve sustainable communities through partnerships with volunteers and communities. By engaging the community in the needs assessment, planning, and fundraising, their success empowers the communities to tackle future projects themselves.

3 The Project

Our student chapter entered the Student Passport Competition in 2017, with a proposal to build street lighting in Toltenco, a community similar to Xalostoc located in the south of Mexico City. Toltenco was also working with TECHO and had identified street lighting as a means to improve their security. After being awarded the funding for project implementation, we began working with TECHO to implement the proposal. However, there was a devastating earthquake in Mexico City in September 2017 that halted our work for two main reasons: the municipality where Toltenco is located halted all construction permits, and TECHO got involved in several emergency construction projects to provide housing to the victims of the catastrophe. When we were able to resume work in January 2018, all progress we had made towards obtaining the necessary permits for construction was lost because of staff changes in the municipality. The upcoming election season complicated matters even more. Collectively, these factors led to the community losing interest in the project over fears of creating conflicts with the municipality, with whom they already had a tense relationship.

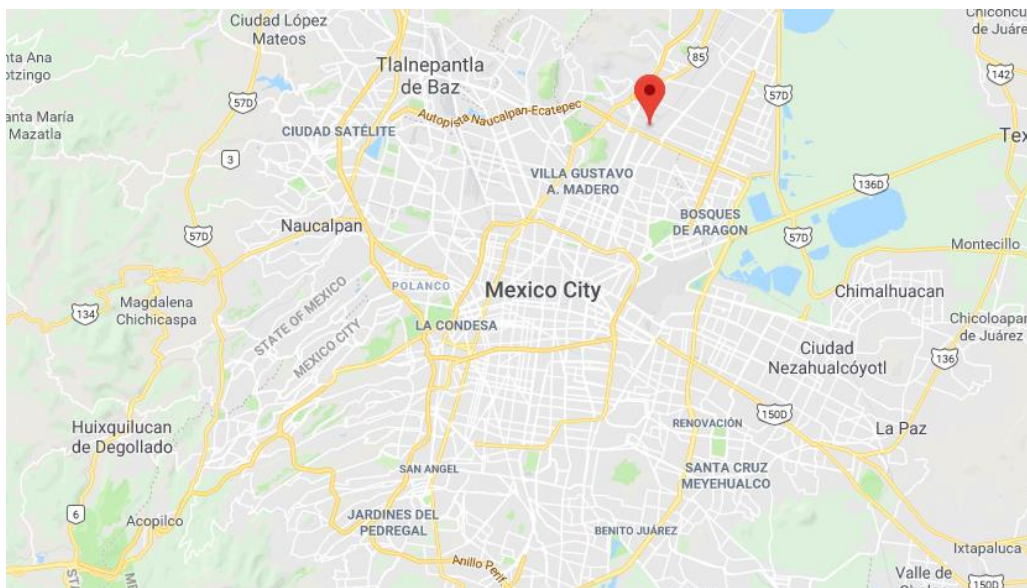


Figure 7: Location of Xalostoc neighborhood relative to Mexico City

In late spring 2018, we decided to relocate the project to another community and TECHO connected us with Xalostoc, whose neighbors were very enthusiastic about the project. Within a short time, the community secured the necessary permissions from the relevant stakeholders, including the rail land owners. Between then and now, we worked with TECHO to finalize the lighting locations and coordinate the construction. A detailed timeline of the project is summarized in Table 1.

Table 1: Implementation Schedule

Dates	Details
2017-07-14	UofT Student Chapter is awarded the 2017 Electri International Student Passport Project and \$20,000 to install solar powered street lights in Toltenco, a community in the south east edge of Mexico City.
2017-09-20	Mexico City experiences a 7.1-magnitude earthquake, killing over 300 people. The epicenter was just SE of the City.
2017-10-16	Cracks in the resolve of the Toltenco community start to appear as consensus on the project is difficult to achieve. TECHO continues discussions with community.
2018-01	Building permit issues also arise as Mexico City is in an election phase and decisions are not being made. There is sufficient support, though, and a building permit application is prepared and submitted.
2018-04-21	Negotiations with the community have stalled. Team examines other neighborhoods in the area with TECHO's help.
2018-05 to 2018-06	Working with TECHO, potential communities in the Mexico City vicinity are narrowed down to four: Pedregal de San Francisco, San Miguel Xalostoc, and Tlalpizaltli, Tizilingo.
2018-07-18	TECHO is informed of our desire to work with San Miguel Xalostoc due to the strong community support and their record of working together. Discussions continue with the community throughout August and September.
2018-10-12	A UofT student visits the community with TECHO. The community will verify lamp locations with right-of-way owner and get approval. Issues, such as lamp orientation and shadows from trees, are discussed with the community as they finalize locations. Decision to use precast footings is made to simplify construction.
2018-11-15 to 2018-11-27	Community members hand dig footing excavations according to manufacturer's specifications. Each hole is covered as it is completed to prevent injuries.
2018-12-02	Precast footings are delivered, placed in excavations, levelled, and backfilled.
2018-12-06	Wassertec inspects foundations to ensure that they meet the manufacturer's approval. The delivery of the lights and poles is booked.
2018-12-14	Installation of the street lights and poles is completed. The first few were assembled and installed with instructions and advice from the Wassertec technicians. The remaining fixtures were installed exclusively by TECHO and the neighbors.
2019-01-11	UofT team arrives in Mexico City!
2019-01-12	U of T meets community with TECHO, develops maintenance plan and gather impact statements. Commissioning of project is complete in close out meeting with TECHO and community members.
2019-01-13	Team completes their reporting, does some sightseeing, and returns to Toronto

Our original plan for the visit was to have a lunch and celebration with the community to close the project. However, one of the community members had a workplace accident and is in critical condition. The community therefore declined the lunch and celebration, so our visit was shortened and focused primarily on reviewing the project and discussing the next steps with the community, well as obtaining their testimonials associated with this experience.

4 The Technical Solution

Wassertec's¹ P90L60 All in One 100-watt lamp was selected to meet the needs of this site. The integrated solar panels and battery systems avoid ongoing electricity costs and eliminate the need for power connections. Lights are mounted on 6 meter (20 foot) regularly spaced poles (shown in Figure 8). The batteries are fully charged with only 4 hours of sun and can provide up to 30 hours of light (see Table 2 for full technical specifications). Sensors turn the lights on and off when the ambient light changes. This provides the community with maximal coverage in important areas, such as the site perimeter and the children's playground.



Figure 8: Yellow circles mark locations of solar street lights; Red box indicates community location; Arrows indicate access points to homes

The region is founded on rock and clay soil. After consultation with the manufacturer, we decided to use 40x75x70cm (16"x30"x30") prefabricated reinforced concrete pyramidal footings. The community was responsible for excavating the footings and installing them. Wassertec inspected the footings to ensure that they were level and properly backfilled. Once satisfied with the quality of the footing installation, they delivered the posts and lamps two weeks later. All of the neighborhood men were available one day. Wassertec trained them on assembly, installation, and maintenance. TECHO was in attendance to oversee and participate in the installation (Figure 9).

COMMUNITY

As an important part of each TECHO project, the neighbors cover a small percentage of the total cost of each improvement... in the end, the results of each day are theirs and for them.

¹ <http://wassertecmx.com/alumbrado-publico-sunlight.html>

TESTIMONIALS

When the community was first told about this project the community was reserved in their reaction. They have become used to empty promises and so were very excited when the project happened and happy with the results. They keep talking about how to get more funding to expand the project and even look into a community fund.

Thanks for thinking of us, we needed it.



Figure 9: Arrival of precast footings; TECHO tent in work area; assembly of lights.

Maintenance needs will be minimal. The LEDs are expected to have useful lifetimes exceeding 50,000 hours or 12 years. The solar panels, with a lifetime of over 25 years, should be cleaned annually, and the lights and batteries should be inspected every six months. According to the manufacturer, the batteries will need replacement every five years at a cost of \$229 per unit. Through the educational program in partnership with TECHO, we will ensure that the community can take ownership of the lights by performing maintenance themselves.

Table 2: Lamp specifications

Model	PL90L60
Solar panel size	90 W
Service life panel	25 years
LED Lamp	60 W
Illumination	6,600-7,200 lumens
Light	White 6,000 K
Lamp service life	50,000 hours
Battery	12V 33AH Lithium
Recharge time	6 hours
Operating time	12-15 hours (continuously)
Recommended height	6-9 m (20 – 30 ft)
Recommended spacing	20-25 m (65 – 85 ft)
Certifications	CE/ROHA/IP65
Dimensions lamp	1340 x 380 x 150 mm (52 ¾" x 15" x 6")

5 Impacts and Next Steps

The impacts of this program will go beyond just street lighting – for everyone involved. It will provide the community with opportunities to become more autonomous and be able to maintain their system with minimal assistance from the manufacturer. We, as the student chapter, now have experience implementing a project like this, and have gained connections with talented partners. TECHO have added another project to their list of successes, allowing them to help even more people in the future.

5.1 Community

The community was invested heavily in the project. They raised 16,000 pesos (approx. \$814 USD) and contributed a great deal of sweat equity to this project. The combination of reduced installation costs and fund raising resulted in one additional light being installed.

Now that the lights have been working for one month, they have seen a dramatic increase in safety and security. The residents are very grateful for the degree of safety gained by the installation of these lights. Children can now safely walk through the empty lands at 7AM on their way to school. They can also use the playground far into the evening as the lighting infrastructure has made the area less attractive to drifters and “trouble makers”.

The process of engaging the community in this project has helped form and solidify bonds. A few neighbors who had not previously been involved are now talking about installing more lamps. The success of this project has demonstrated that they can have significant positive impacts on their community by working together.

TECHO will continue to work with the community. They suggested that the neighbors create a committee to identify other needs in their community and to prioritize them so that future projects can be as effective as possible. The community will also create a Public Lighting committee, which will be responsible for the maintenance of the lamps. Some community members mentioned they were considering a community fund to help finance similar projects.

TESTIMONIALS

We all have to walk through the rail lands to get to our homes. People didn't feel safe crossing this area at night because the darkness attracted the wrong kind of people. This also affected our children, who could not go outside to play in the early evenings.

At night, the lights provide a soft glow. But when the sensors detect movement in the area, the lights get brighter. It is great!

Now that the lights have been installed, members of our community can come and go safely. And, the children can play outside after dark. The loiterers are gone!

5.2 Student Chapter

For the student chapter, the proposal constitutes a unique experience to learn about off-grid street lighting installations, a technology that is becoming more popular with the global push for solar energy development. The chance to work side by side with an experienced non-profit organization and the Xalostoc community has been an invaluable opportunity to explore the impact of good engineering design on communities in need, outside of our context as university students. We appreciate the clean design of the Wassertec lights and the ability to direct the lights to prevent annoying some of the neighbors.

Building a strong working relationship with TECHO could become a gateway for exciting and significant future partnerships that leverage all of our collective efforts, not only in Mexico but throughout Latin America.

Finally, this has been a great opportunity to reaffirm the University of Toronto's role in nurturing well-rounded graduates that are equipped to meet increasingly complex global challenges. Our team members, who are from different cultural backgrounds, travelled to another country with a very different reality than Canada. This experience can serve as an excellent model for future projects, continuing to give students global experiences.

6 Final Cost

The final direct costs are provided in US dollars. Overall, 89% of the budget went directly to the cost of the street lighting.

In addition to cash contributions, we would like to acknowledge significant in-kind contributions in the form of labour, coordination, travel, and communications.

TECHO contributed over 100 person-hours of in-kind support in staff and volunteer time. They also met several times over the past 6 months to meet with the community. Finally, TECHO did the final coordination between Wassertec and the community.

The Xalostoc community contributed over 200 person-hours to the digging of foundations and installation of street lighting system.

Costs	Budget	Actual
Travel – airfare, hotels, car, meals	\$ 6,084	\$ 2,391
Street lights – units, footings	\$19,530	\$17,612
Maintenance	0	\$ 1,520
Total	\$25,614	\$21,523

Revenues	Budget	Actual
ELECTRI	\$20,000	\$20,000
University of Toronto	\$ 600	\$709
Xalostoc community	\$0	\$814
Total	\$20,600	\$21,523

7 Lessons Learned

Our chapter has gained valuable experience carrying this project to completion, of what strategies are effective, and what risks to be wary of in future projects. We attribute our success in large part to the effective partnership we created with TECHO. Their knowledge of the area and its people ensured that the project was not only successfully implemented, but also was valuable and maintainable by the people of the community. They already had in place mechanisms to determine the needs (both type and severity) of the community, which allowed us to find the best place to help. In the future, partnering with a local group, be it a governing body or an NGO, will be one of the first steps, using this partnership as a model.

Not only did this partnership allow us to understand the community needs, it also helped us work directly with the community involved in financing and installing the lights. This

engagement means the community is invested in the project, and they will be sure to maintain them in the future. Without that motivation, the lights would stop working and lose their benefit to the community.

Our chapter will also be more aware of some of the risks involved in implementing a project like this. The original plan with Toltenco fell apart due to factors far out of our control (an earthquake and an election), and we were left with no backup plan. The risk of delays caused by natural, political, social, or other factors is always present. The way to deal with them will be project dependent, but a discussion of what to do at each stage in case of delay would be prudent. Elections are generally hard to avoid, but communicating with the officials before the change in portfolios is important to ensure the survival of the project across those temporal borders.

The CECA/NECA Student Chapter at University of Toronto is very proud of this project and thanks the ELECTRI International Student Passport Initiative, TECHO, University of Toronto, and the community. Without you, this could not have happened.

