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MEXICO SPACE COOLING ELECTRICITY IMPACTS AND MITIGATION STRATEGIES

Analysis Supporting the *Summit on Space Cooling Research Needs and Opportunities in Mexico* February 15-16 Casa de la Universidad de California, Mexico City

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EXECUTIVE SUMMARY

Each summer electricity use jumps by 30% as Mexican homes and businesses turn on their air conditioners. Estimated cooling electricity consumption was 22.6 TWh in 2015. Accounting for losses, this represents about 9% of generated electricity in that year. About half of cooling electricity is used in homes, with the remainder divided roughly evenly between small and large commercial and service buildings, and a small fraction in large industrial facilities. Summer electricity costs Mexican consumers about 31 billion (mil millones) pesos annually and incurs another 46 billion (mil millones) pesos in government subsidies in the residential sector. Because cooling energy use is concentrated in particular regions, months of the year and hours of the day, cooling can be particularly burdensome to the electric grid, contributing to 7.5 GW to peak demand, equivalent to 15 500-MW power plants running at full capacity. In the warmest regions, cooling energy can rise to over a third of electricity in summer months and be responsible for over half of peak electricity demand. Finally, GHG emissions from cooling were about 10 million tons of CO_2 in 2015, but expected to reach 20 million tons by 2030, or about 10 percent of Mexico's 2030 GHG mitigations under the Paris Climate Treaty[1].

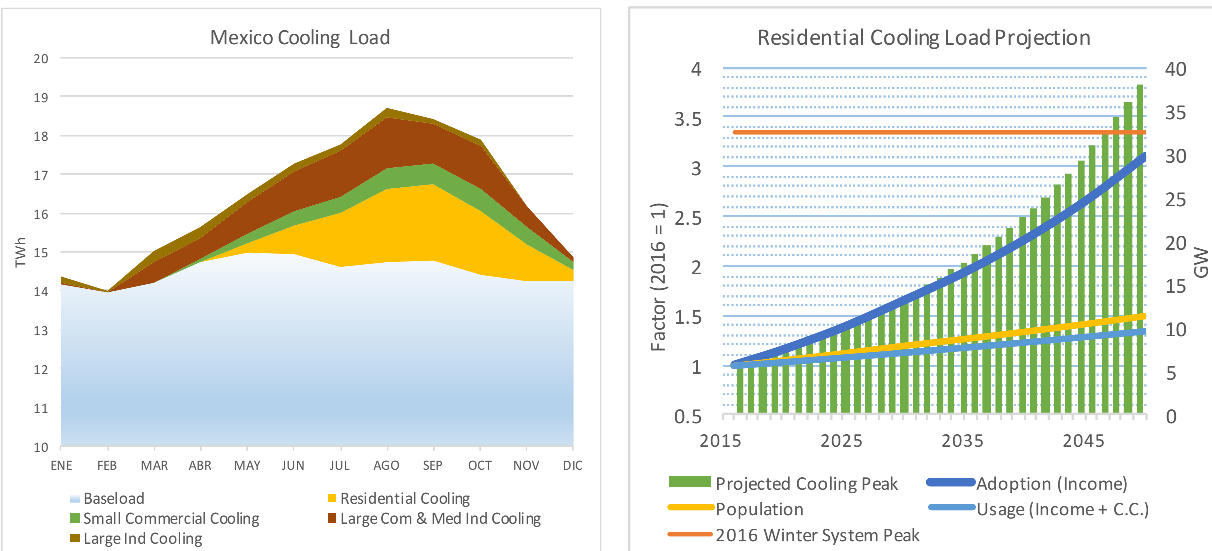

Figure ES- Cooling Load by Sector (left) and Residential Cooling Load Projection (right)

While already large, by 2050 cooling energy use is projected to grow by a factor of 6 in the residential sector and 3.5 overall, implying that costs and subsidies will grow to billions (mil millones) of U.S. dollars each year. Peak load from cooling is expected to grow by 26 GW, requiring significant investment in capacity expansion equal to about three times the approved bids from the Long-Term Auctions (SLP) of 2016 and 2017. Furthermore, much of the cooling peak will occur late at night, when solar electricity is not available and wind output is lower.

[1] Mexico Climate Action Tracker: http://climateactiontracker.org/countries/mexico.html

In summary, a few important points are clear:

- Electricity use from cooling in Mexico is already high, and is expected to grow disproportionately to overall electricity growth over the next 15-35 years, a fact which should be fully incorporated into energy planning and Energy Transition Law implementation strategies.
- The cost of supplying this electricity to consumers is on the order of 75 billion (mil millones) pesos (over 4 billion dollars) each year with at least half that amount being paid through government subsidies, making cooling an issue of critical importance to regulators and the finance ministry (Secretaría de Hacienda y Crédito Público).
- Emissions related to cooling under current energy supply mix could reach 20 million metric tons of CO_2 by 2030. Therefore, cooling is an important consideration in Mexico's commitments under the Paris Climate Treaty (NDCs).

Fortunately, there are many well-established ways to decrease space cooling energy demand, particularly if deployed aggressively through an integrated set of actions, including:

- Equipment Efficiency Standards - Rapidly adopt the best air conditioning technologies on the market through regulations like Mexico's National Standards (Normas Oficiales Mexicanas).
- Voluntary Programs - Develop and disseminate ultra-low energy alternatives to current technologies through voluntary programs such as labeling, rebates, early replacement programs and public information campaigns.
- Technology R&D - Develop alternative cooling technologies such as evaporative cooling and solar-assisted cooling for the Mexican market and deploy them through industry partnerships.
- Building Envelope Best Practices - Lower cooling load with improved construction and retrofits through mandatory building codes and private sector initiatives.
- Cool Solar Reflective Coatings - Lower cooling load by reducing solar heat gain through cool roofs and other reflective coatings.
- Smart Design and Operation - Employ advanced construction, integrated design, user behavior and smart controls to reduce or eliminate cooling loads and respond to peak loads and electricity prices.

Each of these actions pursued individually can yield significant reductions in cooling energy consumption. If pursued in an integrated strategy, they can lead to a future with dramatically lower energy needs for space cooling in Mexico. The ***Mexico Cooling Summit*** organized by USAID and LBNL in partnership with CONUEE and SENER will facilitate development of this integrated and collaborative approach between Mexican government, industry, international organizations, and technical experts. The ultimate goal of the Summit is to put into motion a Cooling Action Plan to address the tremendous projected rise in cooling demand collectively and in coordination with SENER and other stakeholders in Mexico.

ANALYSIS

The electricity used specifically to cool homes and business in Mexico is not measured directly, but can be inferred through analysis of existing data. In estimating this, the Berkeley Lab Mexico Energy Initiative in collaboration with the Berkeley-Mexico Energy and Climate Change Initiative used several primary data sources to make estimates of cooling energy consumption and renewable resources:

- Number of electricity customers, sales and revenue by tariff category and federal entity (state) from the Federal Electricity Commission (CFE 2016).
- Statistics of 2016 electricity sector and forecasts of power plant installations to 2031 from The National Electricity Development Program (PRODESEN) for 2017-2031 (PRODESEN 2017 and PRODESEN PIIRCE).
- Solar PV and wind generation profiles from renewable electricity resource models MERRA-2 models for wind potential and NREL's National Solar Resource Database[2] for solar potential.
- Household demographic data and residential air conditioner ownerships from National Statistics Agency household surveys (INEGI 2014).

Analysis of these data provides insights into the role of space cooling (air conditioning) in the Mexican electricity system and future likely impacts on electricity supply from this important end use.

CONTRIBUTION TO ELECTRICITY DEMAND

Mexico has at least two very distinct climate regions – the central highlands, which enjoy a mild climate and the northern and coastal regions which experience hot summers and corresponding high cooling loads. The latter region can be further subdivided into very hot arid regions and high humidity zones. The overall impacts of cooling as well as the regional differentiation are important to consider. Investigation into the summer cooling load begins with trends in electricity consumption over the year. Sales data from CFE (CFE 2016) is used to estimate cooling. These data are a subset of total electricity consumption in Mexico because they do not include losses (technical and non-technical), self-generation or exports.

Several features are evident from the left side of Figure 1. First, the residential sector shows the strongest cooling effect, with electricity rising nearly 50% from January to August. Large commercial and medium industry (HM tariff categories[3]) consume the most electricity overall and show a cooling trend, though broader and less distinct than in the residential case. Likewise, small commercial (<100kW) shows a broad rise peaking in October. Large industry and street lighting and pumping show a relatively flat trend. Finally, agriculture shows some rise in the summer months, likely from water pumping. Total electricity consumption of the country is about 5 TWh higher in August than the average of December-March, or about 30%. The right side of Figure 1 isolates the cooling load of each sector by comparing with the winter baseload plus the "non-cooling" sectors (street lighting and pumping and agriculture). In this view, it is clear that the residential sector and large commercial and medium industry sectors account for most of the cooling energy in Mexico. Summing the cooling energy (shaded areas) from each

[2] NASA's Modern-Era Retrospective analysis for Research and Applications, Version 2 https://gmao.gsfc.nasa.gov/reanalysis/MERRA-2/and https://nsrdb.nrel.gov/. MERRA-2 data scaled to specific projects was done through https://www.renewables.ninja/ and solar PV project through NREL's System Advisor Model SAM https://sam.nrel.gov.

[3] This is a large category of users with time of use rates and connections between 1 kV and 35 kV, which likely contains both large office buildings, shopping malls and big box stores, as well as smaller industrial customers

sector over the entire year gives the total annual energy. National annual cooling energy derived in this way was 22.6 TWh in 2015, or 8.9% of electricity generated in that year[4].

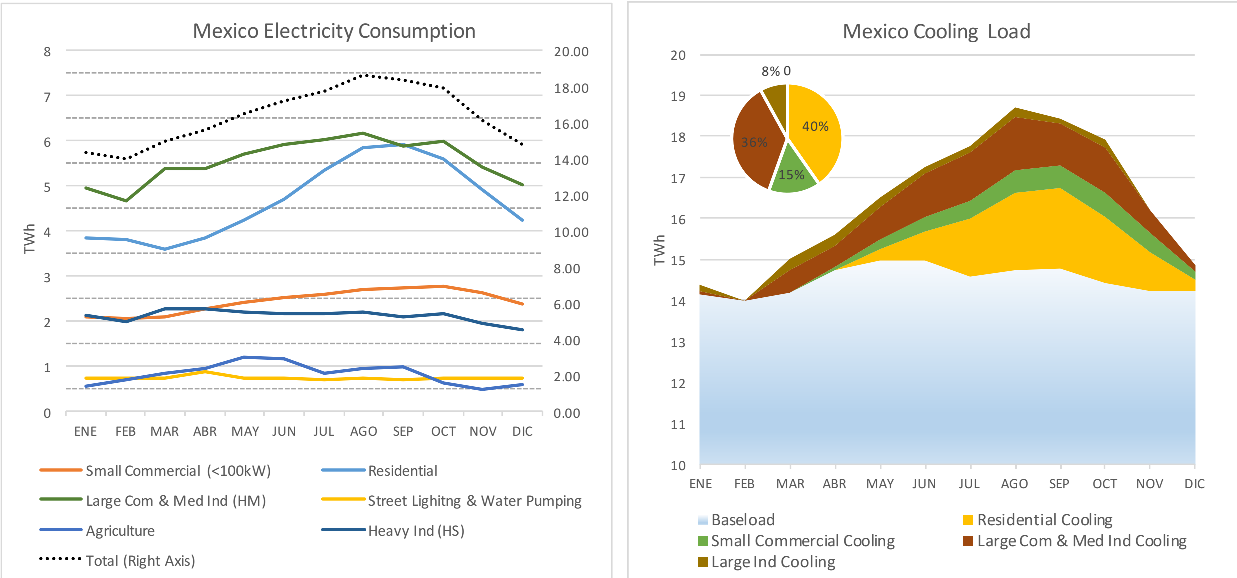

Figure 1 – Electricity consumption (TWh) by month and tariff category

The cost of cooling electricity to Mexican homes and businesses is estimated according to sales figures from (CFE 2016) as the difference in electricity bills in summer vs. winter. The cost to consumers from cooling energy estimated in this way is about 31 billion (mil millones) pesos in 2015 current rates. Specifically, residential utility customers paid over 10 billion (mil millones) pesos for cooling, or about $1.1MX/kWh. This low rate indicates the effects of electricity subsidies, which are highly correlated to air conditioning because residential tariffs are lowered in summer in warm regions. An estimate of this subsidy is made by multiplying the cooling energy by the average difference between the actual rate paid and the DAC (Tarifa Doméstica de Alto Consumo) rate of $3.4 MX/kWh.[5] Cooling electricity subsidies are found to be 46 billion (mil millones) pesos with 21 billion (mil millones) for residential electricity. The magnitude of these costs and in particular the scale of the subsidies provides an idea of the scale of current costs to Mexican society and the amount of funds that could potentially be reinvested in programs to reduce this load. It also indicates the degree to which revenues may not meet costs for this particular end use, providing an incentive to control demand by both CFE and the Ministry of Hacienda.

Finally, electricity consumption for cooling is associated with indirect greenhouse gas emissions in the form of CO_2 emissions from thermal plants. SEMARNAT estimates that Mexican electricity generation emitted 0.454 kg CO_2 per kWh in 2014[6]. CO_2 emissions calculated in this way exceed 10 million metric tons (mt), which constitutes about 5 percent of the required 2030 GHG reduction under Mexico's NDC[7].

While still relatively small in percentage terms, cooling affects sectors and regions in a highly differential way. Cooling energy estimated via the above method is shown by state in Figure 2. The Figure shows

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[4] Calculated by scaling consumption by 13.1% losses and dividing by 288.2 TWh production as reported by PRODESEN.

[5] DAC is a high-use rate set at approximately the cost of electricity production.

[6] See //www.geimexico.org/image/2015/aviso_factor_de_emision_electrico%202014%20Semarnat.pdf

[7] Mexico Climate Action Tracker: http://climateactiontracker.org/countries/mexico.html

total cooling energy in TWh (bars) on the left axis and usage per customer in MWh on the right axis (line). The results show the expected effects of climate, with the Northern states showing very high cooling both in terms of total and per user energy. Sonora is the most cooling-intensive state with over 2.5 TWh and 2.5 MWh per user. In contrast, the states of the central region of Mexico show very low cooling. The range is wide, with warm climate states using roughly an order of magnitude more cooling energy than the cool climate states and the top 5 cooling states (Sonora, Nuevo Leon, Sinaloa, Tamaulipas and Baja California) using over half the cooling energy.

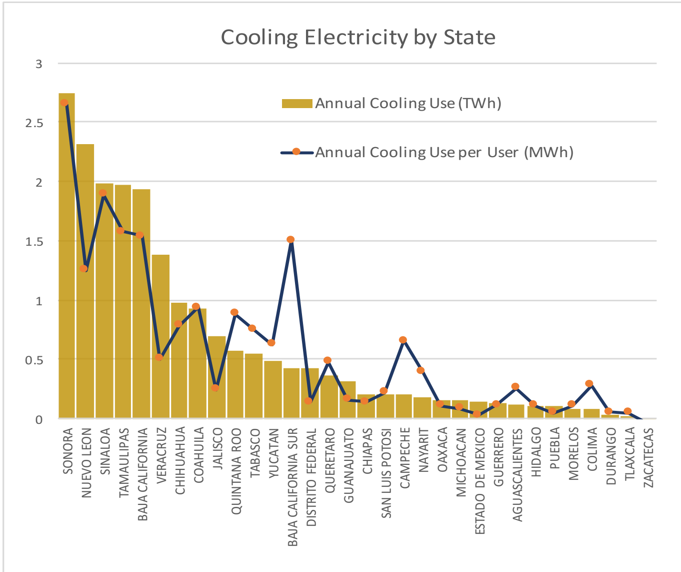

Figure 2 – Cooling Electricity by State

In addition to driving the electricity load especially at certain times of the year and regions of the country, cooling use also is highly correlated to the time of day. This creates important implications for current system peak load requirements, and in terms of correlation with planned renewable electricity sources in the future. In order to gain insight into the shape of the cooling load, we analyzed PRODESEN's modeled forecast for each balance zone for each hour of each day (8760 hours per year) with a forecast to 2030[8]. Data for 2016 is a modeled prediction based on previous years actual load statistics, and we take it to be indicative of current load patterns.

The cooling load profile is calculated by simple subtraction of the average system load during the summer (July and August) to winter (December through March) and comparison between temperate balance zones (central, oriental and occidental) and warm ones (North, Northwest, Northeast, Peninsular, North Baja California and South Baja California. Figure 3 shows the result of the PRODESEN load projection for 2016 for each hour of the day, separated by region and season.[9] The results show very clear and distinct features. The left figure shows the profile for electricity demand in GW for the temperate zones in both winter and summer. The horizontal axis is shifted to start at 6 am to better show late night peaks. The similarity between winter and summer is remarkable for the lack of seasonal variation. The load is relatively flat with a broad shoulder growing gradually throughout the day and leveling through the afternoon. At around 8 PM a clear lighting peak is observed and then consumption

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8 SENER *base de datos demanda horaria* available at http://base.energia.gob.mx/prodesen/PRODESEN2017/DemandaHoraria.xlsx

9 It is important to note that while the PRODESEN model is expected to correlate strongly to past actual load patterns, a more direct analysis using actual load data would be preferable.

gradually decreases to reach its minimum at around 5 am. The only major difference is a very slight uniform increase throughout the day in summer and a shift in the lighting peak by two hours in summer, which corresponds to the shift in the time of sunset.

The seasonal variation in the warm regions is in sharp contrast to the temperate regions. First of all, the winter load overall is only about 60% of the temperate regions, due to lower population and sectoral mix. The shape of the winter load is similar to temperate regions with a broad shoulder at about the same time and a lighting peak at about the same time, although a bit less sharp. Summer load is much higher at all times of the day and contains two sharp peaks with a valley between them. These peaks are shifted relative to the lighting peak. The first appears in the late afternoon while the second appears after midnight[10]. Since they occur only during the summer and consistently in the warm regions they are likely driven by cooling.

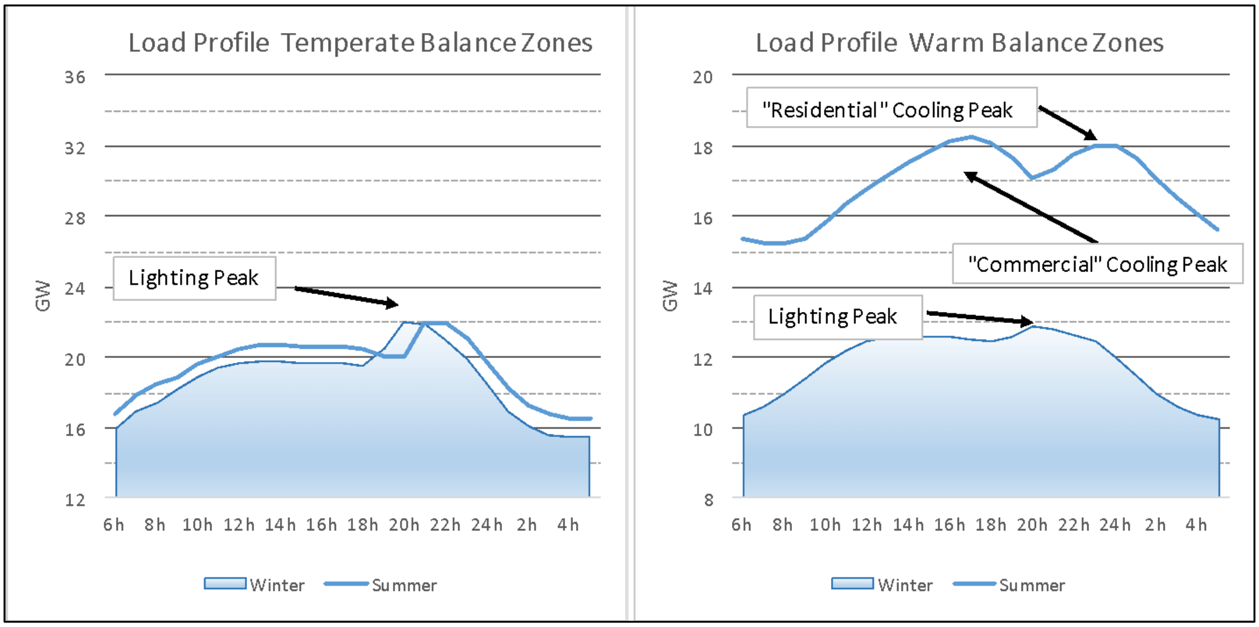

Figure 3 Cooling Load Profiles by Season and Region (note the difference in vertical scales)

The cooling load calculated by subtracting winter from summer averages 4.9 GW throughout the day and peaks at 5.8 GW at 5 PM then 6.2 GW at 1 AM local time in the warm regions. The national cooling peak at this time is only slightly higher, 7.5 GW. Due to a higher baseload in the afternoon, absolute system load is about the same at 5 PM and 1 AM. We hypothesize that afternoon peak arises generally from commercial buildings and is correlated to the hottest part of the day, while the late-night peak is driven by residential individual air conditioners used to provide thermal comfort during sleep.[11] Overall, cooling drives 16% of the national electricity in July and August but accounts for 21% of the load at 1 AM. In the warm regions, these figures rise to 30% and 35% respectively. Finally, in the extreme case of the Northwest balance zone, comprised of Sonora and Sinaloa, cooling reaches 44% of summer electricity and 52% of the peak.

[10] PRODESEN data normalized to Central Time adjusted to local time

[11] Metering data is lacking in both sectors and would be very valuable to confirm or refute this hypothesis

POTENTIAL FOR GROWTH IN AIR CONDITIONER ELECTRICITY CONSUMPTION

As Figure 3 shows, cooling use is an important driver in the national grid, and very significant in some regions. According to INEGI (INEGI 2014), of the 31.7 million Mexican households in 2014, only 14%, or 4.6 million used an air conditioner. Assuming that on average total household cooling capacity is 1.5 ton (18000 BTU/hr or 5.25 kW), we arrive at an average cooling capacity of 0.75 kW per household and 23.9 GW of residential cooling capacity. Further assuming an average air conditioner efficiency of 3.0 W/W and that three-fourths of these are turned on at 1 in the morning, we calculate peak summer cooling of 6.0 GW, roughly consistent with the night time cooling peak calculated above. For context, the three Long-Term Auctions (SLP) of 2016 and 2017 resulted in winning bids of about 8 GW. While already a high load, several trends point to a major increase in residential cooling energy consumption. Among them are:

- Population Growth – Population growth was 1.3% in 2016. A 1.2% growth rate implies 50.5 million households by 2050 if household size remains constant.
- Increased Ownership – Due to higher incomes, air conditioners will be more common. By 2050 most urban households in hot areas are likely to own an air conditioner.
- Increased Use – Currently, most households use one air conditioner for a few hours per day. This is likely to increase to multiple units, larger units and longer hours of use, and is likely to be exacerbated by climate change.
- Demographic Shifts – The percentage of households that were in warm areas increased from about 35% in 1982 to nearly 45% in 2014 according to a recent CONUEE study (de Buen 2016). This trend predicts that 55% of households could be in warm areas by 2050.
- Urbanization – Mexico is currently about 80% urbanized, and can be assumed to reach at least 90% by 2050.

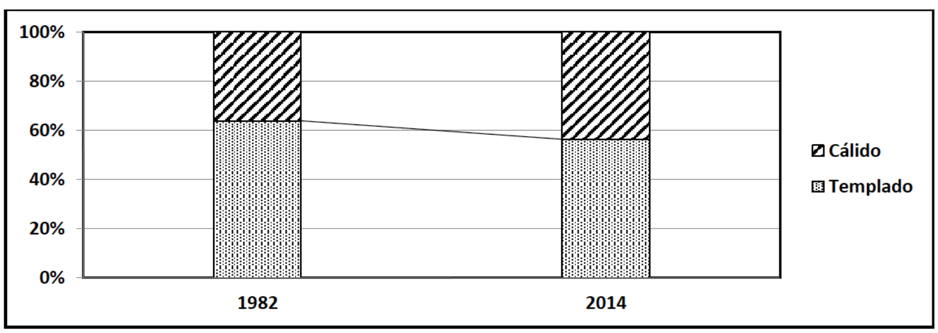

Figure 4 – Evolution of Number of Residential Customers by Climate Type (CONUEE 2016)

Table 1 – Residential Air Conditioner Ownership in Mexico 2014-2050

Urbanization	Climate	Fraction of Households			Ownership of Air Conditioners		
		2014	2030	2050	2014	2030	2050
Urban	Hot	33%	41%	50%	35%	50%	80%
	Temperate	46%	44%	41%	4%	6%	10%
Rural	Hot	9%	7%	6%	10%	15%	25%
	Temperate	12%	8%	5%	1%	1%	2%
Total / Weighted Average		100%	100%	100%	14%	24%	45%

Tables 1 and 2 summarize the assumptions of the factors driving residential air conditioner ownership due to shifts to through 2050. All of the above assumptions lead to higher air conditioner use, mitigated somewhat by a moderate 'market driven' efficiency increase of about a third by 2050. In this "Business as Usual" picture, the transition to advanced technologies and significant improvements in building envelope that are the subject of a Cooling Action Plan are not made. The combination of factors driving growth results in a projected load reaching 13.5 GW by 2030 and increasing by a factor of 6 in 2050 to reach over 38 GW, exceeding the 2016 national system peak of 33.4 GW on a winter day.

Table 2 – Projected Residential Air Conditioner Load

	2014	2030	2050
Ownership Rate	14%	24%	45%
Households (millions)	31.7	38	48
Cooling Capacity per Household (kW)	5.25	6.30	7.88
Efficiency (W/W)	3.0	3.5	4.0
Climate Change Usage Factor	1.0	1.1	1.2
Coincidence Factor	0.75	0.75	0.75
Residential Cooling Load (GW)	6.0	13.5	38.0

These factors and the resulting projected load are visualized in Figure 5. This figure shows each main driver as an index defined with the 2016 value set to one. Adoption is the household ownership rate of air conditioners, driven mainly by income growth, but also including migration and urbanization. This is the largest driver, increasing by a factor of three by 2050. Population also shows a growth of about 50% over the time period, whereas usage includes increases in size and number of air conditioners per household, but is mitigated by market-driven increases in equipment efficiency. The resulting projected cooling load in GW is shown as a bar chart, which grows to meet the Mexico's national peak load in winter, shown by a horizontal line at 33.4 GW.

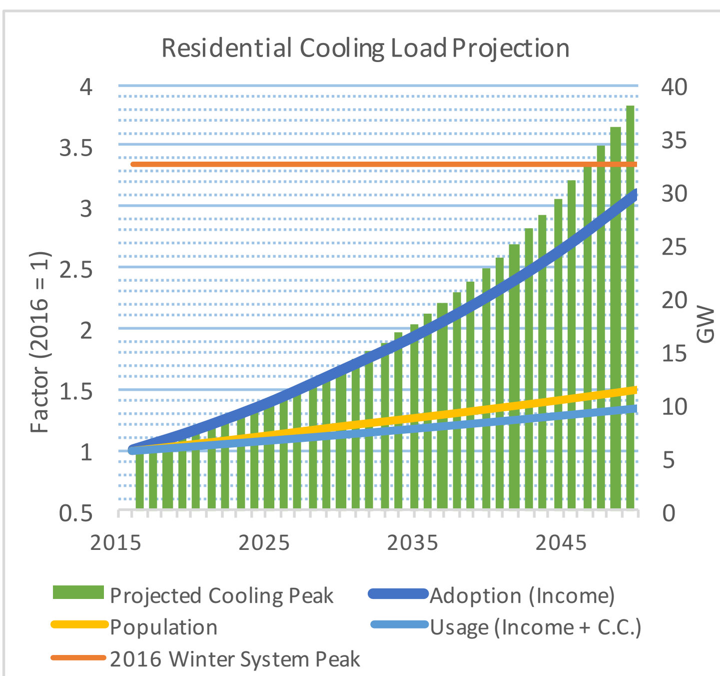

Figure 5 – Residential Cooling Peak Projection

The residential sector is not the only contributor to electricity demand from cooling. Air conditioning is already prevalent in office buildings, shopping malls, big box stores and other businesses in Mexico's warm climates. It is also likely that air conditioning in this sector will grow, driven by many of the same factors as household cooling, especially economic growth in the service and commercial sectors. Unfortunately, this energy has been difficult to quantify to date in Mexico due to the lack of robust data on commercial and industrial sector electricity consumption. Finally, metering data to precisely identify the components of each sector is needed but largely lacking. In order to forecast the impacts of cooling in 2030, we use the growth in residential cooling in Table 2. For the other sectors, we make the simplistic assumption that cooling will double by 2030 then remain constant due to saturation. Results are shown in Table 3.

Table 3 – Impacts of Cooling 2015-2050

Cooling Use	Energy (TWh)			Cost $MN (thousand millions)			Subsidies $MN (thousand millions)			GHG Emissions (millions of tons)		
	2015	2030	2050	2015	2030	2050	2015	2030	2050	2015	2030	2050
Residential	9.1	20.4	57.3	10.2	22.9	64.2	20.7	46.5	130.7	4.1	9.3	26.0
Sm. Com.	3.4	6.9	6.9	10.0	19.9	19.9	4.0	7.9	7.9	1.6	3.1	3.1
Lrg Com. + Med. Ind.	8.2	16.5	16.5	3.5	6.9	6.9	17.4	34.7	34.7	3.7	7.5	7.5
Large Industry	1.8	3.6	3.6	9.0	17.9	17.9	4.1	8.2	8.2	0.8	1.6	1.6
Total	**22.6**	**47.4**	**84.3**	**32.6**	**67.6**	**109.0**	**46.2**	**97.4**	**181.6**	**10.3**	**21.5**	**38.3**

Source: CFE 2016, SENER 2015 and SEMARNAT

CORRELATION WITH RENEWABLE ELECTRICITY SUPPLY

Under the Energy Transition Law, Mexico has a strong commitment to increasing the renewable contribution to the electricity grid, and this has been significantly bolstered by three recent capacity expansion auctions, all of which were dominated by least cost wind and solar generation and resulted some of the world's lowest projected renewable electricity rates. An important element of transitioning to reliable low-carbon energy systems is the relationship between the intermittent renewable resource (wind and solar) and peak demand, shown above to be largely driven by cooling.

In order to better understand the correlation between cooling electricity needs and renewables, we modeled future solar and wind resources using two models, MERRA-2 for wind resources and NREL's National Solar Resource Database for solar potential to determine the variation in availability over time. The overall contribution of the resource is projected according to PRODESEN forecasts of capacity increases, but corrected for the impact of the third resource expansion auction, not yet included in PRODESEN's models.

The results of this modeling are shown in Figure 5. The solar resource shows the expected shape with a strong peak in the middle of the day and zero availability outside of daylight hours. Only a slight offset is seen between summer and winter. Overall the peak wind resource is higher and expected to be relatively constant in winter when averaged over the entire country. In summer however, wind availability is lower, and peaked around 8 PM. Summing solar and wind shows a high availability at midday in winter, but less both at night and in the summer generally, making renewable electricity a poor match for the cooling load, particularly for the late night residential load in the absence of extended solar production windows and/or storage.

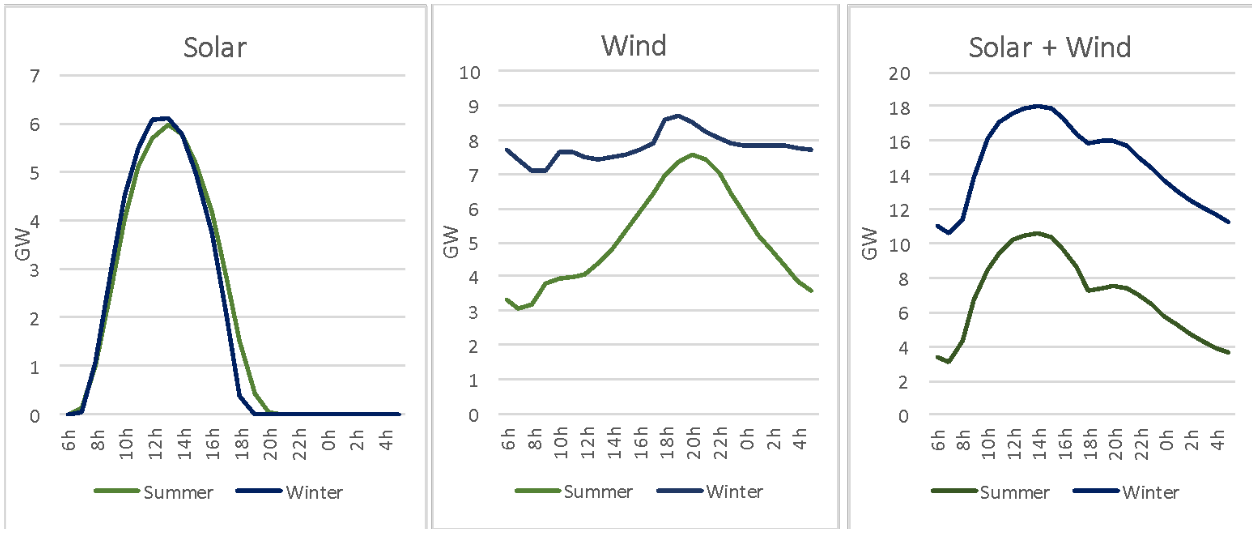

Figure 5 – National Projected Renewable Energy Resources in 2030

Another picture of this effect is given by correlating the demand profile to the renewable resource as shown in Figure 6. The correlation is calculated by scaling both supply and demand to between 0 and 1 and analyzing over a period of hours and days in the summer. The left graph shows the correlation visually in a scatter plot. The red square encloses the number of days that maximum demand is correlated with maximum supply for a characteristic region (Baja California del Norte) and clearly shows an anti-correlation, meaning that renewable resources rarely simultaneously peak at peak demand times. The right graphic provides this relationship overall balance zones. The dark areas in this plot show times and regions for which the demand is poorly correlated to renewable supply. It is apparent that correlation is poor during the late-night peak (0h to 6h) for all of the warm regions.

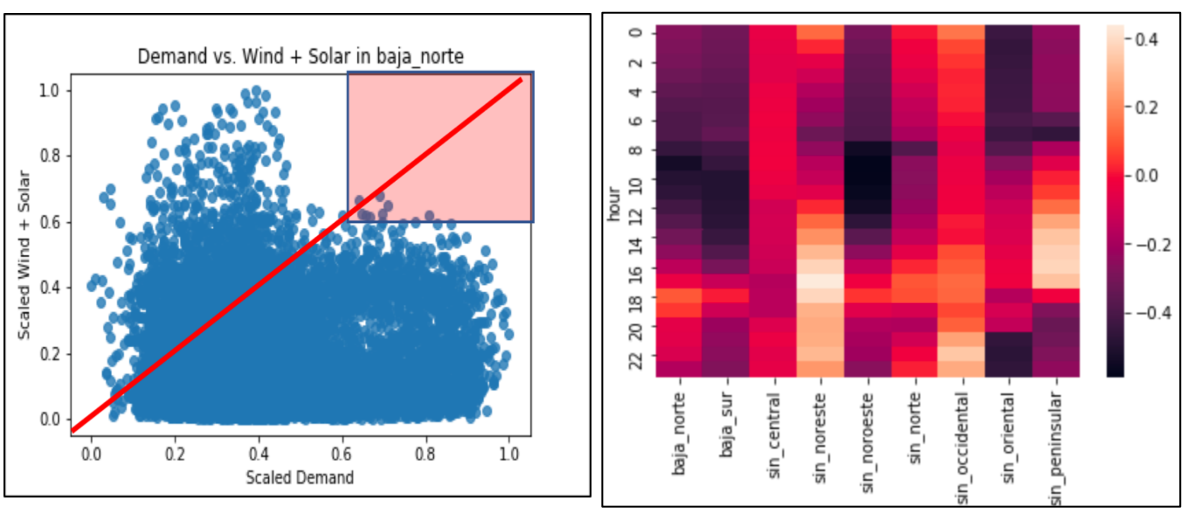

Figure 6 – Correlation between electricity demand and renewable resources.

Though simplistic, the above analysis clearly demonstrates a few important points:

- Electricity use from cooling in Mexico is already high, and is expected to grow disproportionately to overall electricity growth over the next 15-35 years, a fact which should be fully incorporated into energy planning and Energy Transition Law implementation strategies.
- The cost of supplying this electricity to consumers is on the order of 75 billion (mil millones) pesos (over 4 billion dollars) each year with at least half that amount being paid through government subsidies, making cooling an issue of critical importance to regulators and the finance ministry (Secretaría de Hacienda y Crédito Público).
- Emissions related to cooling under current energy supply mix is already over 10 million metric tons of CO_2 and growing rapidly. Therefore, cooling is an important consideration in Mexico's commitments under the Paris Climate Treaty (NDCs).
- The time of year and hour of the day that air conditioning is used may not correlate well to renewable electricity resources being deployed as part of Mexico's expansion plan and clean energy strategies.

MITIGATION STRATEGIES

The above analysis indicates strong and somewhat negative impacts to Mexican consumers, government spending, the environment, and the electricity grid as a result of strong growth in electricity demand to meet cooling needs. Fortunately, there are a multitude of ways in which a portion of the need for air conditioning can be alleviated and the remaining demand can be met efficiently. Furthermore, Mexico has been proactive with strong political leadership in these areas. Essentially, the two main ways to reduce the energy used by cooling are to (1) reduce the demand for cooling and (2) improve the efficiency with which cooling is achieved:

- <u>Equipment Efficiency Standards</u> - Rapidly adopt the best available air conditioning technologies on the market through regulations like Mexico's NOM's.
- <u>Voluntary Programs</u> - Develop and disseminate ultra-low energy alternatives to current technologies through voluntary programs such as labeling, rebates, early replacement programs and public information campaigns.
- <u>Technology R&D</u> - Develop alternative cooling technologies such as evaporative cooling and solar-assisted cooling for the Mexican market and deploy them through industry partnerships.
- <u>Building Envelope Best Practices</u> - Lower cooling load with improved construction and retrofits through mandatory building codes and private sector initiatives.
- <u>Cool Solar Reflective Coatings</u> - Lower cooling load by reducing solar heat gain through cool roofs and other reflective coatings.
- <u>Smart Design and Operation</u> - Employ advanced construction, integrated design, user behavior and smart controls to reduce or eliminate cooling loads and respond to peak loads and electricity prices.

BARRIERS TO IMPLEMENTATION AND ACTIONS TO LOWER THEM

Each of these measures exists to some degree in Mexico and there are strong institutions in place to support them. Nevertheless, each one of them is subject to significant barriers to full implementation in order to reach the potential afforded by the advanced technologies currently readily available on the market, as well as some that are near to commercialization. The following is a preliminary assessment of what some of these may be in each area. The main objective of the ***Mexico Cooling Summit*** is to refine and expand upon these through collaborative conversation between Mexican stakeholders and technical experts.

- Equipment efficiency standards require a high degree of data and analysis to guide conversations with stakeholders, including comprehensive energy consumption surveys, market analysis, engineering studies and metering projects. These apply to product categories already under regulation, but can also help expand the scope of standards to new products.
- Voluntary programs can be expanded and the ambition of targets can be increased towards more effective market transformation. New resources can be tapped through large organizations with a financial stake in reducing subsidies (ministry of finance) and reducing peak demand (CFE).
- Building codes have a long successful history in North America and Europe, and Mexico has developed technical standards underpinning these, but adoption is still weak despite some recent success, largely due to low technical capacity and political buy in from municipalities responsible for implementing them. A major push is needed to scale recent successes to the national level, particularly in those areas with very high cooling loads, including well-organized campaigns to educate, train and incentivize mayors and city staff.
- Alternative technologies for cooling, including evaporative cooling, solar-assisted cooling and demand response-enabled cooling exist but have not gained a significant footing in the Mexican market. Research is needed to adapt innovative technologies to Mexican climate and market conditions in order to accelerate their commercialization, including through government-funded deployment programs.
- Cool reflective coatings have shown promising initial successes and local industry is active and ready to increase deployment. Support is needed to help reach critical mass through government and industry partnerships, including codes and standards.
- A wide array of buildings technologies and operations practices now exists to dramatically lower the way buildings use energy. These require demonstration and pilot projects as well as the development of partnerships with researchers, NGOs and the private sector in order to spur development of local enterprises in these partnerships.

Aggressively tackling growth in air conditioner energy consumption and the related financial and environmental costs associated with it requires a coordinated effort from multiple parties, of which the Mexico Cooling Summit hopes to be an important first step. The ultimate goal of the Summit is to put into motion a Cooling Action Plan to address the tremendous projected rise in cooling demand collectively and in coordination with SENER and other stakeholders in Mexico.

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