IRENA INNOVATION WEEK 2025

Plenary:

Digitalisation for the Energy Transition

Organised in partnership with:

12 June 2025 | 10:00-12:00

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IRENA INNOVATION WEEK 2025

Keynote

Norela Constantinescu
Acting Director
IRENA Innovation and Technology Center

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Digitalisation of power systems is a catalyzer for innovative solutions

Digital solutions can unlock unprecedented efficiencies in power systems, maximizing the benefits of the energy transition for diverse stakeholders.

- Reduction of energy costs
- Higher penetration of renewables
- Better user comfort and control
- Enhanced security of supply
- Enhanced business efficiency

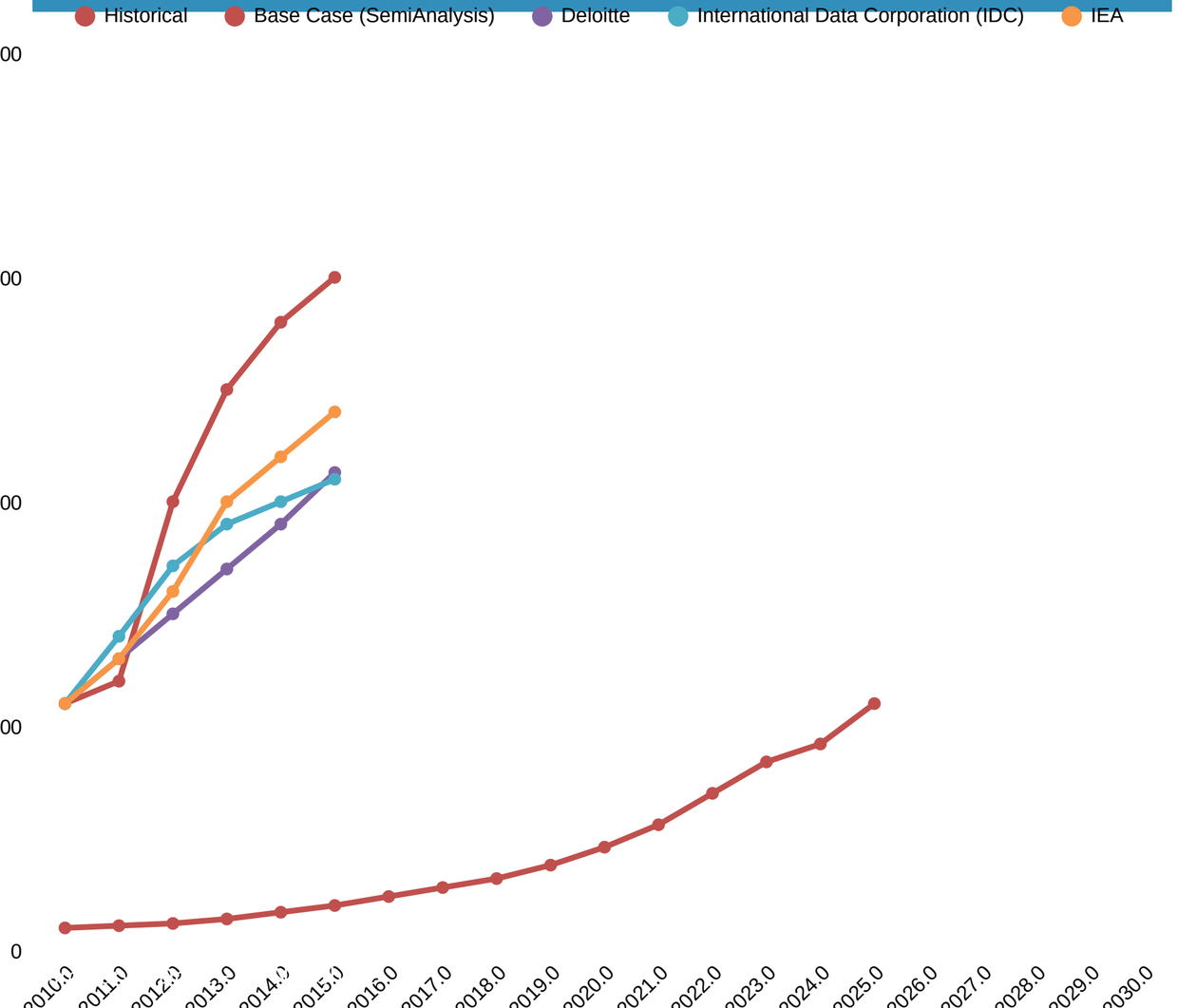
Digitalising power systems needs comprehensive risk management

To harness the opportunities of digital solutions in power systems, careful data and location management is needed to meet the challenges:

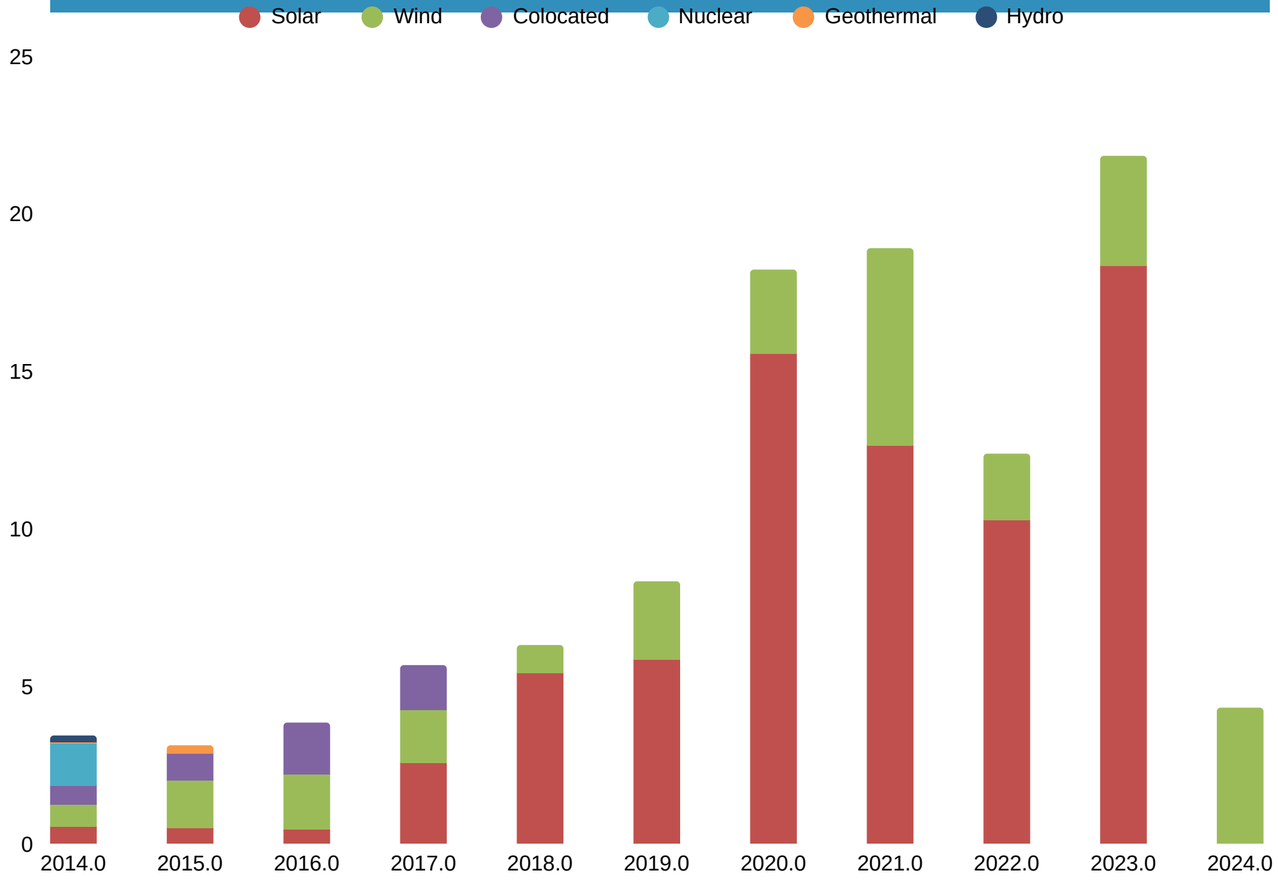
- Surging energy demand for digital technologies
- Increased cybersecurity vulnerabilities in critical infrastructure
- Robust data governance needs as prerequisite for safe and effective digital deployment
- Operational conflicts in legacy systems

Cheap renewables will become ever more important for sourcing AI

Range of scenarios of electricity demand for data centres globally (TWh)

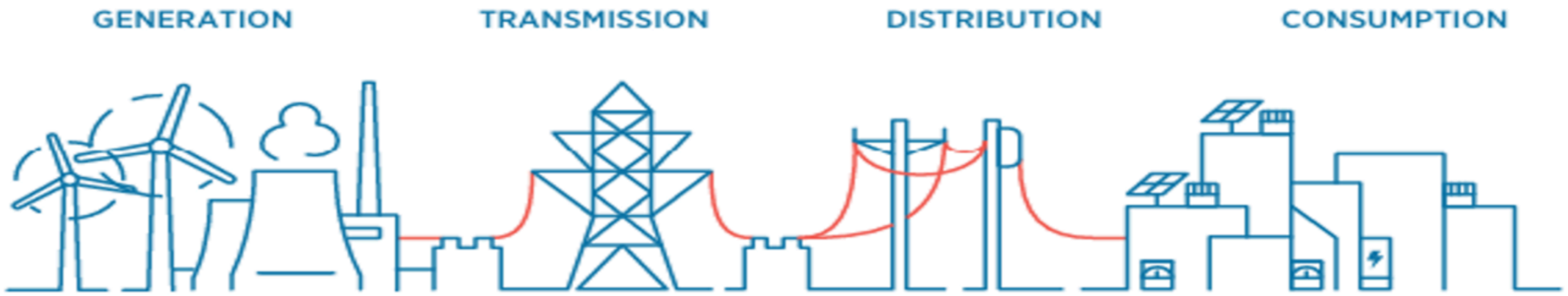


Yearly PPA capacities contracted by major data centre operators (GW)



Source: IRENA calculations based on Bloomberg BNEF data, 2025

IRENA's work of the last years on different digital enabling technologies and the approach to electricity/digital nexus



Use cases for smart energy systems

Demand and supply forecasting | Asset optimization | Grid management | Aggregation of distributed resources

Digital technologies

Artificial intelligence | Internet of things | Software applications | Digital twins | Other

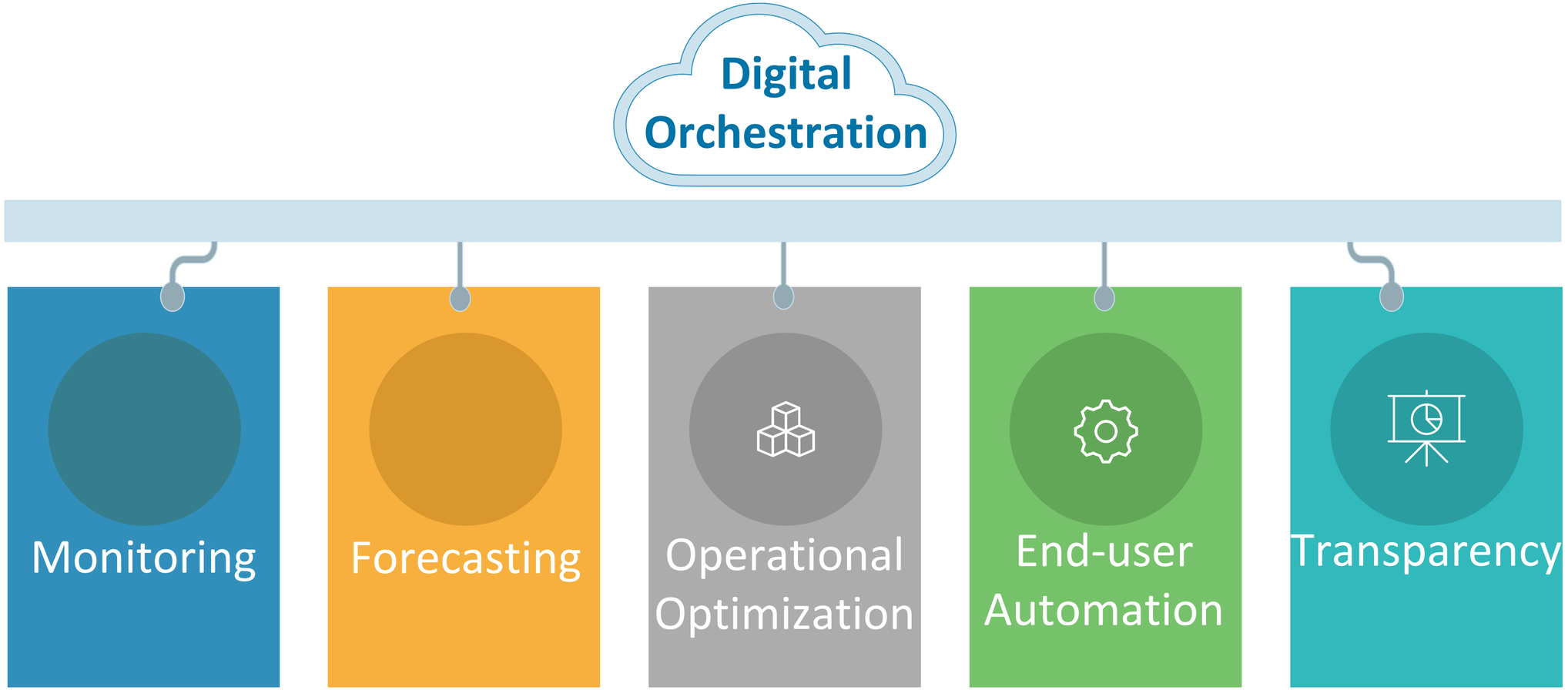
Data layers

Weather | Assets | Market operation | System Operation | Consumer

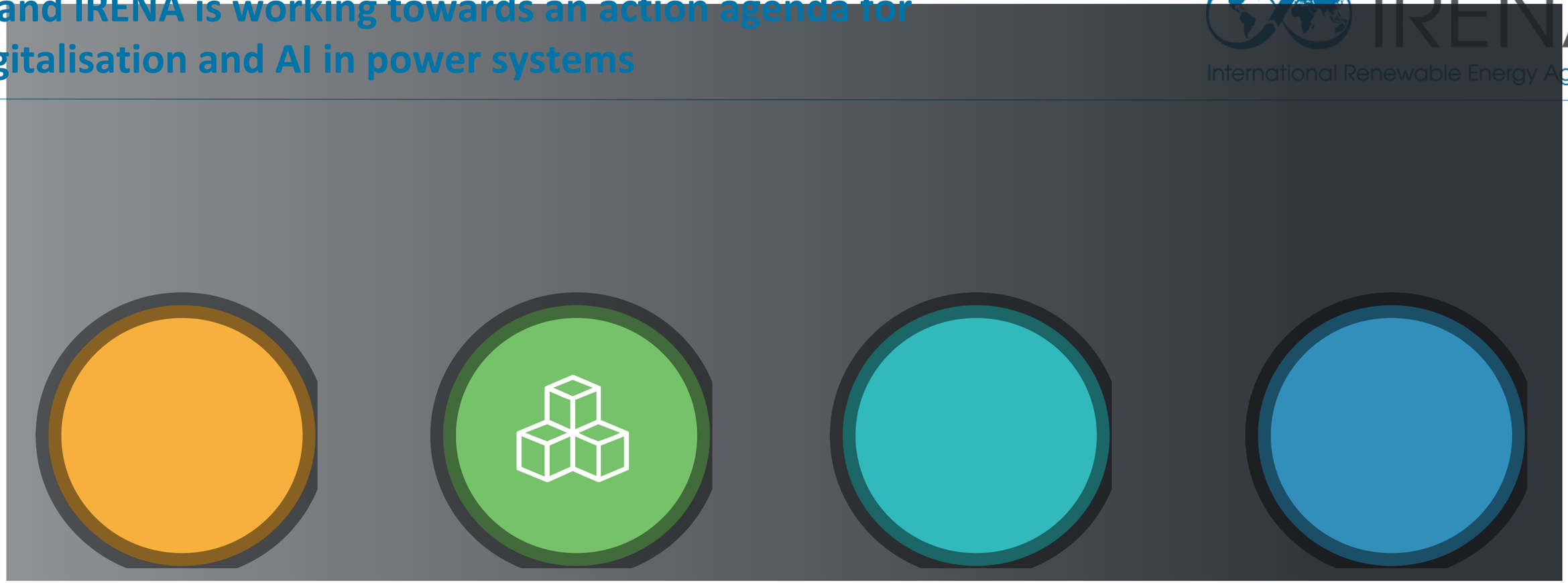
Data gathering technology

Sensors | Data acquisition and management systems (SCADA) | Advanced monitoring systems | Smart meters

Digitalisation and AI applications help unlock new system value…



… and IRENA is working towards an action agenda for digitalisation and AI in power systems



Short-term applications

Value clusters

Technology readiness

Opportunities in EMDE

Essential takeaways on digitalisation and AI

Digitalization is a high-return investment that maximizes the socioeconomic welfare provided by renewables, and raising awareness is an essential pilar to accelerate their synergetic deployment.

Smartness in the electricity value chain has quantifiable benefits as reduction of final prices and emissions, and qualitative benefits as enhanced security of supply and added transparency.

Artificial Intelligence is a component of the evolving digitalization of power systems that allows revolutionary optimizations for integrating high shares of renewables with surging electrification.

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Thank you!

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IRENA INNOVATION WEEK 2025

Keynote

Vincent Berrutto
Head of Unit Research, Innovation, Competitiveness and Digitalisation
European Commission, Directorate General for Energy

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Scene-setting presentation

Maxime Souvignet
Team Lead Climate Risk Analytics
United Nations Un

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IRENA INNOVATION WEEK 2025

Scene-setting presentation

Marcia Poletti
Head of European System Change
Octopus Energy

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Digitalisation for the energy transition

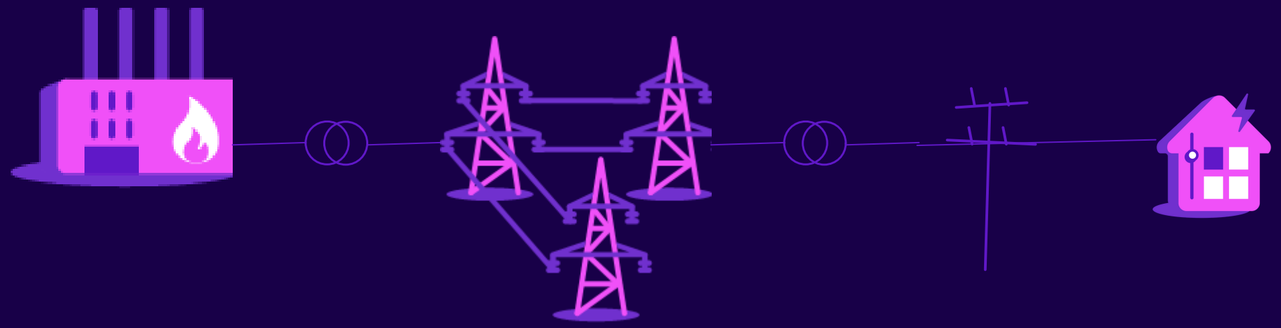
IRENA Innovation Week 2025
12 June 2025, Bonn

octopus energy

We use **technology** to drive the global green energy revolution – making it **cheaper and faster** for citizens and the planet.

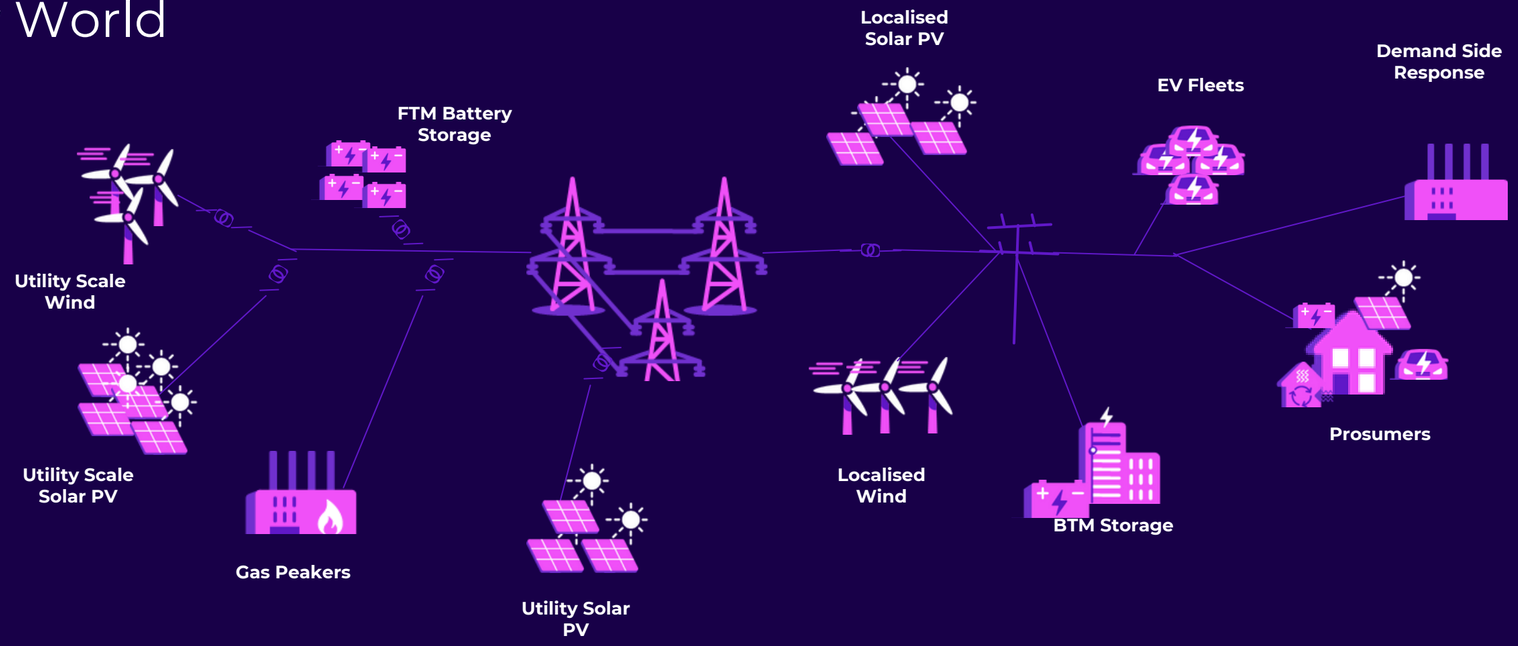
The energy landscape is changing rapidly and the change is bringing about unprecedented complexity

Old World



- **Unidirectional flow** from generation to consumer
- **Output easily adjustable** in response to demand changes
  Centralized generation connected to the transmission system.

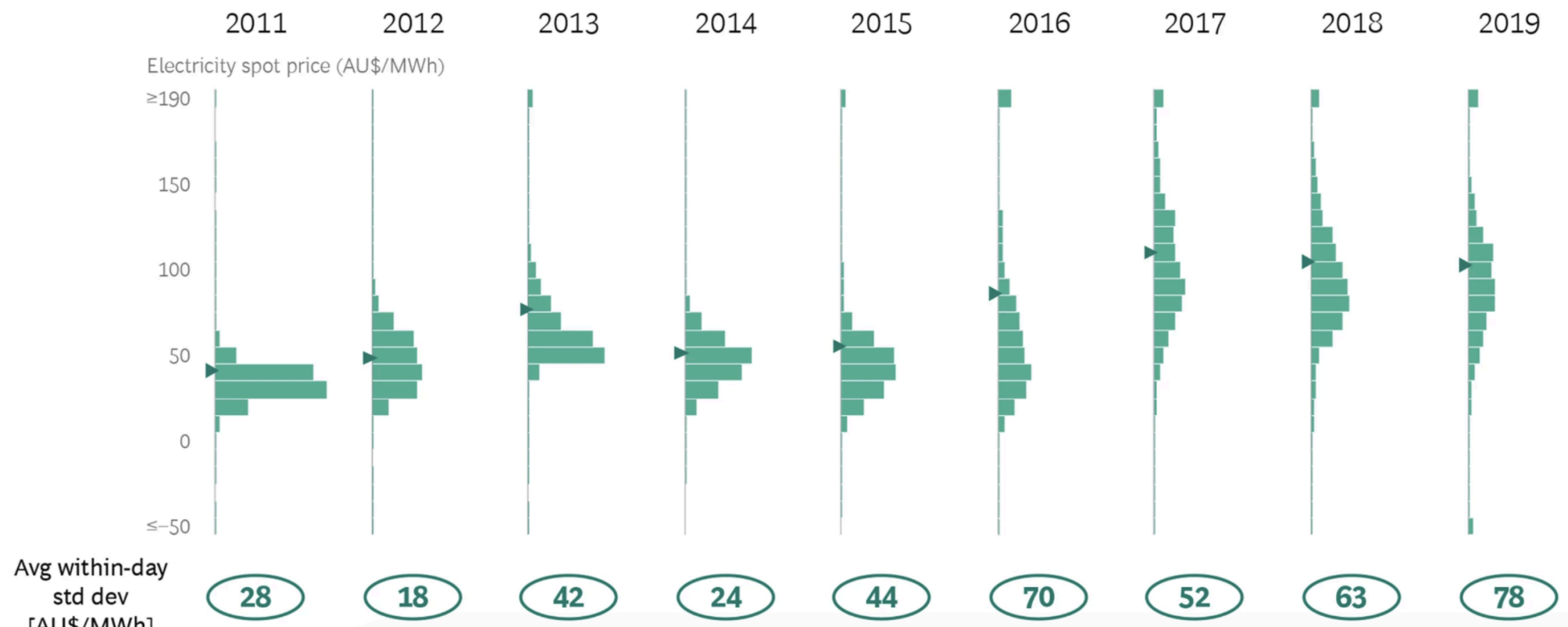
New World



- **Distributed energy -** Balancing requires real-time changes in supply and demand
- **Transportation Electrification -** requires a coordinated approach to charging and management.
- **Bidirectional flow of energy -** with the rise in distributed energy resources (DER)

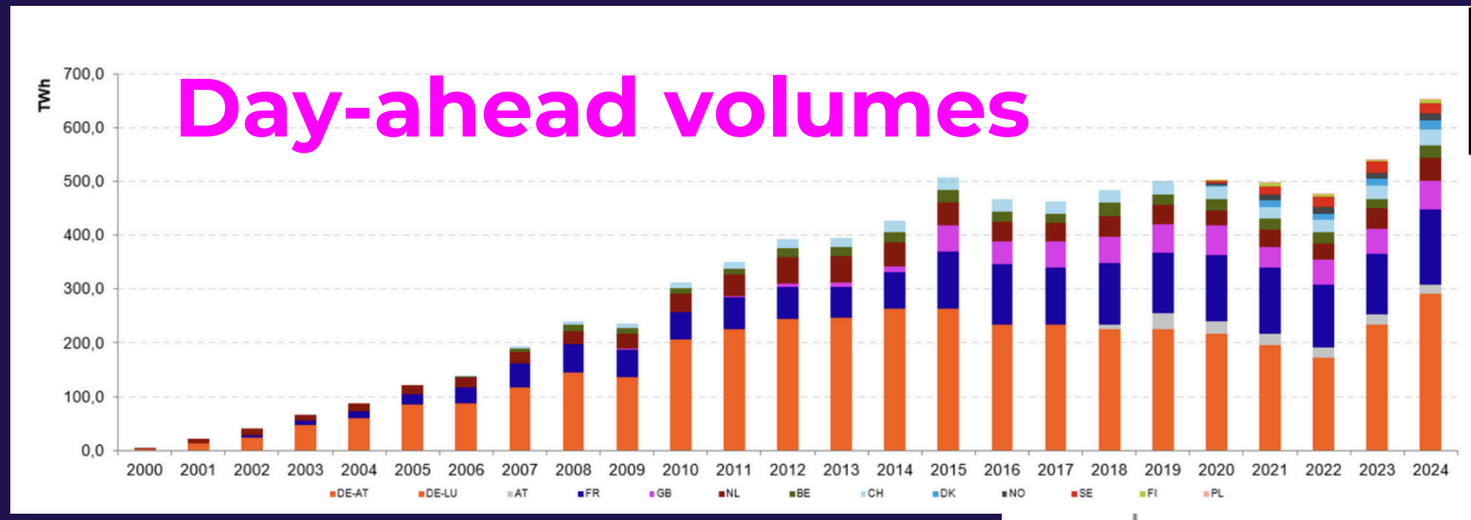
Electricity systems are becoming more volatile ...

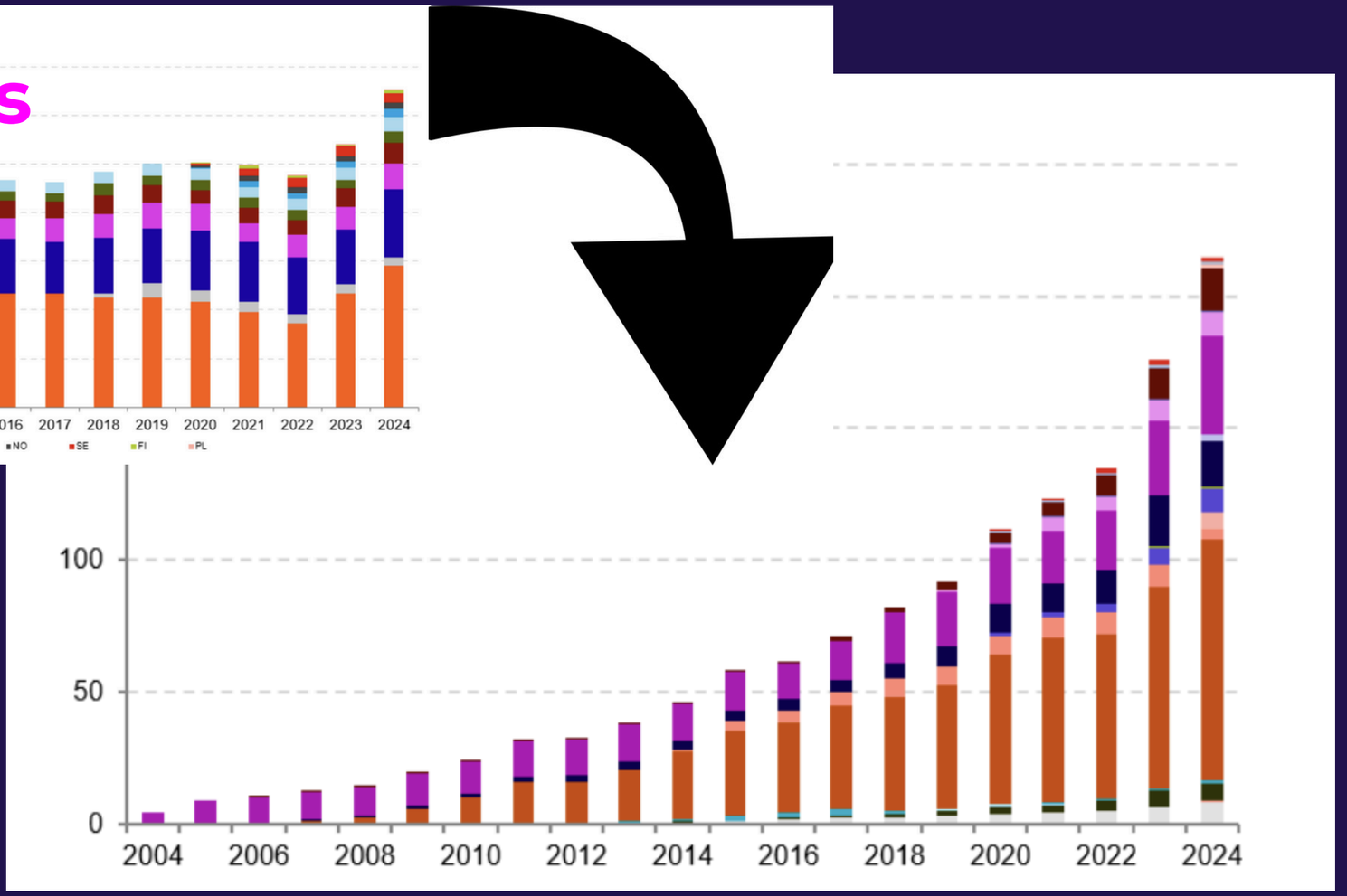
Exhibit 1 - Prices in South Australia Became More Volatile Between 2011 and 2019



https://www.bcg.com/publications/2022/free-electricity-unlikely-when-needed

Electricity systems are becoming more dynamic





Intraday volumes

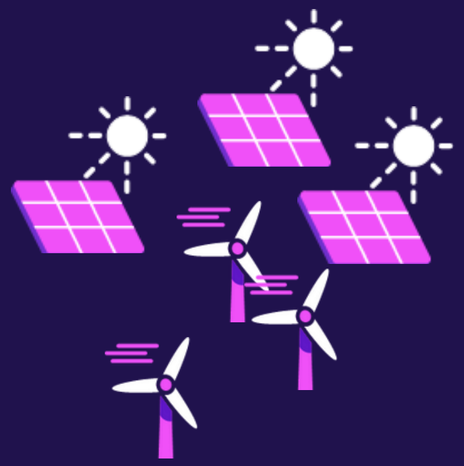
As renewable penetration increases, more trading is moving to intra-day markets

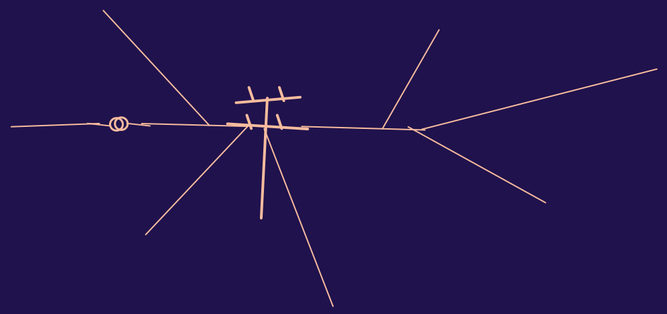
https://www.epexspot.com/sites/default/files/download_center_files/2025-01-28_EPEX%20SPOT_Annual%20Power%20Trading%20Results%202024_finaldraft_0.pdf

And to keep costs down we need to sweat assets more

We can’t do all of this effectively without AI (and lots of data)

AI (mostly machine learning) is used extensively across the electricity value chain





EV Fleets

BTM Storage

Generation

- Predictive Maintenance
- Performance optimisation
- Forecasting generation

Networks

- Forecasting congestion, inertia etc
- Planning

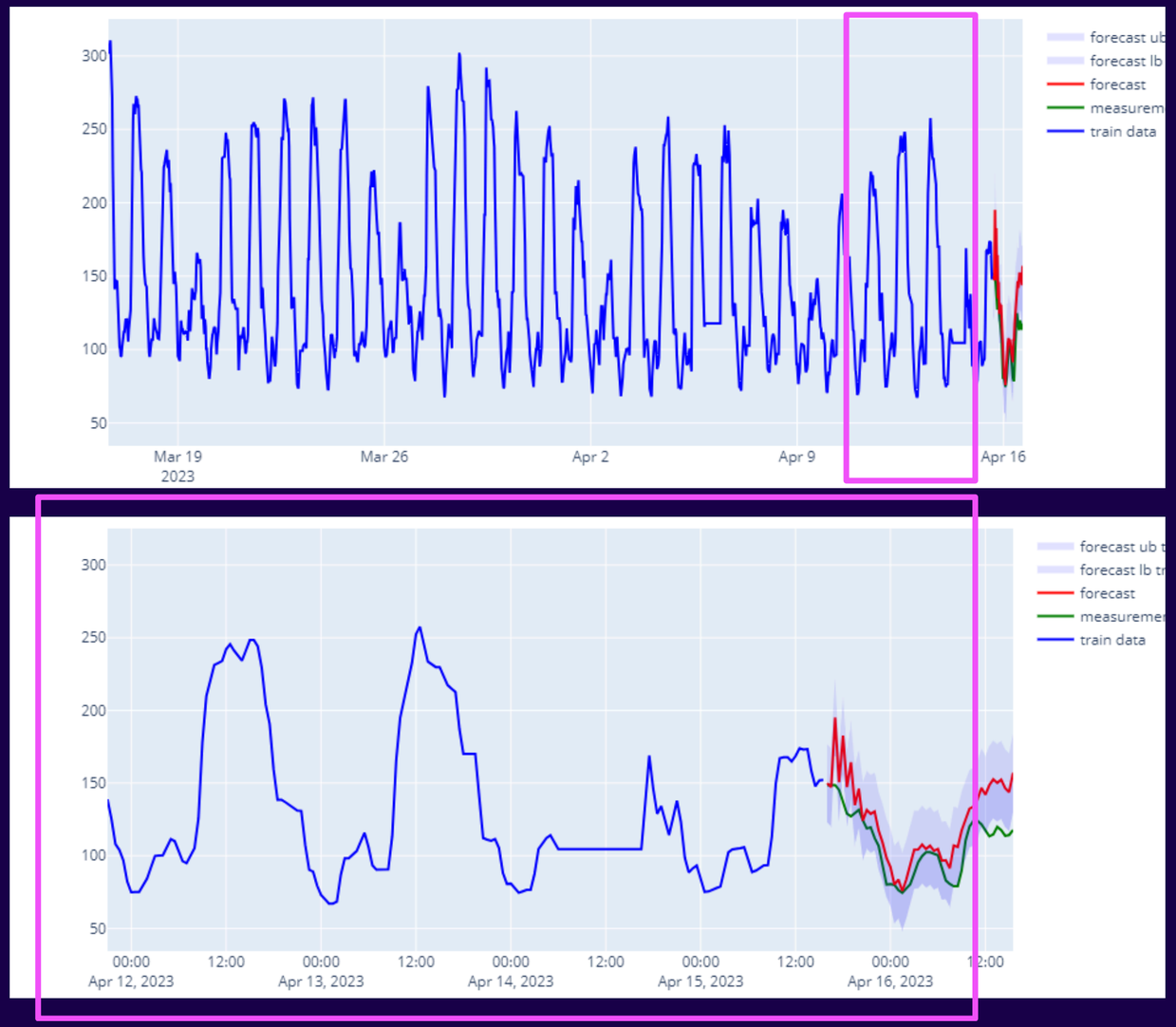
Load and Flex

- Mobilising consumer flexibility

Customers

- Customer service

Networks | Forecasting congestion using machine learning

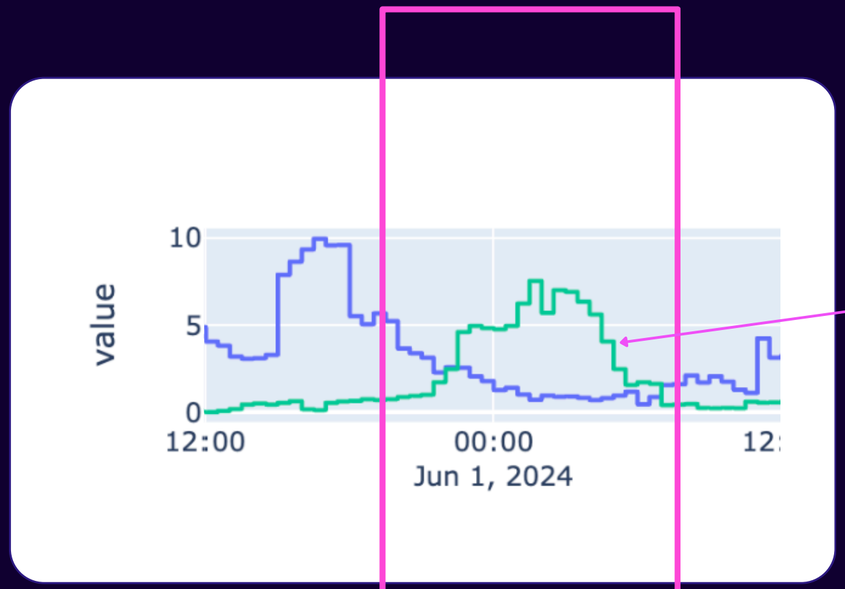


Forecasting congestion use cases:

- Dynamic price for smart devices
- Triggering activation of flexibility products
- Managing flexible connections or assets (BESS)

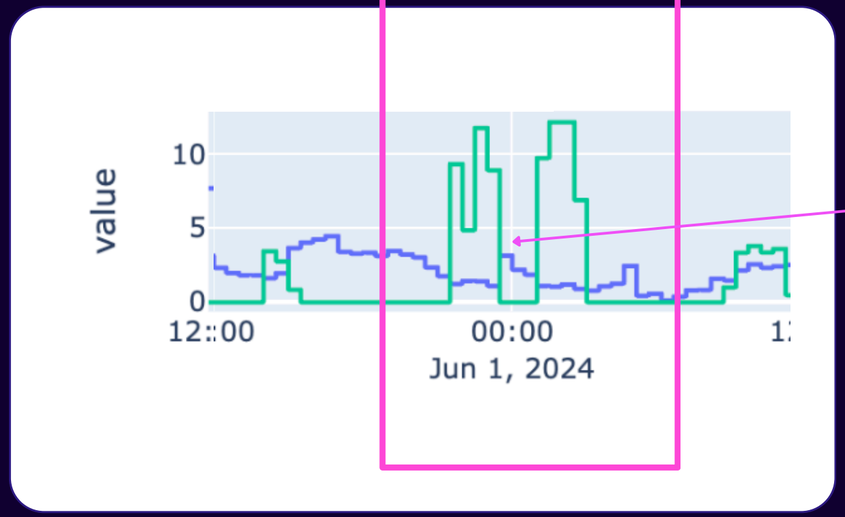
Networks | EVs Dynamically avoiding Congested Periods

Control Group

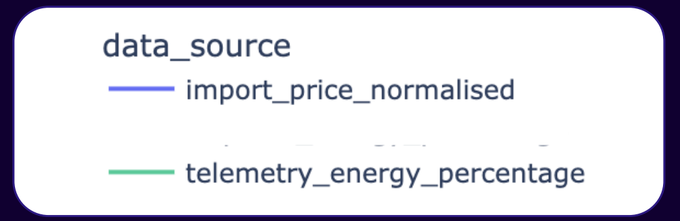


Unmanaged charging creates a secondary peak

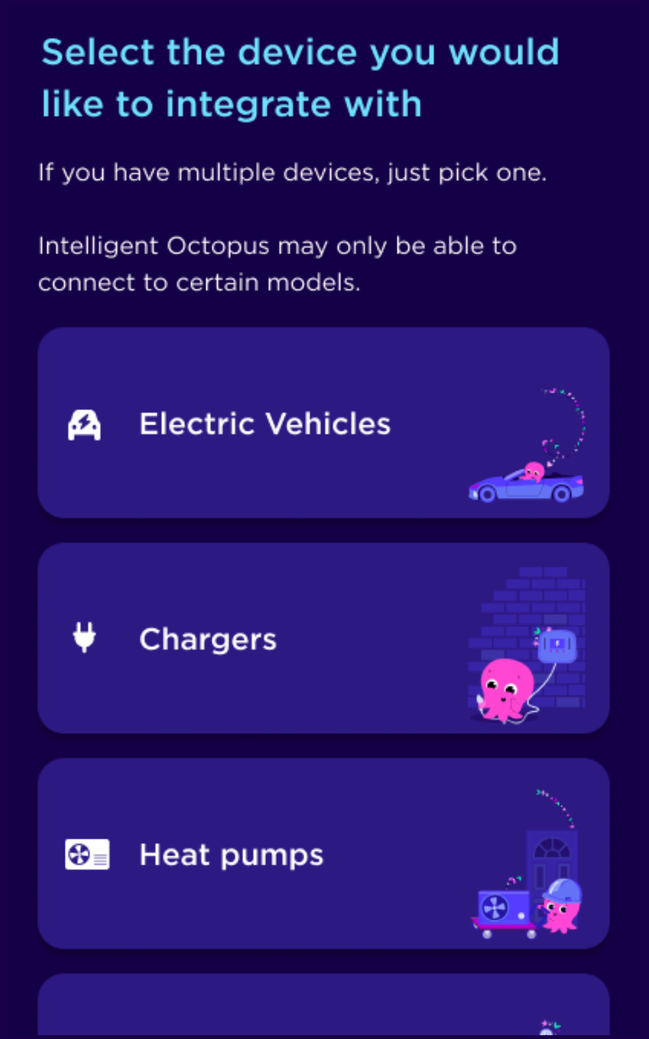
Optimized Group

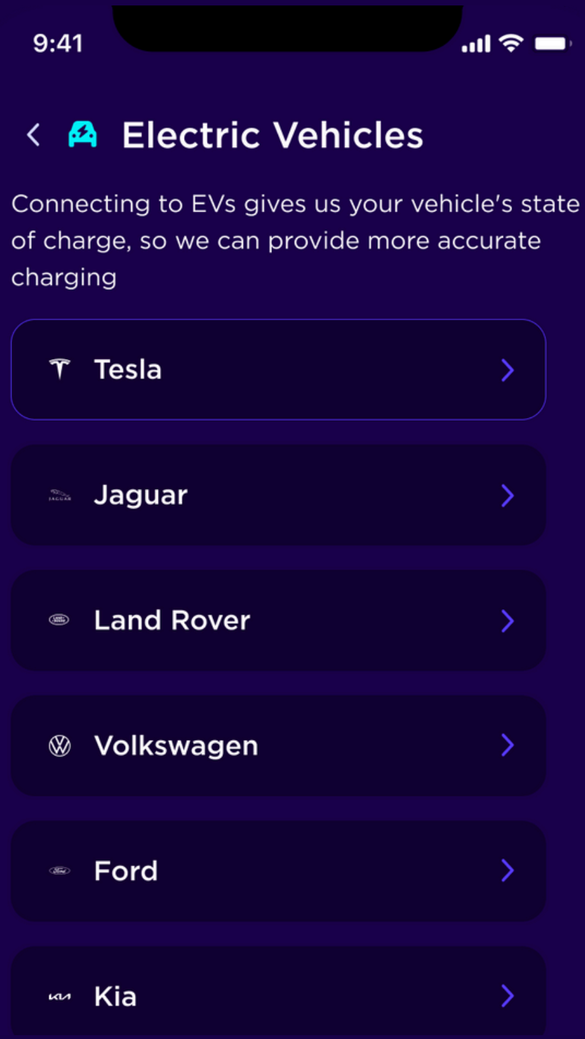


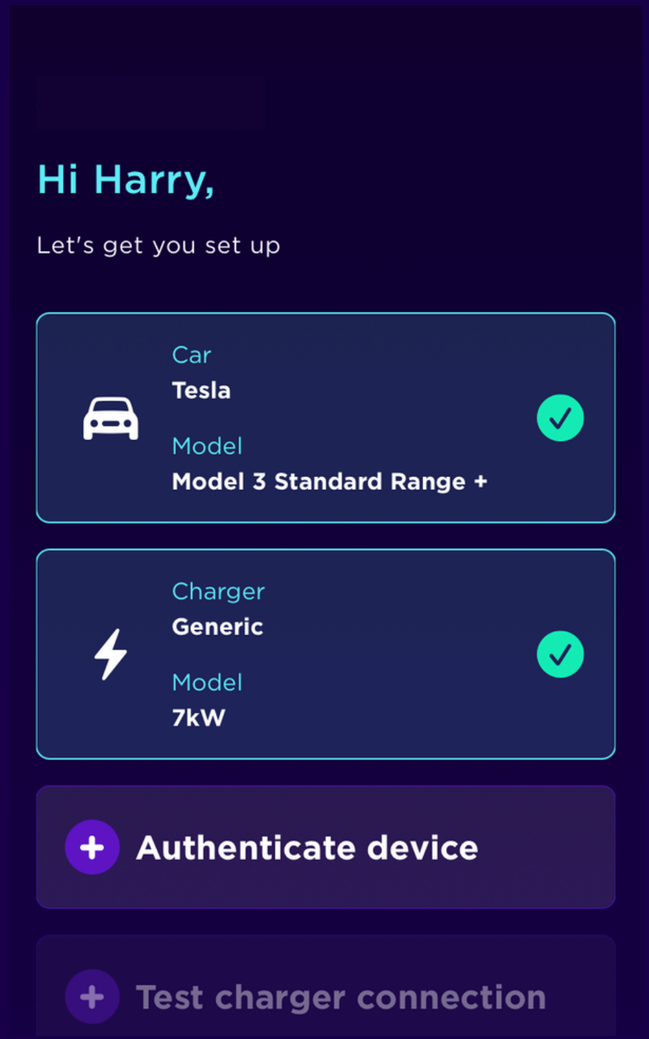
High congestion at midnight avoided by smart charging EV fleet



Load - Consumer flexibility | Consumers sign up their smart device







Load - Consumer flexibility | Consumers save

Cut your EV charging costs by up to 70%

Intelligent Octopus Go: the UK's most popular EV tariff

Automatically charge your car when it's cheapest and get **super low smart charging rates** plus 6h of cheap energy for your whole home every night.

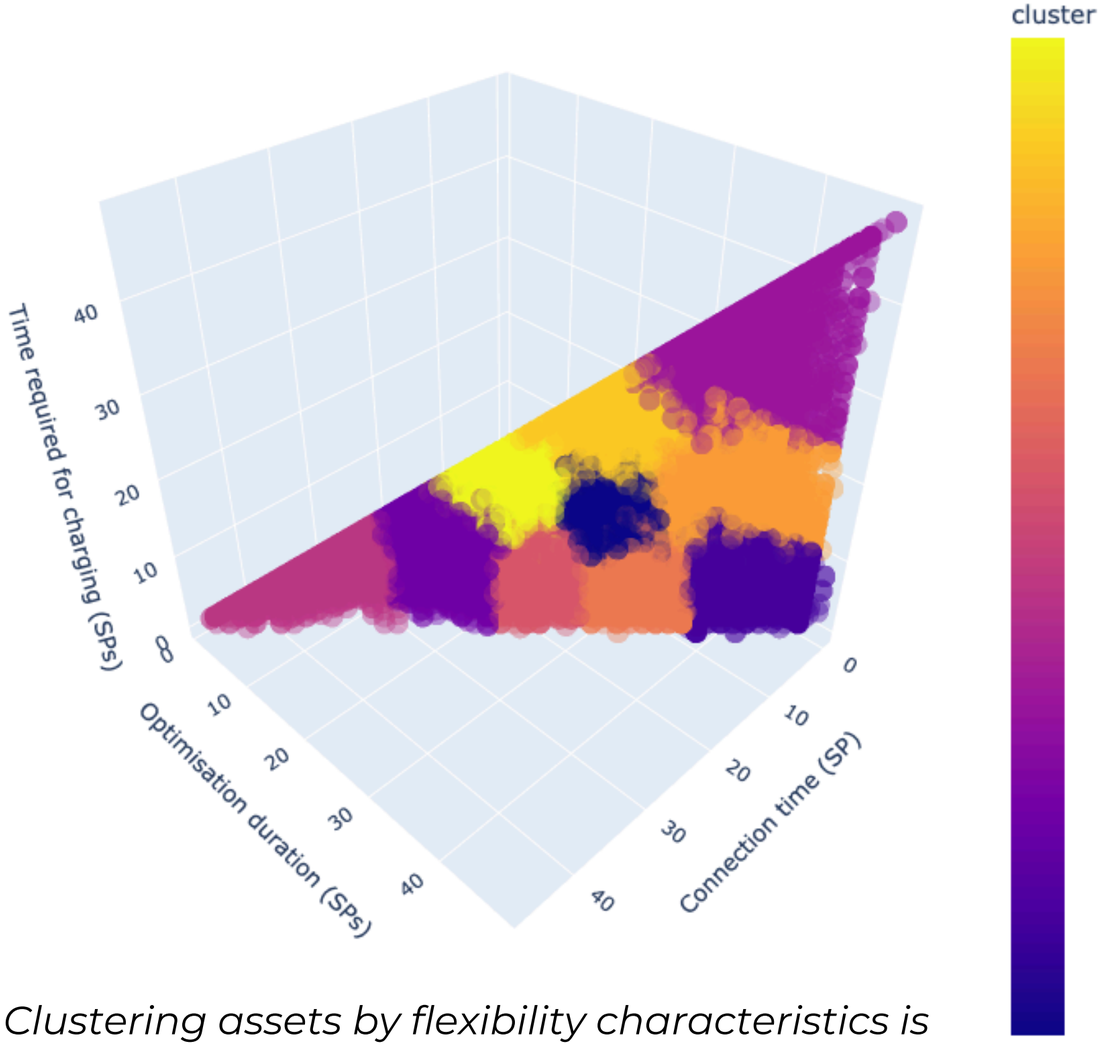
Will it work for me?

Charge for only 7p/kWh

up to 70% less than price cap rates

Load - Consumer flexibility | Forecasting fleet-level constraints to mobilise flexibility

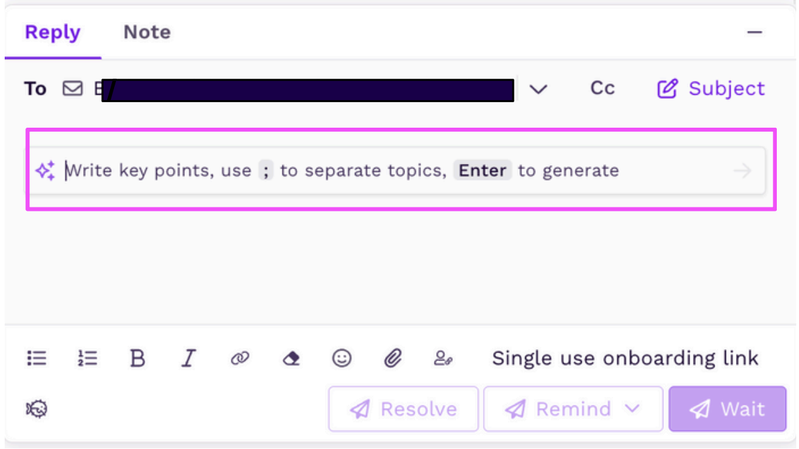
- An advanced simulation of fleet behaviour is an essential element of the optimisation process.
- A machine learning clustering approach divides the fleet of thousands into clusters of similar flexibility characteristics (plug in time, starting SoC, charger size etc).
- Each cluster can then be described by a single archetype (one example EV). This simulates a fleet of thousands with”archetype” EVs allowing forecasting and rapid testing of different dispatch schedules.
- The number of clusters represents a trade off between computational efficiency and accuracy. The optimum number of clusters is determined by regularly reviewing performance.



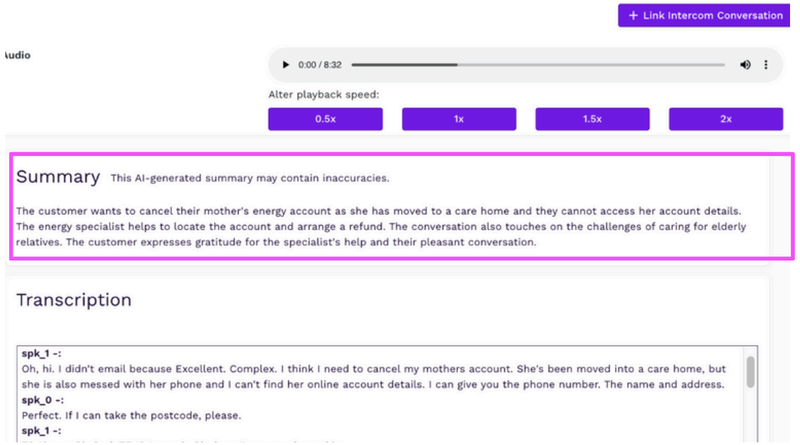
Clustering assets by flexibility characteristics is performed via machine learning algorithm

Customers | OE Operations uses GenAI in three key ways

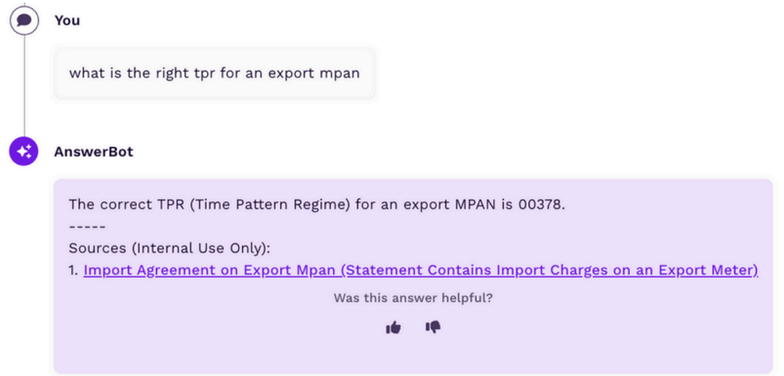
1 Magic Ink to draft emails



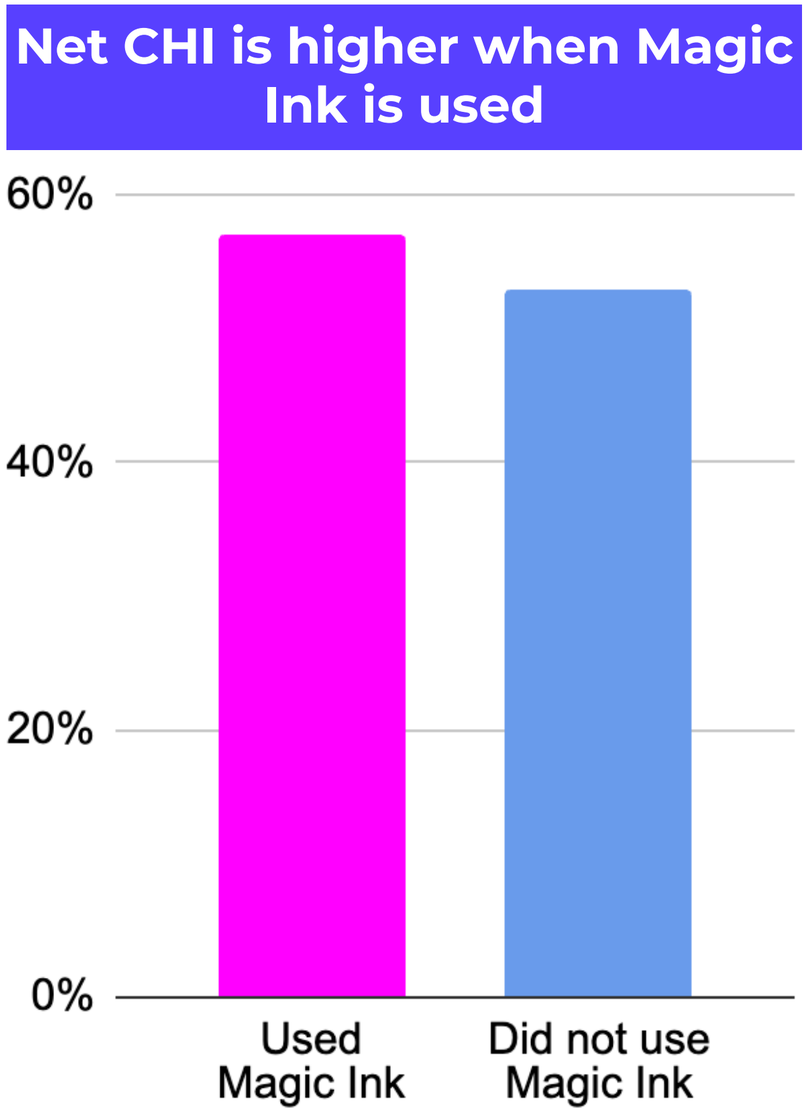
2 Summarise calls and emails



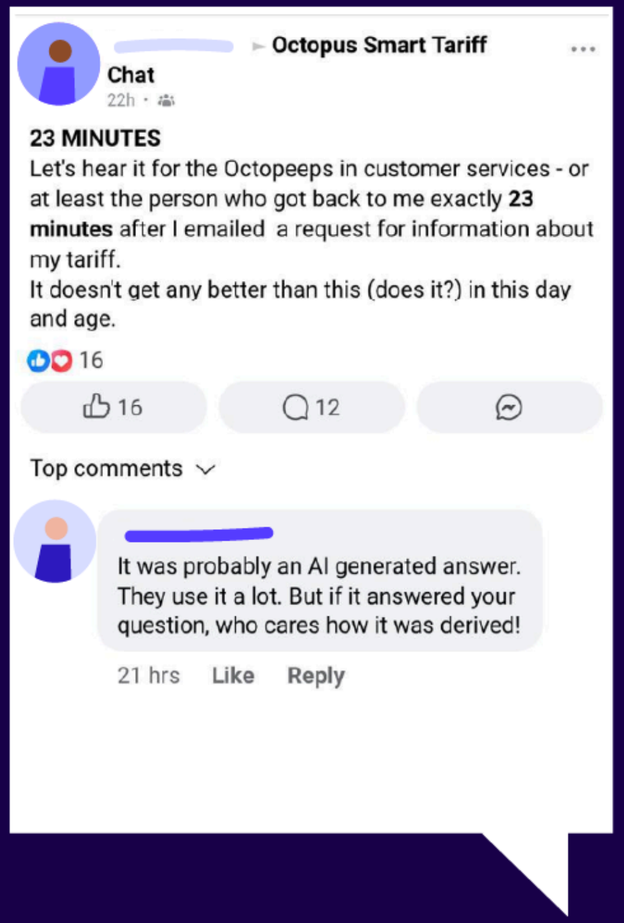
3 Technical advice

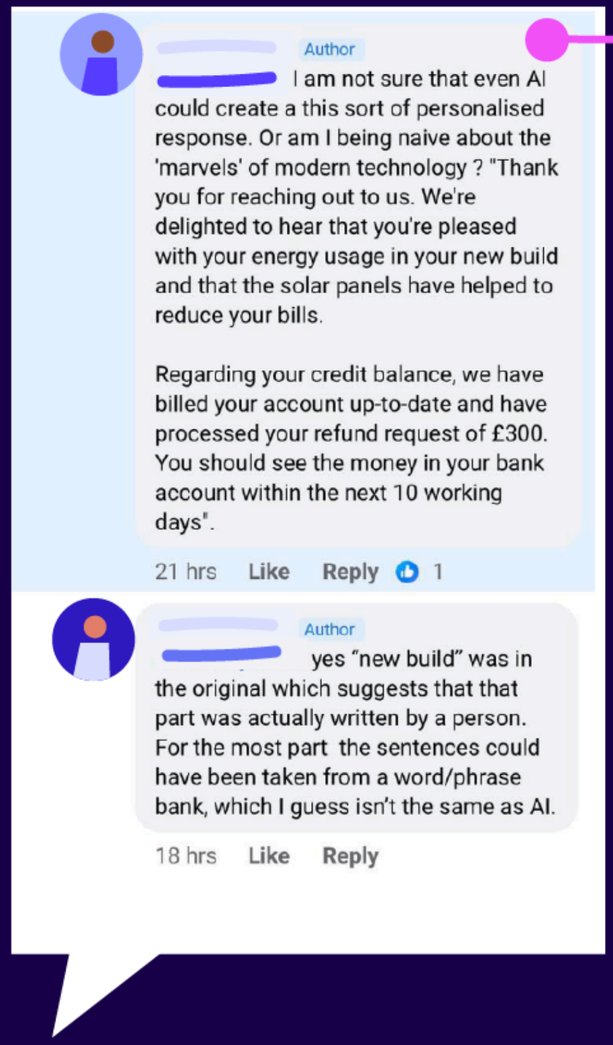


Customers | Magic Ink is being used over 100K times per week in OEGB Ops and Customer happiness is higher when used



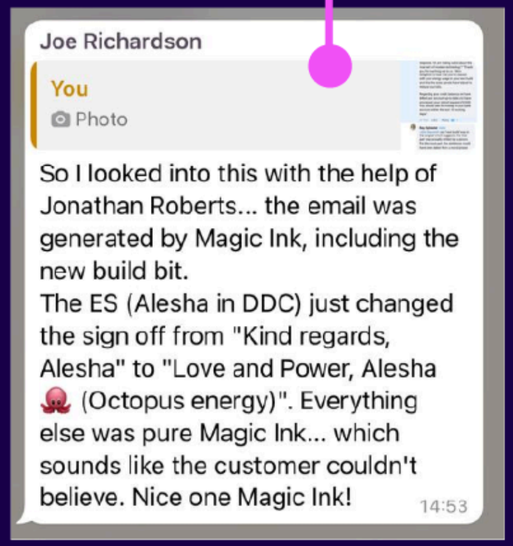
Customers can’t believe it’s AI!





Customer suggesting that AI could never deliver something so personalised…

So we quickly looked into it!



Thank you

marcia.poletti@octoenergy.com

IRENA INNOVATION WEEK 2025

Scene-setting presentation

Márcio Venício Pilar Alcântara
Innovation Coordinator
Brazilian Electricity Regulatory Agency, ANEEL

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DIGITALISATION IN THE BRAZILIAN ELECTRICITY SECTOR

Márcio Venício Pilar Alcântara

Brazilian Electricity Regulatory Agency

2025

June 12th

The Brazilian Electricity Sector: SEB

SECTOR POLICY

NATIONAL CONGRESS

PRESIDENCY (CC/SPPI)

MINISTÉRIO DE MINAS E ENERGIA
Minas e Energia

CNPE / CMSE / MME

REGULATION, SURVEILLANCE AND MEDIATION

CONSUMER PROTECTION ENTITIES:
Consumer Council
SENACON/PROCON

MARKET AND SYSTEM OPERATION

ONS

G GENERATION

T TRANSMITION

D DISTRIBUTION

M TRADING

ccee

PLANNING

epe

87%

of the electricity

RENEWABLE

mix

28.1%

of the WORLD'S

electricity mix

RENWABLE

Brasil

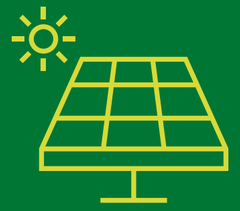
RENEWABLE ENERGY

PROTAGONIST

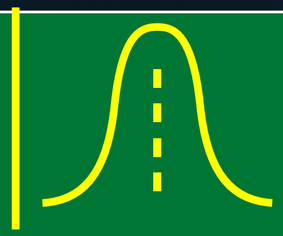
The Brazilian Electricity Sector at a Glance

NUMBER OF CONSUMERS
91.6 MILLION
212 MILLION pop.

ACCESS TO ELECTRICITY
99,8%
of the population

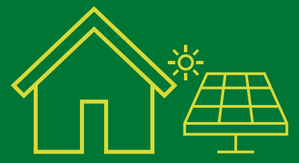


CENTRALIZED GENERATION CAPACITY
210 GW



MAXIMUM LOAD
106 GW
(February 2025)

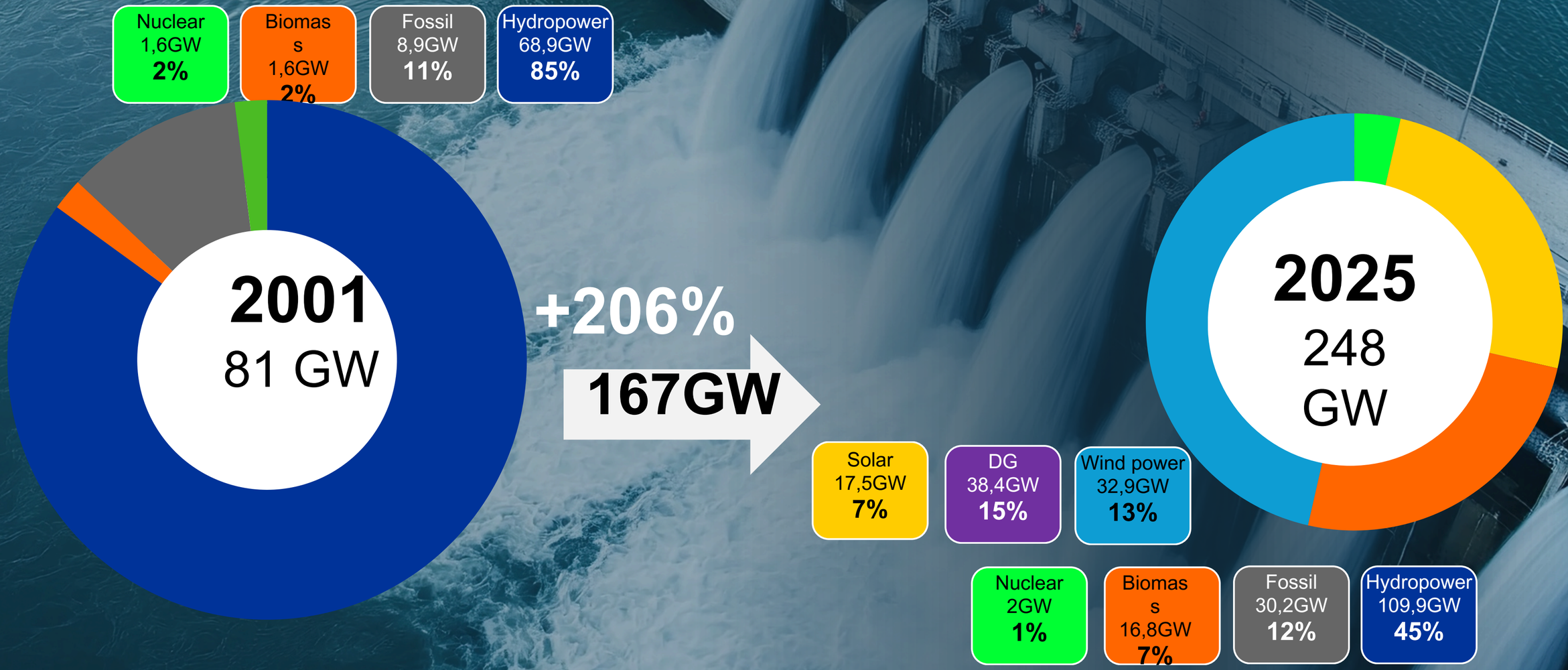
ELECTRICITY LOSSES (2023)
14,1%
7.4% EN 6.7% PNT



DISTRIBUTED GENERATION CAPACITY
38.2 GW
3.4 million plants

SOURCE: ANEEL

Evolution of the Brazilian Electricity Mix



Source: Aneel
April/2025

TRANSMISSION expansion

“no transition without transmission”

Australian expression

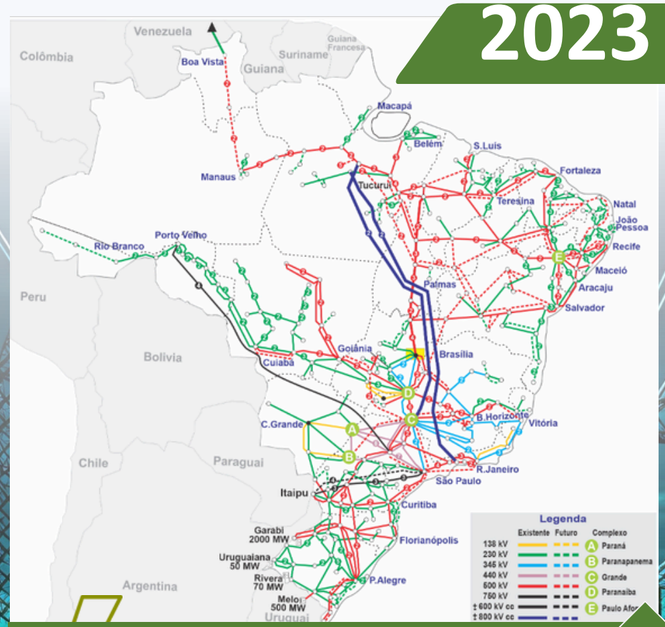
“Hug pylons, not trees”

The Economist

2001

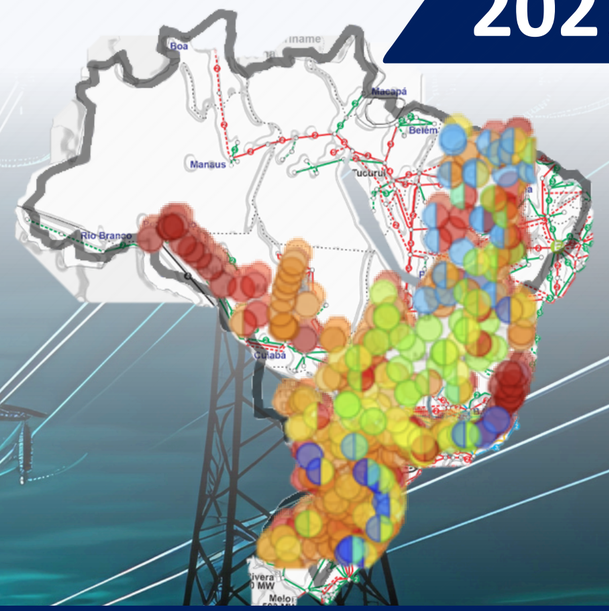
70,000 km

2023



171,000 km

2027



216,000 km

- 84 transmission lines under construction
- Auction 001/2024: R$ 18.2 billion
- Auction 002/2024: R$ 4.6 billion

- 1 Auction planned for 2025

ANEEL and the RDI Program: Advancing Brazilian Electricity Sector

RDI Projects Focused on Artificial Intelligence

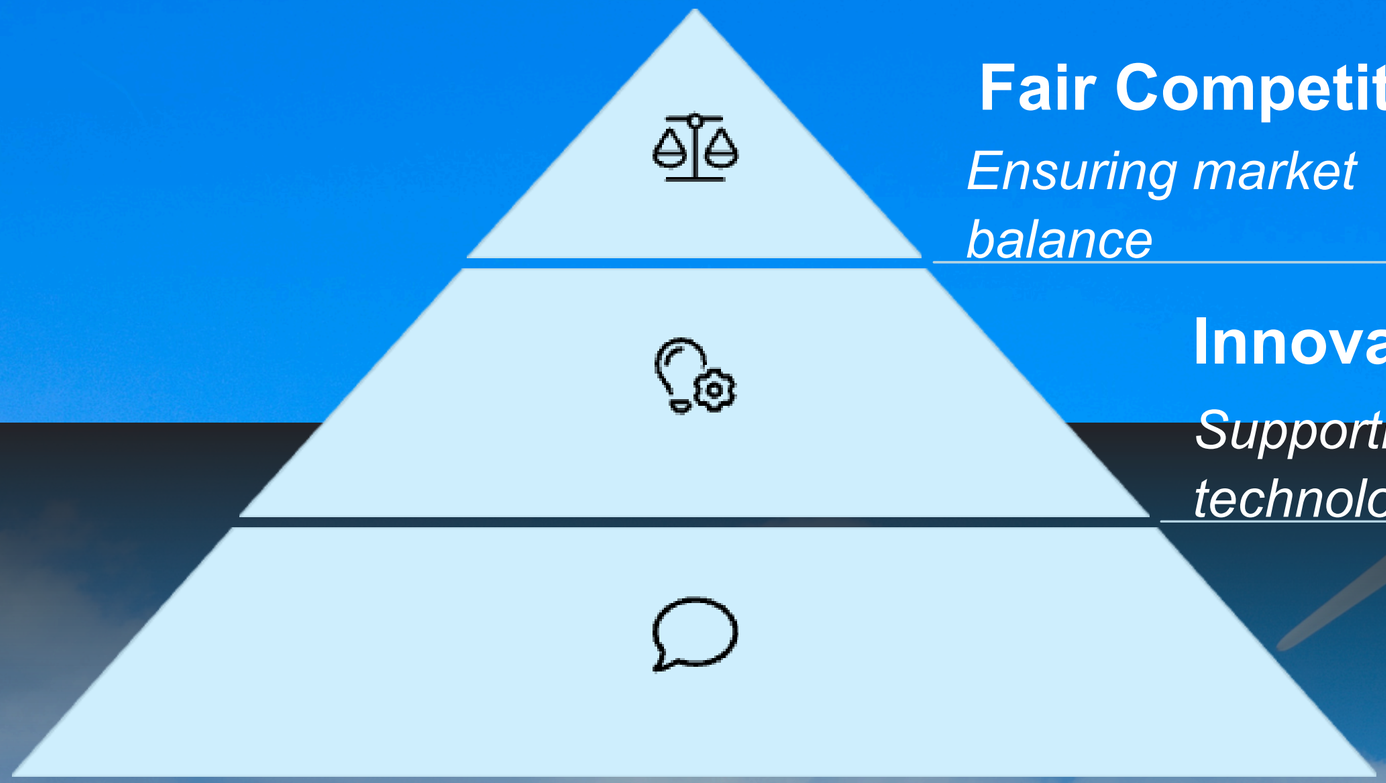
41

AI Projects

BRL 300M

Planned Investment

ANEEL's Role in Enabling the Energy Transition



Fair Competition

Ensuring market balance

Innovation

Supporting new technologies

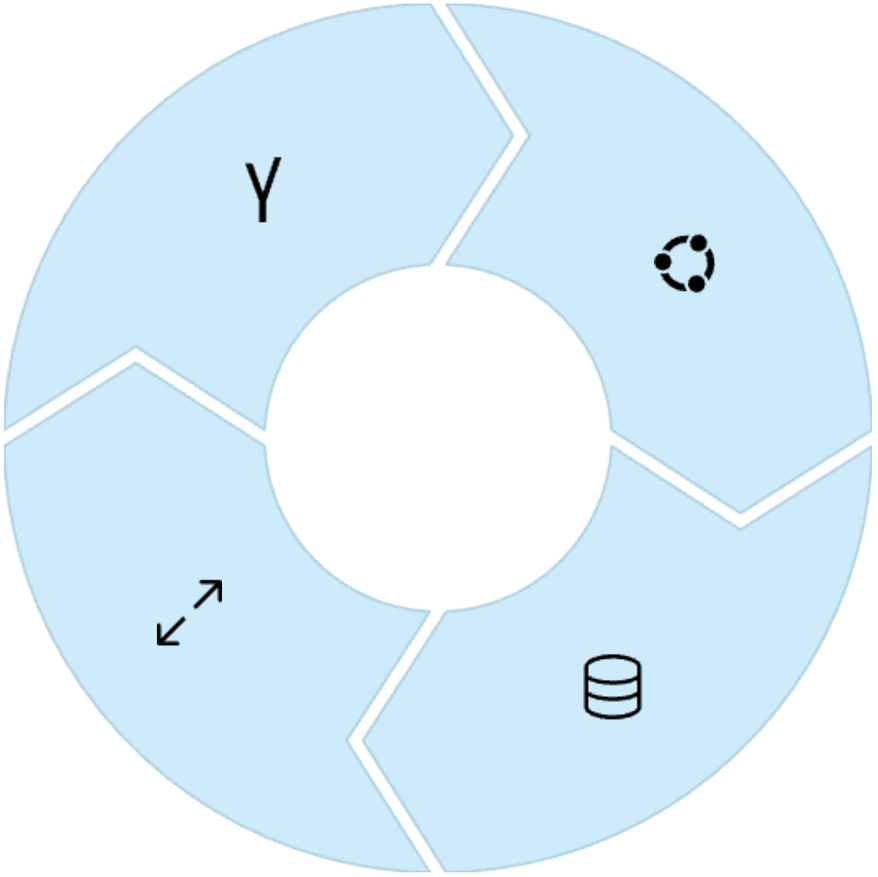
Modernization

Updating regulatory frameworks

Digitalisation as a Key Driver

DER Integration
Connecting distributed energy resources

Smart Operations
Intelligent grid management



Scalability
Growing with demand

Real-time Data
Immediate information access

Current Regulatory Framework and Priorities

Distributed Generation

Expansion of Distributed Generation (DG) under Law 14.300/2022

Smart Metering

Smart metering implementation (AMI - Advanced Metering Infrastructure)

Tariff Modernization

Tariff modernization (especially for low voltage consumers)

Energy Storage

Regulation of energy storage systems and ancillary services

Regulatory Sandbox

Establishment of regulatory sandbox environments for innovative solutions

Challenges and Forward Agenda

ANEEL

DG Valuation
Need for structured valuation of costs and benefits from DG

New Market Models
Gradual integration of aggregators, VPPs, NWAs

Fair Competition
Equal conditions for fair competition and interoperability

Regulatory Principles
Focus on simplicity, transparency, and adaptability

Final Message

Leadership Position

Brazil is uniquely positioned to lead digital energy transitions in the Global South.

Regulatory Commitment

Digitalisation is not only a technical path—it is a regulatory commitment to a just, efficient, and clean energy future.

Thank you!

2025

June 12th

IRENA INNOVATION WEEK 2025

High level dialogue

Moderator:

Maher Chebbo

UNIVERS

Panelists:

Vincent Berrutto

European Commission

Márcio Alcântara

ANEEL

Marcia Poletti

Octopus Energy

Guilherme Castro

IRENA Youth Delegation & Faculty AI

Arnoud Kamerbeek

Jungle AI

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Audience Q&A

The Slido app must be installed on every computer you're presenting from

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Arnoud Kamerbeek

Jungle AI

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Closing Remarks

Norela Constantinescu
Acting Director
IRENA Innovation and Technology Center

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IRENA INNOVATION WEEK 2025

Global survey on digitalisation and AI for power systems

Thank you for your support

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IRENA INNOVATION WEEK 2025

Announcement

Coming next: Youth in the AI and RE nexus of the next decade

&

Lunch Break

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