

Descripción de sistema energético en México y de sus riesgos, especialmente ante el cambio climático

CUADRO 3.1 PRODUCCIÓN DE ENERGÍA PRIMARIA
(Petajoules)

	2021	2022	Variación porcentual (%) 2022/2021	Estructura porcentual (%) 2022
Total	7,081.42	7,468.99	5.47	100.00
Carbón	137.56	137.59	0.02	1.84
Hidrocarburos	5,775.91	6,028.50	4.37	80.71
Petróleo crudo	3,905.63	3,807.56	-2.51	50.98
Condensados	293.79	563.00	91.63	7.54
Gas natural	1,576.50	1,657.94	5.17	22.20
Nucleoenergía	124.99	152.77	22.23	2.05
Renovables	1,042.97	1,150.13	10.28	15.40
Hidroenergía	282.18	315.29	11.74	4.22
Geoenergía	92.20	98.16	6.47	1.31
Solar	150.22	196.66	30.91	2.63
Energía eólica	166.05	180.54	8.73	2.42
Biogás	2.78	2.40	-13.52	0.03
Biomasa	349.55	357.08	2.16	4.78
Bagazo de caña	103.95	112.61	8.33	1.51
Leña	245.59	244.47	-0.46	3.27

FUENTE: Sistema de Información Energética (SIE). SENER.

NOTA: La suma de los parciales puede no coincidir con los totales debido al redondeo de las cifras.

Las cifras pueden cambiar respecto al Sistema de Información Energética (SIE), Base de Datos Institucional de PEMEX (BDI) o Base de Datos de Refinación de PEMEX (BDR) debido al cierre de cifras

El poder calorífico del petróleo crudo usado en la conversión de unidades cambia año con año, dependiendo de la calidad del crudo.

Se considera la producción del carbón todo uno (Incluye Impurezas).

CUADRO 2.1 EVOLUCIÓN DE LA GENERACIÓN TOTAL DE ENERGÍA ELÉCTRICA 2018-2022 (MATRIZ DE GENERACIÓN DE ENERGÍA ELÉCTRICA)
(GWh)

TECNOLOGIA/FUENTE DE ENERGÍA	2018	2019	2020	2021	2022
Hidroeléctrica total	32,234.09	23,602.43	26,817.01	34,717.16	35,558.85
Geotermoeléctricas	5,064.66	5,060.66	4,574.61	4,242.90	4,412.68
Eolo eléctricas	12,435.25	16,726.91	19,702.89	21,074.87	20,528.75
Fotovoltaica total	3,211.71	9,964.32	15,835.62	20,194.91	20,342.04
Fotovoltaica	2,176.31	8,393.66	13,527.68	17,068.97	16,277.72
Fotovoltaica Generación Distribuida	1,018.15	1,564.84	2,303.56	3,110.32	4,049.30
Fotovoltaica-Abastecido aislado	1.41	4.37	4.37	15.62	15.02
Fidelcomiso de Riesgo Compartido (FIRCO)	15.84	1.45	0.00	0.00	0.00
Bioenergía total	1,989.17	1,866.49	2,206.51	1,595.58	2,141.26
Nucleoeléctrica	13,200.33	10,880.73	10,864.27	11,605.53	10,539.47
Frenos Regenerativos	3.60	3.60	3.60	3.60	3.60
Cogeneración Eficiente Total	2,424.62	3,378.24	4,295.27	3,415.51	4,204.13
Energía libre de combustible fósil	-	-	-	-	7,502.09
Energía adicional por enfriamiento auxiliar	-	-	-	-	925.82
Baterías	-	-	-	-	12.27
LIMPIAS TOTAL	70,563.43	71,483.39	84,299.77	96,850.07	106,170.96
CONVENCIONALES FÓSILES TOTAL	243,414.81	250,101.03	232,968.74	231,747.91	234,541.79
TOTAL	313,978.24	321,584.42	317,268.51	328,598.0	340,712.75

FUENTE: Programa de Desarrollo del Sistema Eléctrico Nacional 2023-2037.

^{17/} <https://www.gob.mx/sener/articulos/programa-de-desarrollo-del-sistema-electrico-nacional-2023-2037-335360>.

- La **energía** es indispensable para el bienestar social y el crecimiento económico, en especial para la competitividad de la industria y la atracción de inversiones
- Macrotendencias que impactan la **seguridad y la energía**:
 - Cambio climático
 - Nueva geopolítica
 - Otras disrupciones globales (por ejemplo, las pandemias, avances tecnológicos)
- Elementos tradicionales de la seguridad energética:
 - Accesibilidad
 - Confiabilidad
 - Economía
 - Seguridad
- Elementos nuevos de la Seguridad energética:
 - Cambio climático, riesgos físicos; descarbonización; penetración de renovables
 - Digitalización; vulnerabilidad a ciberataques

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INTERNATIONAL INDEX OF ENERGY SECURITY RISK®

Assessing Risk in a Global Energy Market

*Foreword by U.S. Assistant Secretary of State
for Energy Resources Francis R. Fannon*

GLOBAL ENERGY INSTITUTE
U.S. CHAMBER OF COMMERCE

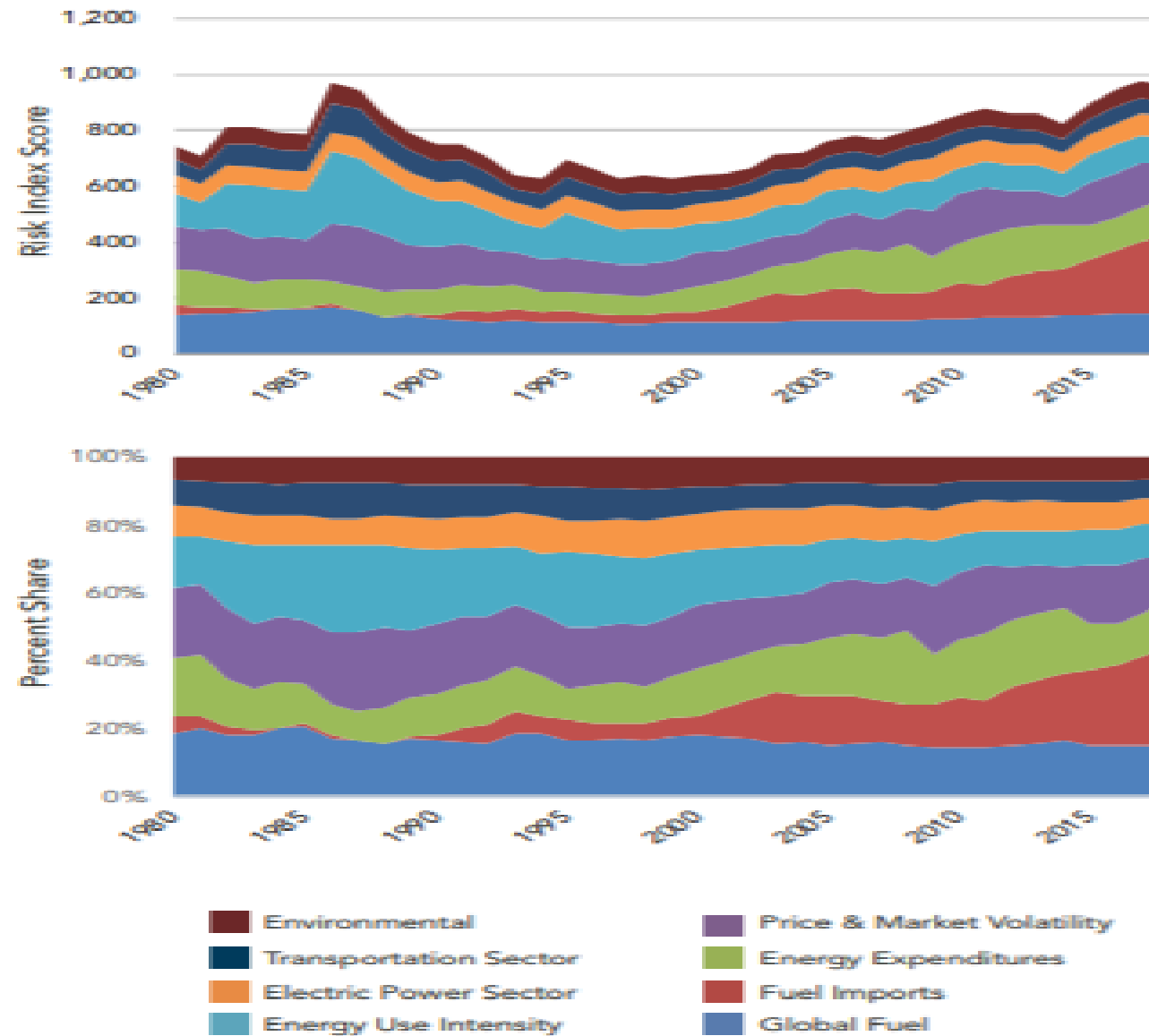
Classification of Energy Security Metrics Used in the International Index

Metric Category	General Description of the Metrics
1. Global Fuels	Measure the reliability and diversity of global reserves and supplies of oil, natural gas, and coal. Higher reliability and diversity mean a lower risk to energy security.
2. Fuel Imports	Measure the exposure of the national economies to unreliable and concentrated supplies of oil and natural gas, and coal. Higher supply reliability and diversity and lower import levels mean a lower risk to energy security.
3. Energy Expenditures	Measure the magnitude of energy costs to national economies and the exposure of consumers to price shocks. Lower costs and exposure mean a lower risk to energy security.
4. Price & Market Volatility	Measure the susceptibility of national economies to large swings in energy prices. Lower volatility means a lower risk to energy security.
5. Energy Use Intensity	Measure energy use in relation to population and economic output. Lower use of energy by industry to produce goods and services means a lower risk to energy security.
6. Electric Power Sector	Measure indirectly the reliability of electricity generating capacity. Higher diversity means a lower risk to energy security.
7. Transportation Sector	Measure efficiency of energy use in the transport sector per unit of GDP and population. Greater efficiency means a lower risk to energy security.
8. Environmental	Measure the exposure of national economies to national and international greenhouse gas emission reduction mandates. Lower emissions of carbon dioxide from energy mean a lower risk to energy security.

Energy Security Rankings for Large Energy User Group: 1980-2018

COUNTRY	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Australia	4	2	2	4	4	8	4	4	5	4	4
Brazil	15	12	12	7	11	12	11	13	13	13	13
Canada	10	7	5	6	6	5	3	5	4	3	3
China	21	20	23	22	18	19	12	9	10	9	8
Denmark	19	13	8	10	5	7	9	6	6	6	5
France	14	15	11	11	10	15	17	15	15	15	15
Germany	18	18	14	12	9	6	14	14	14	14	14
India	7	9	15	21	21	22	20	19	17	17	16
Indonesia	3	5	10	8	13	13	7	10	7	8	9
Italy	17	17	17	16	17	21	22	20	21	21	20
Japan	20	21	20	19	14	20	21	22	22	22	22
Mexico	1	1	4	2	2	3	5	7	8	10	11
Netherlands	9	14	13	15	12	9	19	16	16	16	17
New Zealand	6	4	6	3	7	4	2	3	2	2	2
Norway	5	3	3	5	3	2	1	1	1	5	6
Poland	23	23	22	18	15	11	13	12	12	12	12
Russia	–	–	–	24	24	14	6	11	11	7	7
South Africa	11	16	18	14	20	16	15	17	20	18	18
South Korea	22	22	21	23	23	23	24	24	24	24	24
Spain	13	19	9	13	16	18	16	18	18	19	19
Thailand	16	11	16	17	22	24	23	23	23	23	23
Turkey	8	10	19	20	19	17	18	21	19	20	21
Ukraine	–	–	–	25	25	25	25	25	25	25	25
United Kingdom	2	6	1	1	1	1	10	8	9	11	10
United States	12	8	7	9	8	10	8	2	3	1	1

Mexico: Risk Scores by Metric Group and Share of Total Risk by Metric Group



Electric Power Sector Metrics	
Electricity Capacity Diversity	Non Carbon Generation
1. Spain	1. Norway
2. United Kingdom	2. France
3. Canada	3. Brazil
4. Italy	4. New Zealand
5. Germany	5. Canada
6. New Zealand	6. Denmark
7. France	7. Ukraine
8. Turkey	8. Spain
9. Brazil	9. United Kingdom
10. Ukraine	10. Germany
11. China	11. Russia
12. United States	12. Italy
13. Russia	13. United States
14. South Korea	14. South Korea
15. Japan	15. China
16. Denmark	16. Turkey
17. India	17. Japan
18. Mexico	18. South Africa
19. Thailand	19. India
20. Netherlands	20. Thailand
21. Australia	21. Mexico
22. Poland	22. Australia
23. South Africa	23. Poland
24. Indonesia	24. Netherlands
25. Norway	25. Indonesia

Mexico vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells $\geq 10\%$ Above OECD; Green Cells $\leq 10\%$ Below OECD; White Cells $< 10\%$ to $< -10\%$ of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	-79	-96	-93	-72	-79	-46	-42	-8	-2	9	20
Energy Expenditure Metrics	-36	-37	-27	-40	-13	-6	-16	-17	-15	-16	-15
Price & Market Volatility Metrics	2	17	70	76	27	34	21	25	28	27	36
Energy Use Intensity Metrics	-18	17	40	37	-12	-3	-4	-4	5	1	0
Electric Power Sector Metrics	-4	7	9	7	11	17	26	29	34	35	36
Transportation Sector Metrics	-18	0	22	12	-26	-17	-6	-9	-3	-7	-9
Environmental Metrics	-25	-2	8	5	-7	-5	10	17	25	23	23
Total Weighted Index	-26	-18	-5	-6	-19	-9	-8	1	5	7	9

¿Cuál sería el modelo ideal del sistema energético para México en un mundo de 2.5-3 grados?

Mayores Riesgos y Vulnerabilidades

- Importaciones
- Volatilidad de precios
- Sector eléctrico
- Medio ambiente

Elementos de la Descarbonización

- eficiencia energética
- descarbonización del sector eléctrico
- sustitución del uso de combustibles fósiles por electricidad en los sectores donde la electrificación sea posible y uso de combustibles limpios en los sectores que no lo sea
- mantenimiento y creación de sumideros de carbono para capturar las emisiones restantes
- el control de las emisiones antropogénicas de otros gases de efecto invernadero

ANEXO
IEA Electricity 2025
Mexico

Mexico Record-high electricity demand and extended droughts strained Mexico's power system in 2024 Mexico's electricity demand rose 2.7% in 2024, driven higher by economic and population growth, as well as increased industrial activity. Electricity demand is expected to grow at a steady annual rate of just 3% during 2025-2027, though political and economic uncertainties may impact this outlook. Gas-fired power – the largest source of supply in the generation mix, exceeding 60% of the total – covered all of the additional demand. By contrast, hydropower generation continued to struggle as drought conditions persisted in 2024. Despite increasing by 9% y-o-y, this was the lowest level seen in over two decades, excluding 2023. This reduced the output from the country's large hydroelectric plants, which are critical for system flexibility and meeting peak demand. This prolonged water scarcity placed additional pressure on other generation sources and highlighted the importance of improving water resource management. A series of rolling outages took place in May. Triggered by record-high electricity demand of nearly 50 GW – 9% higher than 2023's peak – and generation unavailability, the outages affected over 2.6 million customers nationwide. Investigations pointed to a combination of factors, including inadequate maintenance planning, infrastructure constraints, and the inability to meet surging demand with existing capacity. These events highlighted vulnerabilities in the power system and the urgent need for investment in reliability measures.

In November 2024, the Mexican government introduced a National Energy Plan (NEP), which aims to balance the roles of the state and private sector in electricity generation. The plan stipulates that the Comisión Federal de Electricidad (CFE) will maintain a minimum 54% share in new energy assets, while private sector investment is encouraged for the remaining 46%, particularly in renewable energy projects. Public-private partnerships will play a central role, with wind and solar power development prioritised to meet growing demand. To attract private investment, the government has committed to streamlining regulatory processes and addressing bureaucratic hurdles. The plan also assures that electricity tariffs will not increase beyond inflation rates in order to maintain affordability for consumers while ensuring the financial viability of infrastructure investments. Additionally, the modernisation of transmission and distribution networks is a key focus, targeting a reduction in bottlenecks and the enhancement of grid stability. These efforts could help address longstanding challenges in Mexico's power infrastructure, including financial constraints and regulatory hurdles that have previously hindered progress. The NEP is part of Mexico's renewed commitment to its energy transition, with a focus on accelerating renewable energy development and modernising regulatory frameworks to support decarbonisation goals. Achieving these ambitions will require sustained effort, careful planning, and close collaboration between public and private stakeholder