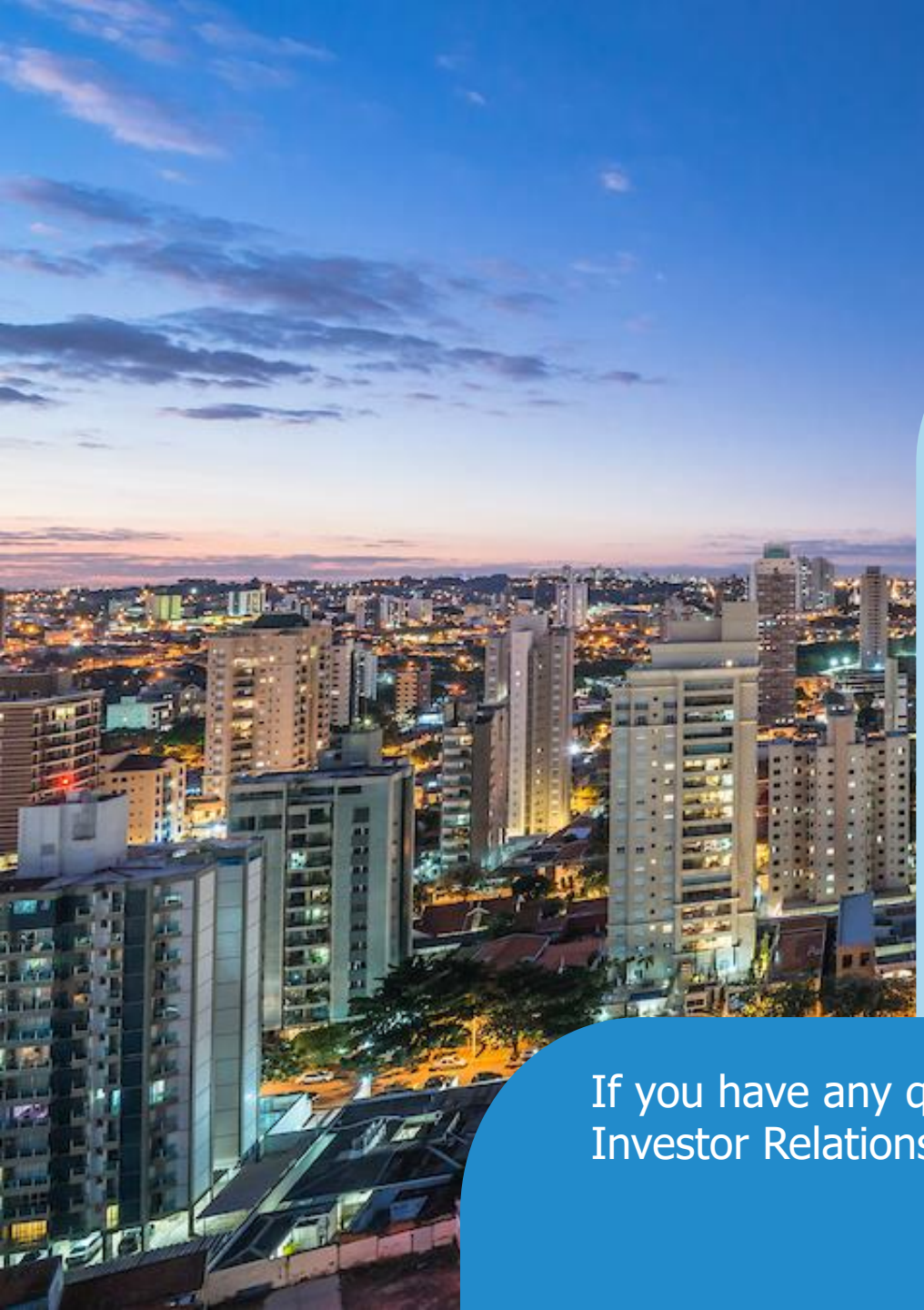
Investor Education
Energy Price Formation

May/2024



Objectives of the day

- ✓ Discuss the most important points about energy pricing
- ✓ Provide guidance on data presentation
- ✓ Guide analysts who need to build their models
- ✓ Indicate the main risks to be considered in the energy trading activity
- ✓ **We are not going** to discuss CPFL Energia's specific results and figures, but only point out the issues that are most relevant to out business.

If you have any questions about CPFL Energia's performance, the Investor Relations team is *call*

Talk to RI: **ri@cpfl.com.br**

Schedule

01 Energy Prices in Brazil and the PLD

02 Main Impact Factors

03 Models of PLD Formation

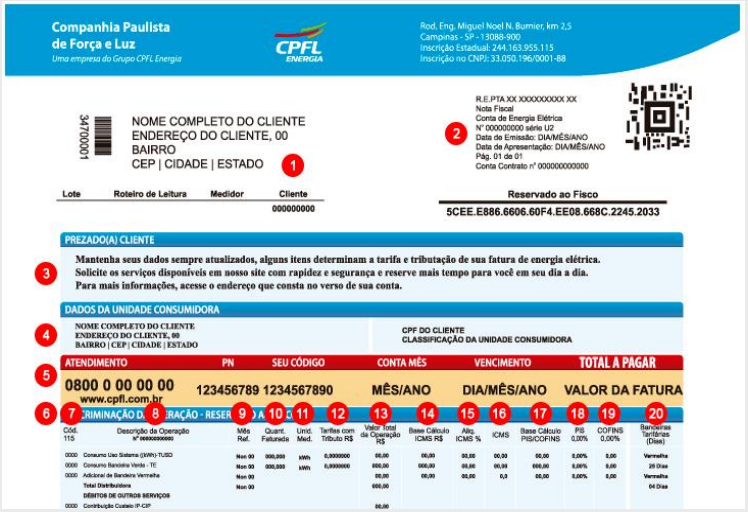
04 Commercialization Environments and Market Perspectives

05 New Challenges

Energy Prices in Brazil

Tariff

It is the price of energy established by the distributors for the **captive consumer**, under ANEEL regulation



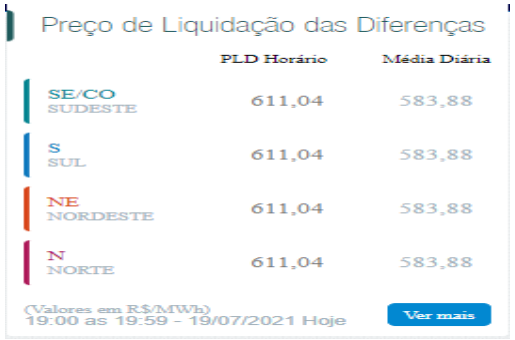
Differences Settlement Price - PLD

It is used to value energy exposures in the settlement of CCEE contracts

It is defined based on the marginal cost of the operation, represents the price of the last generation resource to meet demand

Are set for **past periods**

Influences market prices



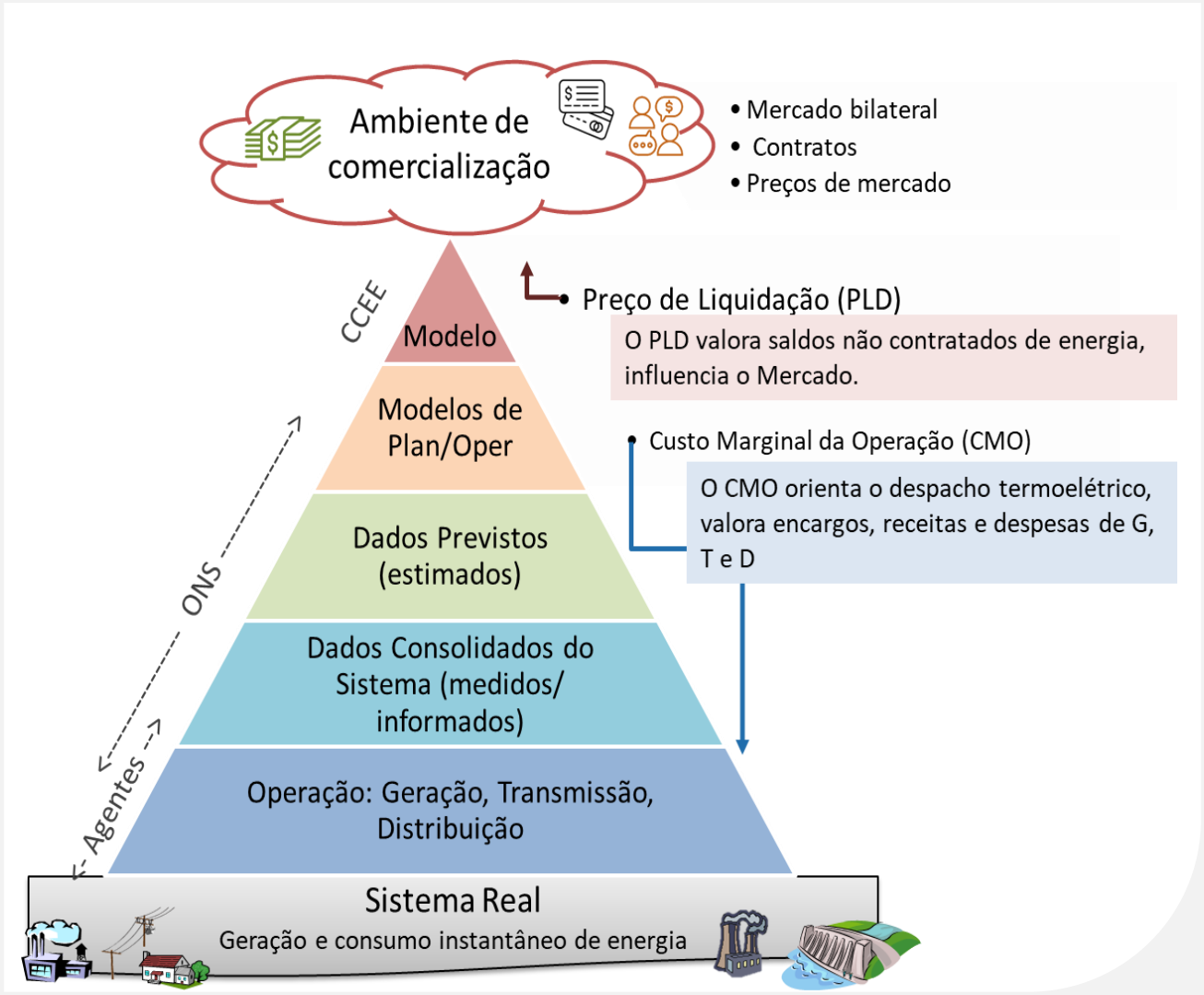
Price Foward

It is the price charged in bilateral energy negotiations (purchase/sale) in the free market

They are defined for a set of **future periods**, generally related to the term of the contracts and consider the generating source (conventional or incentivized)

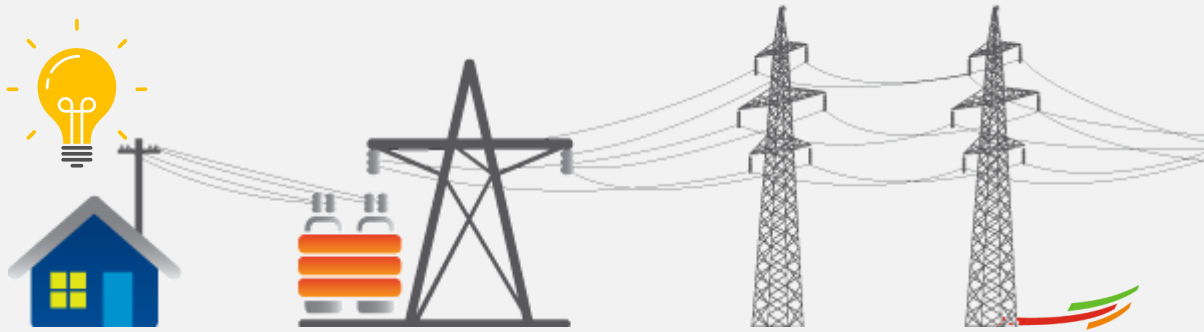
They are influenced by the PLD, but also consider market aspects such as generating source, liquidity and risk

Concept and Origin of PLD



The CMO is the Marginal Cost of Operation

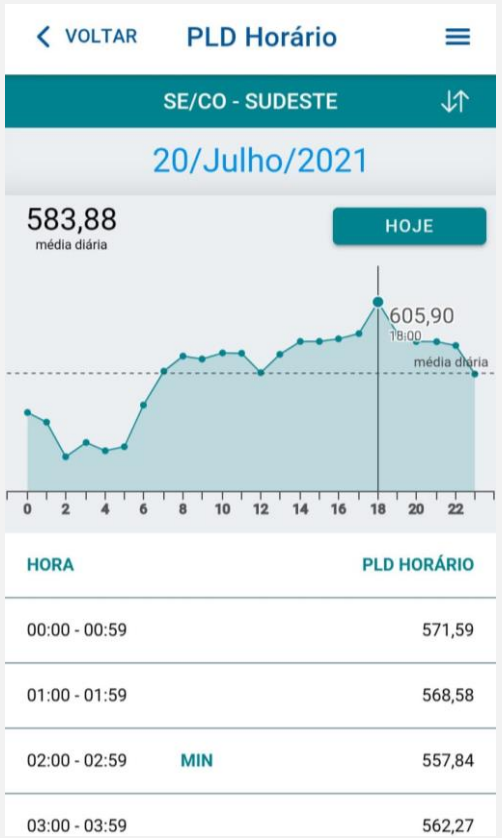
- What is the **minimum** cost to add the next unit of power to the system?
- It's not always simple to define this cost!

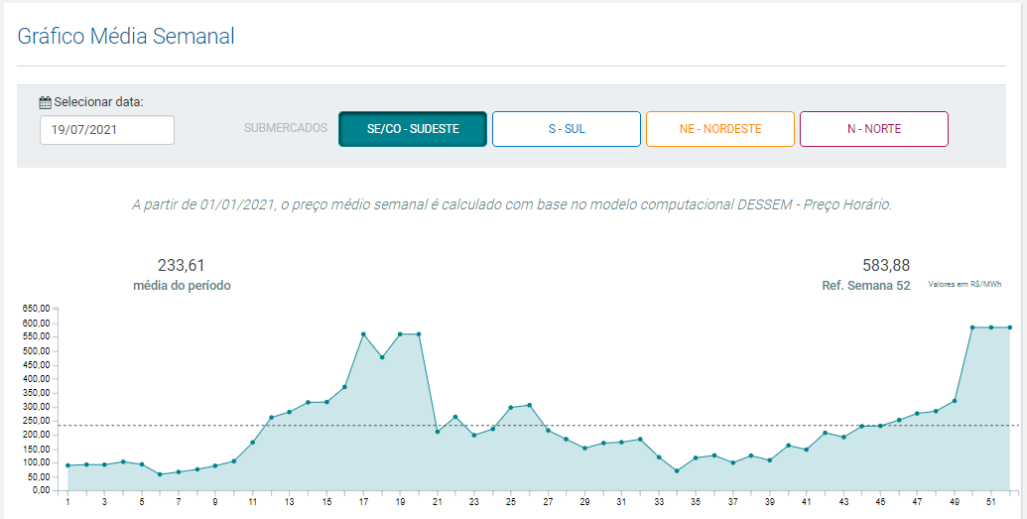


PLD – Differences Settlement Price

It is defined by the Electricity Trading Chamber - CCEE: https://www.ccee.org.br/

Since Jan/21, the PLDs are published daily, always for the next day, on an hourly basis

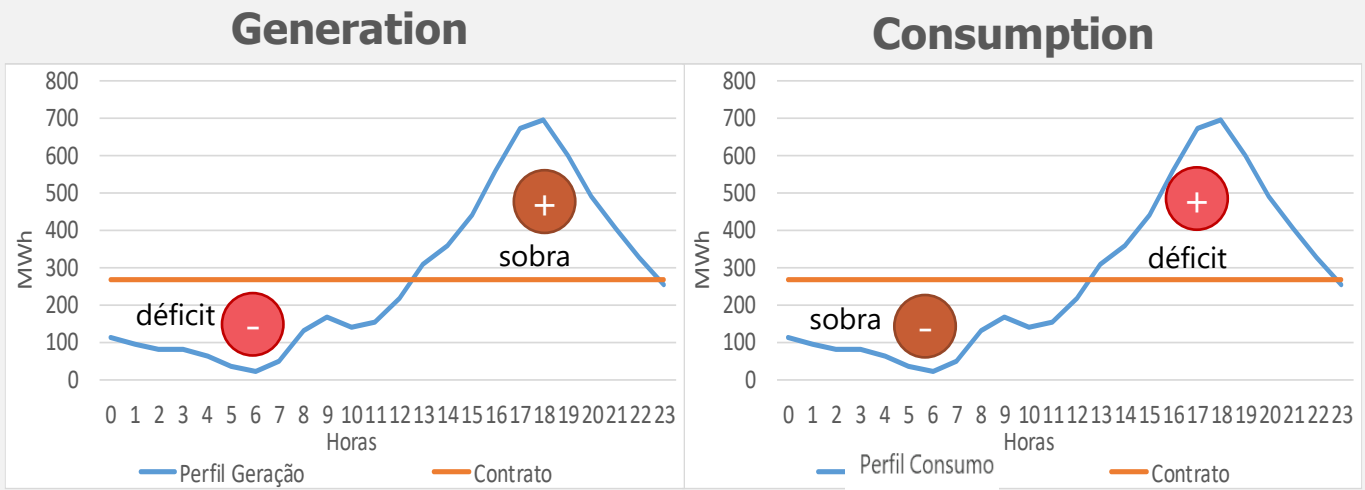


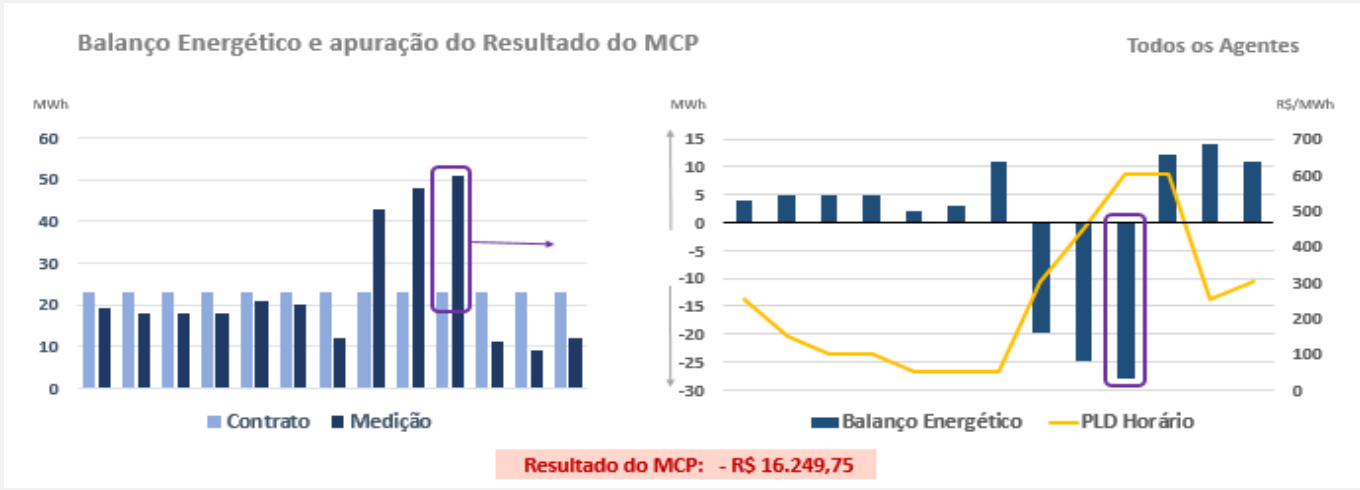


What is PLD used for?

The PLD values the settlement of contracts in the CCEE in the Short-Term Market (MCP)

- Energy exposures are calculated by the difference between the measurement and the contract and valued at PLD
- The calculation is done hourly by hour: (Surplus or Deficit)* PLD, but the settlement is monthly!

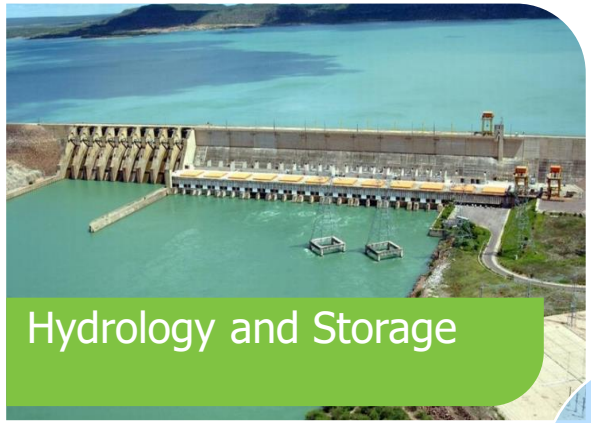




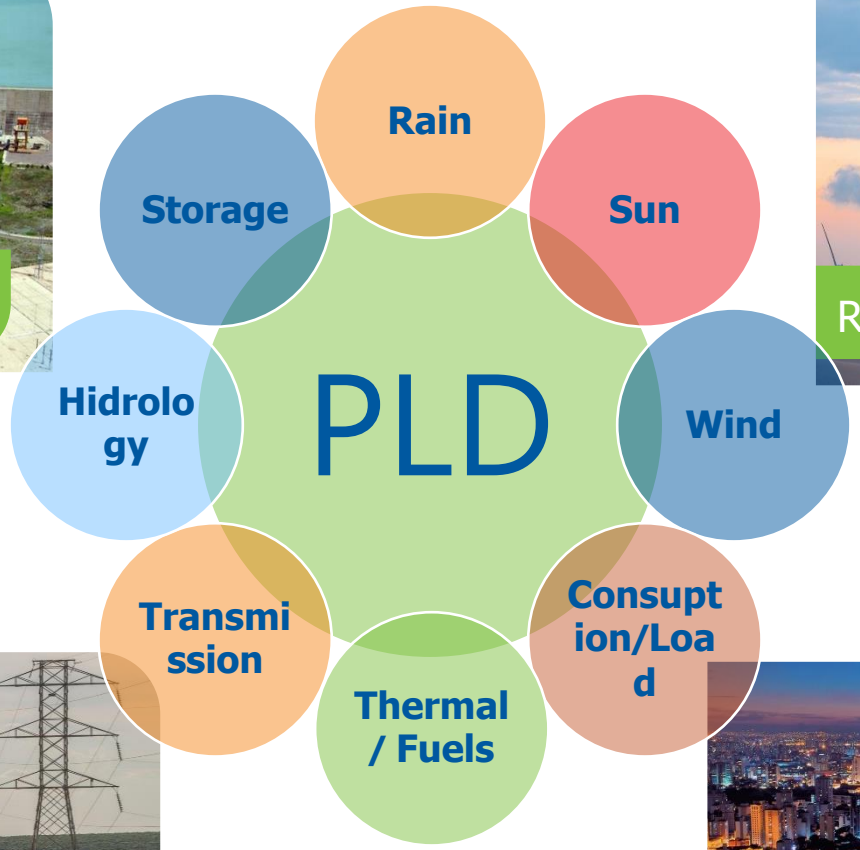
Schedule

Main Factors Impacting the PLD

Maint factor impacting the PLD, the only one whose variability is modeled by scenarios



49% of the Eletricity Matrix



Increasing participation in the energy matrix, effects on PLD more relevant to hourly prices

34% of the Eletrecity Matrix*

Extermal or operational interference

Transmission network limitations

Thermoelectric dispatch unavailability, authorization for out-of-merit Generation, grants, fuel costs...

Operating rules

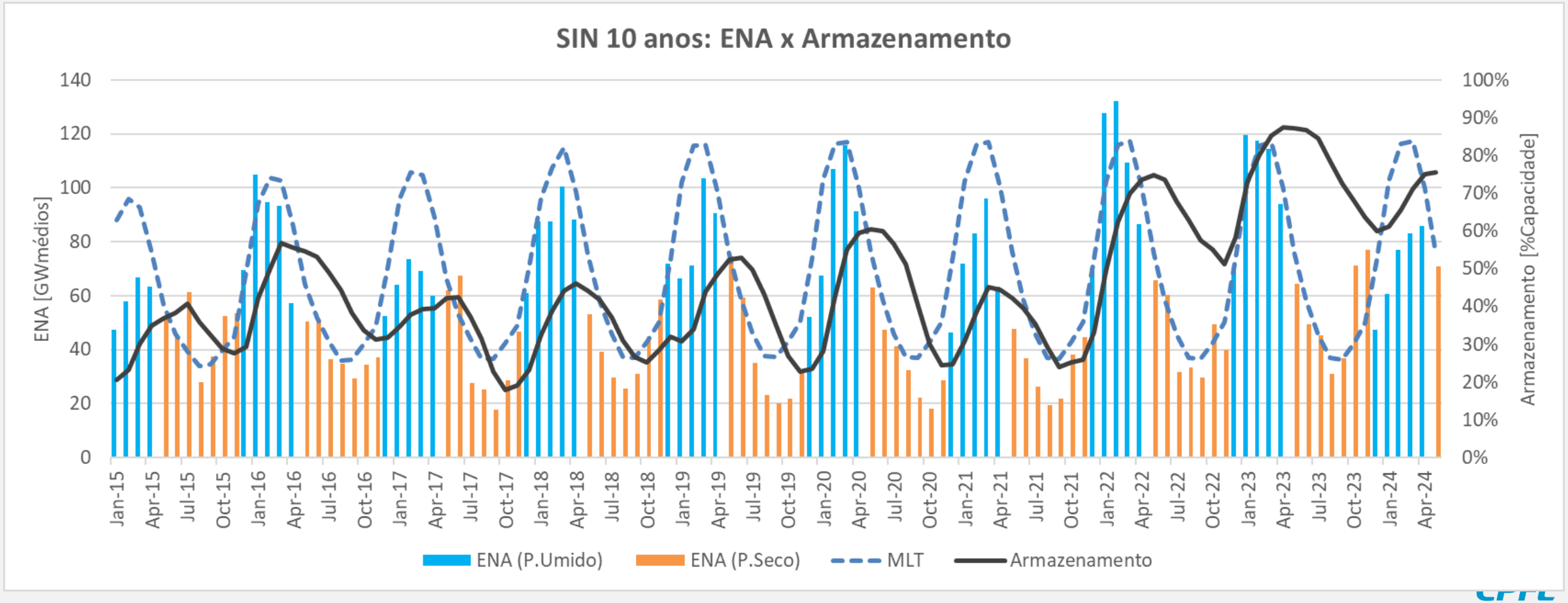
It has a well-known historical pattern, but this has been **disrupted by the insertion of distributed generation**

Fonte: https://www.ons.org.br/paginas/sobre-o-sin/o-sistema-em-numeros *Eólica, solar e

Hidrology

The most influential quantity in the system

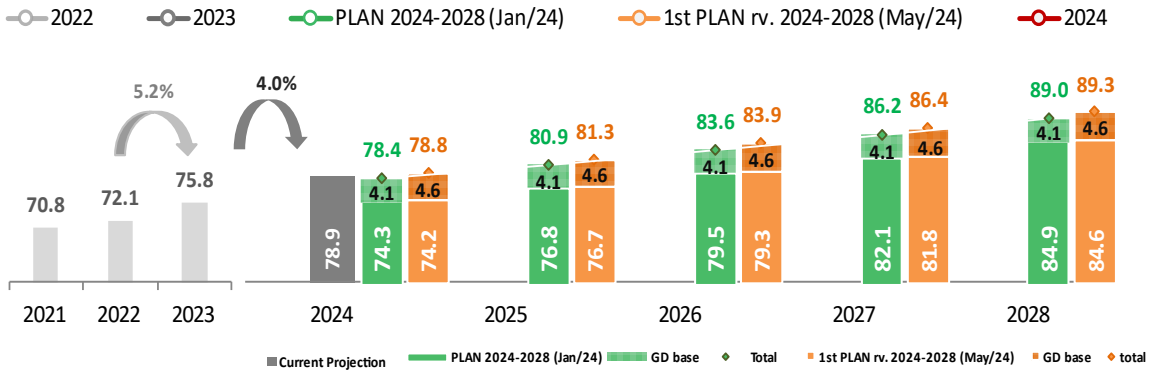
- Meteorological rainfall models are used to forecast the flow, which is converted into ANE (Affluent Natural Energy).
- In the médium term, 2000 synthetic ANE scenarios are generated to build a robust operating policy.



Demand

Load projection takes place over 4 time scopes:

1. PLAN (National Energy Plan): 5-year projection, 3 times a year (January, May and September). Model bases on economic variables, ignores spurious factors (calendar, temperature, etc...)



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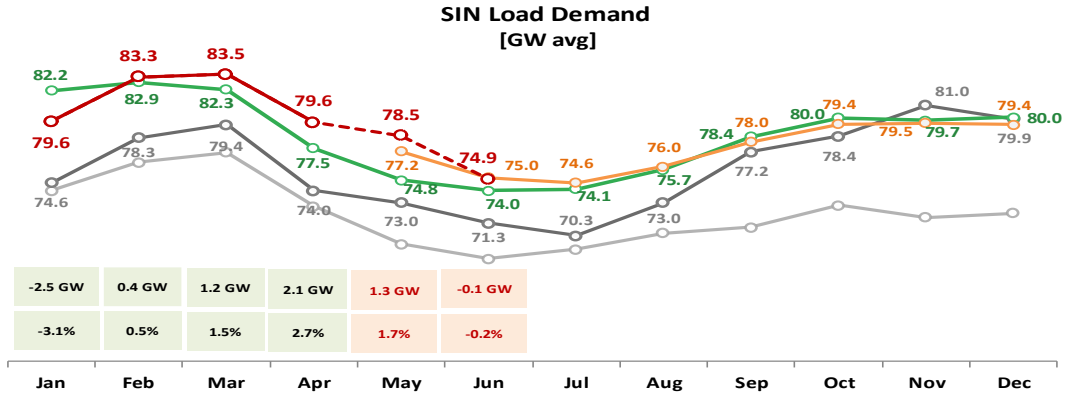

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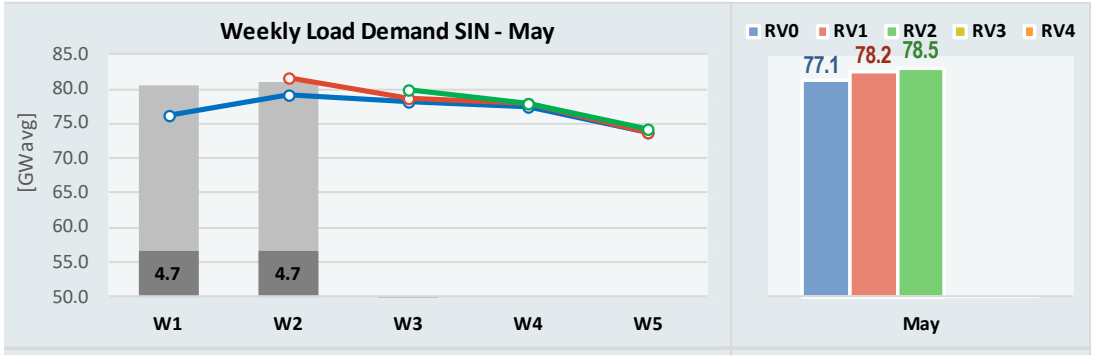

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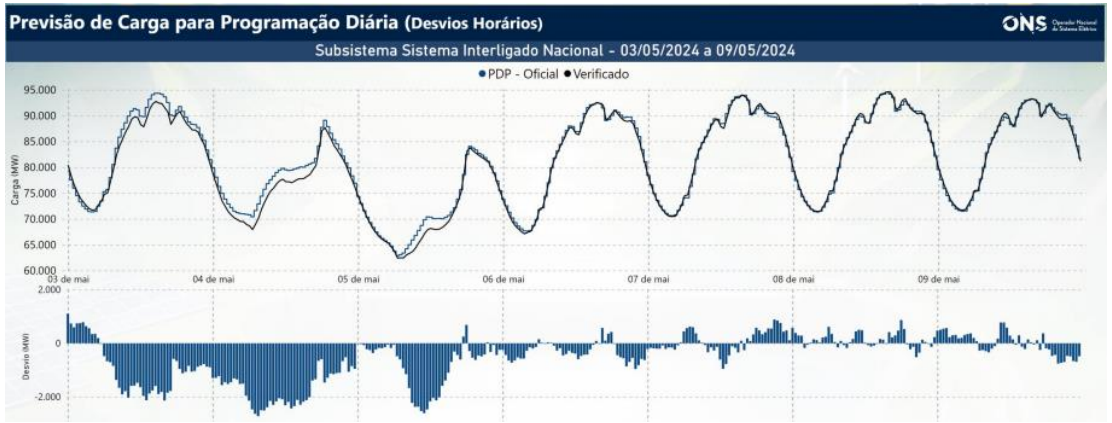

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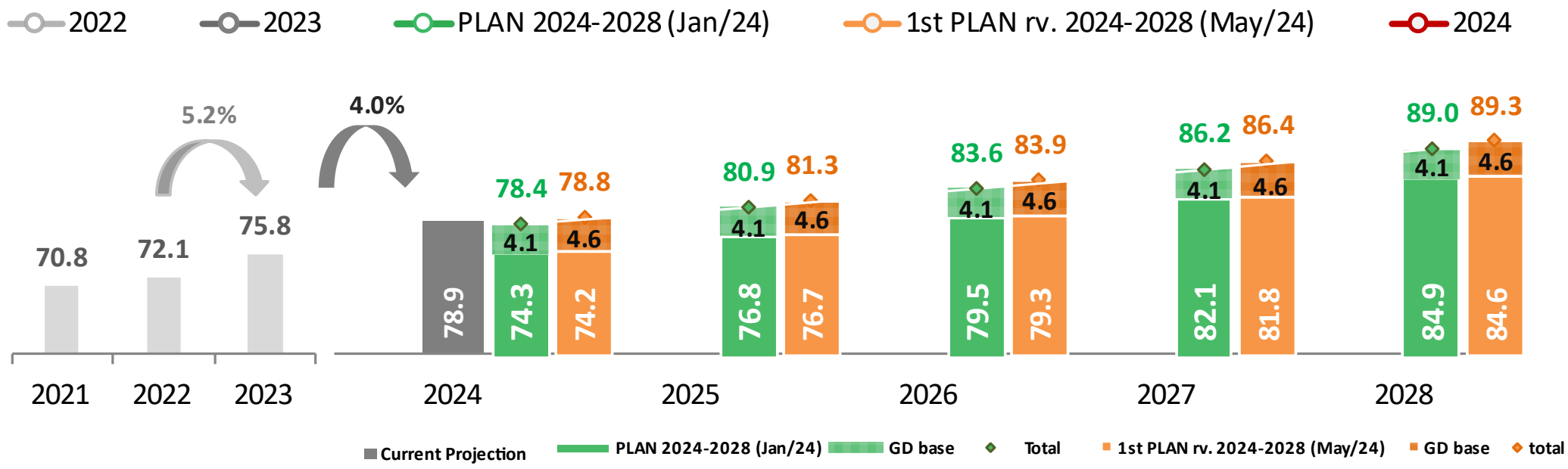

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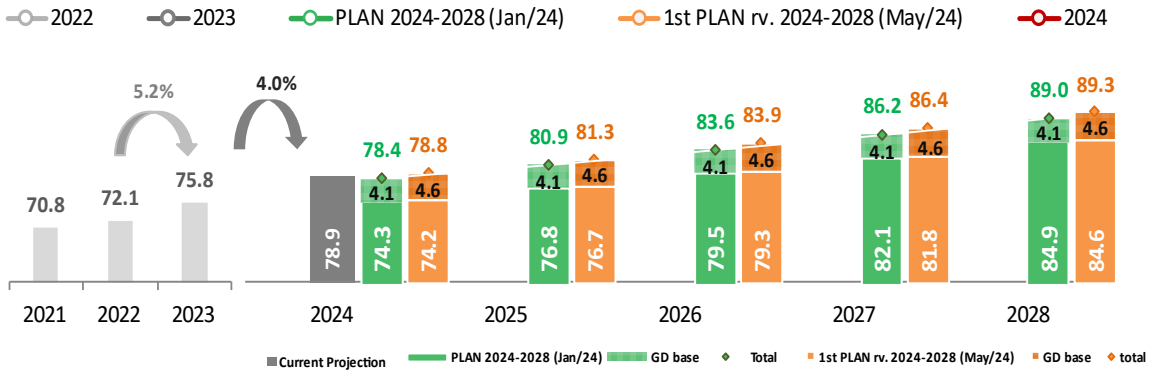

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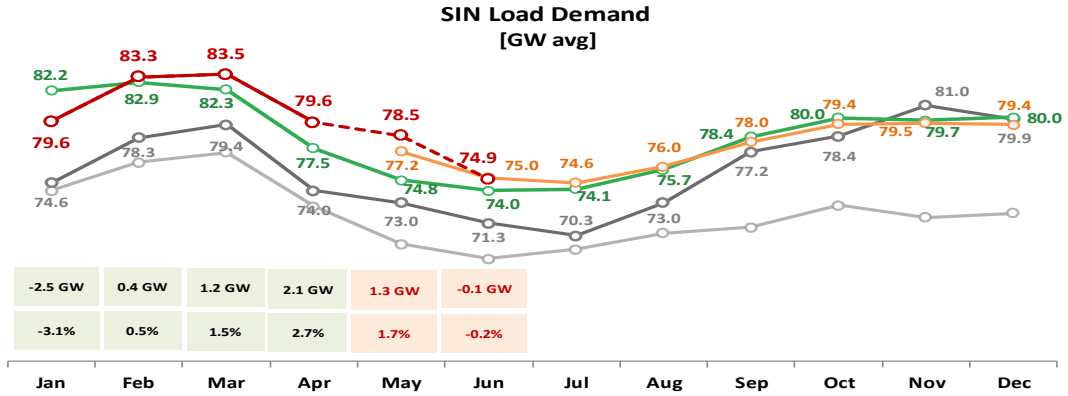

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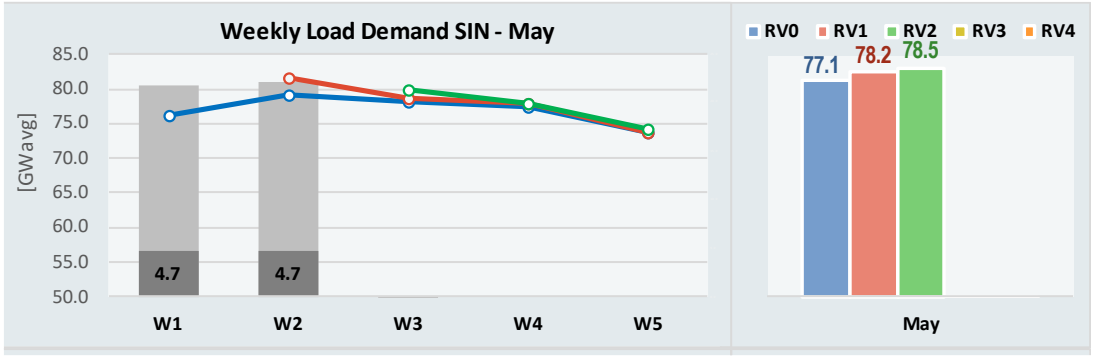

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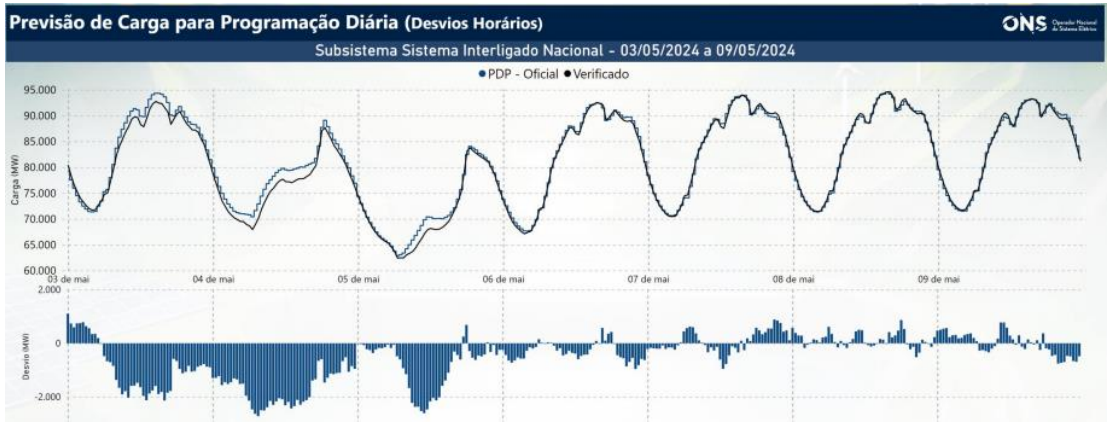

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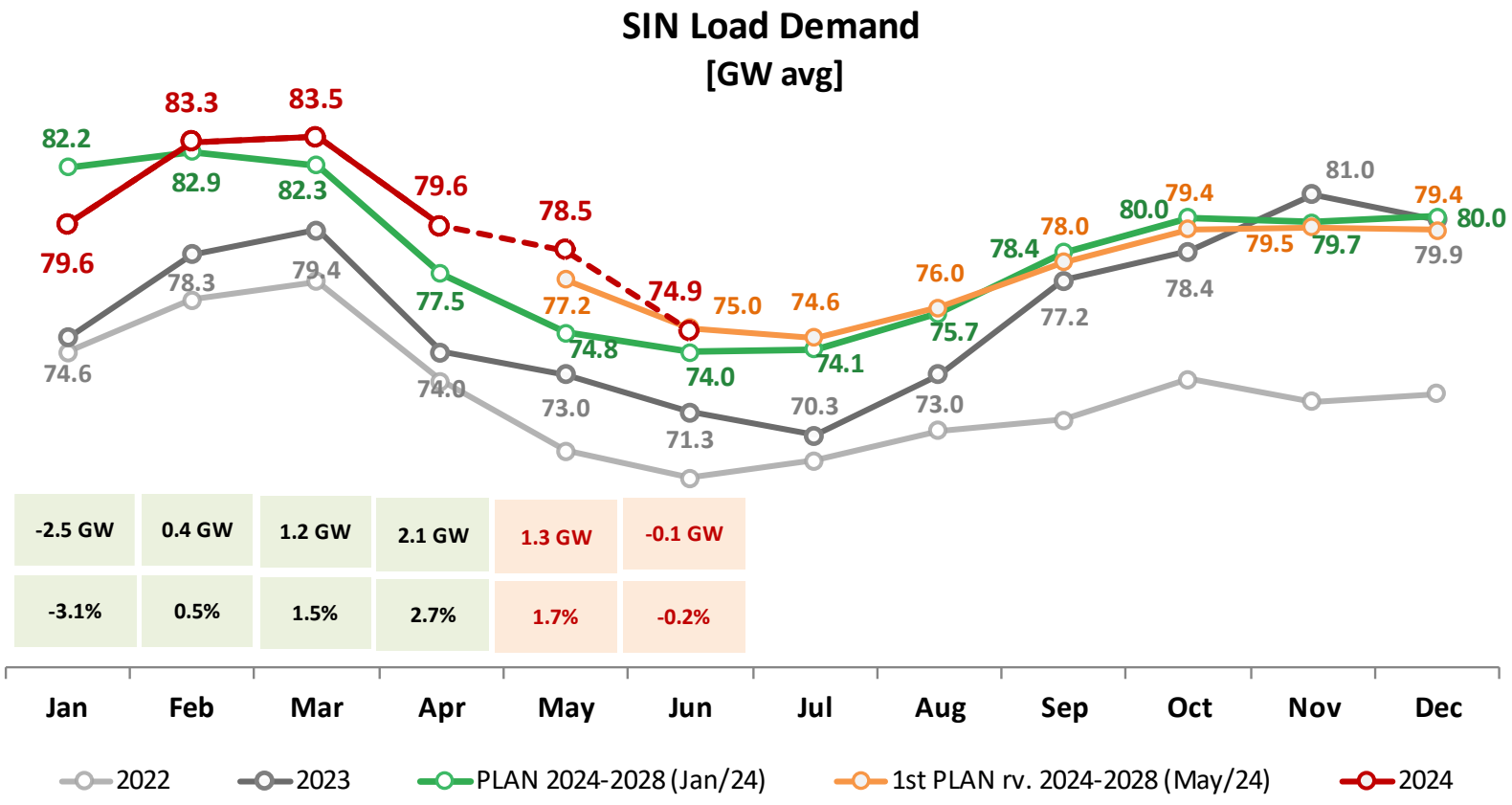

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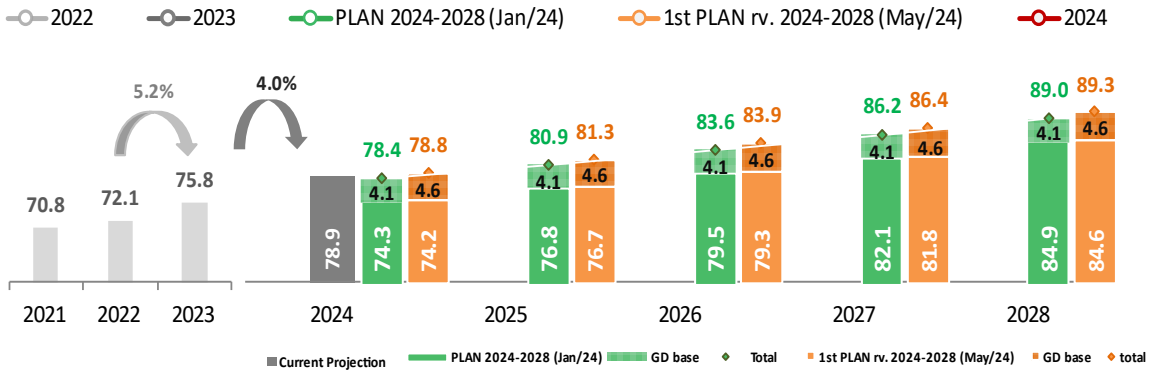

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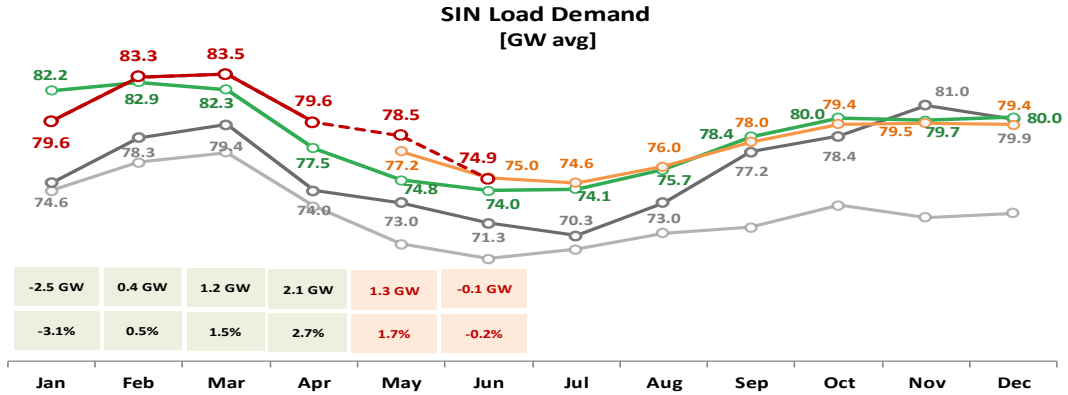

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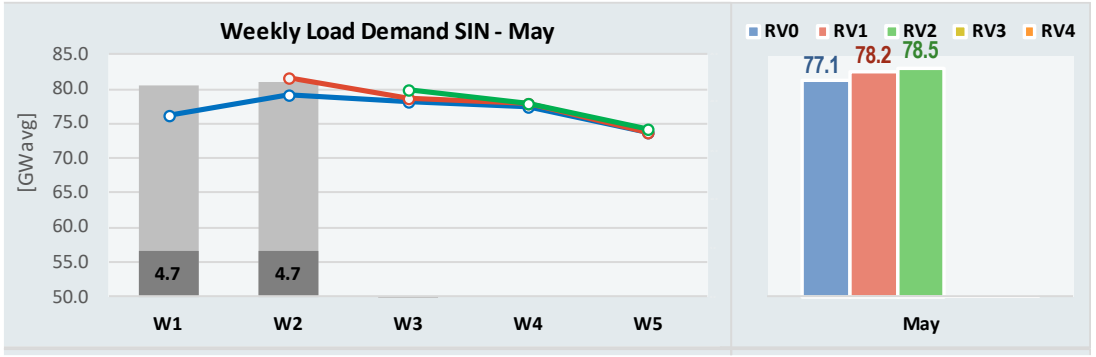

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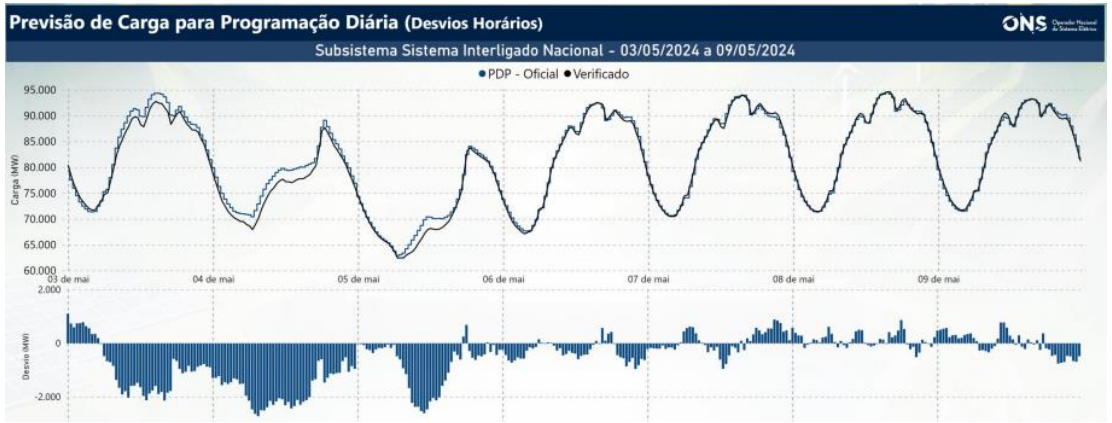

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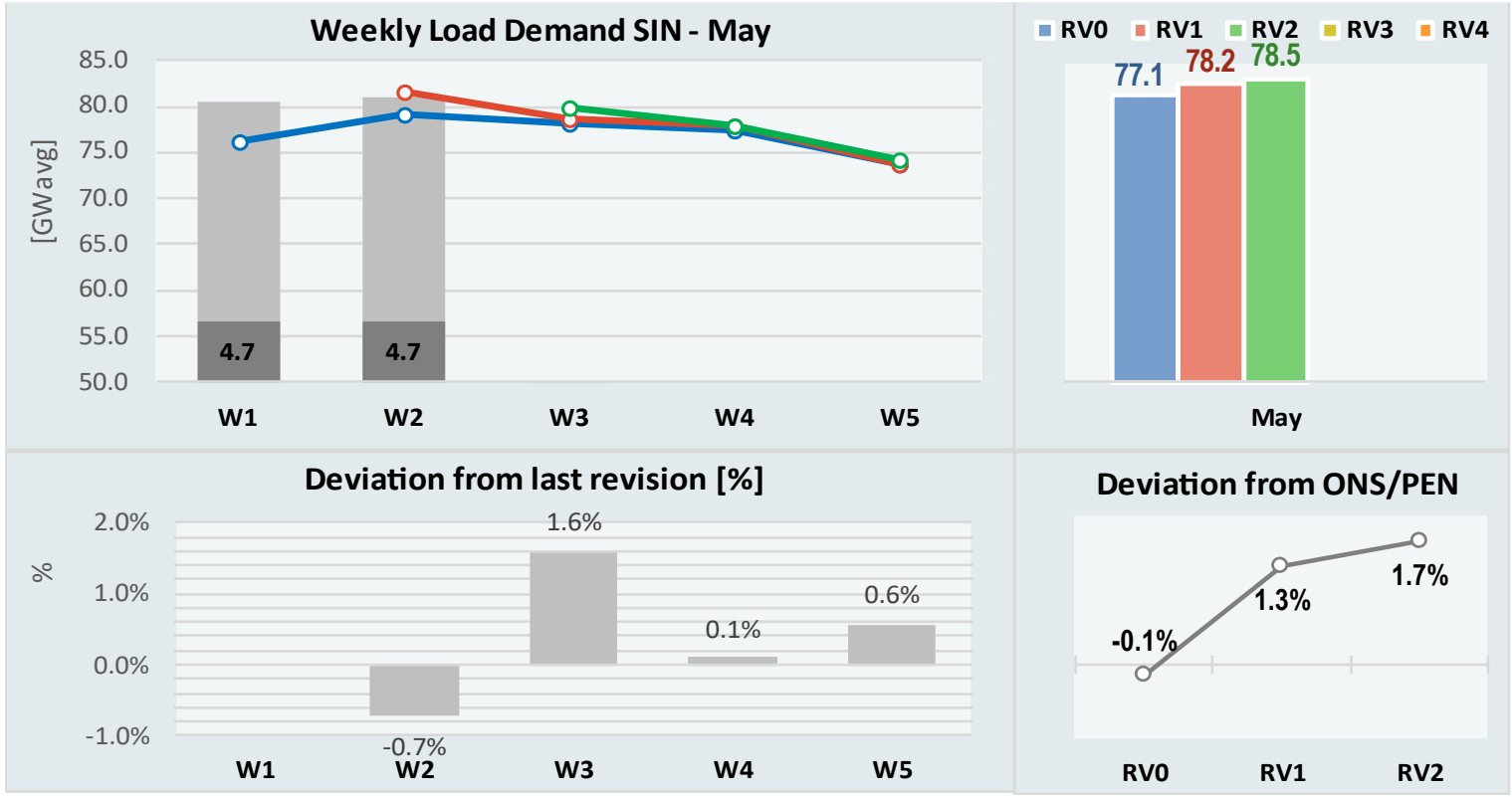

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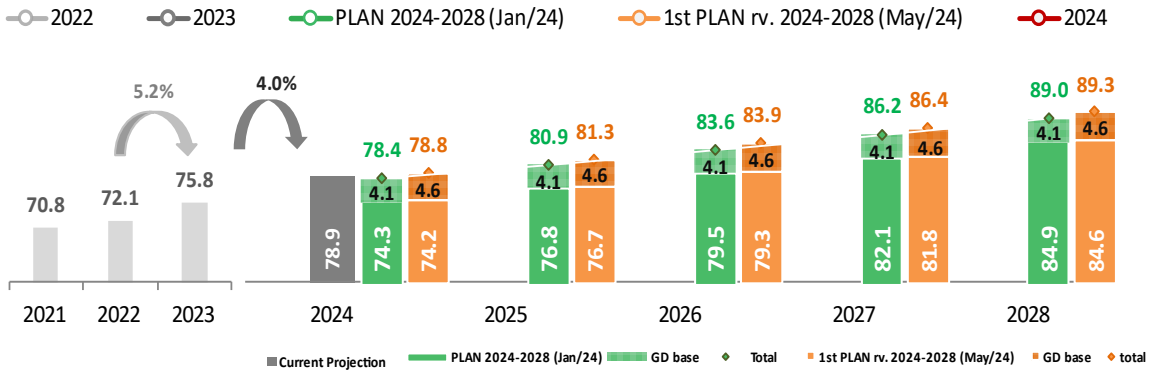

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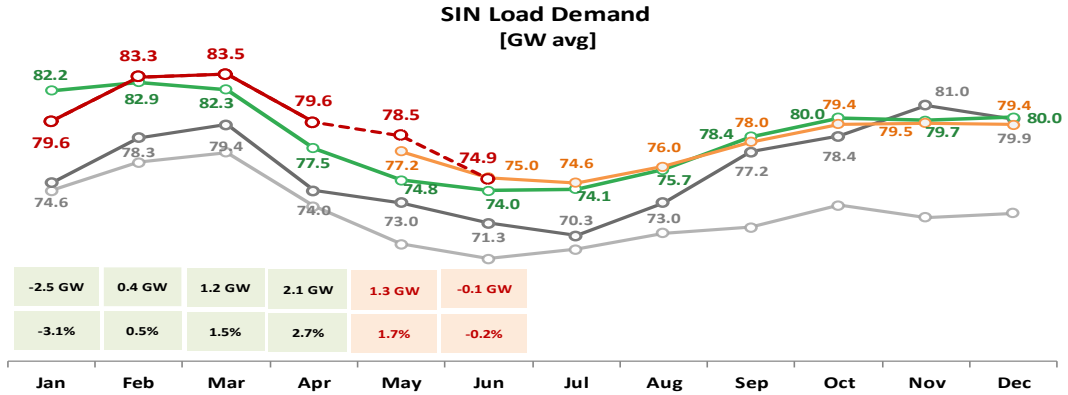

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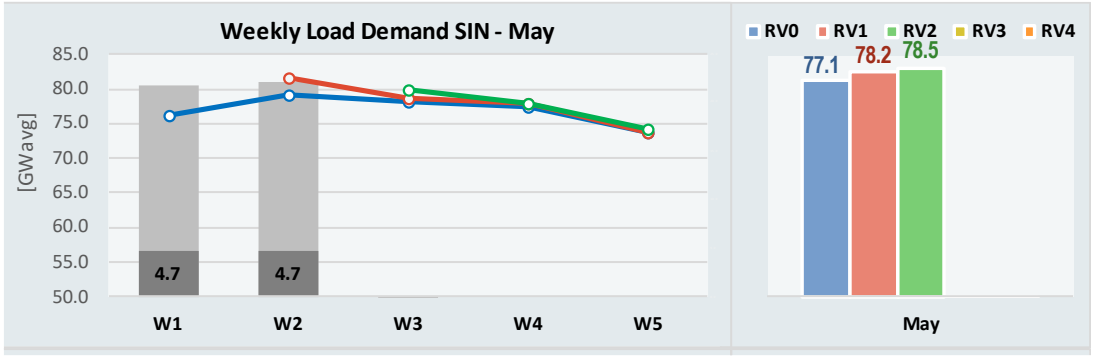

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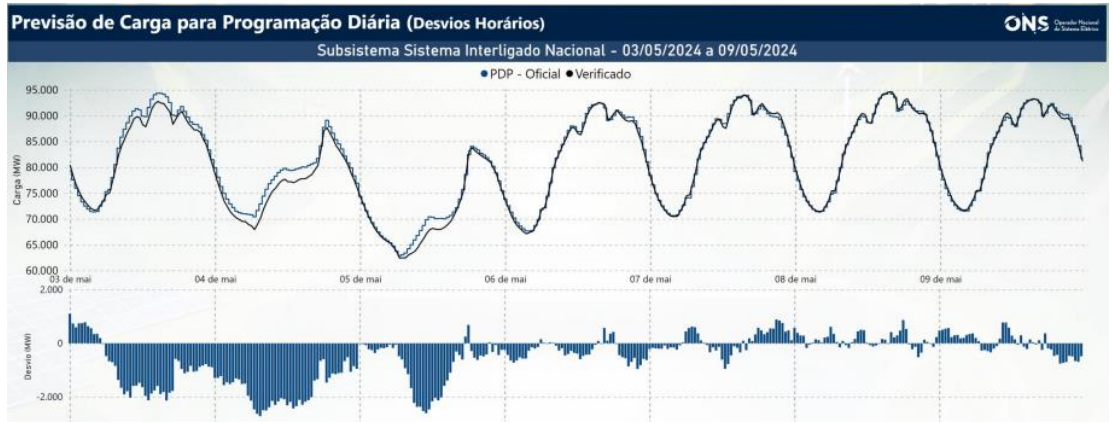

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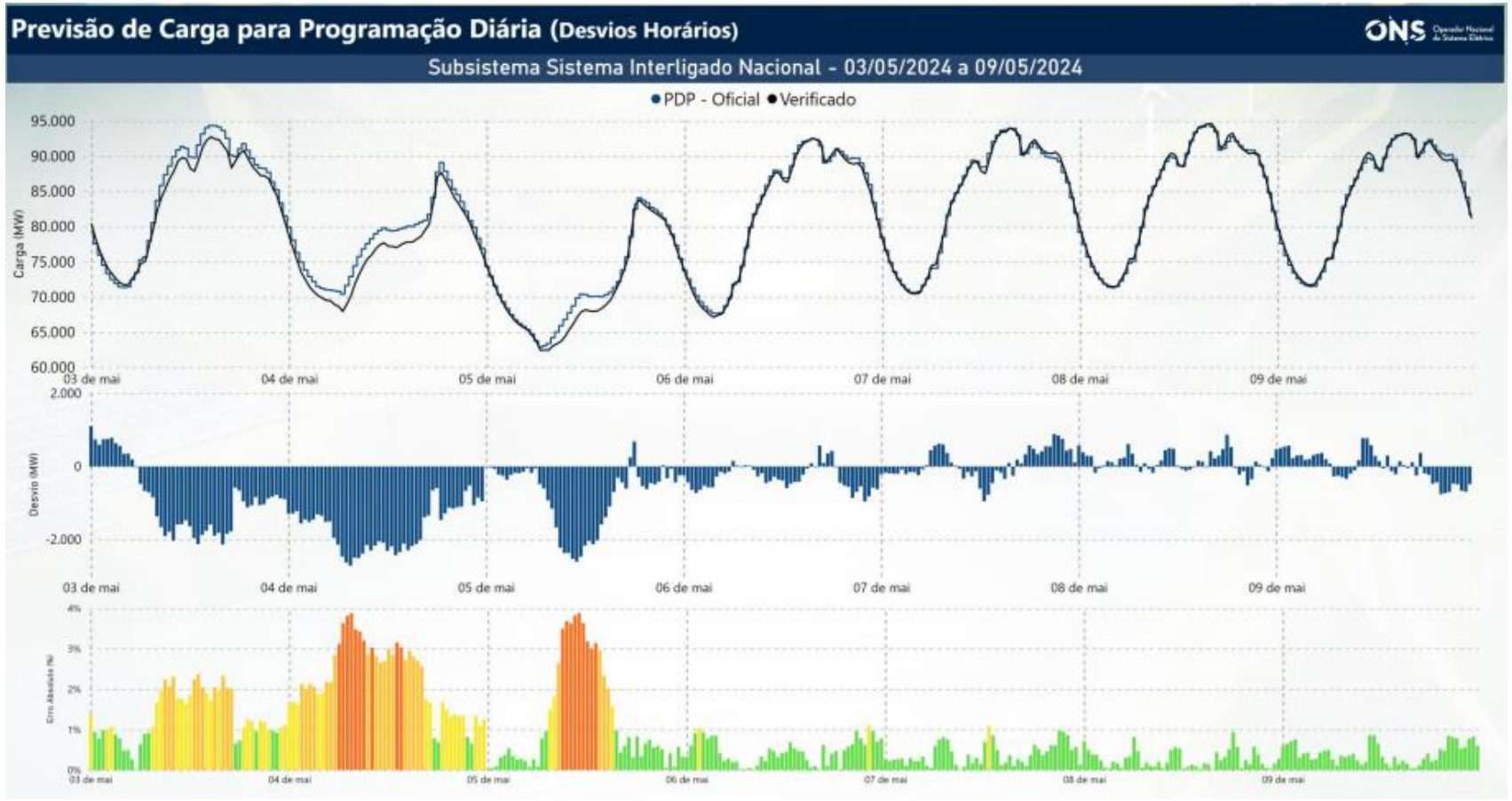
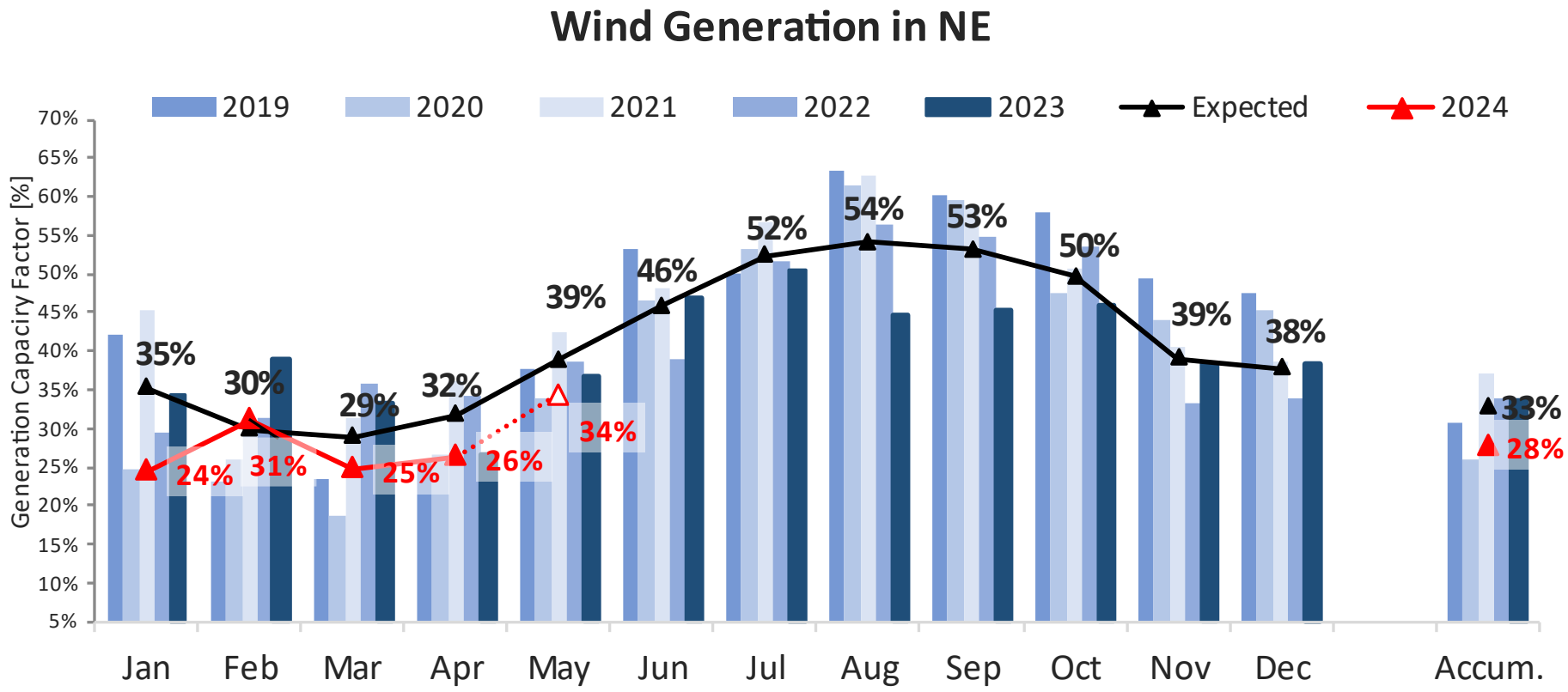


Renewable Resources

Wind Generation provides significant power Generation for the SIN, especially in the NE subsytem, where it can already supply most of the consumption in some months.

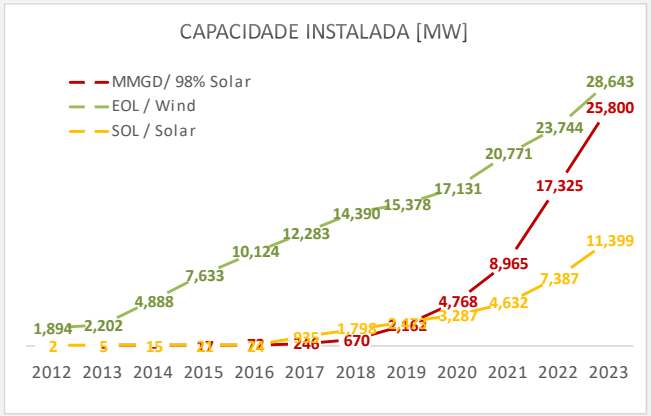


Source: ONS - Capacidade instalada NE 24,4 GW.

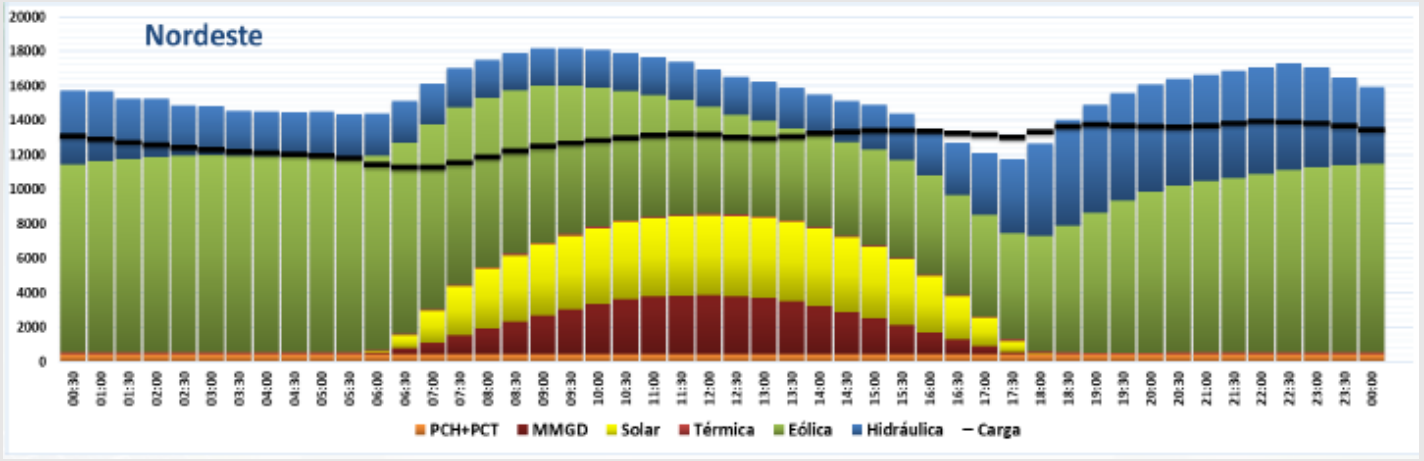
Renewable Resources

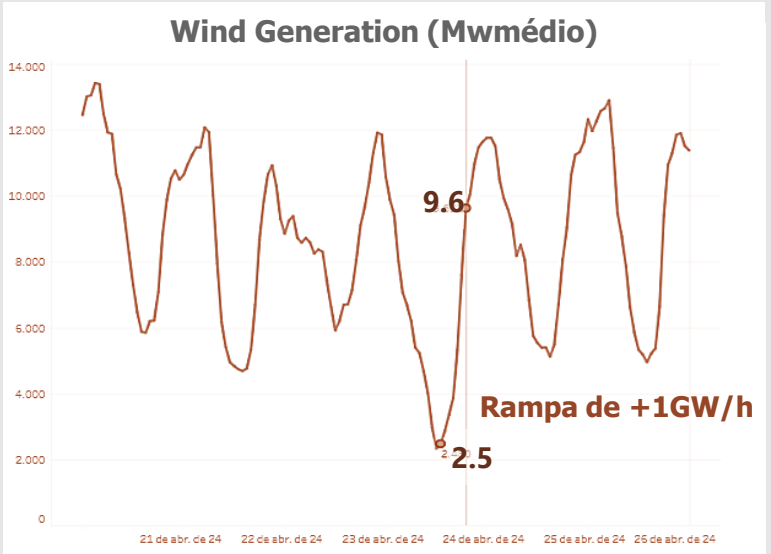
It is a non-controllable resource (generation is according to wind/sun availability) and highly Variable, including large increases/decreases in minutes

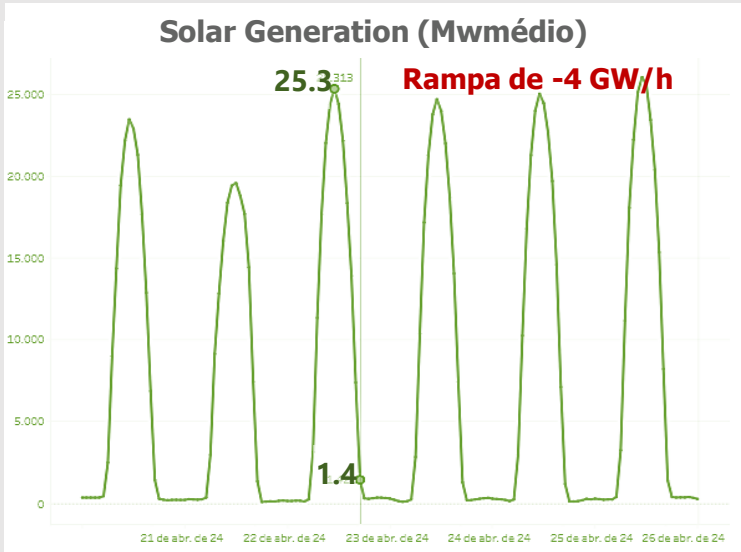
Increasing insertion of new sources of distributed Generation means that the load perceived by the operator has a more Variable horly profile



Weekly Schedule Energy Balance – 20 to 26 Abr 2024



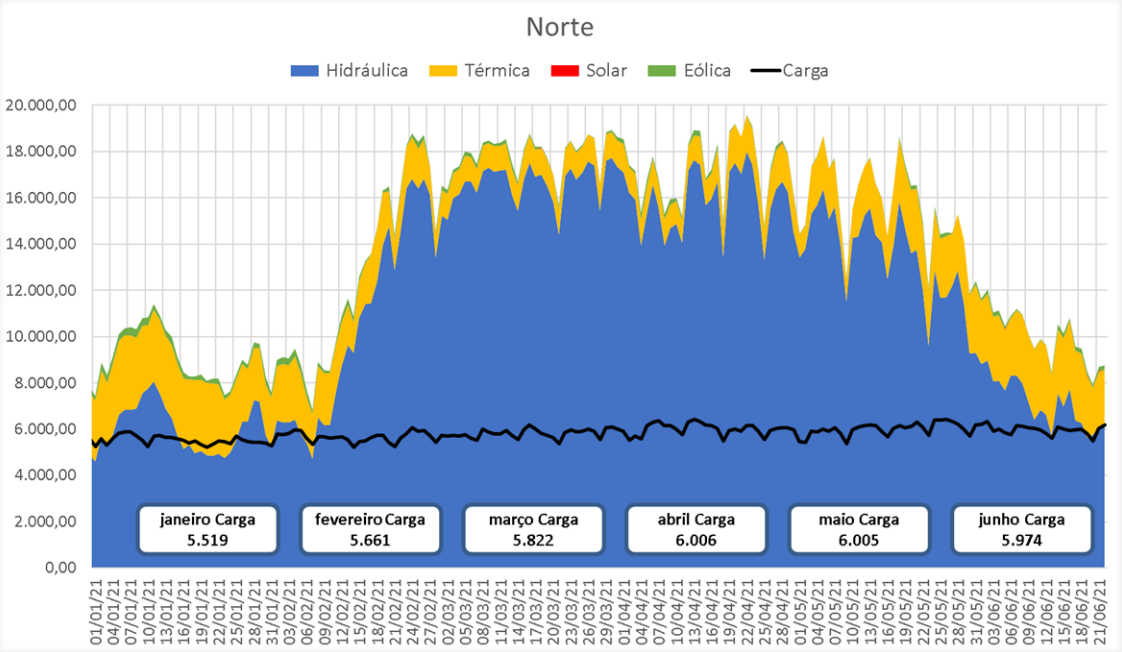


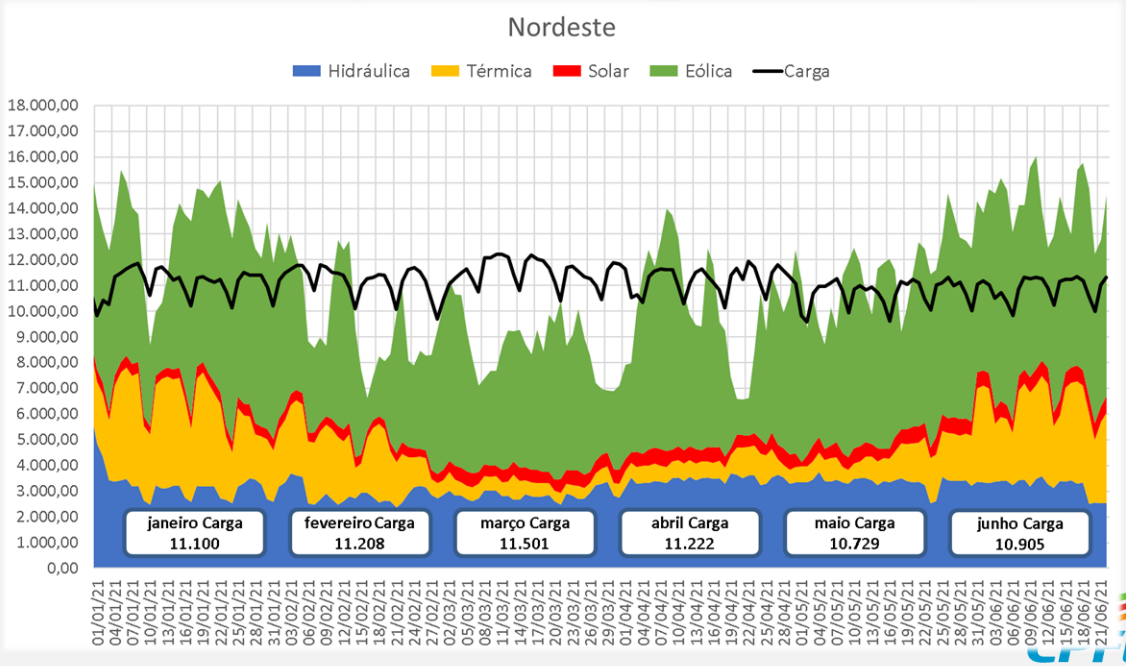


Source: ONS, Programação Mensal da Operação (PMO); https://www.ons.org.br/Paginas/resultados-da-operacao/historico-da-operacao/geracao_energia.aspx

Transmission and External Interference

- Brazil has different energy Generation characteristics between regions: in the NE wind farms predominate and in the NW large run-of-river hydroelectric plants, with marked seasonality of flows
- Changes in water policy can have an impact on operations and the impact on energy prices is not greater because of the intervention of the CCEE





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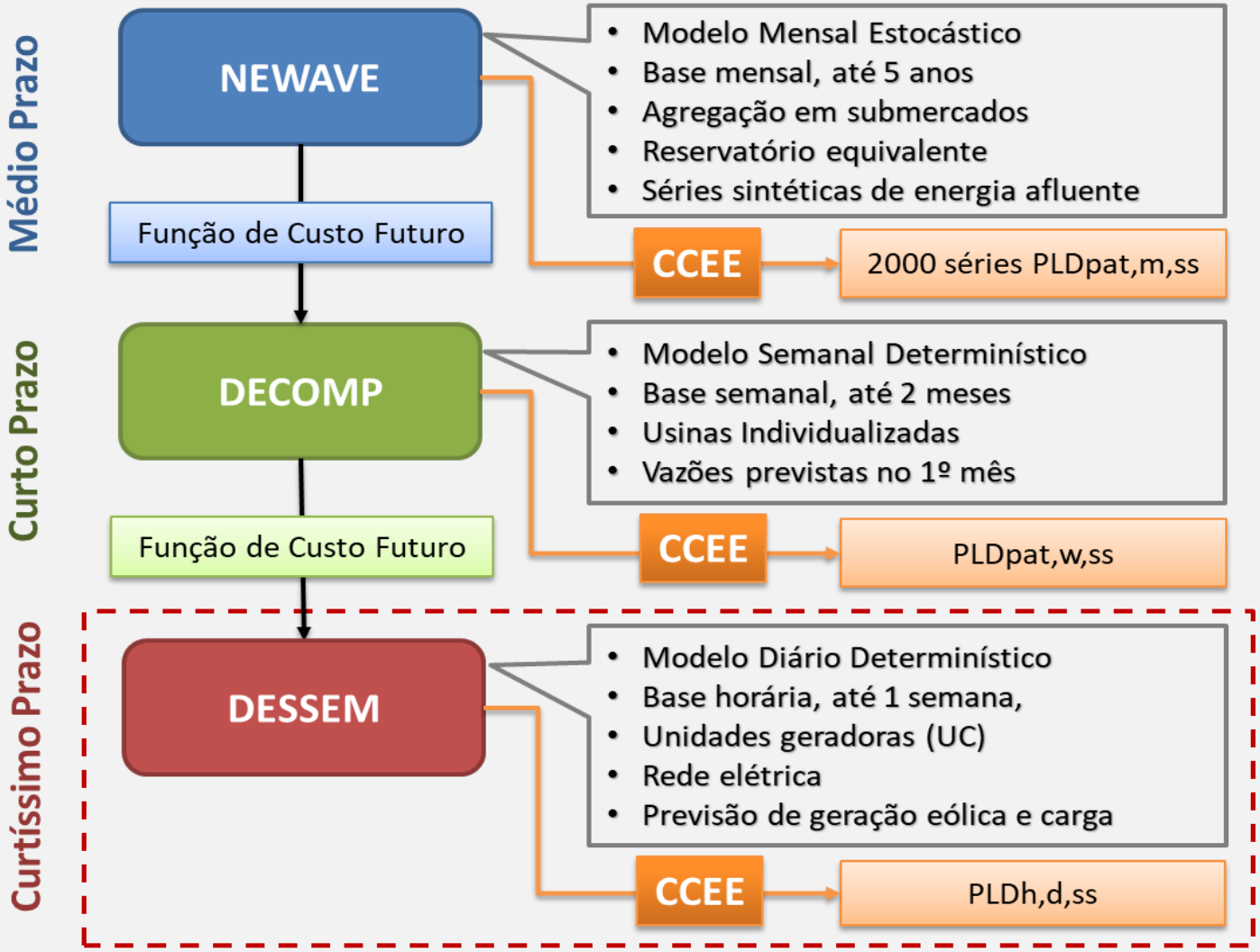
Schedule

Operation Planning and Scheduling Models



At each stage of planning, a specific optimization model is used, with characteristics more in line with the objective of the horizon in wich it operates

New hourly model adopted for PLD formation as of Jan/21

Desenvolvida pelo Centro de Pesquisas Eletroenergéticas CEPEL - https://www.cepel.br/

Operation Planning and Scheduling Models

Médio Prazo

Curto Prazo

Curtíssimo Prazo

NEWAVE

- Modelo Mensal Estocástico
- Base mensal, até 5 anos
- Agregação em submercados
- Reservatório equivalente
- Séries sintéticas de energia afluente

Função de Custo Futuro

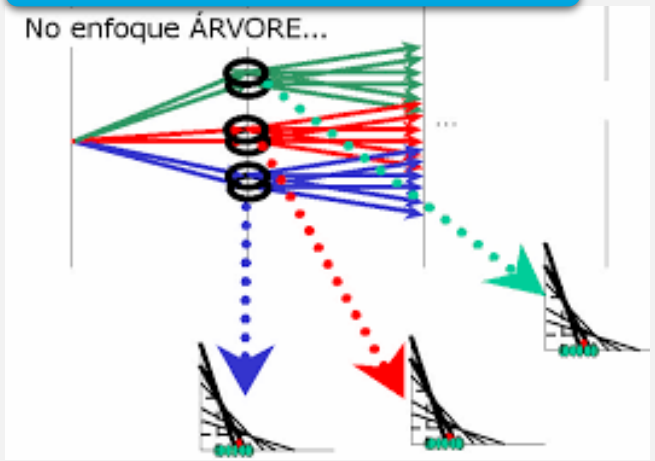
CCEE → 2000 séries PLDpat,m,ss

DECOMP

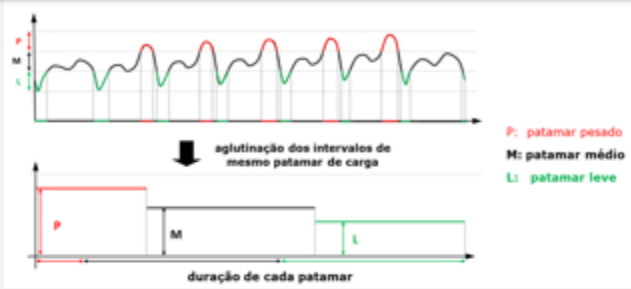
Função de Custo Futuro

DESSEM

2000 Cenários de Vazão



Agregação temporal em patamares



Agregação espacial

Short-term models

Médio Prazo

Curto Prazo

Curtíssimo Prazo

NEWAVE

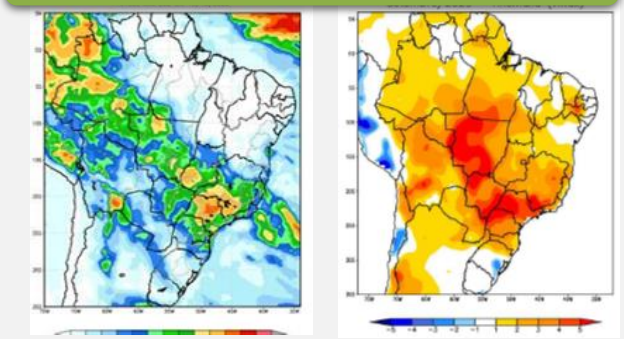
Função de Custo Futuro

DECOMP

Função de Custo Futuro

DESSEM

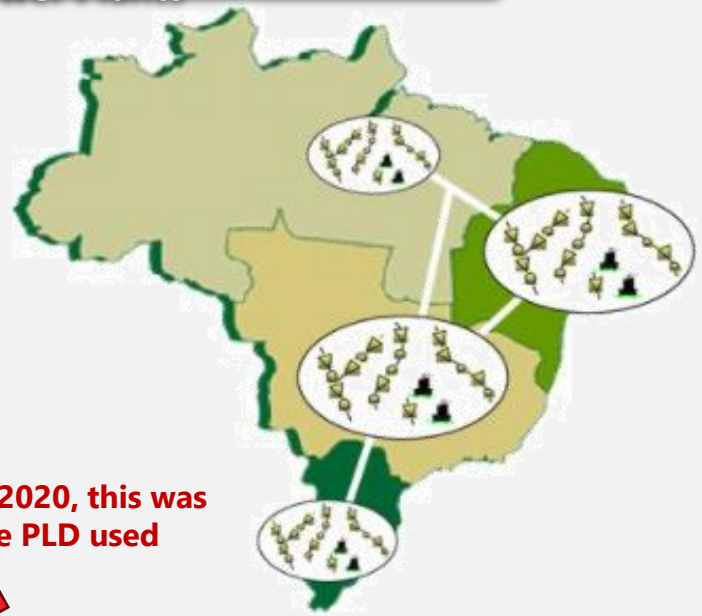
Load and Flow Forecasting*



- Modelo Semanal Determinístico
- Base semanal, até 2 meses
- Usinas Individualizadas
- Vazões previstas no 1º mês

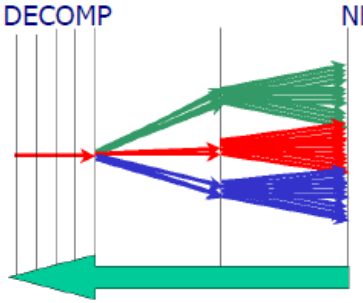
CCEE → PLDpat,w,ss

Individualized Hydroelectric Power Plants



Until 2020, this was the PLD used

1st month deterministic, 2nd month by scenarios, then coupled to Newave



* Estudos para a inclusão de previsão de geração eólica estão adiantados. Mudança exige ajuste regulatório, que já foi publicado e estará vigente a partir de junho/24

Very Short-Term Models

Médio Prazo

NEWAVE

Função de Custo Futuro

Curto Prazo

DECOMP

Função de Custo Futuro

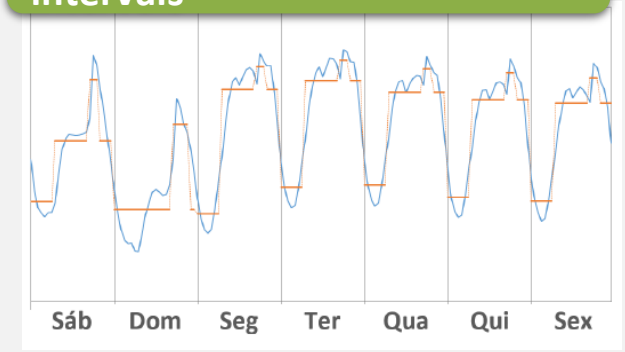
Curtíssimo Prazo

DESSEM

- Modelo Diário Determinístico
- Base horária, até 1 semana,
- Unidades geradoras (UC)
- Rede elétrica
- Previsão de geração eólica e carga

CCEE → PLDh,d,ss

Time representation in 30 min intervals



Forecasting models for load, flow, wind and solar generation+

Detailed system, including electrical network*

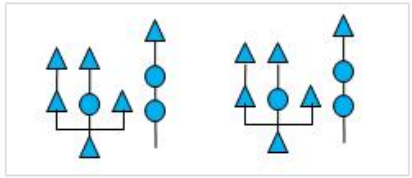
As the optimization model takes into account wide variations in intra-day supply and demand, a greater fluctuation in PLDs is to bem expected compared to the previous model

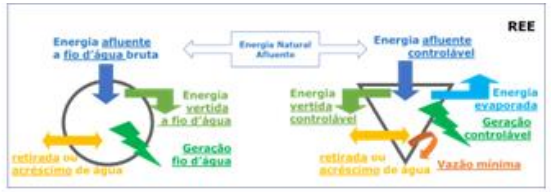
* Representation includes power bars from 138 kv upwards +Typical curve fitting by radiation indicces

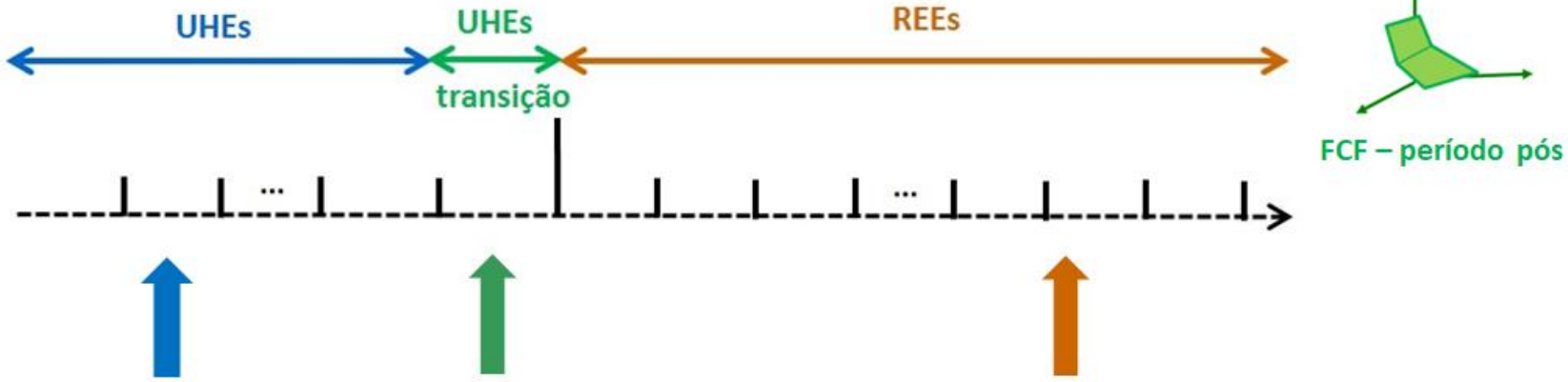
Model improvements

NEWAVE Hybrid or Individualized

- Modeling of individual hydroelectric plants in the first months of the study (proposal: 12 months)
- High computational time problems







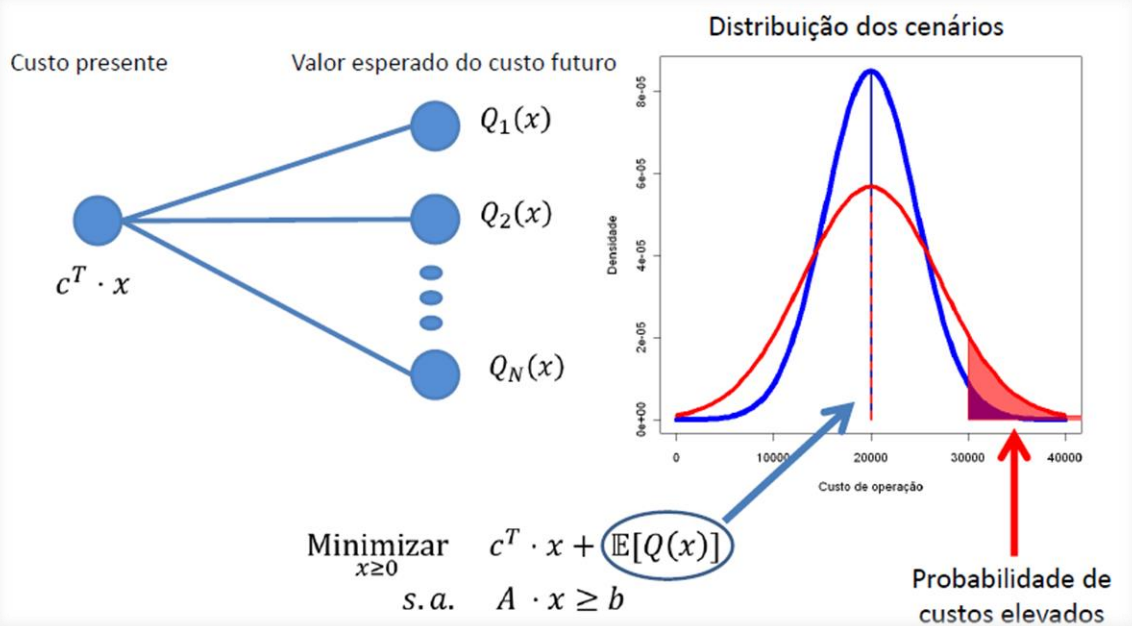
Source: https://www.cepel.br/

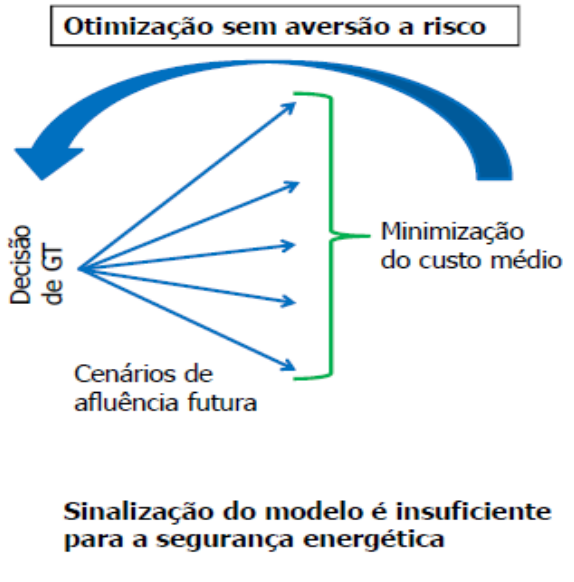
Improving Models

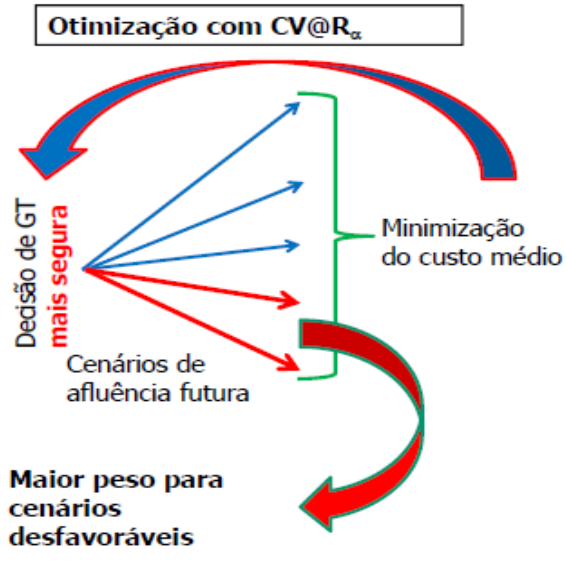
Conditioned Value at Risk (CVaR ou CV@R)

Methodology Applied to the future cost, which applies a weight λ to the a scenarios with the highest cost

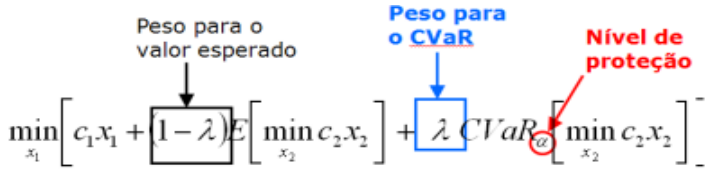
Currently the parameters used are (α, λ) = (25,35)







Todos os cenários tem o mesmo peso



Source: https://www.cepel.br/

Schedule

01 Energy Prices in Brazil and the PLD

02 Main Impact Factors

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04 Commercialization Environments and Market Perspectives

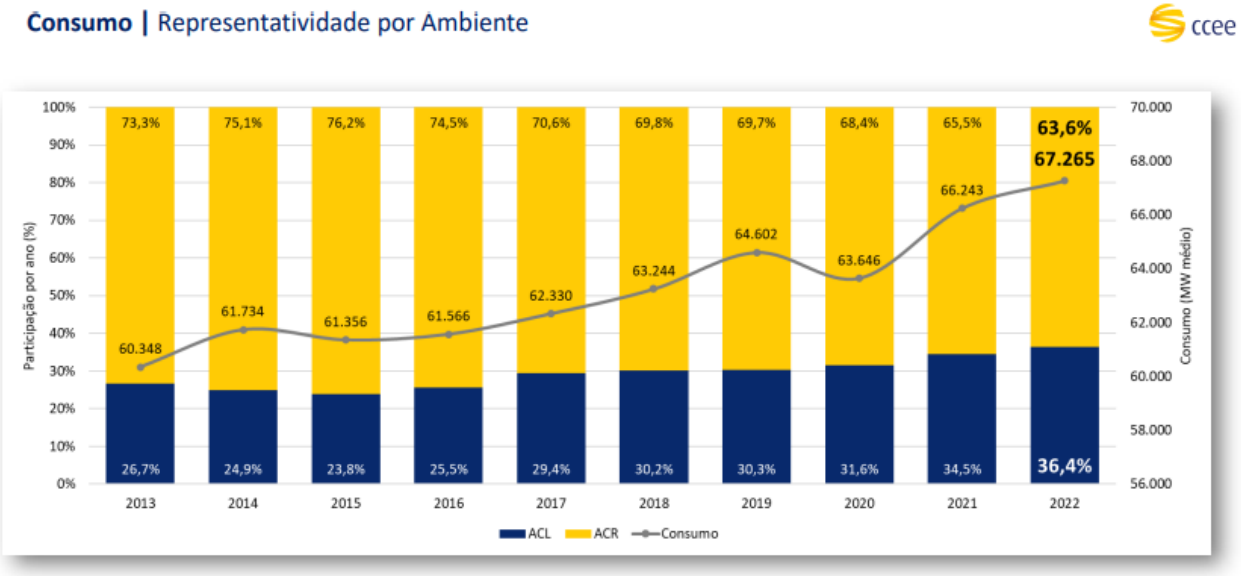
05 New Challenges

Trading Environments: Regulated and Free

ACR

Regulated environment: 63%

- Auctions, distributors, transmission companies, captive consumers, long term, major projects



ACL

Free environment: 37%

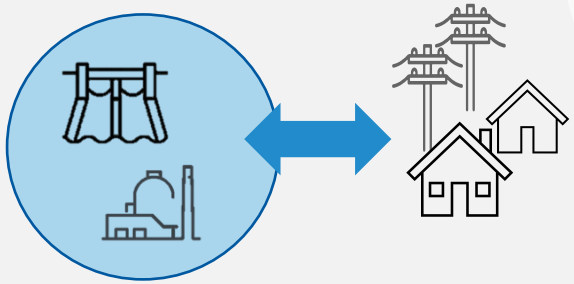
- Bilateral contracts, trader, free consumer, short and medium term, small/renewable projects

Source: CCEE Dados e Análises->Consumo

Expansion Planning

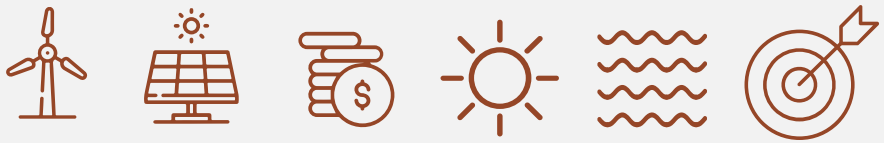
In 2004...

Regulated Environment



Generation / Transmission / Distribuition

Energy needs are defined by the distribu



...2024

Regulated Environment + **Free Environment**

New Energy
Existing Energy

Reserve Energy
Structuring projects
Capacity

New Energy
Existing Energy

Generators
Suppliers
Free Customers

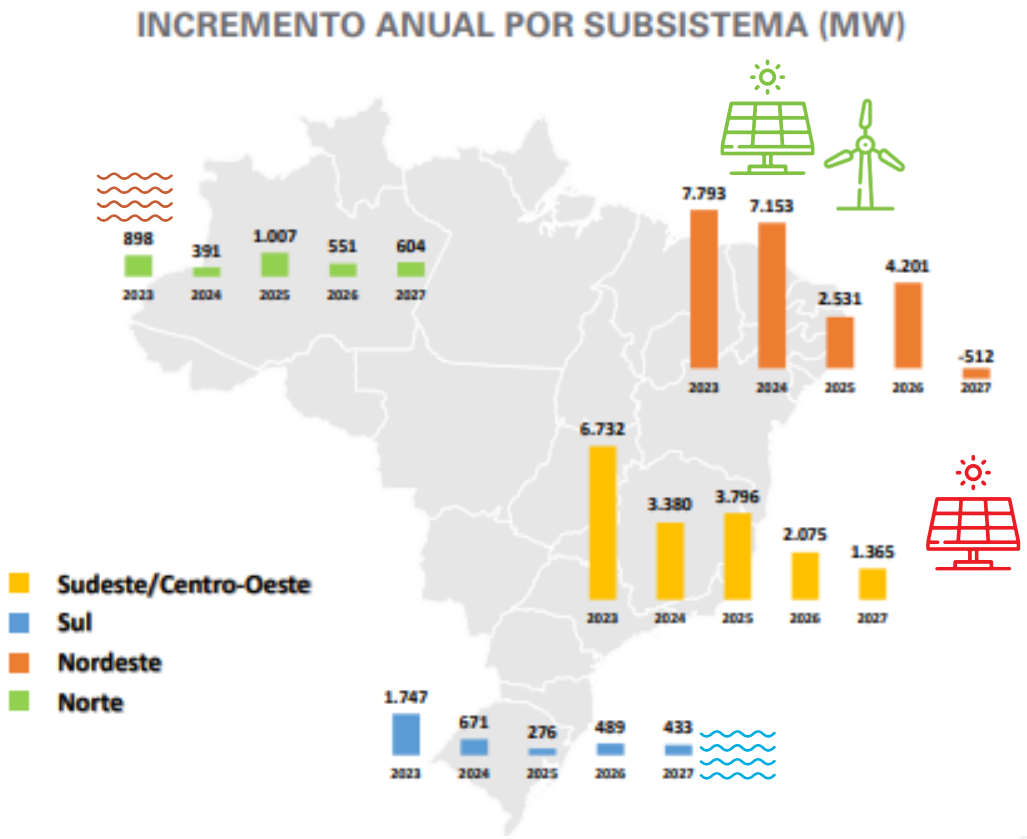
Generation
Transmission
Distribuition

The volume contracted is defined by market appetite!

Source: CCEE

Market Appetite

Accelerated growth of non-controllable renewable sources, mainly **through the free market***, with projects located mainly in the NE and SE/CO regions



Prospects for heavy investiment in expanding the transmission system to allow energy flow between regions and operational security

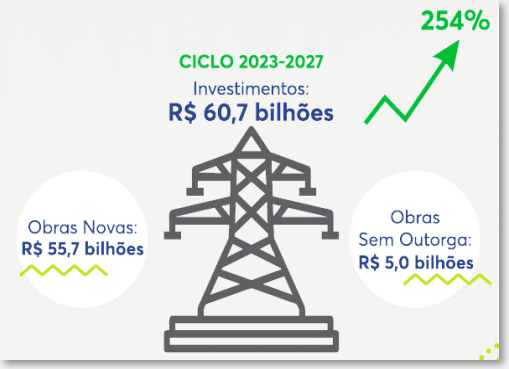
Tipo	2023	2024	2025	2026	2027
Hidráulica	101.167	101.167	101.217	101.217	101.217
Térmica[1]	26.281	26.296	26.915	27.545	26.337
PCH	7.286	7.396	7.598	7.774	7.889
MMGD	26.022	30.265	33.808	36.762	39.520
		32.608	36.218	39.039	42.260
Biomassa	15.504	16.347	16.630	16.693	16.713
Eólica	27.428	32.405	34.427	34.737	34.737
		35.630	37.030	38.180	38.180
Solar	10.754	15.747	18.627	20.224	20.424
		31.810	40.480	44.220	44.220
Total	**214.442**	229.623	239.842	244.952	246.837
		251.254	266.708	274.668	276.816

(*) Geração considerada no PAR/PEL 2023 que contempla CUST assinado.

(**) Previsão de MMGD informada pelas distribuidoras para o PAR/PEL 2023 (Maio/2023).

(***) EOL + UFV com parecer emitido ou em andamento: +19 MW em 2027

[1] Estão sendo desconsideradas as gerações das usinas termelétricas que não possuem Contrato de Compra de Energia no Ambiente Regulado (CCEAR) e excluídas as gerações a partir da data de término dos respectivos contratos

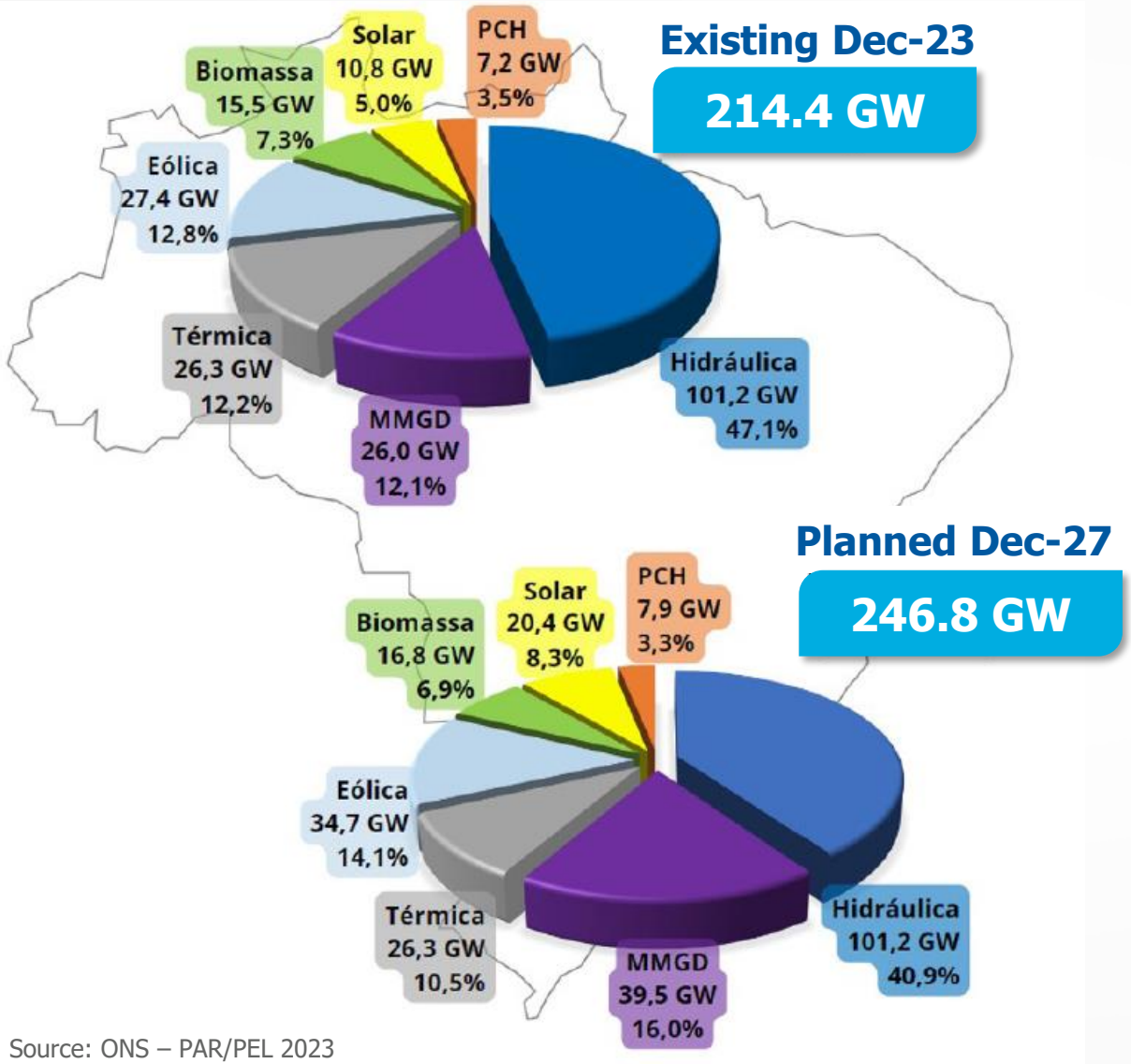


Potential to go from 38 GW to 82 GW in 5 Years (+216%)

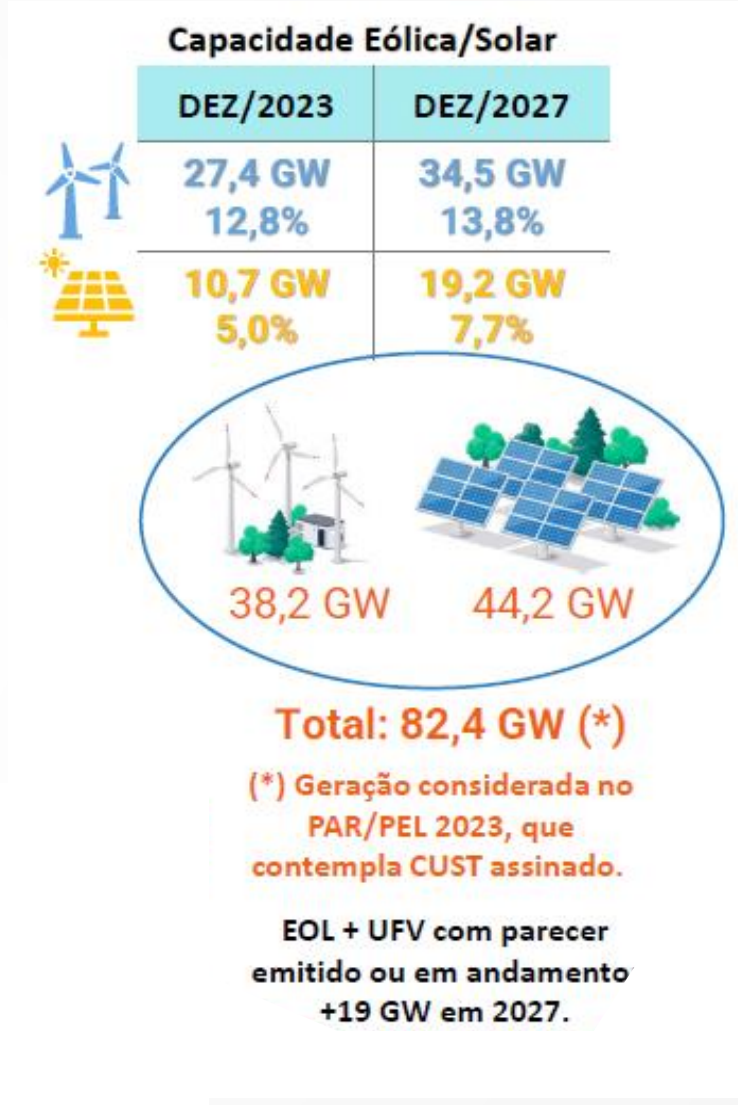
Source: ONS – PEN 2023 e PAR/PEL 2022

Brazilian Electrical Matrix

Installed Capacity Evolution (GW)[1]



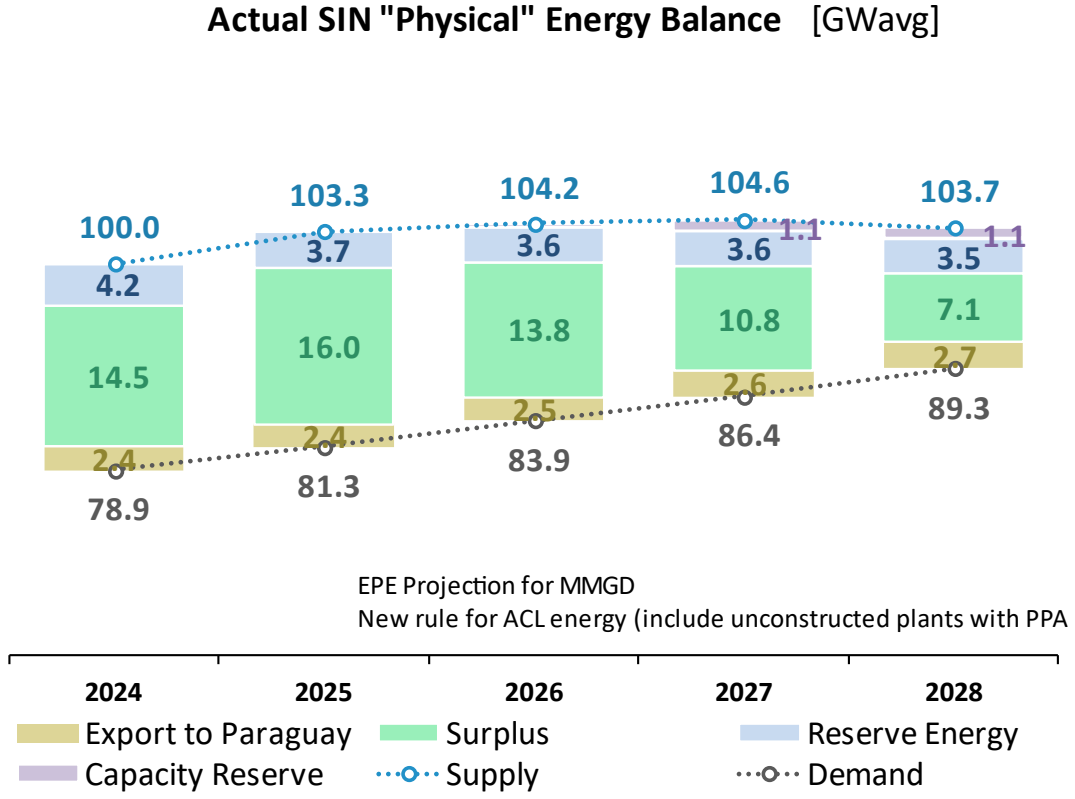
Source: ONS – PAR/PEL 2023

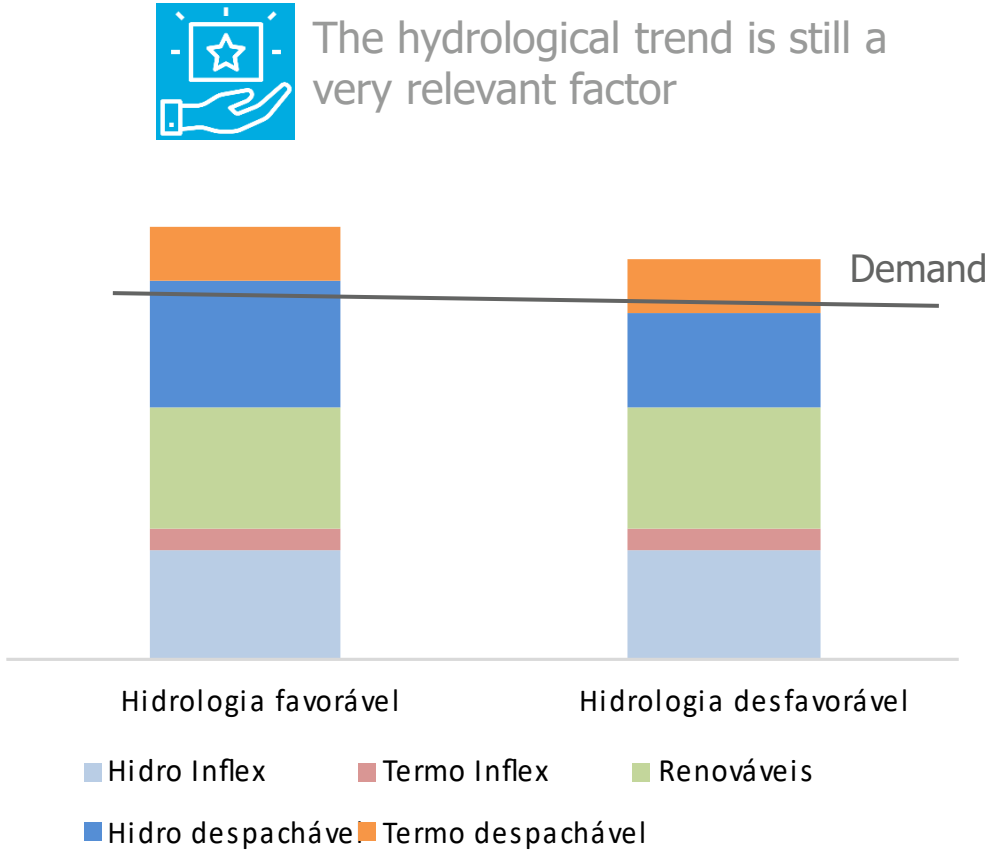


Medium Term Pricing

Balance between supply and demand

- For the medium term (up to 5 years ahead), much of the supply expansion has already been contracted, so prices tend to reflect the SIN's energy balance
- The first year is influenced by the unfavorable hydrological condition of the previous year
- From the second year onwards, the price level reflects the energy balance and the cost of sources





Source: CPFL production based on official data from ONS, CCEE and ANEEL for the PMO of May/24

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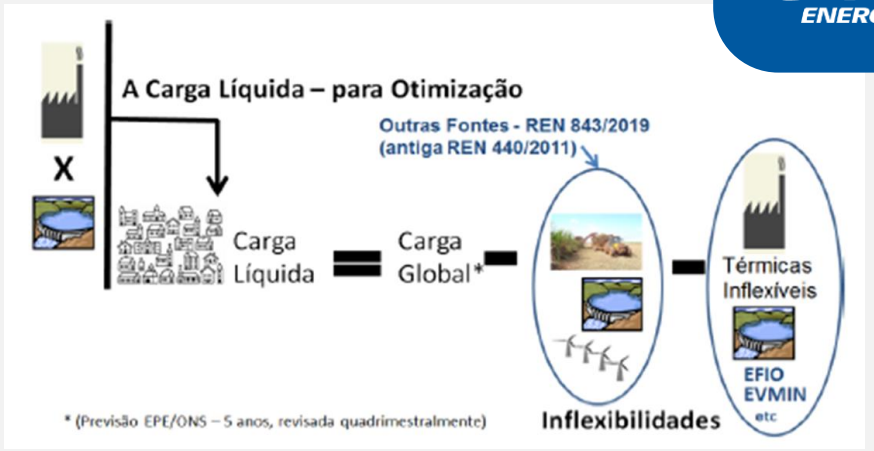
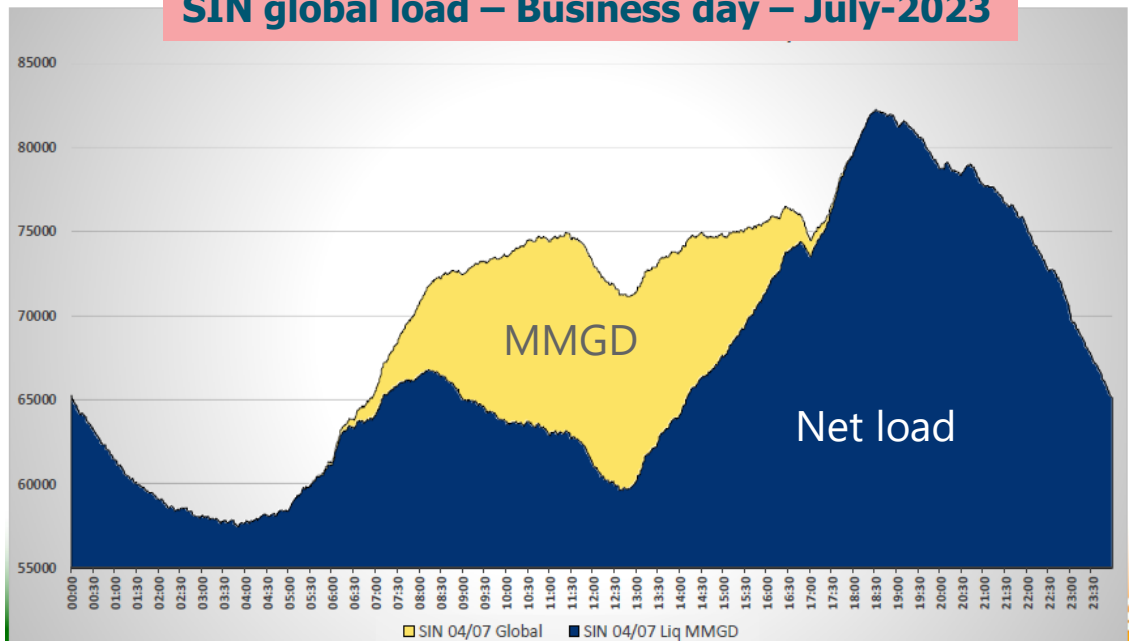
Impacts of Inserting Solar in the Matrix

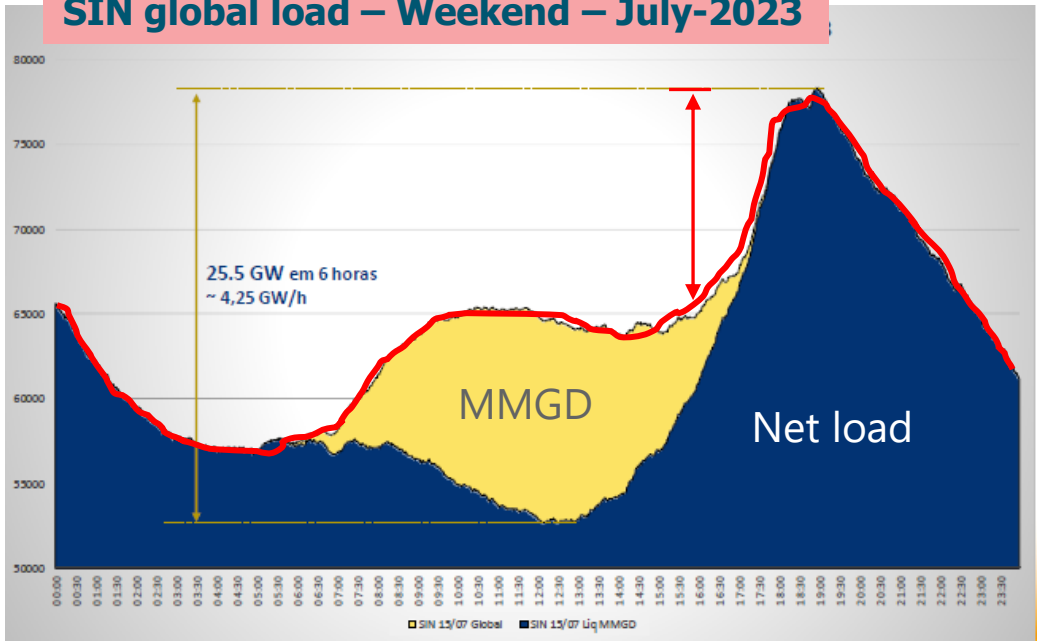
- Solar source has a well-defined profile (daytime)
- The net load of these resources must be met by other dispatchable sources and the intensity of this increase over time is the load ramp
- Hydraulics are the most used sources, but have ramp restrictions. Fast thermals can be triggered to complete
- The PLD follows the net load (cost of activated sources)



SIN global load – Business day – July-2023



SIN global load – Weekend – July-2023

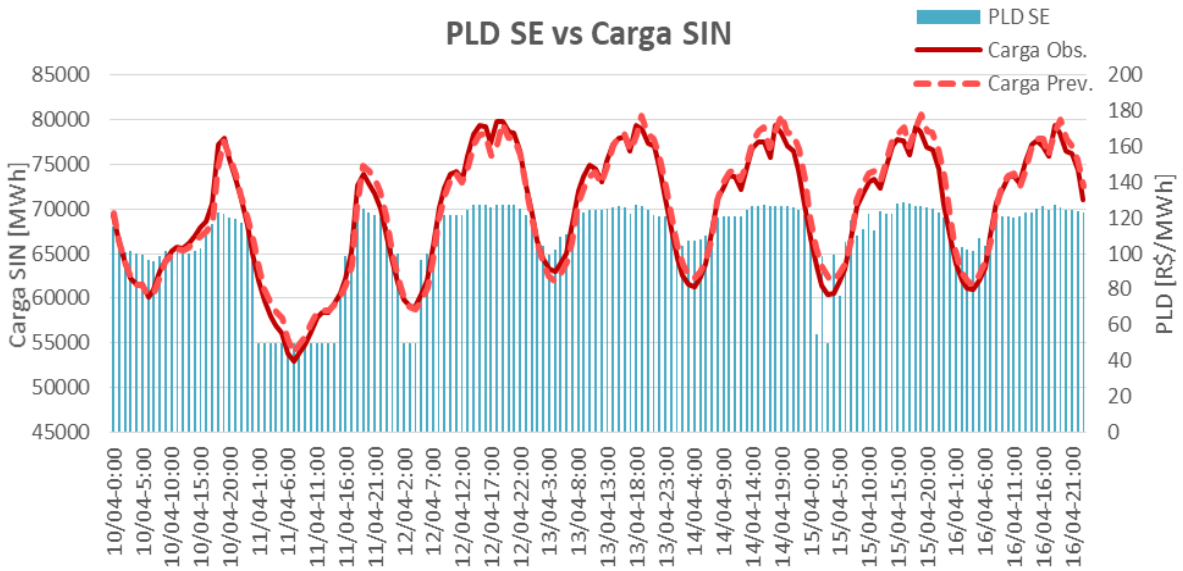


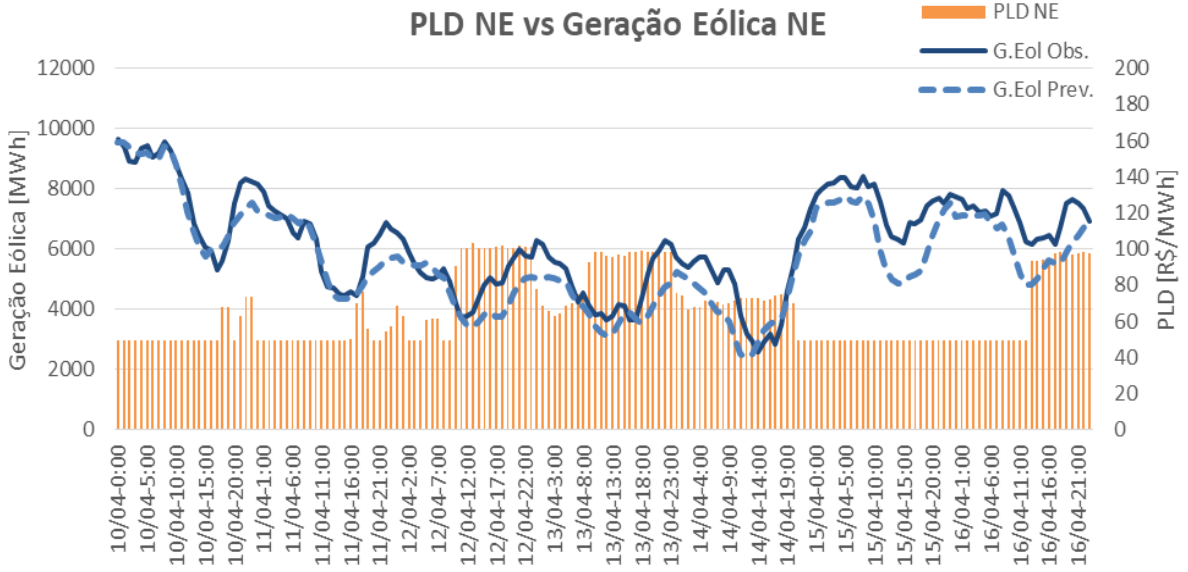
Source: ONS PEN 2023

Impacts of Wind Generation and Consumption Uncertainty

Hourly PLD

- Hourly prices respond quickly to variations in load, wind generation and hydrology, the values of which are predicted by forecast models.
- SE/CW is the submarket with the largest load (almost 60% of SIN) and has a diversified supply, mostly hydraulic: the PLD follows the load profile
- NE PLD has a high correlation with the wind generation profile (predicted) since this source accounts for most of the supply, considering the frequent hydraulic restrictions.

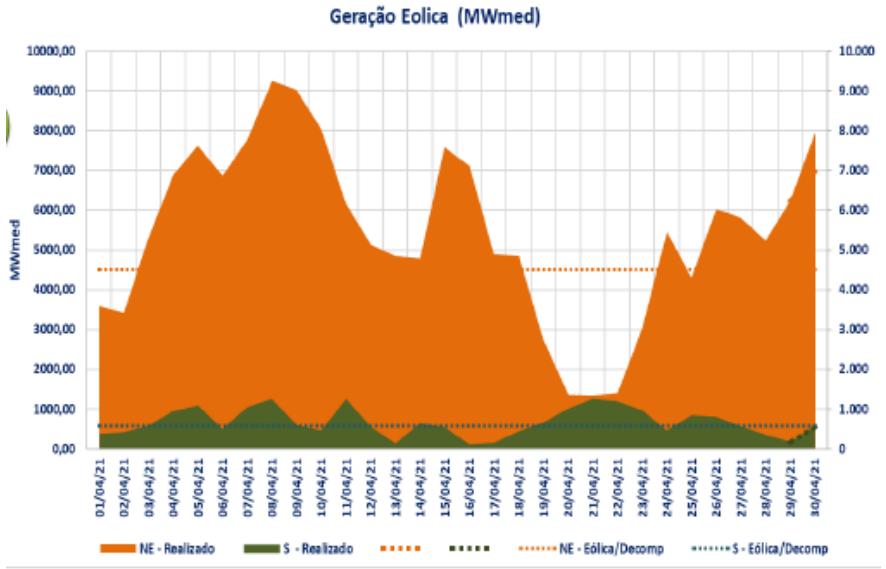




Impacts of Transmission Capacity

PLD differences between submarkets with new drivers

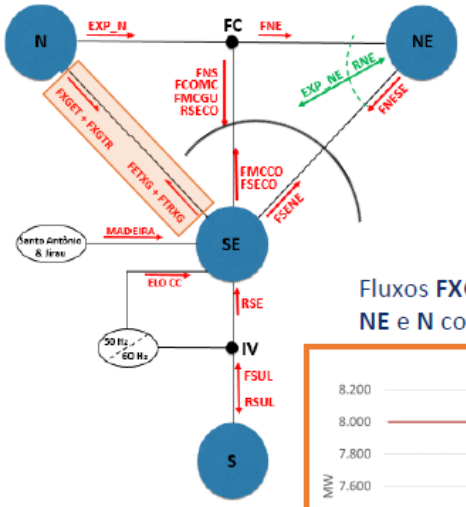
- Dynamic exchanges
- Influence of forecast models for load, flow and wind generation

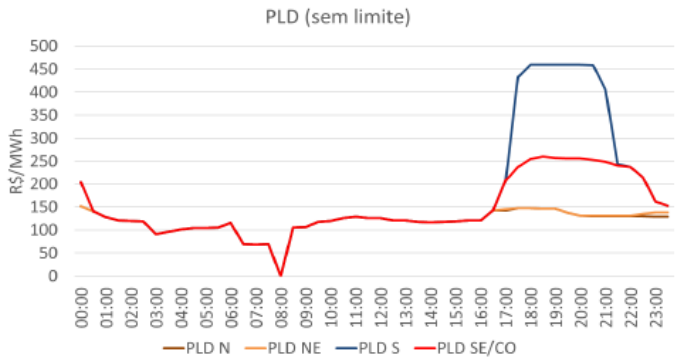


Análise do Preço Horário – 1ª Semana – Maio

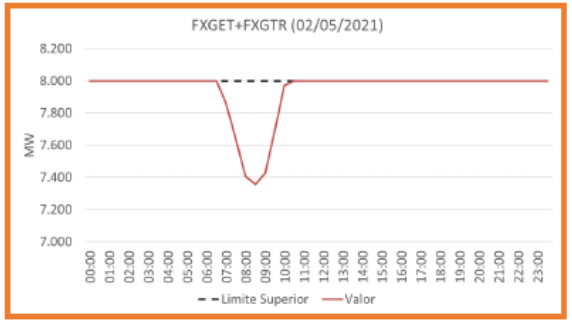
ccee

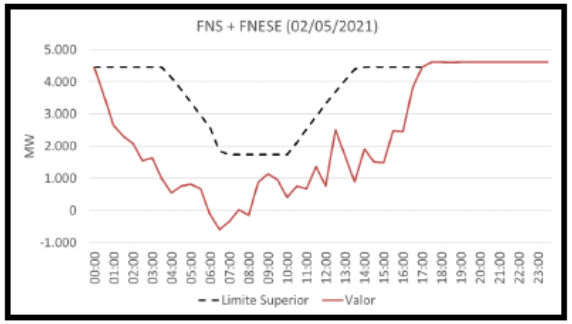
Diagrama de Intercâmbio (02/mai)





Fluxos **FXGET+FXGTR** e **FNS+FNESE** com limite atingido, causando o descolamento dos submercados **NE** e **N** com **SE/CO** e **S**

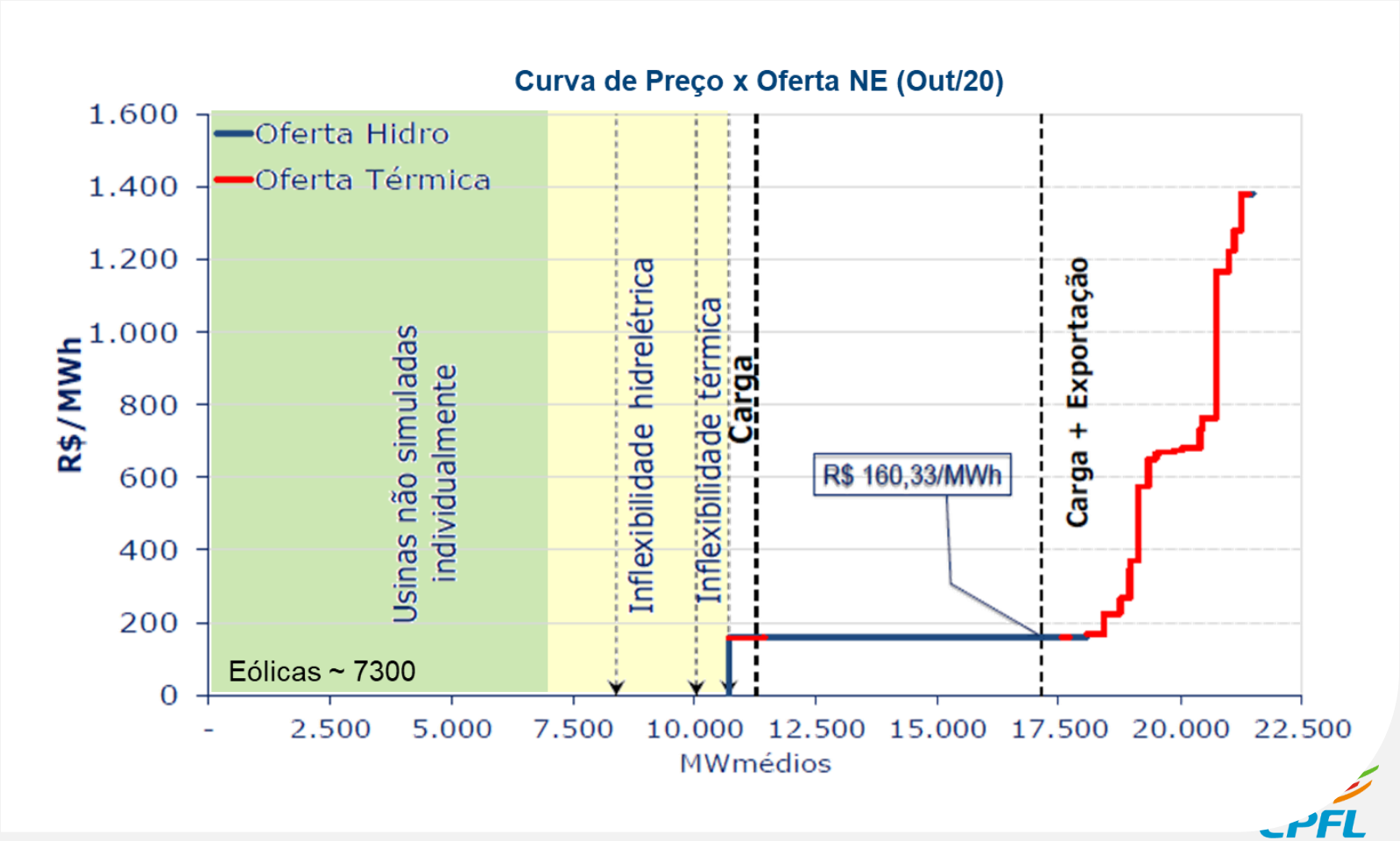




Formation of the Hourly Price

- To meet the load with economic criteria, generation sources with the lowest cost are prioritized and then other sources are added in **order of cost merit** (from lowest to highest)

- In planning and programming models, **renewable sources have zero cost** (hydraulic, wind, solar, biomass)
- The minimum thermal generation portion, which is given by the inflexibility declaration, is also **deducted from the load**
- The significant participation of renewable sources (wind and solar) makes the importance of refining the models and using forecasts for this generation source even more evident.



Charges

Costs shared by all consumers

- Charges are amounts intended to cover the costs of system services, including ancillary services, resulting from dispatched generation regardless of the order of merit

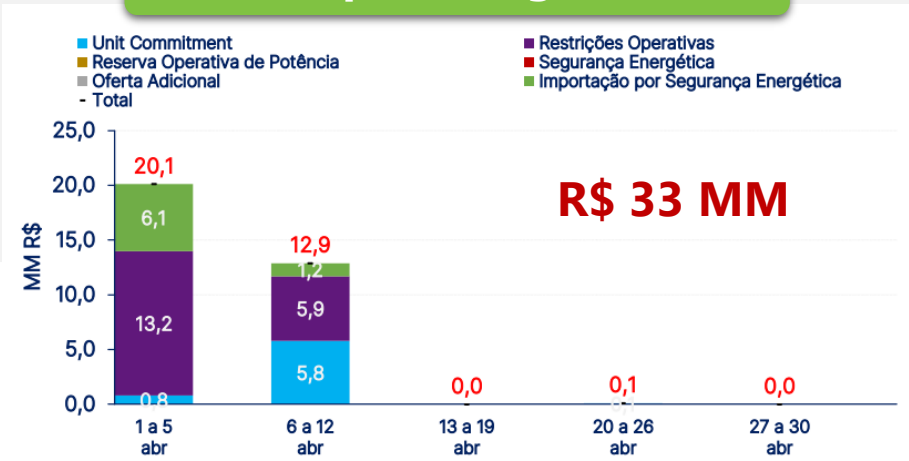
Operatives (great uncertainty)

- Energy Security (ESS)
- Operative restriction (Constrained-On/Off)
- Hydraulic displacement (Electric reasons/Electrical)
- Power Reserve
- Restriction by Unit Commitment

Contractors (medium uncertainty)

- Reserve energy (EER)
- Capacity reserve (ERCAP)

April Charges



R$ 33 MM

Import and other dispatches generate charges

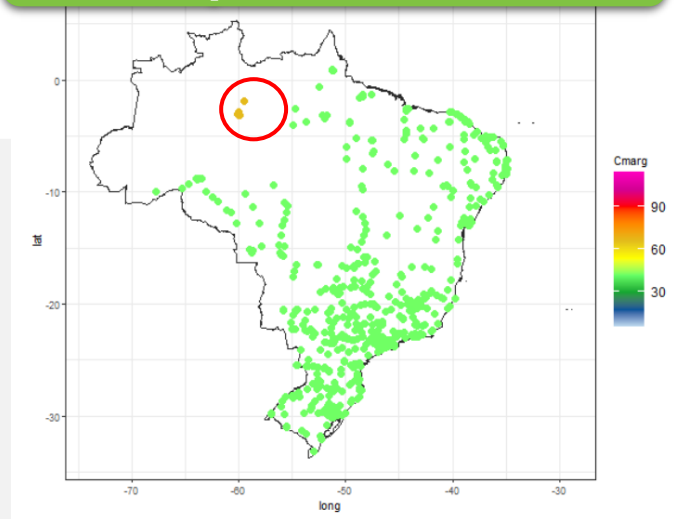
Geração Térmica (MWmed)

	SE/CO	S	NE	N	SIN
(UC) Unit commitment	37	0	6	22	65
Exportação	0	0	0	0	0
Recomposição de Reserva	0	0	0	0	0
Energia de Reposição	0	0	0	0	0
Razão Elétrica	319	1	98	0	418
Ordem de Mérito	0	0	0	132	132
Inflexibilidade	3.020	304	3	673	4.000
	0	0	0	0	0
	3.376	305	107	826	4.614

IMPORTAÇÃO CONVERSORAS

CONVERSORA	CAP.	TOTAL
RIVERA	70	0
MELO	500	116
GARABI I	1.100	700
GARABI II	1.100	267
TOTAL	2.770	1.083

High CMOs in the NW dispatch on merit



Trends and Challenges

Agenda of the Electric Sector Modernization

- ✓ Market opening drives consumer migration and investment towards the free environment
- ✓ Greater attention to energy and power guarantee criteria in planning
- ✓ Greater appreciation of ancillary services and environmental factors

Changes in planning and pricing models

Current

- ✓ Annual Model (Par_p-A)
- ✓ Representation of Micro and Mini distributed generation (MMGD)
- ✓ Representation of ACL Offer not started (with PPA)

Proposed

- ✓ Hybrid NEWAVE (12 months individualized)
- ✓ Increased Risk Aversion (CVaR)

- Current growth is driven by **cyclical** aspects (incentives)
- How many of the ACL grants are carried out?
- Transmission capacity is **structural**. How to size it?


Energia solar atinge 23,9 GW, passa eólica e se se torna 2ª maior fonte do Brasil, diz Absolar

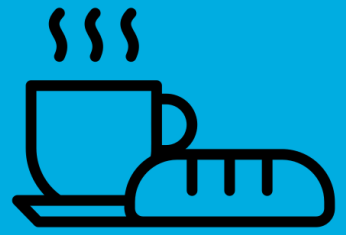
Crescimento é impulsionado por isenção que acaba na sexta (6) e tem estimulado a instalação de placas fotovoltaicas em telhados, empresas e terrenos

- Capacity auctions are part of structural planning. They are an important solution to strengthen the operation with renewables... Will they be effective? Will they be enough?

- Climate change changing scenarios?

- Will green hydrogen be Brazil's new favorite?

Coffee break!



Talk to IR

ri@cpfl.com.br

Your opinion gives us energy

Satisfaction Survey

Investor Education

Risks of the Commercialization

Satisfaction survey

Schedule

1. General concepts
2. Credit Risk Metrics
3. Market Risk Metrics

1. General Concepts

What you need to know

- ✓ What is credit risk
- ✓ How is evaluate the credit risk of market agents

What is credit risk

Credit Risk

Its the **possibility of financial loss** resulting from **non fulfillment of contractual obligations** by the counterparties involved in the energy trading.

(i) Non payiment or delayed payiment of Invoices, debt or renegotiation terms; and

(ii) Market credit risk.

To mitigate this risk, all Energy Commercialization process in the Free Market pass throw **Credit Analysis** stages, done by the Credit área in Corporate Finance Office (segregation of duties).

Main phases of Credit Analysis

	Objective	Way
Financial Analysis	Evaluate the Economic and Financial conditions	Through Counterparts income statement
Sectorial Analysis	Sector assessment and consultation of informations which indicates a market behaviour	Consult of sectorial basis and in credit reports (Serasa)
Risk Classification and Maximum Counterparty Limits	Definition of rating and Maximum individual exposure limits	Use of own and market methodologies market ones
Periodic Reviews and Risk Monitoring	Risk Classification revisions and Continuous Monitoring of Credit Portfolio Risk	Predefined recurrence in internal policy and statistical methodology for the risk exposure calculation

CPFL ENERGIA

Trading Markets Agents

Main Credit risks with the agents

Direct Credit Risk

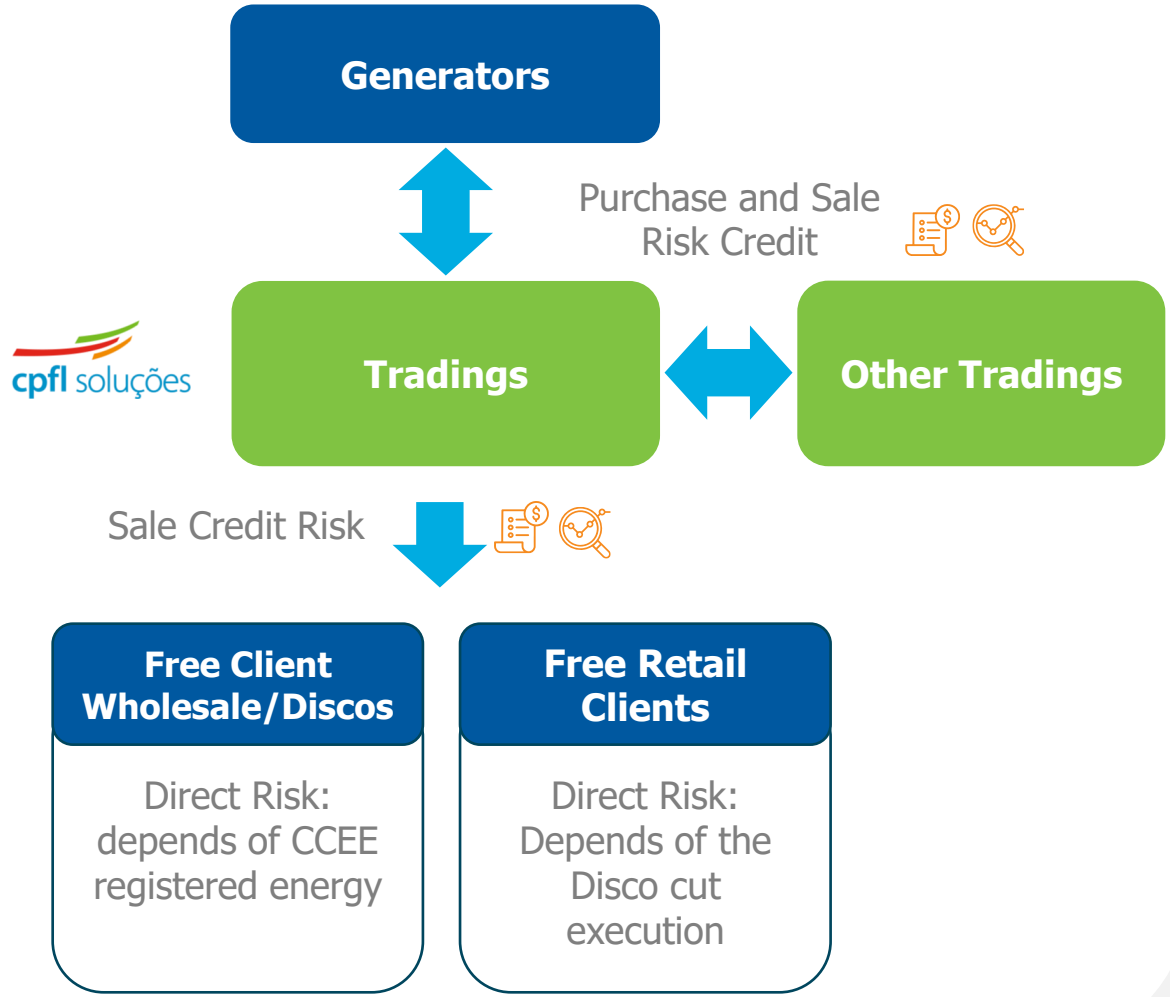
Possibility of (i) energy billed non payiment and; (ii) "drop" in the record purchased energy

- Billed Value (MWh x R$;MWh) and delivered energy
- + taxes (PIS/COFINS → trading/generator and PIS/COFINS+ICMS [if ST] → final consumer)

Market Credit Risk

Possibility of non payiment of price diferences in contracts

- Estimated loss in case of contract non fulfillment
- Sale: Risk increase if the prices decrease
- Purchase: Risk increase if the prices increase



2. Credit Risk Metrics

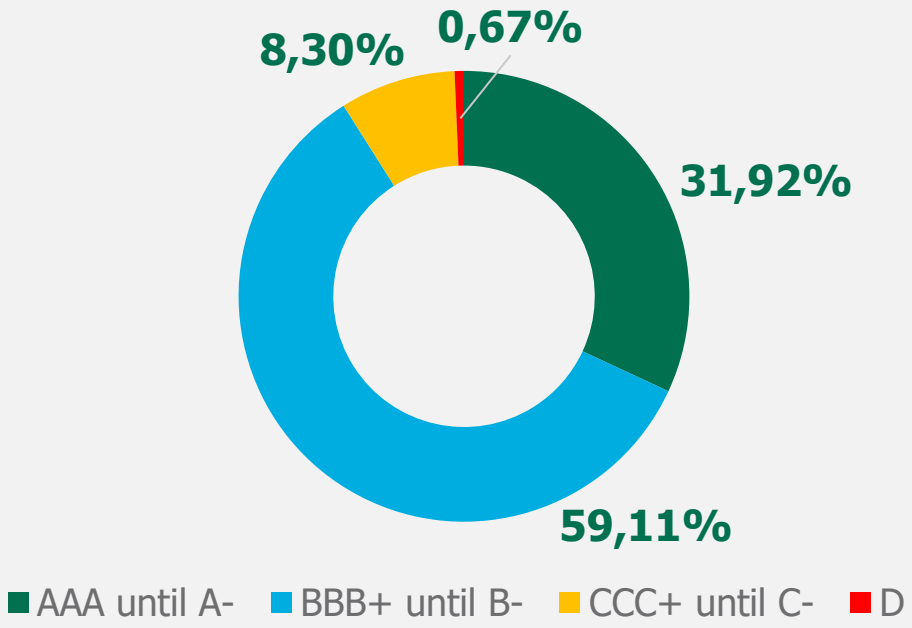
How is measured...

- ✓ Risk Distribution
- ✓ Risk Monitoring

Credit Risk Distribution and Monitoring | CPFL Soluções

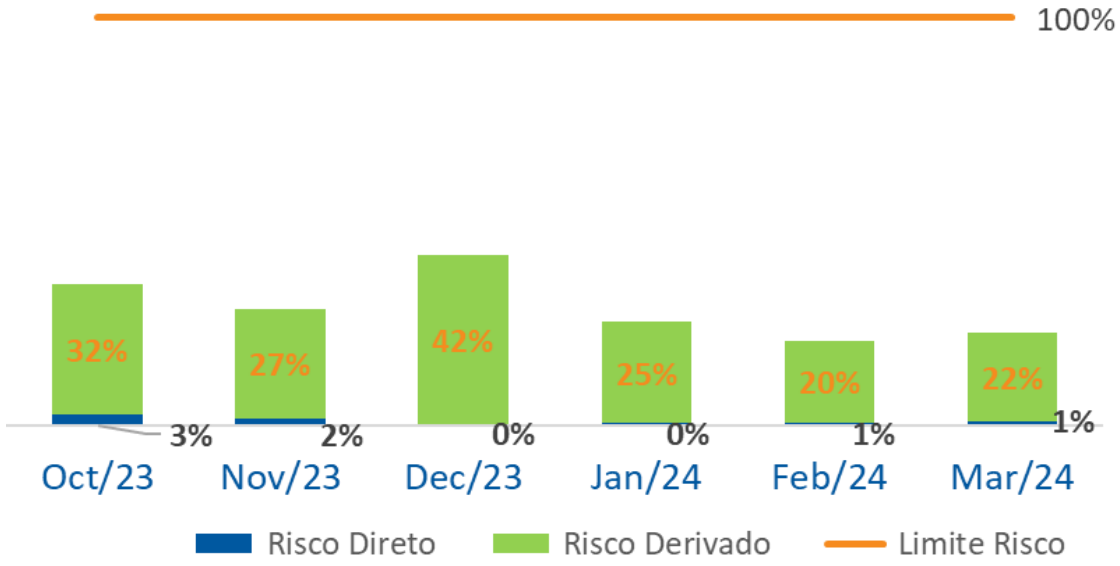
Rating by Billing

32% of portfolio is distribuited betwen counterparts ofRating AAA and A-



Credit Risk (6 months)

The credit risk estimated of the last overcame 6 months does not overcame 50% of the risk Maximum limit.



CCEE liquidation

Financial Liquidation

- Done on a Monthly basis by CCEE
- Involves the payiment or receipt of debts and credits calculated in the energy market the
- Done by a financial institution authoried by the Central Bank, hired by CCEE
- CCEE doesn't act as counterparty in the settlement, just makes possible the financial Compensation

2023 Annual Result

R$ 9.3 billion
Short Term Market

R$ 4,5 billion
Nuclear Energy

R$ 11,5 billion
Physical Garantee Quota

R$ 15,3 million
Existing Energy MSCSD

R$ 1,8 billion
New Energy MCSD

R$ 1,3 billion
Energy Surplus Sell

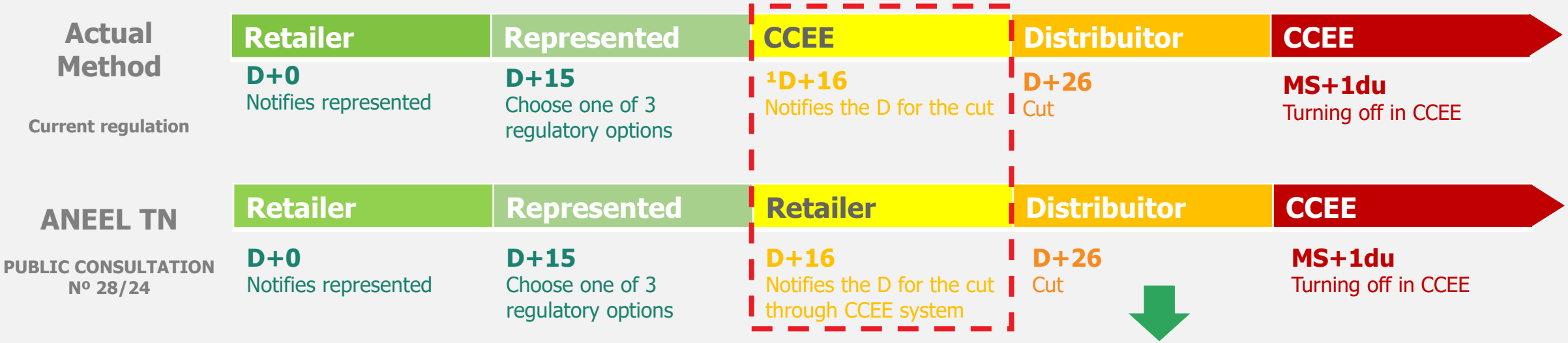
R$ 18,9 million
Penalties

R$ 11,9 billion
Reserve Energy

R$ 1,2 billion
Flag Quotas - Creditors

Retailer's client disconnection

Actual Method x ANEEL 28/2024 PC



Delay in Turning off by Distribuitors (>10d)

- Costs of the defauting representative **transfered to the D** after delay in cutting (without tariff pass-through)
- Non agente distribuitor will have costas transfered to the supplier D

Public Consultation open until 06/07/2024

[1]Actually there is no regulate term to the CCEE issue this notification, being possible to postpone the remaining stages schedule with losses to retailer.

Risk Distribution and Monitoring | CCEE

Financial Garantees

- CCEE defines the values that the agentes should deposit Monthly, calculate from its energy transactions
- Financial Garantees assure the stablish and security in operations in the energy market
- Allows that CCEE keeps the financial and operational balance of the electrical system

Delinquency

- Agents don't provision enough resources to pay its debt in the liquidation date, is characterized as delinquent

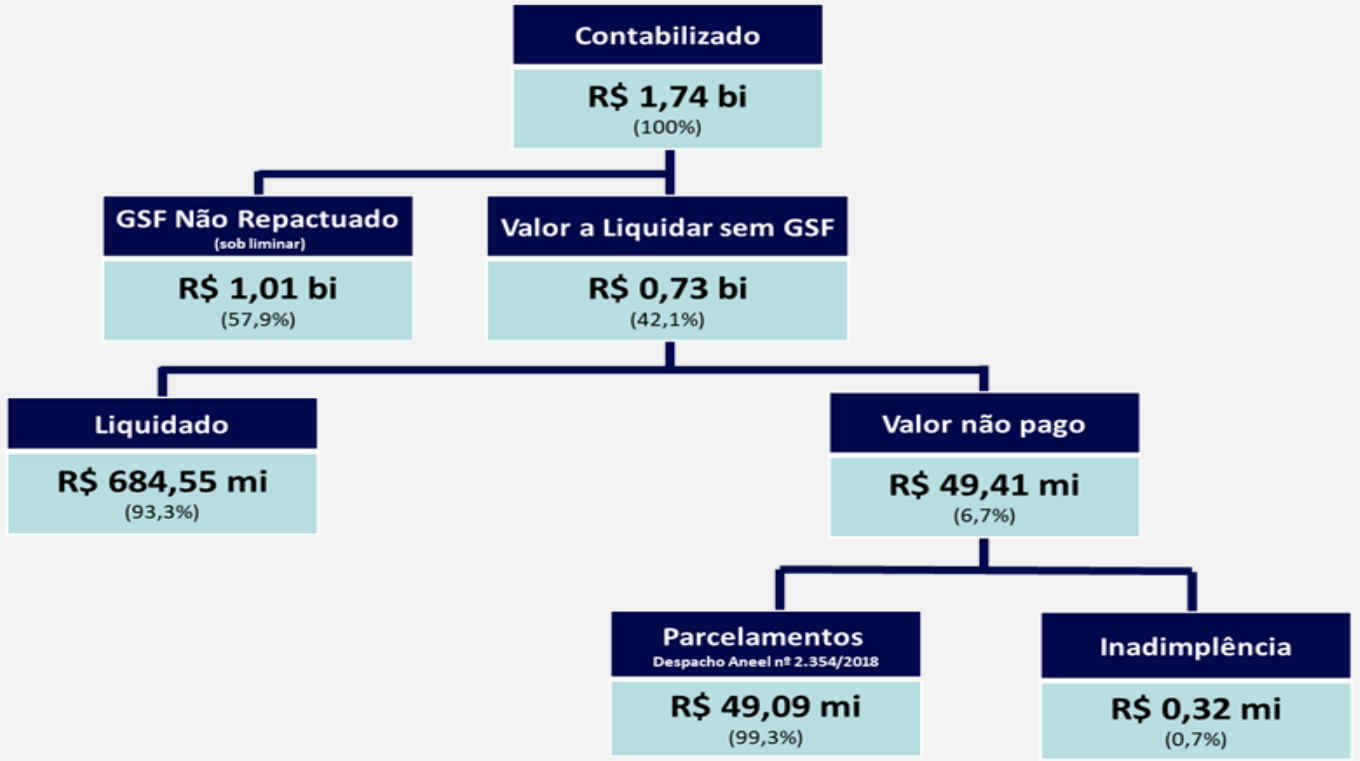
Consequences

- Unpaid value is distribuited among the creditors
- The delinquent agent is sbject to the incidence of moratory charges on the unpaid value, charged in the month following the settlement

Restraint Measures

- Implementation of Monitoring politiques and harder charges

Informations about financial liquidation[1]



Provisions of Garantees: From MS+12wd to MS+15wd

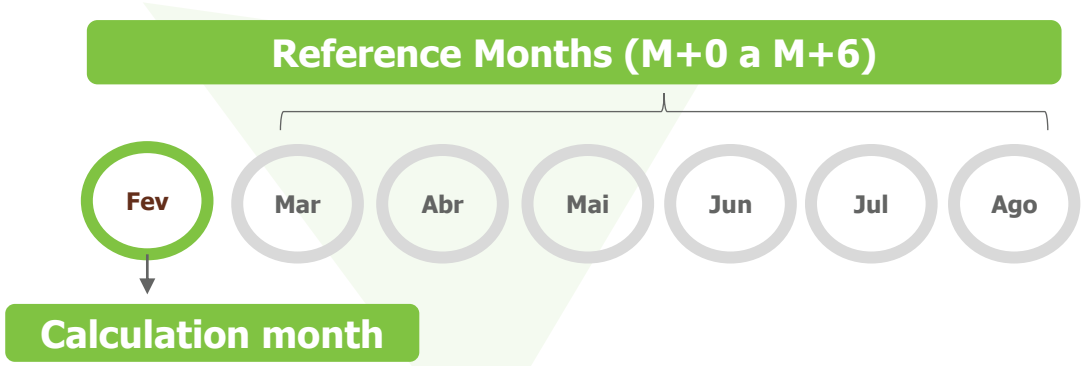
Financial Liquidation in STM: From MS+22wd to MS+29wd

1. Source: CCEE, update March/24

Monitoramento Prudencial | Período Sombra vigente

- CCEE is responsible for this process
- **The goal is to identify** companies and operations which show **risks to the market**
- **Participants Agents:**
  - ✓ Consumers
  - ✓ Tradings
  - ✓ Generators
- **Information Periodicity:**
  - ✓ Monthly for consumers
  - ✓ Weekly for tradings and generators
- **Shadow Period:**
  - ✓ Begining: November/2023
  - ✓ Ending forecast: November/2024
  - ✓ Monitoring Comitee: 1 representative for each class
- **After the shadow period:**
  - ✓ New public consultation for final rule

CCEE



CCEE metric

$$\textbf{FA\_RISCO} = \frac{RWA}{PLA}$$

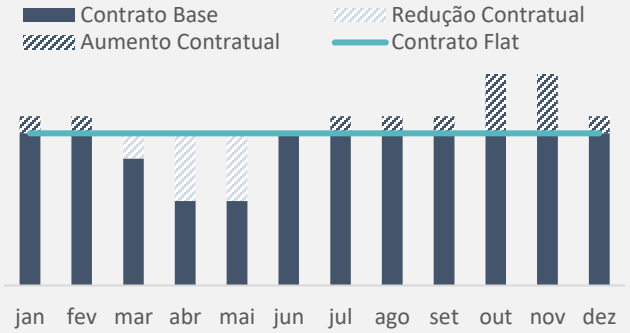
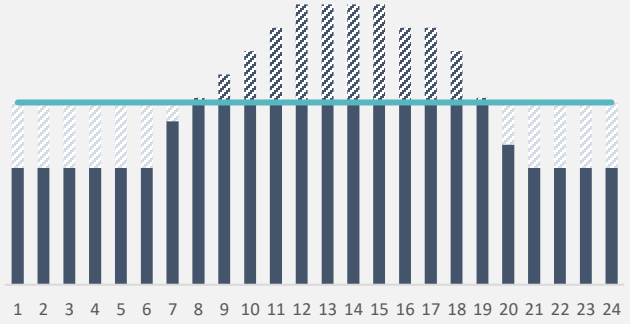
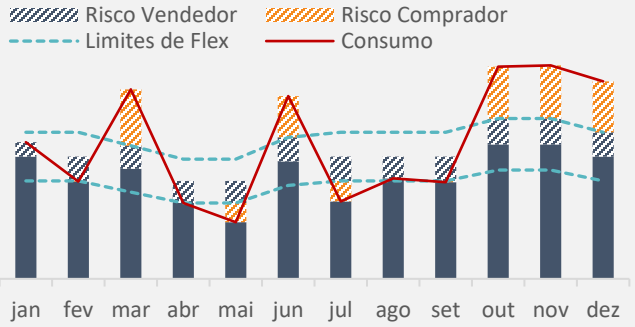
Where:

- FA_RISCK= Leverage Factor
- RWA = Agent risk
- PLA = Adjusted Net Worth

3. Market Risks

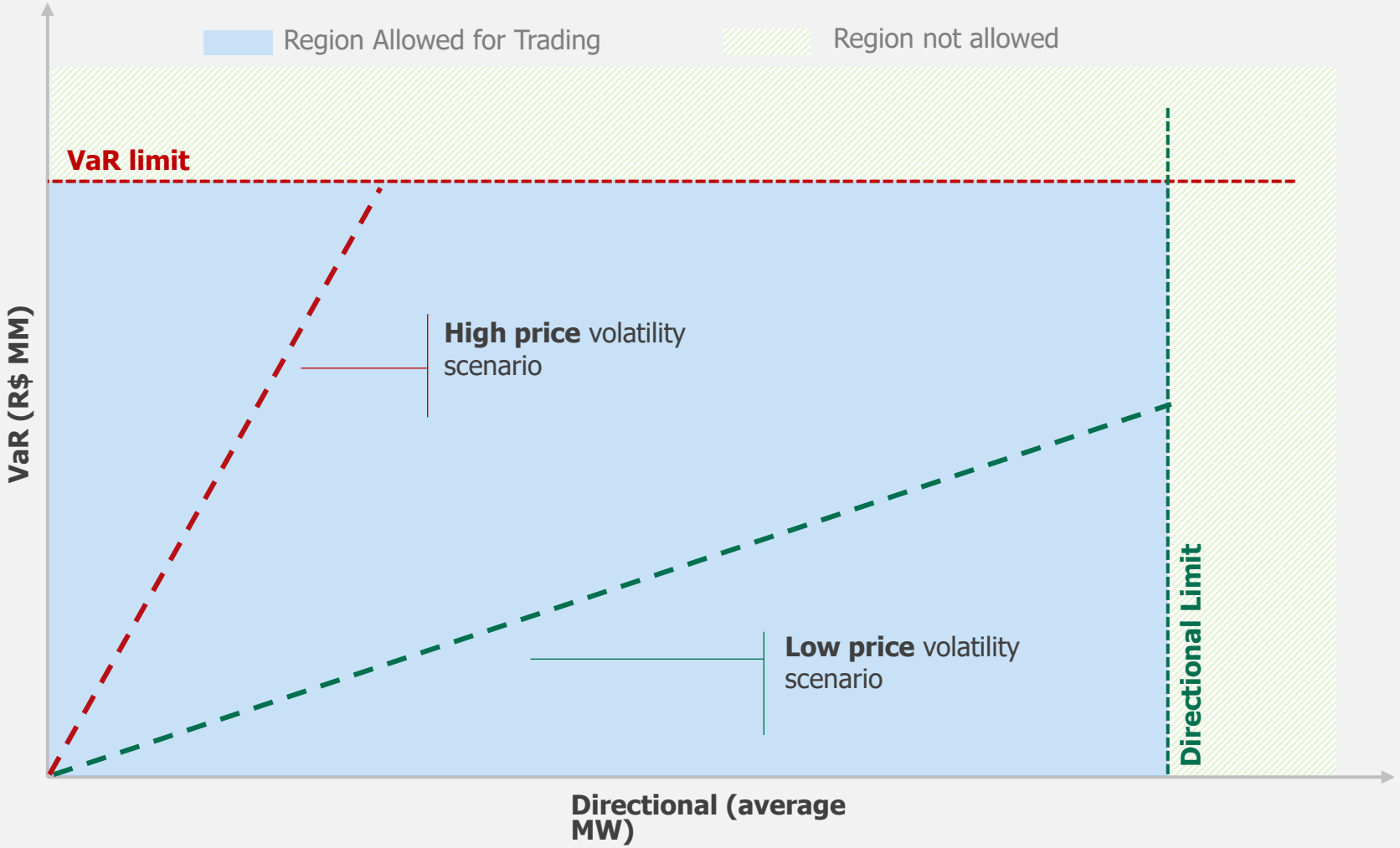
- ✓Market Risks
- ✓Energy Tariff Charges
- ✓ Evolution of Charges

Contractual parameters are negotiated to define the level of market risk to be assumed by each counterparty

Contractual Parameters	Details	Examples, in BRL/MWh	Impact
Seasonalization	• Distribution of the annual volume of energy contracted for the months of the year • Buyer can contract different seasonalization limits to protect Against variations in consumption • Ex-ante exercise (usually until November of the previous year		
Modulation	• Distribution of the Monthly volume of contracted energy over the hours of the month • In the FTA**, the Risk of Exposure to the Hourly PLD** by Modulation Type: • **Apartment**: Assumed by Consumer (Final Buyer) and Generator (InitiAl Seller) • **Consumption Profile**: Assumed by the Seller		**Δ Volum x (PContract – PLD)**
Flexibility	• Ability of the contract to **accommodate variations in the customer's energy consumption** • Limits are agreed in advance according to the customer's needs • Use of flexibility is assessed ex-post		

Market Risk Management in the portfolio is fundamental for sustainable operations in the Free Energy Market

Portfolio Market Risk Control Rationale

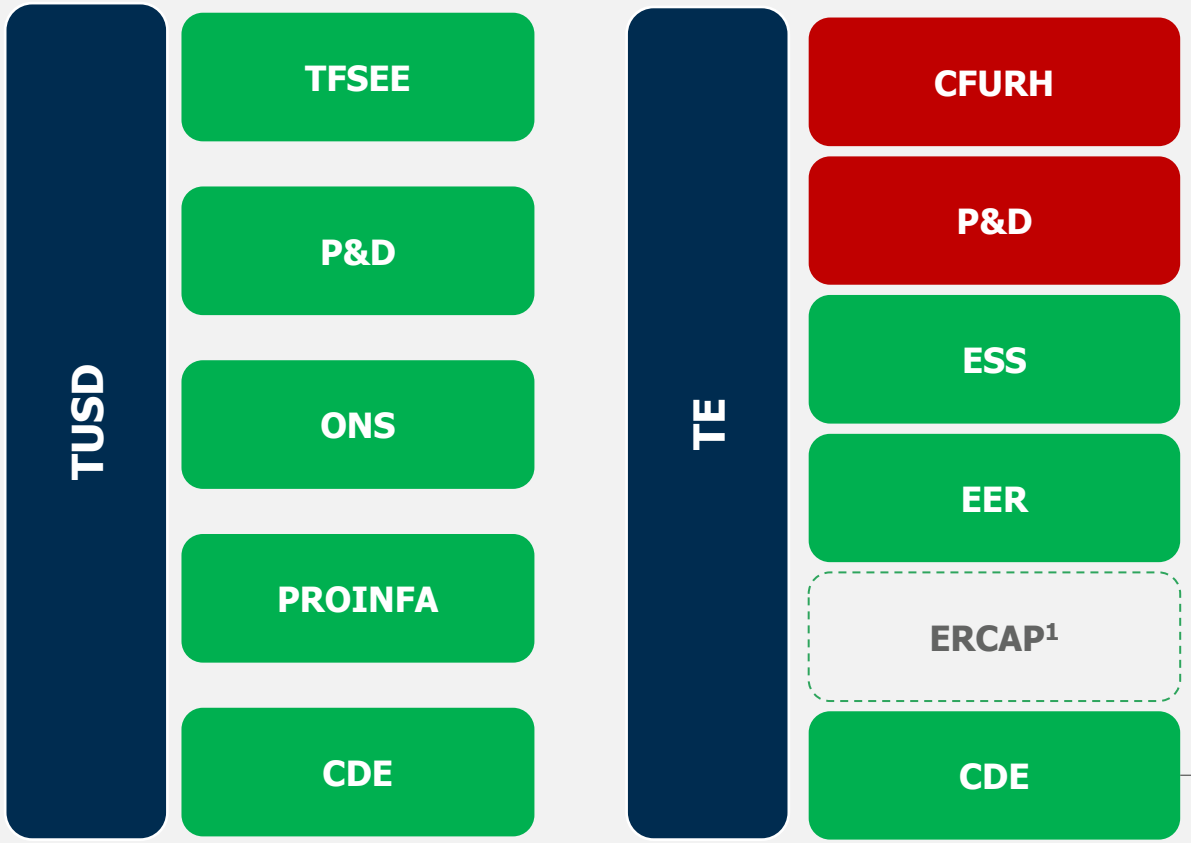


Highlights

- **VaR (Value at Risk):** estimates the maximum loss of a portfolio within a time horizon
- **Directional:** Net Portfolio Position
- **Market risk management** can involve controlling two main indicators by setting limits.
- When price volutility is low, the **directional limit** is used to keep risk under control.
- When price volatility is high, the **VaR limit** is activated to protect the portfolio from potentially large losses.

Energy Tariff Charges

Captive Market Tariff Structure | Vision of Charges



ESS, EER e ERCAP:

Self-represented Free Customers: payment via CCEE

Retail Free Customers: payment by the Retail Representative

- **Scarcity Account** — Migrations after 13/12/2021
- **Covid Account** — Migrations after 08/04/2020
- **GD**

Free Market Impact

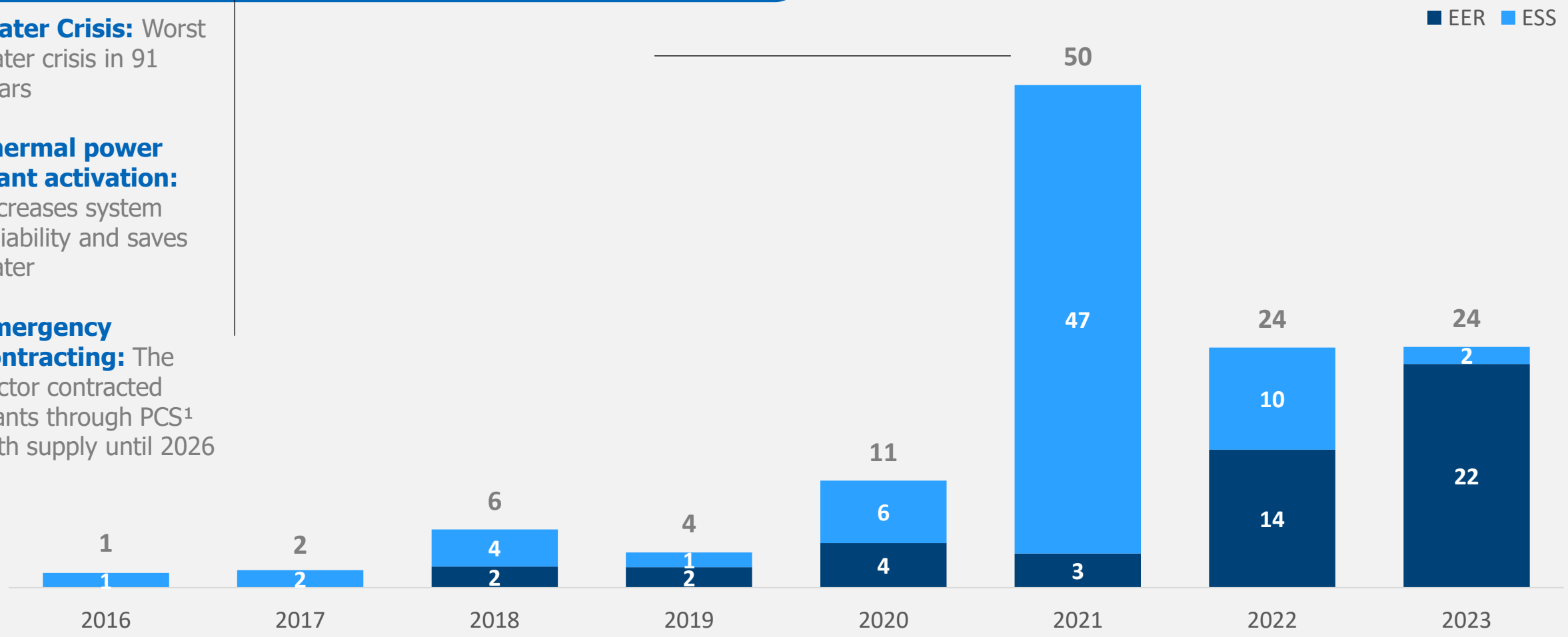
Yes No

1. ERCAP a partir de 2026

Evolution of Charges: Structural Increase in the Reserve Energy Charge Post-2021 due to Emergency Contracts to Cope with the Energy Crisis

Historical Charges, in R$/MWh

- **Water Crisis:** Worst water crisis in 91 years
- **Thermal power plant activation:** Increases system reliability and saves water
- **Emergency contracting:** The sector contracted plants through PCS[1] with supply until 2026



Sources: (1) Simplified Competitive Procedure

Q&A

Sua opinião nos dá energia

CPFL ENERGIA

cpfl soluções