Understanding the Mexican Capacity Balance Market 2024

Production year 2023

TECHNICAL NOTE: GME 01-2024

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Mexican Capacity Balance Market Operation

1. The Capacity Balance Market (CBM)

The Market Guidelines establish a Capacity Balance Market (CBM) to ensure a reliable peak demand supply. It operates annually based on the previous year's (called the 'production year') capacity requirements during the 100 critical hours.

In accordance with the LIE, Generators have to offer all their available capacity to the WEM. Therefore, their participation in the CBM for the amount of capacity not committed in contracts is mandatory. The considered availability depends on the type of generation:

- Thermal generation: Its average available capacity.
- Hydro, Solar, and Wind Generation: Average real production in the 100 critical hours.

Each February, CENACE settles the CBM for the preceding production year. Based on this settlement, each Market Participant (MP) honors their capacity obligations.

The CBM is based on three concepts:

i) Capacity Zones,
ii) Reference Generation Technology, and
iii) 100 Critical Hours.

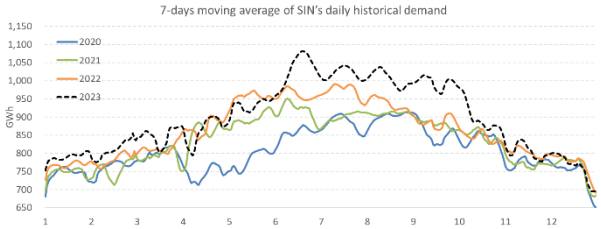
Capacity Zones: Capacity zones for each system, currently three: SIN, BC and BCS systems.

Reference Generation Technology (RGT): The Industrial Gas Turbine is the selected RGT for the SIN and BC zones, and the Aero Gas Turbine for BCS.

100 Critical Hours: The regulation defines the 100 critical hours of each year, used for capacity recognition, as the 100 hours with minimum generation reserve of the year. The generation reserve is the difference between the available capacity and the demand to be supplied at every hour.

The 100 critical hours serve as the basis for assessing capacity supply and demand for each Market Participant during the prior production year.

In 2023, the energy demand of the SIN had a significantly different behavior than in previous years, being significantly high during all the summer months up to and including October.



Source: GME elaboration based on CENACE data.

This resulted in most critical hours happening during the summer season. In 2023, 80% took place between August and September.

Another observed trend is that critical hours generally happen late in the afternoon and evening. In 2023, 98% of these hours were between 6 PM and midnight.

For reference, in the previous CBM that considered the production year 2022, all critical hours occurred between April and August, and 94% were between 6 PM and

midnight[1].

This distribution of critical hours, largely excluding daytime, results in minimal capacity recognition for solar power plants. This scenario poses significant challenges for solar generators with capacity obligations, as their recognized capacity may be negligible. Consequently, they may need to procure firm capacity at substantial costs within the system to meet their contractual commitments.

Exhibit 1: CBM 2024 (production year 2023) – 100 critical hours

Month \ Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	6	3	2	-
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	2	5	4	2	1
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	18	18	13	5	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: GME elaboration based on CENACE data.

2. Capacity Price

The capacity price for each capacity zone can be briefly explained with the following expression:

$$Cap\ Price\ (USD/MWy) = GLFC * FACTOR - IMTGR$$

The **Generation Levelized Fixed Cost (GLFC)** expresses the annuity cost for both the investment costs and fixed operation and maintenance (O&M) costs associated with the Reference Generation Technology established for each capacity zone.

The GLFCs of the Reference Generation Technology for the 2023 production year increased significantly compared to the values determined for 2022 for each system.

Generation Levelized Fixed Cost (USD/MW-y)

System	2022	2023	Variation
SIN	171,930	208,594	+21.3%
BC	98,240	129,358	+31.7%
BCS	162,495	219,764	+35.2%
Exchange Rate MXN/USD	19.593	17.186	-12.3%

CENACE justifies the variation in the fixed levelized cost by the combined effects of cost variations of the RGT and a new value for the discount rate used to determine the annuity of the investment

[1] The particular situation observed in CBM 2022 (production year 2021), where critical hours were observed in the months of August and later, was due to restrictions in the first critical hours of the year, which could not occur before August 7, 2021.

This restriction was caused by a regulation that limits the time window for critical hour determination to no earlier than 14 days from the first critical hour (with no restrictions) identified the previous year (2020). This in turn was due to the change in the demand profile that happened in 2020 due to Covid-19, and affected the critical hours of the CBM 2021.

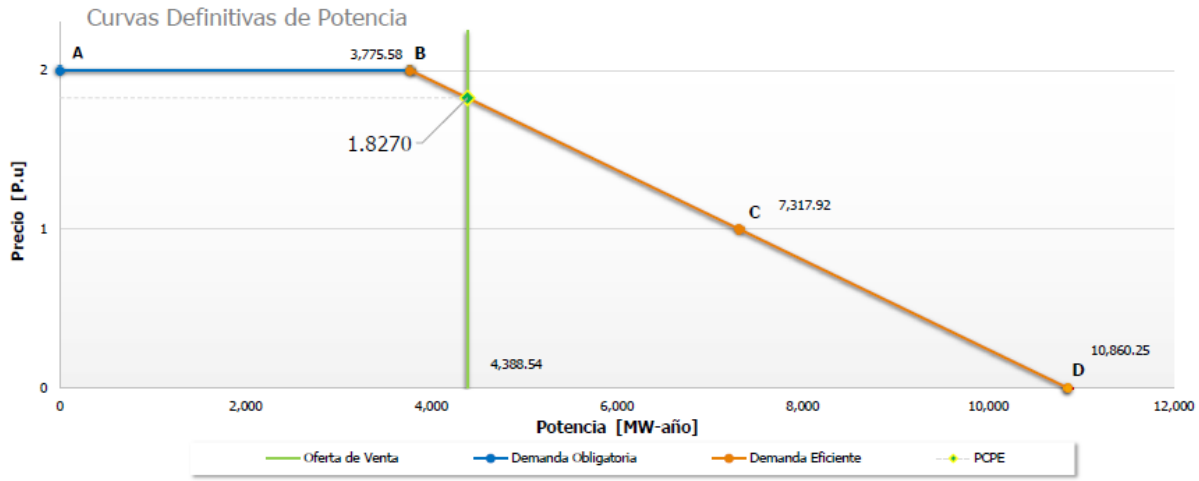
costs.

The **FACTOR** is determined by the generation reserve resulting from the capacity demand and supply that CENACE measures during the 100 critical hours of the previous year. This factor varies depending on the year's generation reserve, varying within a range of 0 to 2. A value of 0 indicates a reserve higher than twice the optimal level, 1 indicates an optimal reserve, and 2 indicates a reserve lower than the minimum required. The FACTOR follows a linear reduction between the maximum and minimum reserve values.

In 2023, for the SIN region, the FACTOR was calculated to be 1.8270, indicating a condition of reserve scarcity[2] (where reserve is under the optimal level).

IMTGR is the theoretical marginal revenue of the Reference Generation Technology calculated for the production year (previous year). In 2023, a greater dispatch was considered for the reference unit, resulting in higher IMTGR values compared to those recorded in previous years.

Exhibit 2: CBM 2024 (production year 2023) – Factor (SIN system)



Source: CENACE.

The following exhibits show the values of the Capacity Price for the three Capacity Zones for 2024 (production year 2023).

In 2024 (production year 2023), the resulting capacity price for the SIN system was 22.75 [USD/kW-m], showing a very high volatility of the capacity price from year to year.

As a reference, prices went from 0 USD/kW-m in 2022, to 12.5 USD/kW-m in 2023, to the current 22.75 USD/kW-m.

This increase in prices in the SIN system is due to a relative scarcity of supply, affecting the factor, as well as due to an

[2] Total firm capacity demand went from 38,010 MW in production year 2021, to 41,729 MW in 2022, to 45,473 MW in 2023, a 19.6% increase in two years. Meanwhile, total firm capacity offers went from 44,142 MW in 2021, to 45,235 MW in 2022, to 46,086 MW in 2023, a 4.4% increase in the same period.

increase in the cost of the reference technology. The latter was caused by the inclusion of a fixed fuel transport cost approximately equivalent to a 300 km long dedicated gas pipeline[3] and the increase in the cost of capital to around 13.7%, from 9.9% in 2022[4].

The capacity prices in the BC and BCS regions remain high since the generation reserve is lower than the minimum, which implies supply risks.

Exhibit 3: CBM 2024 (production year 2023) – Capacity Price

System	Reference Technology	Fuel	Capacity [MW]	Factor [#]	Levelized Cost [USD/MW-y]	IMTGR [USD/MW-y]	Capacity Price [USD/MW-y]	[USD/kW-m]
SIN	Industrial GT	NG	260	1.827	208,594	106,736	272,941	22.75
BC	Industrial GT	NG	260	2.000	129,358	115,366	139,849	11.65
BCS	Aero GT	Diesel	70.13	2.000	219,764	121,542	317,339	26.44

Exchange Rate: 17.186 MXN/USD

Source: CENACE.

In the SIN, the Generation Levelized Fixed Cost went from 120,913 USD/MW-y in 2022, to 167,382 USD/MW-y in 2023 to the current 208,594 USD/MW-y in 2024. This translates to a 72% increase in just two years.

The following table shows the CBM price evolution for the years 2016 to 2023 including the parameters used for their calculations.

Exhibit 4: SIN System CBM for production years 2016-2023 – Capacity Price

Year	Levelized Fixed Cost [USD/MW-yr]	Factor [#]	IMTGR [USD/MW-yr]	Capacity Prices [USD/MW-yr]	USD/kW-mo]
2016	109,430	1.18	65,364	63,545	5.3
2017	102,620	1.62	128,587	37,350	3.11
2018	103,260	2	200,336	6,184	0.52
2019	120,401	1.51	170,473	11,333	0.94
2020	118,089	0.32	6,850	31,474	2.62
2021	120,913	0.03	9,460	-	-
2022	167,382	0.95	8,573	149,636	12.47
2023	208,594	1.827	106,736	272,941	22.75

Source: CENACE.

[3] Fixed fuel transport cost equal to 84,587.75 USD/MW-year (for reference, this is equal to 41% of the total levelized cost, or 73% of the levelized cost of the capex annuity, or 5 times the amount included in the BC system for the same concept). This cost is much lower in the BC system, explaining the difference between the levelized costs of both systems, even though they are based on the same technology and capacity.

[4] This was caused by an increase of 444 bps both in the cost of capital and in the cost of debt. The Reference Technology Report mentions that the CRE instructed the CENACE to update this values, expressing that previous year's values were no longer consistent with current market conditions.

3. The Capacity Price as an economic signal

In electricity markets where a capacity remuneration exists (as is the case in Mexico), the capacity price along with energy prices (PMLs) serve as economic signals aimed at short-term operational efficiency and optimal expansion of the generation fleet.

Thus, a high capacity price implies a low generation reserve and therefore high risks of not being able to meet demand with adequate service quality. On the contrary, a low capacity price suggests there is an over-supply of generation relative to demand requirements.

In recent years, in the BC and BCS systems, high capacity prices have persisted without promoting the installation of new capacity that would allow these systems to operate with an adequate generation reserve.

In the Mexican SIN system, a high capacity price and a low reserve margin were also observed in the production year 2023. This is explained by the combined effect of high demand in the summer months of 2023 and possibly also by the delay in the commissioning of new generation capacity.

It is worth mentioning that as of December 2022, there were 2,760 MW (as detailed in the following table) of new generation in testing phases, expected to start commercial operation during 2023. A significant portion of these projects did not come into operation before the summer of 2023 (e.g., CT TOPOLOBAMPO III), which contributed to a lower generation reserve.

Exhibit 5: Capacity additions expected for 2023 in December 2022 - SIN System

Technology	Installed Capacity [MW]
Wind / Solar	1811
CC NG	883
Others	66
Total	**2760**

Source: SENER.

Our estimatations suggest that if this capacity had been operational by the summer of 2023, the capacity price would have been reduced to around 18.5 USD/kW-month.

Considering the preceding paragraphs, a significant impact of the generation expansion on capacity prices is observed. Therefore, it is understood that authorities should promote the commissioning of new plants in the three systems as a way to guarantee supply security and energy and capacity prices aligned with those of an efficient market with a high level of competition in the generation segment.

As high prices remain over time in the three regions, it indicates that the

economic signal associated with the Capacity Balance Market is not attracting new generation investment in these regions.

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