



Transformers | Motors | Generators

19-21 May 2026

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Case Study: Efficiency Challenges for Distribution Transformers in Argentina's Energy Transition

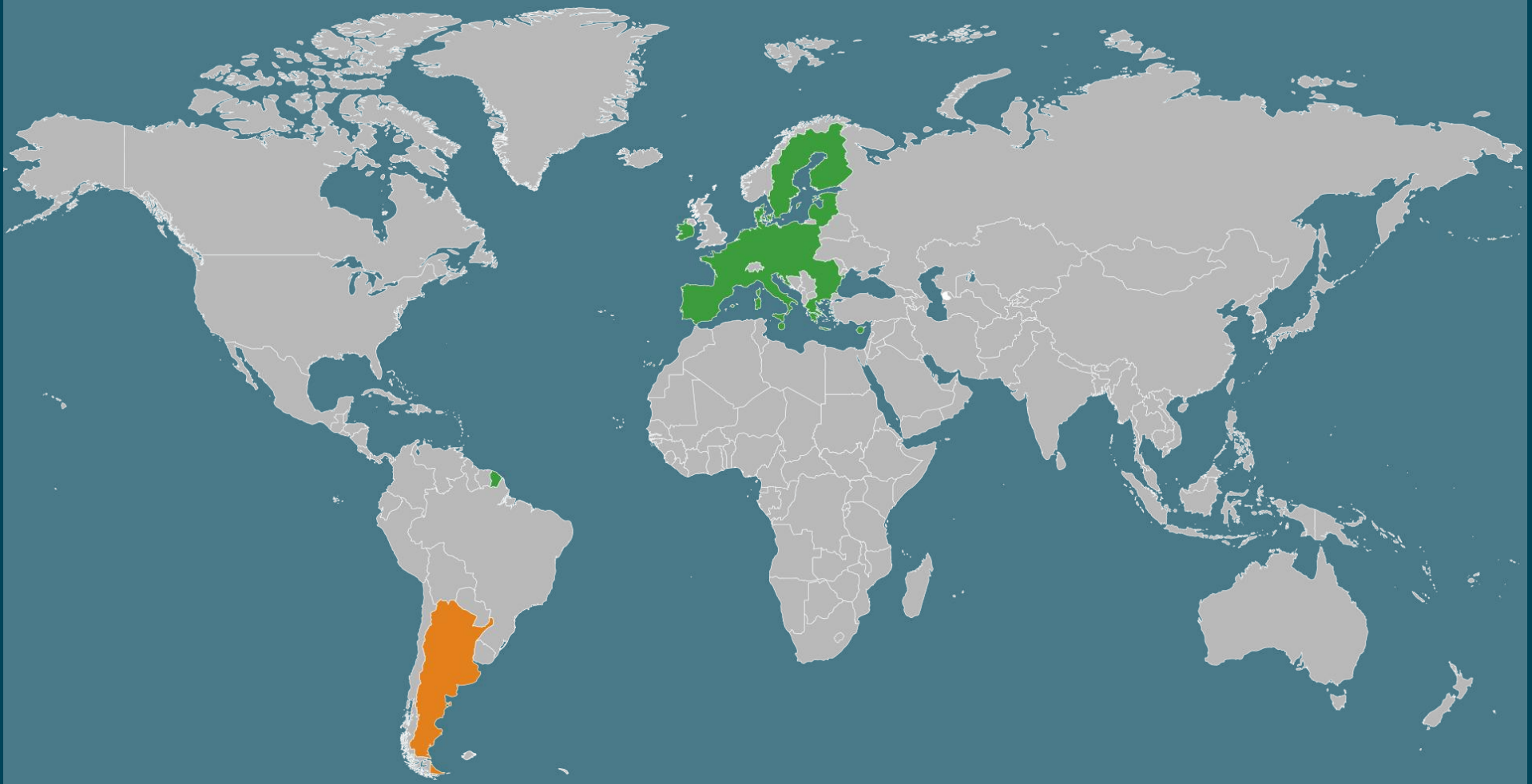
Dr. Diego M. Ferreyra, UTN San Francisco, Argentina

General context



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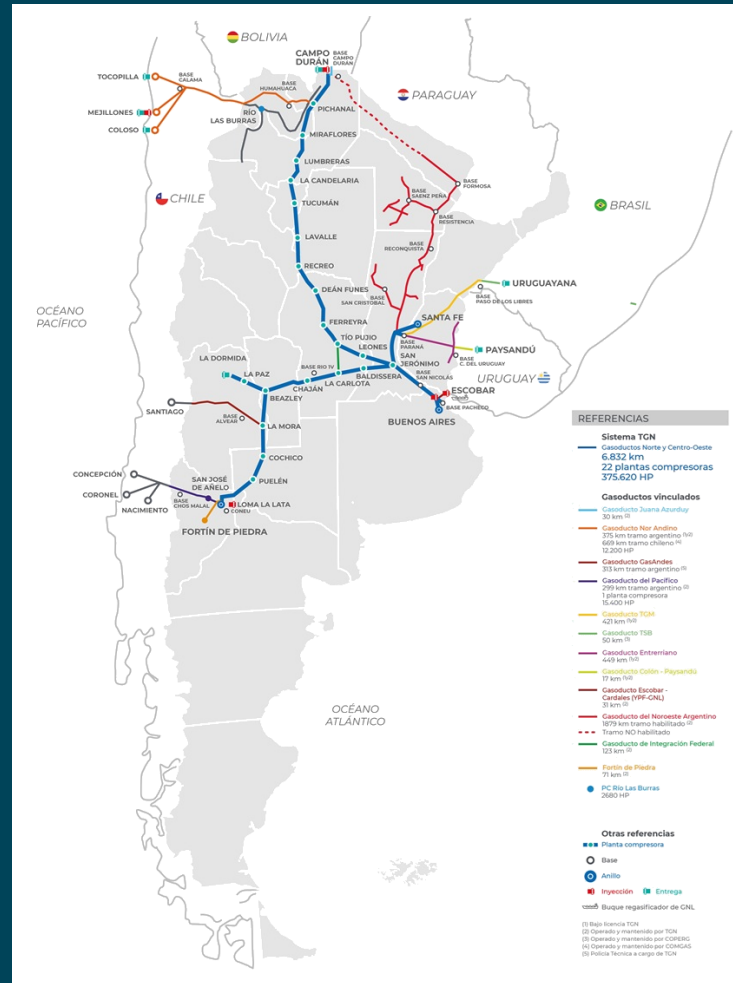


Argentina: general geographic context

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Argentina split into 3 regions of the same population



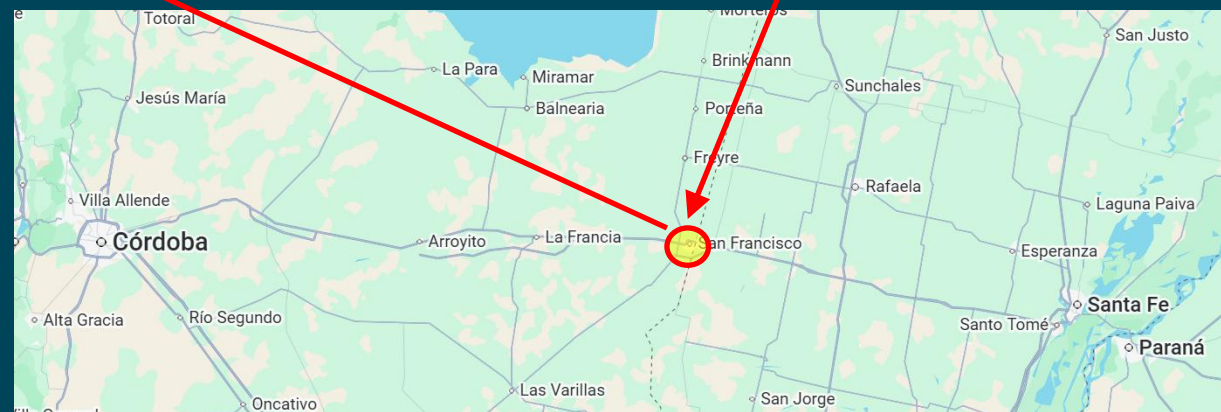
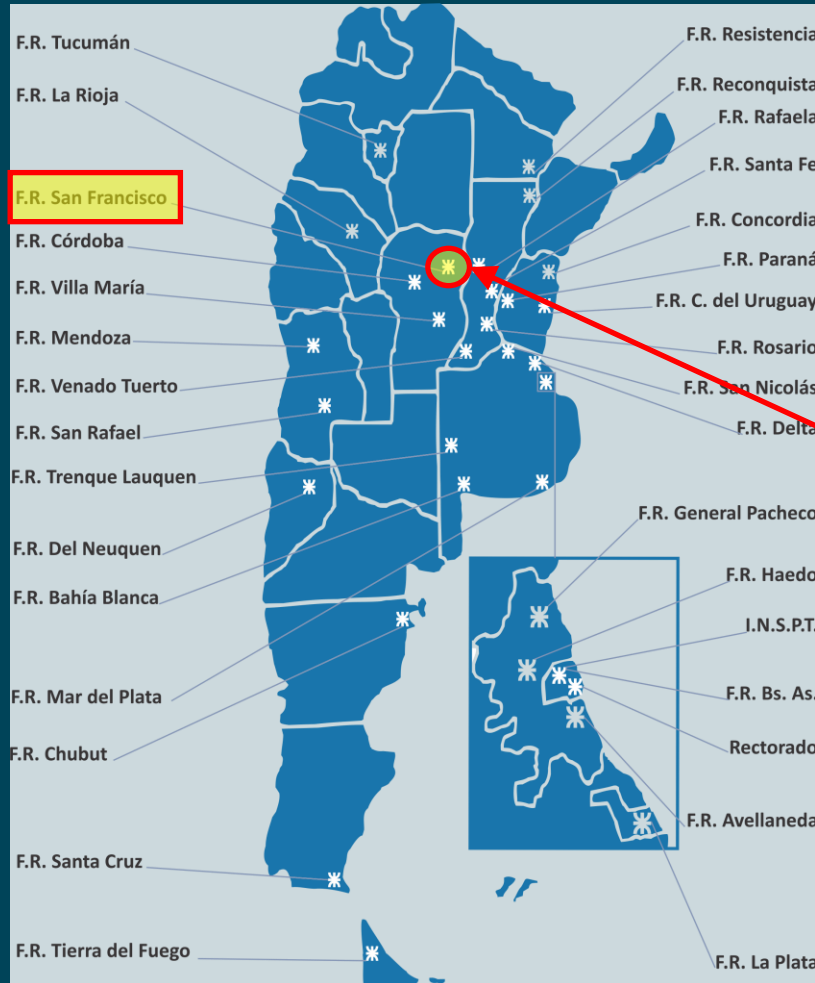
TGN, 2026



CAMMESA, 2026

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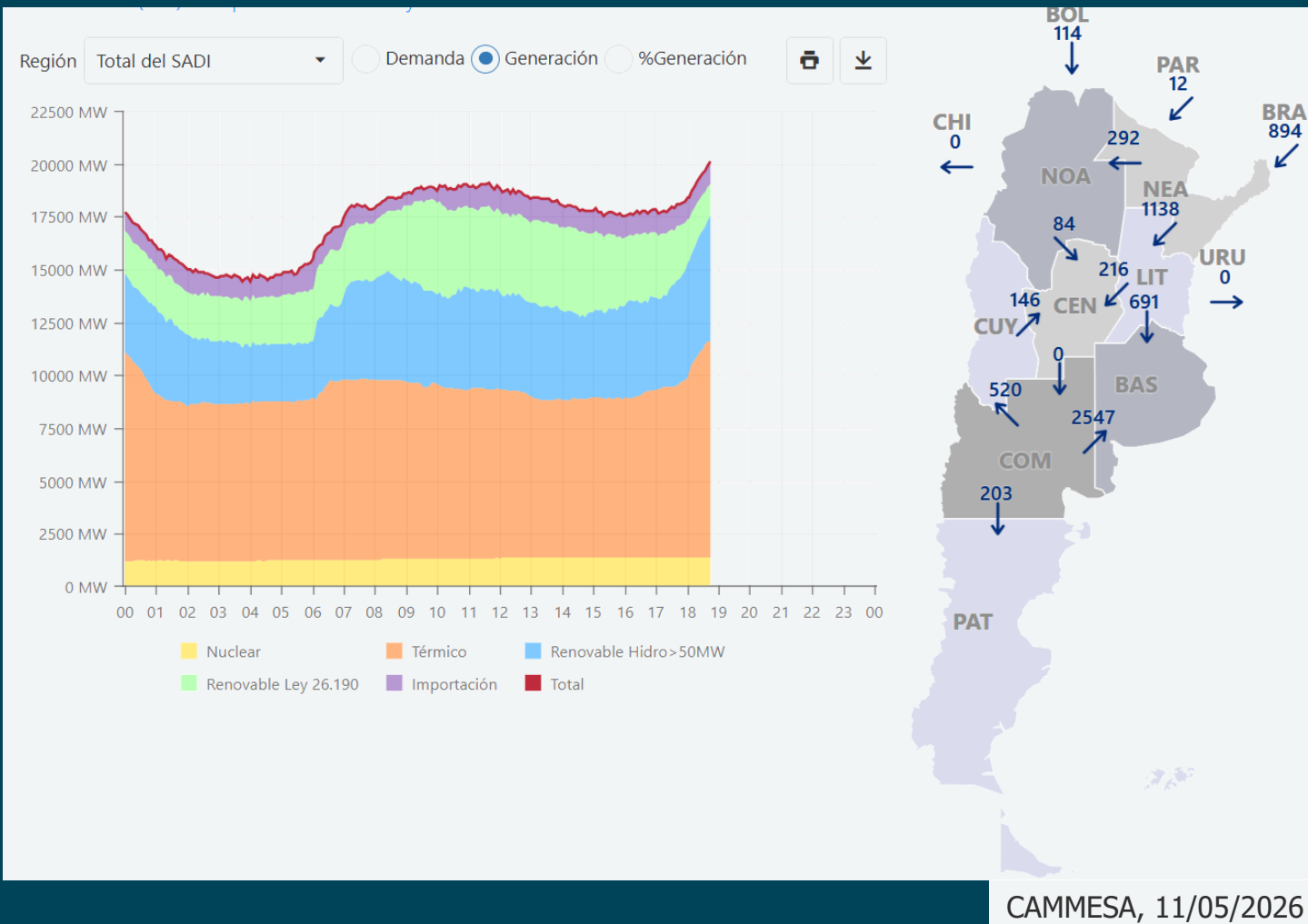
UTN in general || UTN San Francisco in particular

Energy context in Argentina



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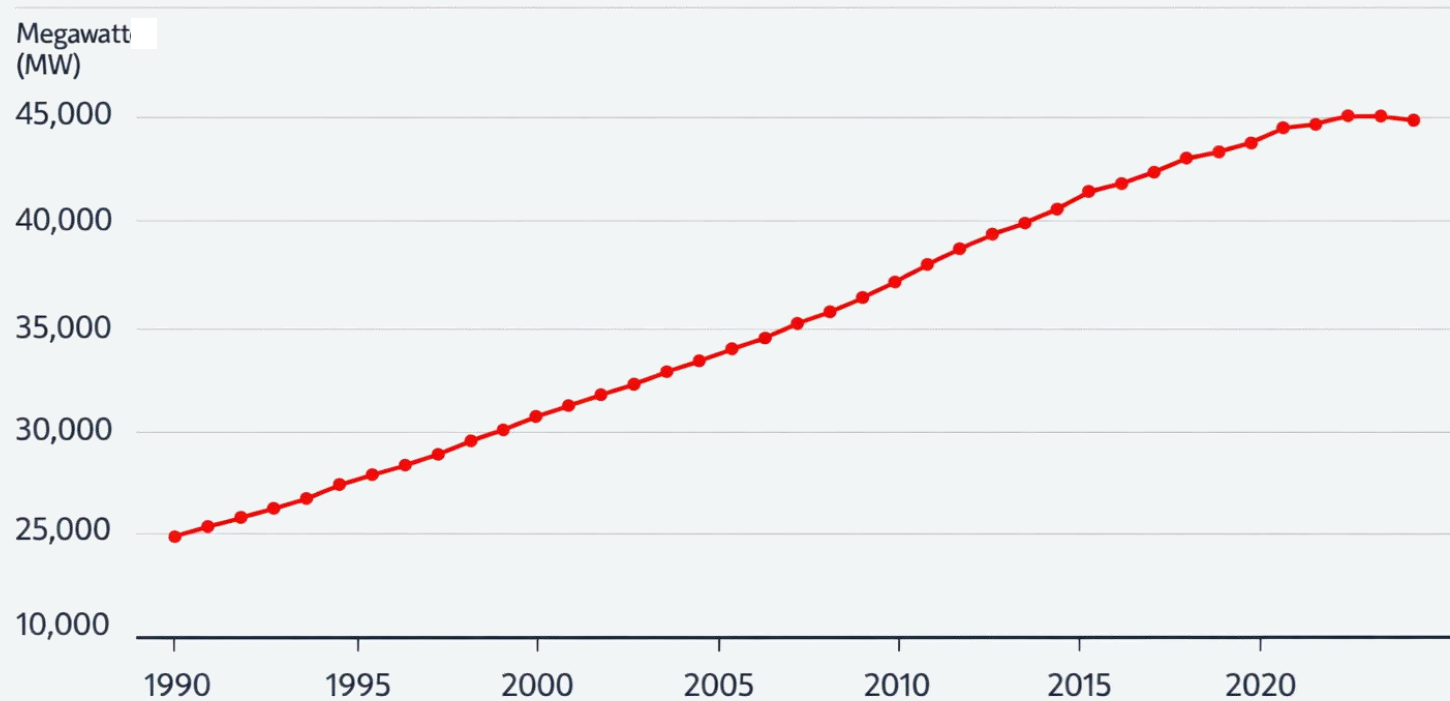
2025: ~21 % energy from hydraulic power

2025: ~18 % energy from renewables

Argentina: current electric market conditions

Installed Power Capacity in Argentina: 1990-2025

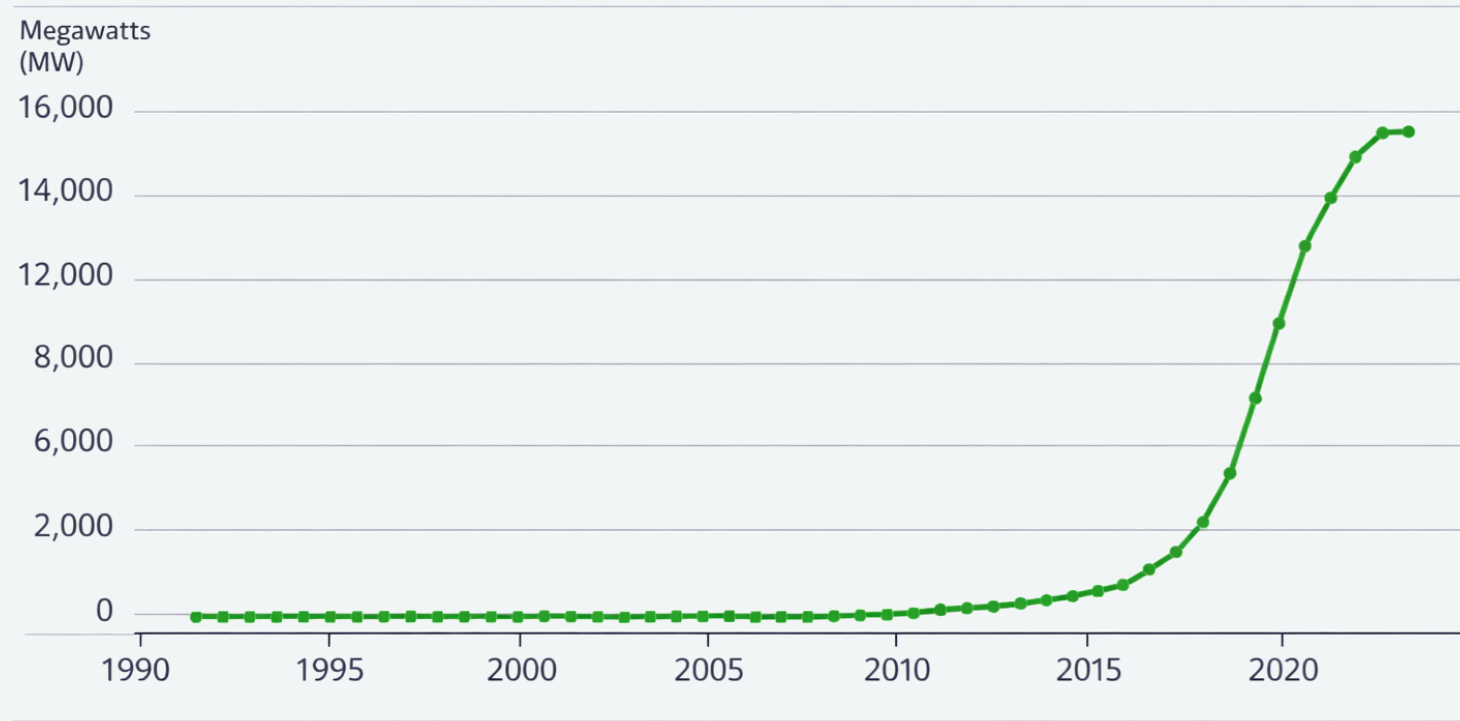
Total Installed Capacity of the Argentine Interconnected System (SADI) in megawatt (MW)



Source: CAMMESA - Installed Capacity [MW]

Installed Renewable Capacity in Argentina: 1990-2025

Total Installed Renewable Capacity of the Argentine Interconnected System (SADI) in megawatts



Source: CAMMESA - Installed Capacity [MW]

Renewable Share of Installed Power in Argentina: 1990-2025

Percentage of Renewable Installed Capacity in the Argentine Interconnected System (SADI)

Percentage of
Installed Capacity

30%

25%

20%

15%

10%

0%

1990

1995

2000

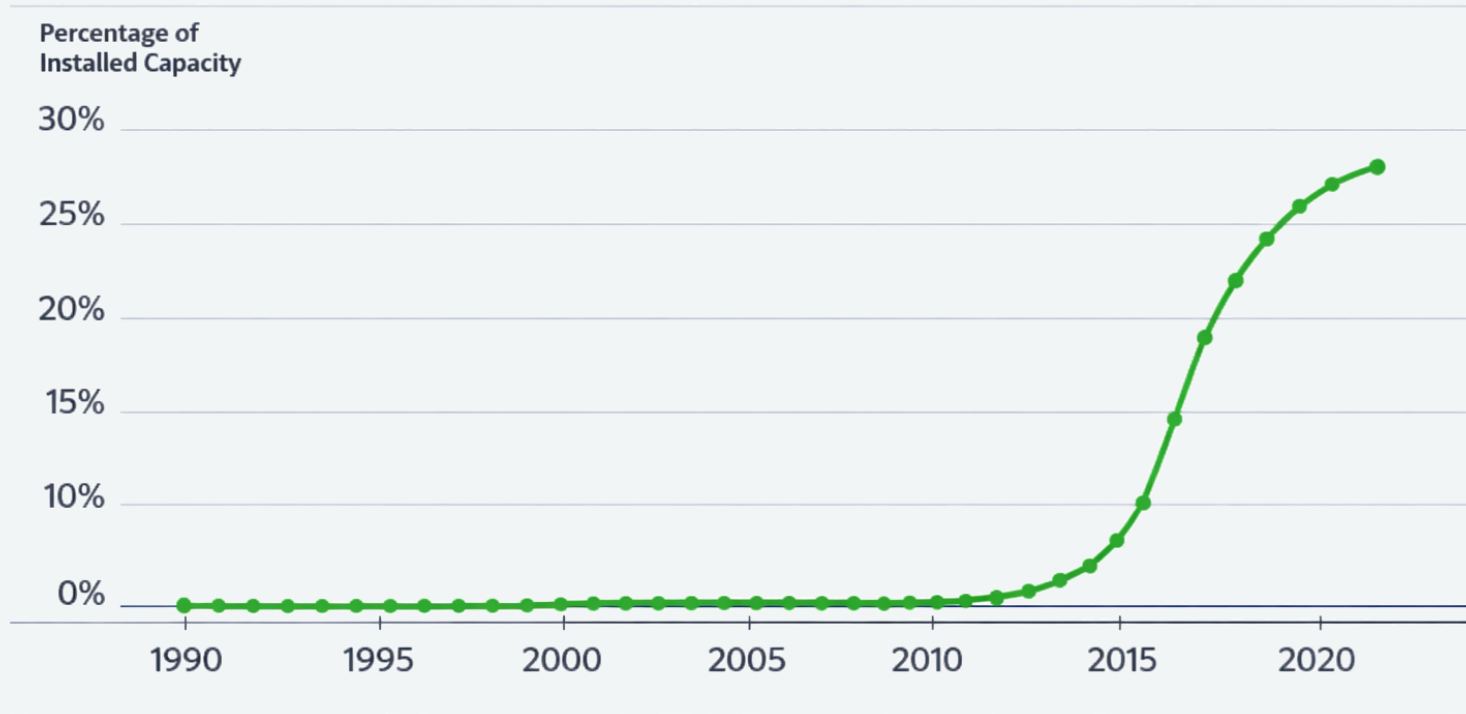
2005

2010

2015

2020

Source: CAMMESA - Installed Capacity [MW]



Evolution of the installed renewable power capacity [%]

Current situation: distribution transformers



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IRAM 2250

Transformadores c/tanque de expansión - Relación $13,2 \pm 2 \times 2,5\%$ / 0,4 kV								
Potencia (kVA)	Pérdidas (W)		Ucc (%)	Dimensiones (mm)				Masa (kg)
	Po	Pcc		Largo	Ancho	Alto	Trocha	
* 16	100	500	4	1250	750	1250	600	400
25	160	600	4	1250	750	1250	600	450
* 40	200	900	4	1300	750	1300	600	600
63	270	1350	4	1300	750	1300	600	600
* 80	315	1500	4	1450	750	1300	600	650
100	350	1750	4	1450	750	1350	600	700
* 125	420	2100	4	1500	750	1350	600	750
160	500	2500	4	1600	750	1450	600	850
200	600	3000	4	1650	850	1450	600	900
250	700	3500	4	1650	900	1450	700	1100
315	850	4250	4	1650	900	1500	700	1400
400	1000	5000	4	1700	950	1700	700	1500
500	1200	6000	4	1700	1050	1700	700	1800
630	1450	7250	4	1700	1050	1900	800	2100
800	1750	8750	5	1950	1050	2025	800	2500
1000	2000	10500	5	2100	1100	2050	800	3200
1250	2300	13800	5	2200	1250	2150	1000	3700
1600	2700	17000	6	2400	2200	2100	1000	4300
2000	3000	21500	6	2500	2500	2200	1000	5300
2500	3300	24800	6	2700	2500	2300	1200	5900
* 3000	3750	27000	6	2800	2600	2700	1200	7200

* Modelos no contemplados en IRAM 2250



<https://www.tadeoczerwony.com/productos/3>

Current Argentinian standards for distribution transformers

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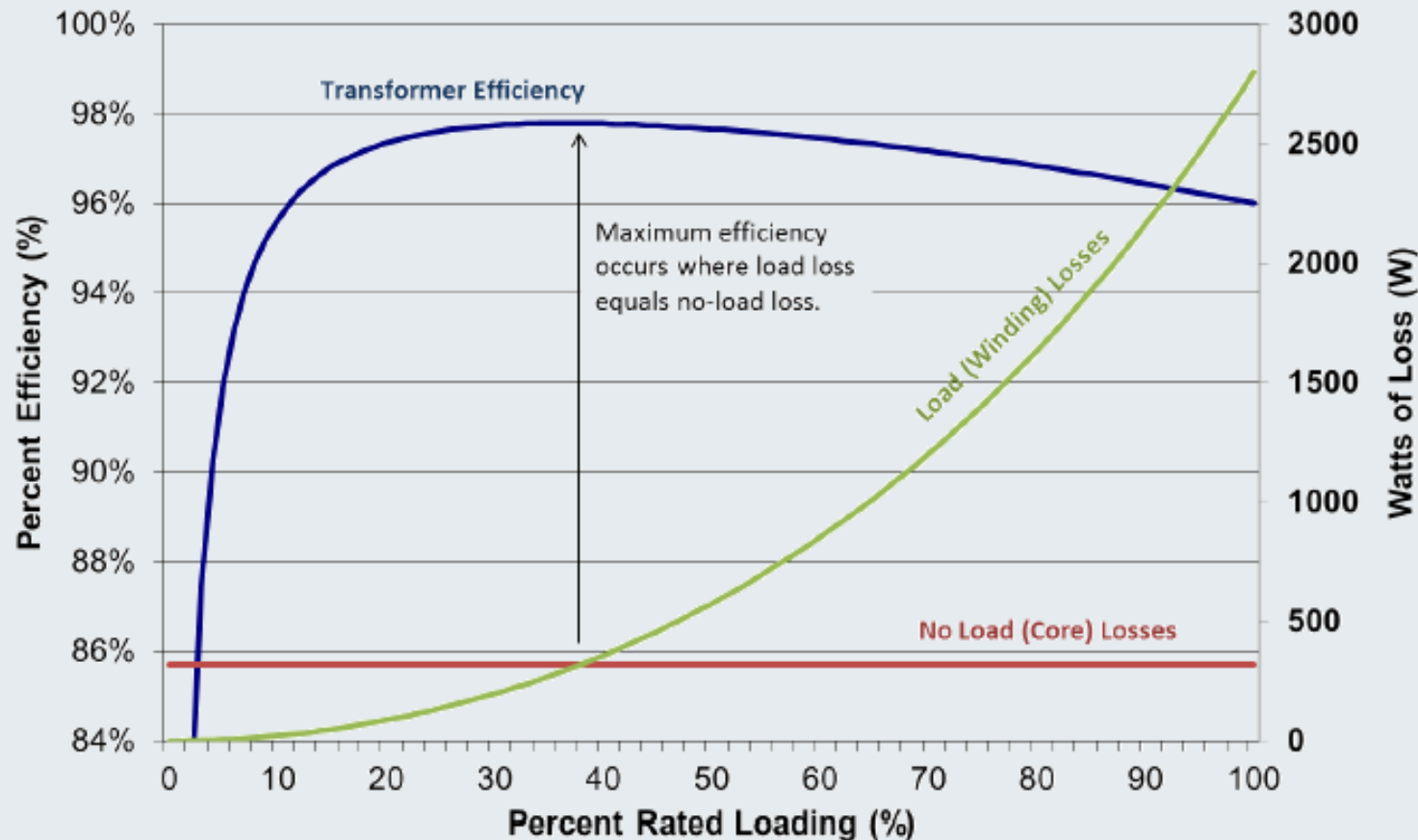


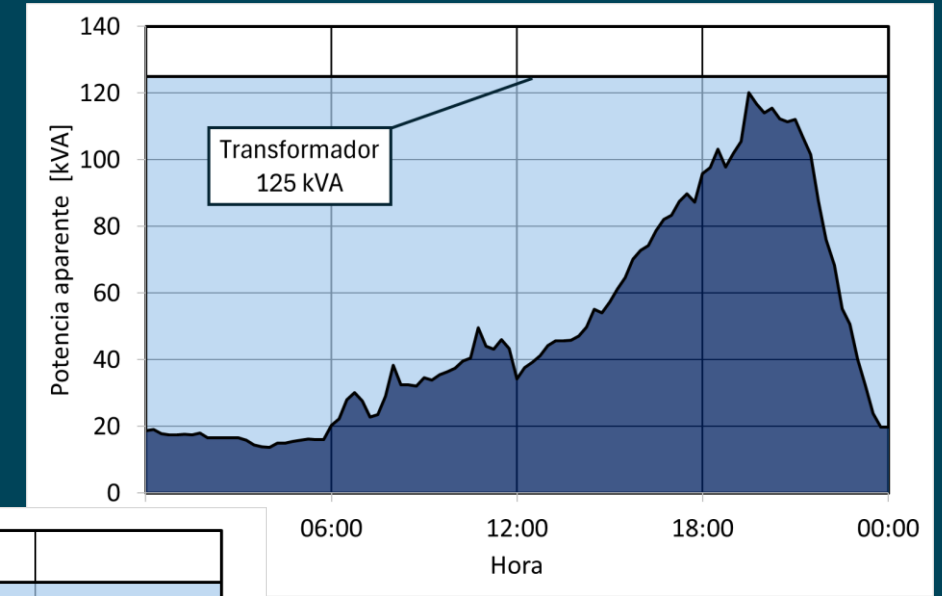
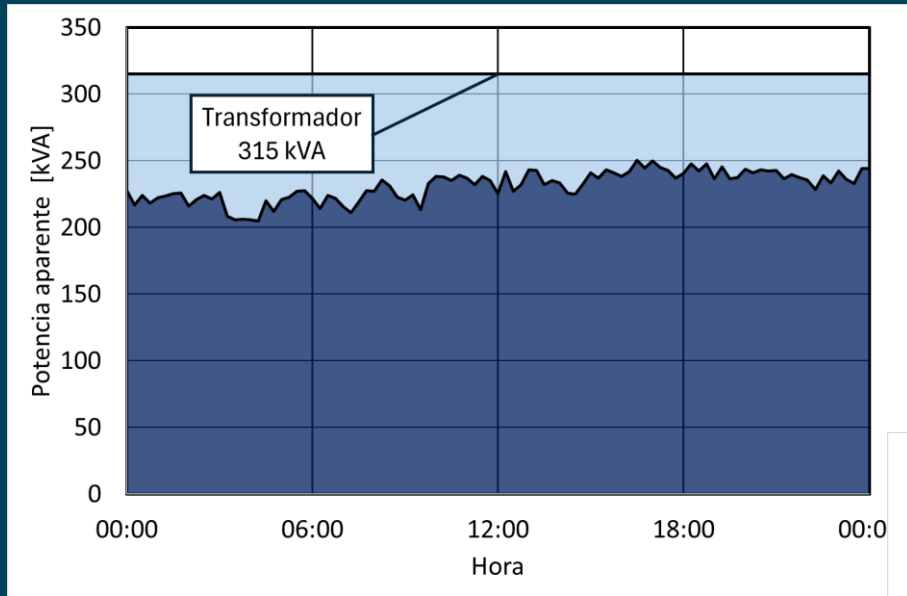
Figure A. Illustration of Relationship Between Losses and Efficiency

4E Mapping Document, USA, 2014

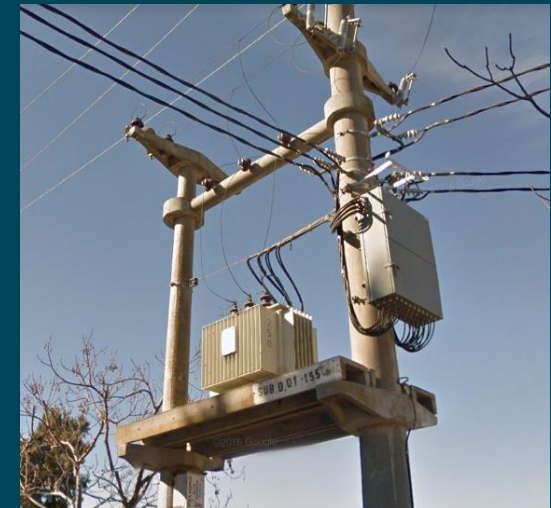
Impact of transformer load factor on losses and efficiency

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Electroinstalador (Ferreyra,
Szwarc, Sarmiento), 2024



Some typical daily load profiles

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TABLE I. 100 KVA TRANSFORMER

Transformer versions	Nominal losses ^a		
	P_0	P_k	$P_0 + P_k$
<i>Standard</i>	350 W	1750 W	2100 W
<i>Version #1</i>	260 W (-25.7 %)	1840 W (+5.1 %)	2100 W (0.0 %)
<i>Version #2</i>	290 W (-17.1 %)	1240 W (-29.1 %)	1530 W (-27.1 %)

^a. P_0 : no load losses
 P_k : load losses

TABLE III. ENERGY SAVINGS FOR EACH LOAD ASSESSED FOR A STANDARD TRANSFORMER VERSUS HIGHER-EFFICIENCY VERSIONS

Transf. power		100 kVA			400 kVA
Load profile		<i>Load #1</i>	<i>Load #2</i>	<i>Load #3</i>	<i>Load #3</i>
Transformer version	<i>Std.</i>	15.70 kW·h	15.20 kW·h	30.77 kW·h	87.91 kW·h
	<i>#1</i>	13.90 kW·h (-11.4 %)	13.40 kW·h (-11.9 %)	29.76 kW·h (-3.3 %)	84.99 kW·h (-3.3 %)
	<i>#2</i>	12.12 kW·h (-22.7 %)	11.78 kW·h (-22.5 %)	22.81 kW·h (-25.9 %)	63.93 kW·h (-27.3 %)

IEEE URUCON (Ferreyra, Szwarc, Sarmiento), 2024

A proposal of higher-efficiency loss relationships

Energy transition & distribution transformers



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Experience with local and regional photovoltaic (PV) installations

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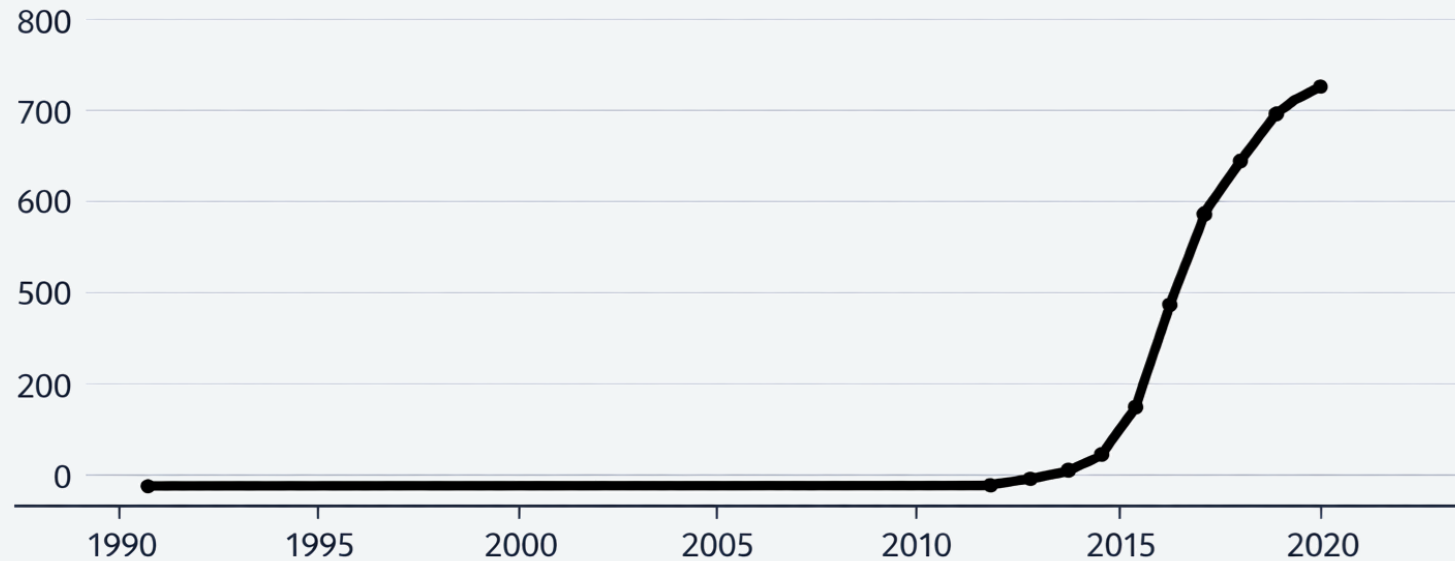


Draft projects for larger industry distributed generation (DG)

Installed Distributed Generation Power in Argentina: 1990–2025

Total Installed Capacity of Distributed Generation in the Argentine Interconnected System (SADI) in

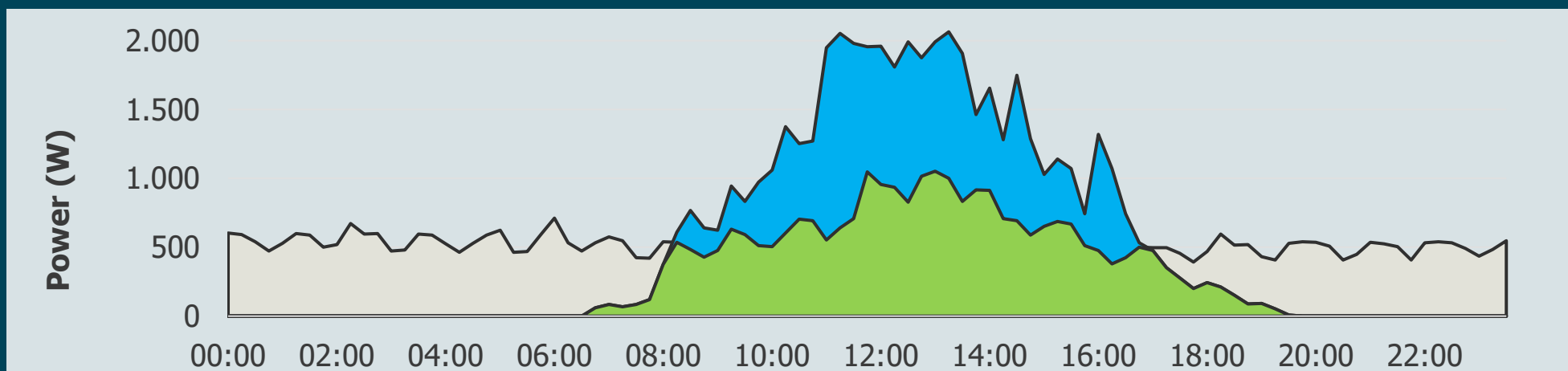
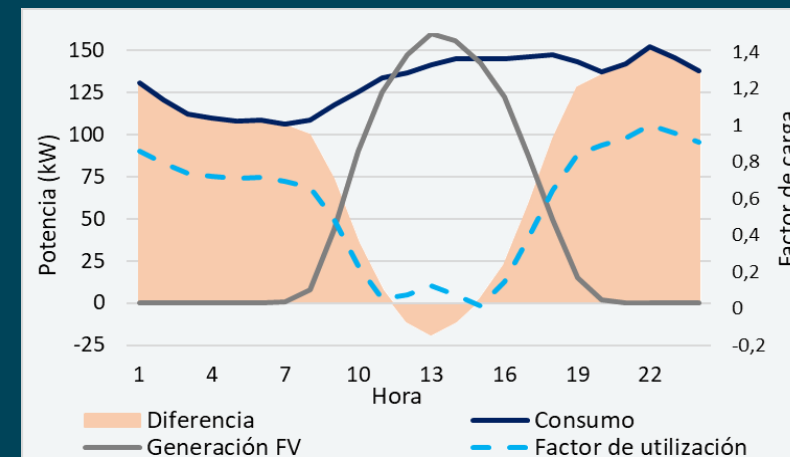
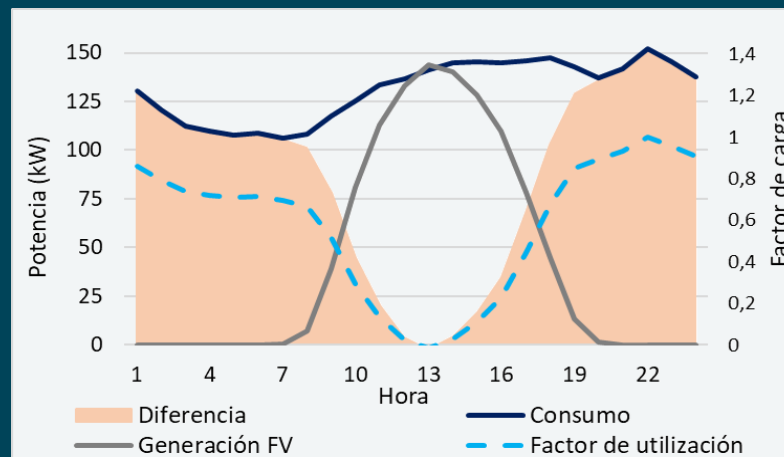
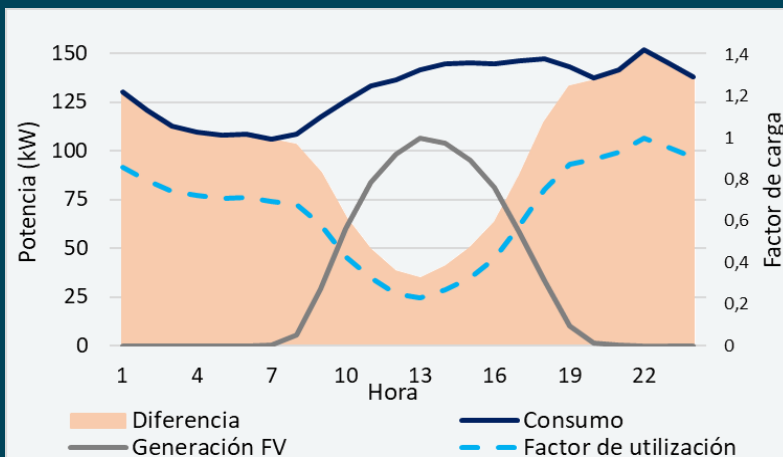
Megawatts
(MW)



Source: CAMMESA - Installed Distributed Generation Capacity [MW]

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Analysis of energy injection and impact on transformers

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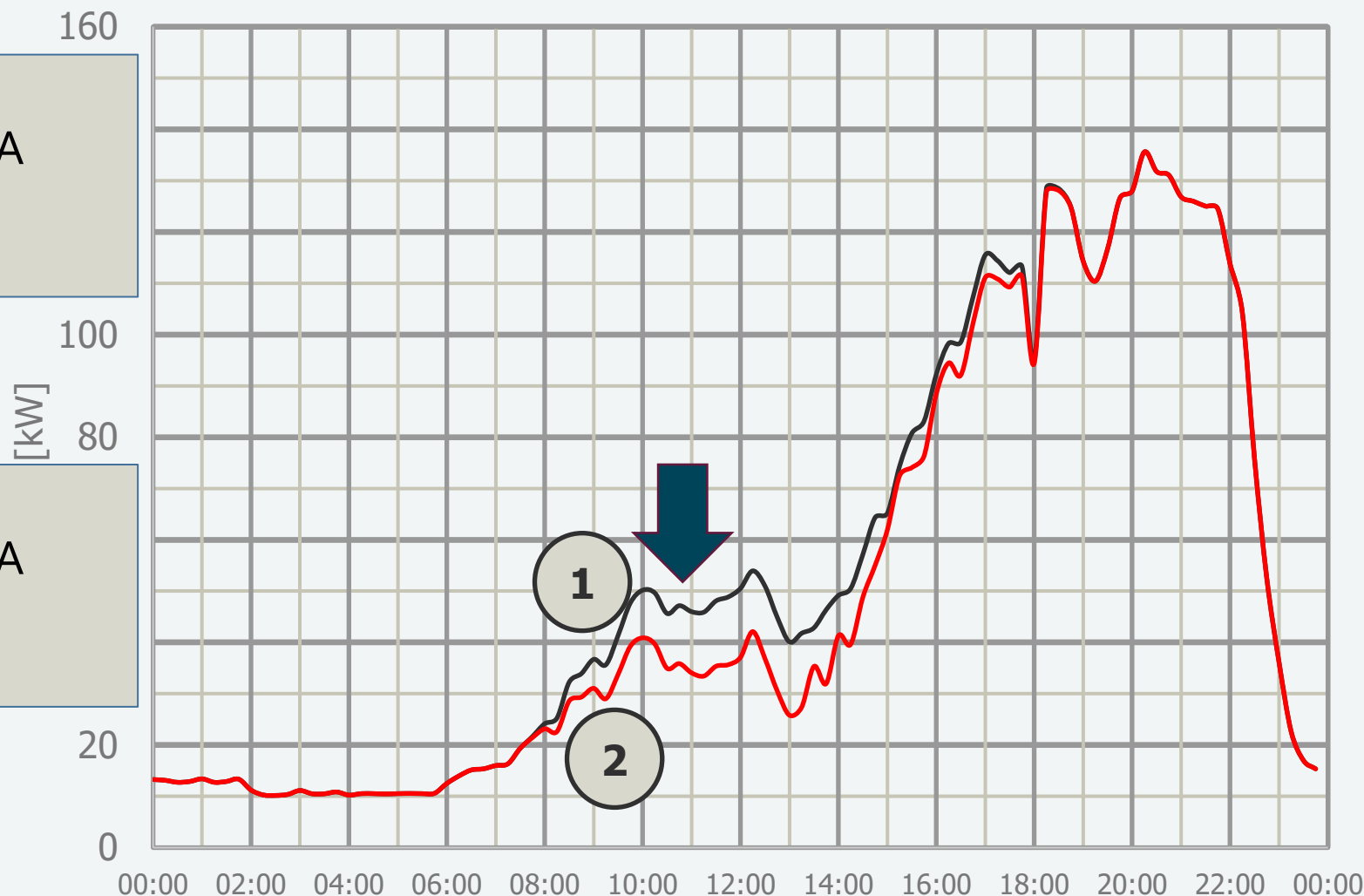
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Example 1 (original)

- Transf. **160 kVA**, max. 143,61 kVA
- Load factor = **89,76 %**
- Utilisation factor = **36,21 %**

Example 2 (10 times more PV)

- Transf. **160 kVA**, max. 143,61 kVA
- Load factor = **89,76 %**
- Utilisation factor = **34,08 %**



An example on an existing consumer including PV DG

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WEG, 2026



San Francisco Municipality, 2021

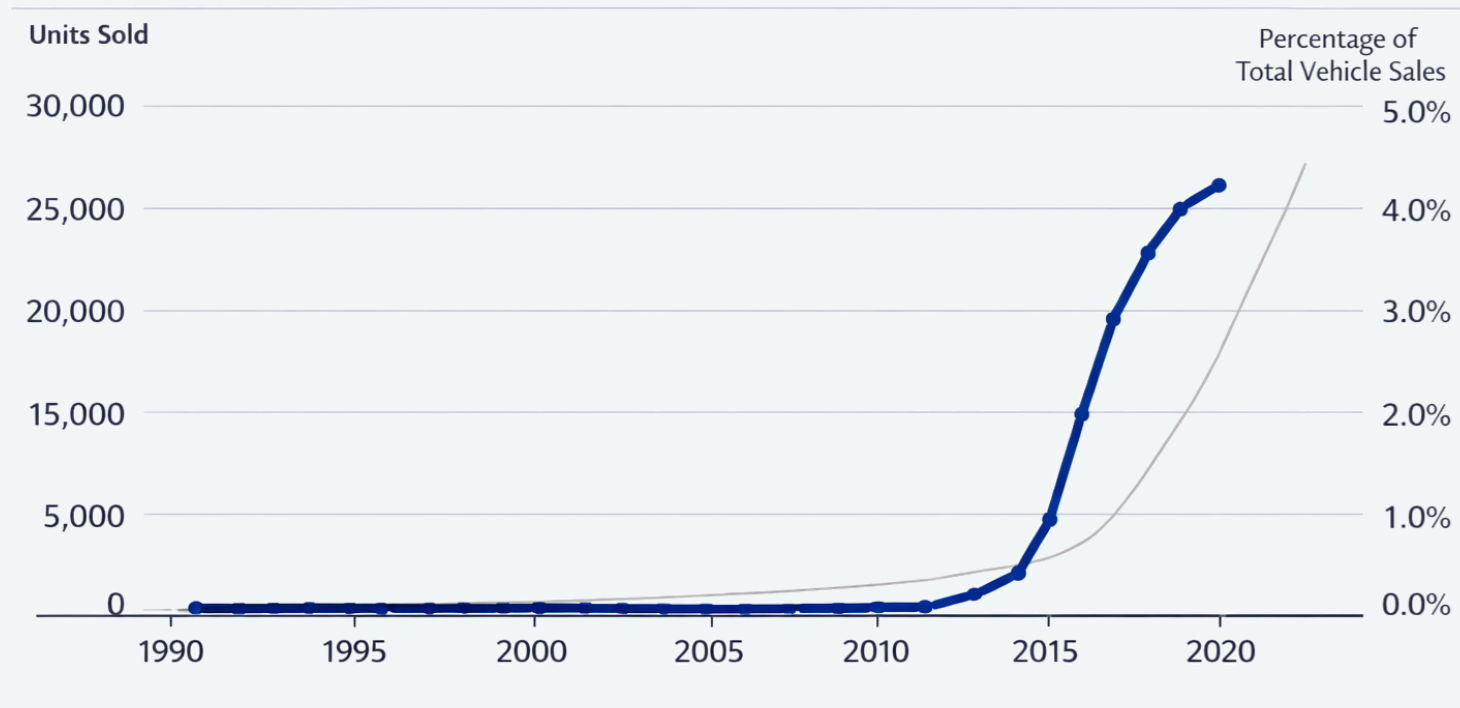
Local electric vehicle (EV) charger availability

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Plug-in and Hybrid Vehicle Sales in Argentina: 1990–2025

Sales of Plug-in Electric and Hybrid Vehicles in Units and Market Share Percentage



Source: SIOMAA - Sistema de Información On-Line del Mercado Automotor;
CIDOA - Cámara de Importadores y Distribuidores Oficiales de Automotores

Evolution in EV sales in Argentina

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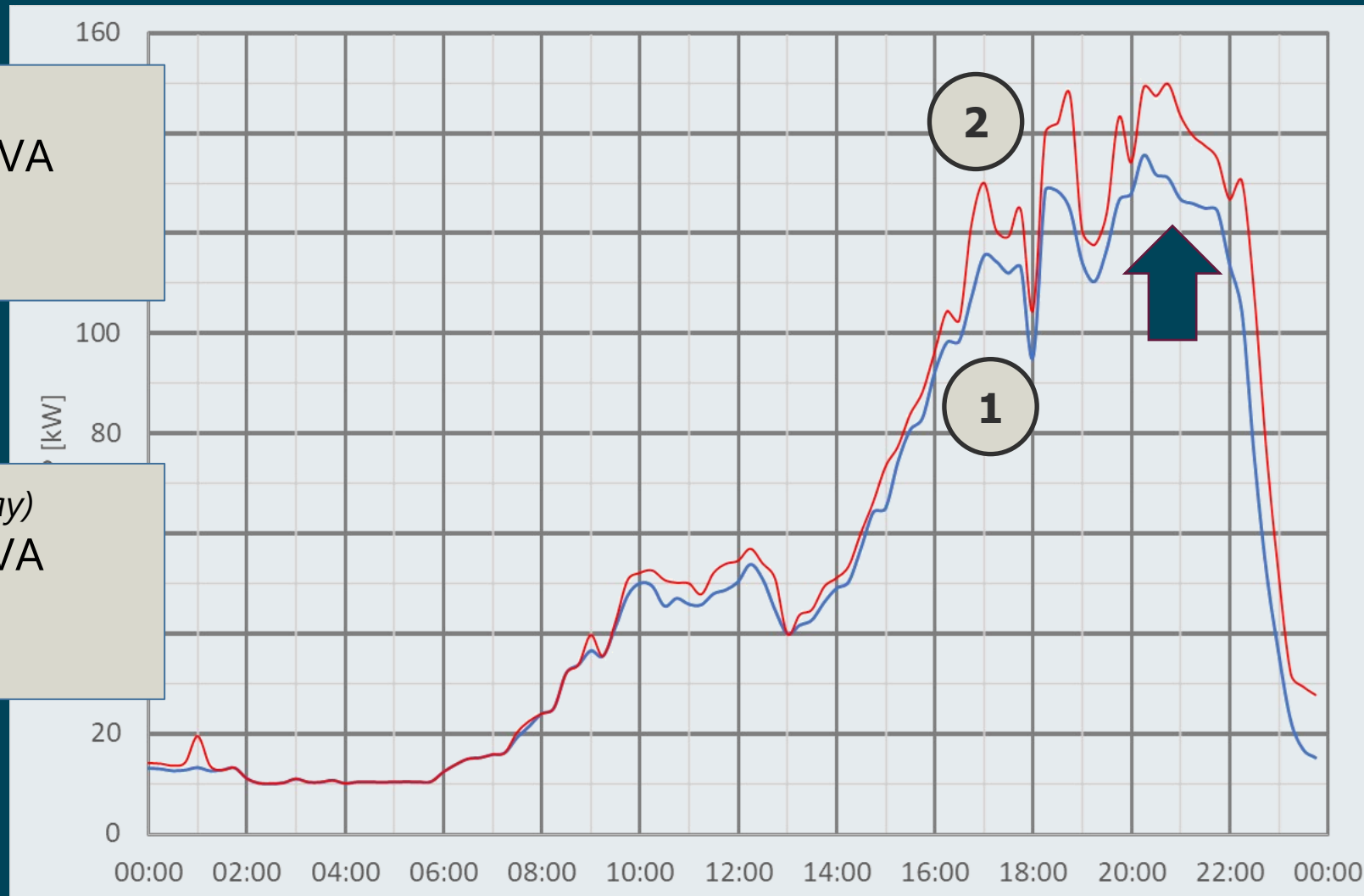
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Example 1 (original)

- Transf. **160 kVA**, max. 143,61 kVA
- Load factor = **89,76 %**
- Utilisation factor = **36,21 %**

Example 2 (+10 % energy, 12 charges/day)

- Transf **160 kVA**, max. 160,28 kVA
- Load factor = **100,2 %**
- Utilisation factor = **36,55 %**



An exercise with an existing consumer including EV charging

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Cahndra Mouli et ál., *Applied Energy* (2016)

EV charging in high-DG scenarios

Main ideas



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- DG still growing in Argentina
- EV chargers also growing slowly
- Even with traditional loads, distribution transformers feature low utilisation factors
- Opportunity to adjust standards and reduce total technical losses
- Ongoing research projects



TTE SA, 2018

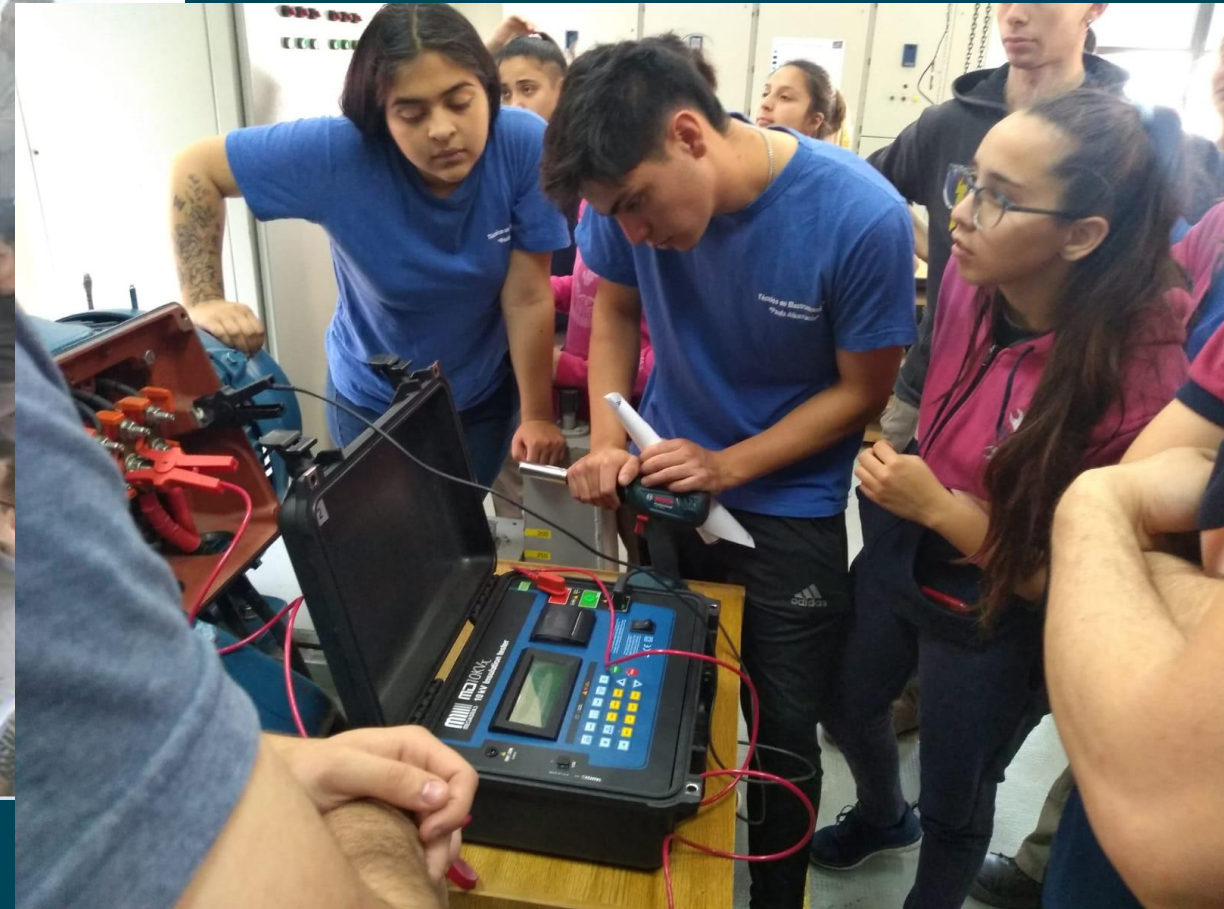
General ideas based on ongoing projects

The team



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Open laboratory activities

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Student participation for permanent outreach

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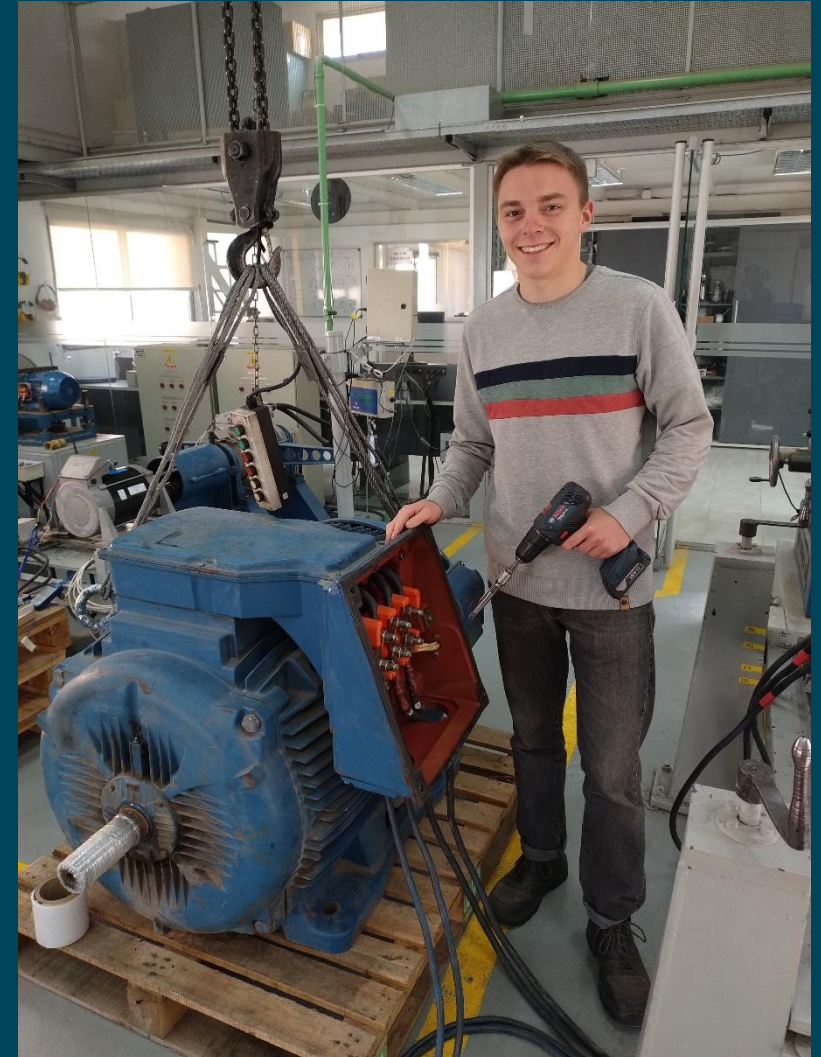
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National and international interactions

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International internships

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Academic growth and projection

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Thank you very much! Any questions?

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