

From concept to reality:
Accelerating the development of Virtual Power Plants
(VPPs)

**#1: Demystifying Virtual Power Plants –
Models, Enablers & Early Experiences**

**WELCOME TO THIS
WEBINAR!**

Please note that live translation in Spanish &
Portuguese is available through Zoom



About the series

Multiple events discussing frameworks, implementation and scaling for Virtual Power Plants.

This session covers:

- VPP readiness assessment
- Pilots from Brazil and Colombia
- Scaling VPPs in mature markets

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 **BASE** &  **INTEGRATE TO ZERO** WEBINAR

From concept to reality:
Accelerating the development
of Virtual Power Plants (VPPs)

#1: Demystifying Virtual Power Plants –
Models, Enablers & Early Experiences

With experts from

 **auren**

 **octopus**
energy

 **CELSIA**

 24 February 2026

 16:00 CET

Register and
join on **zoom**



From concept to reality: Accelerating the development of Virtual Power Plants (VPPs)

#1: Demystifying Virtual Power Plants – Models, Enablers & Early Experiences



Francisco Ramirez Cartagena

Senior Sustainable Energy and Transport Finance Specialist at BASE

Moderator



Dan Hamza-Goodacre

Chief Energy Officer



Kit Fitton

Global Strategy Manager



Tania Nalborczyk Leites

R&D and Innovation Consultant & VPP Project Manager



Juan Esteban Bernate C.

Innovation Project Implementation Engineer



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BASE is a Swiss not-for-profit foundation and a Specialized Partner of UN Environment.

BASE develops innovative, actionable financing strategies and market-driven solutions to unlock investment in sustainable energy and climate change solutions.


BASE, together with partners Auren and Celsia, has developed & deployed Virtual Power Plant pilots in Colombia, Brazil and South East Asia (upcoming).





Housekeeping notes



- Duration: 75 minutes.
- Questions:
 - Please type them in the Zoom Q&A tool.
 - Q&A session of 10 minutes at the end of the webinar.
 - Depending on capacity, questions unanswered during the Q&A will be answered in a written format in the days following the event.
- Live translation: select your preferred language using the  button located in the bottom ribbon

Francisco in a few words:

- Francisco Ramirez is an energy engineer specialized in financing, with over 15 years of international experience mobilizing investment for the energy transition across Latin America, Africa and Asia.
- Francisco combines finance and risk expertise with hands-on work in renewables, e-mobility, and energy efficiency, bridging strategy and implementation.
- Francisco currently leads the VPP initiatives at BASE and serves as the **moderator of the webinar.**



Francisco Ramirez Cartagena

Senior Sustainable Energy and
Transport Finance Specialist



About Virtual Power Plants (VPPs) - a short introduction

01 — Virtual Power Plants aggregate distributed energy resources.

02 — VPPs provide flexibility and enhance system reliability.

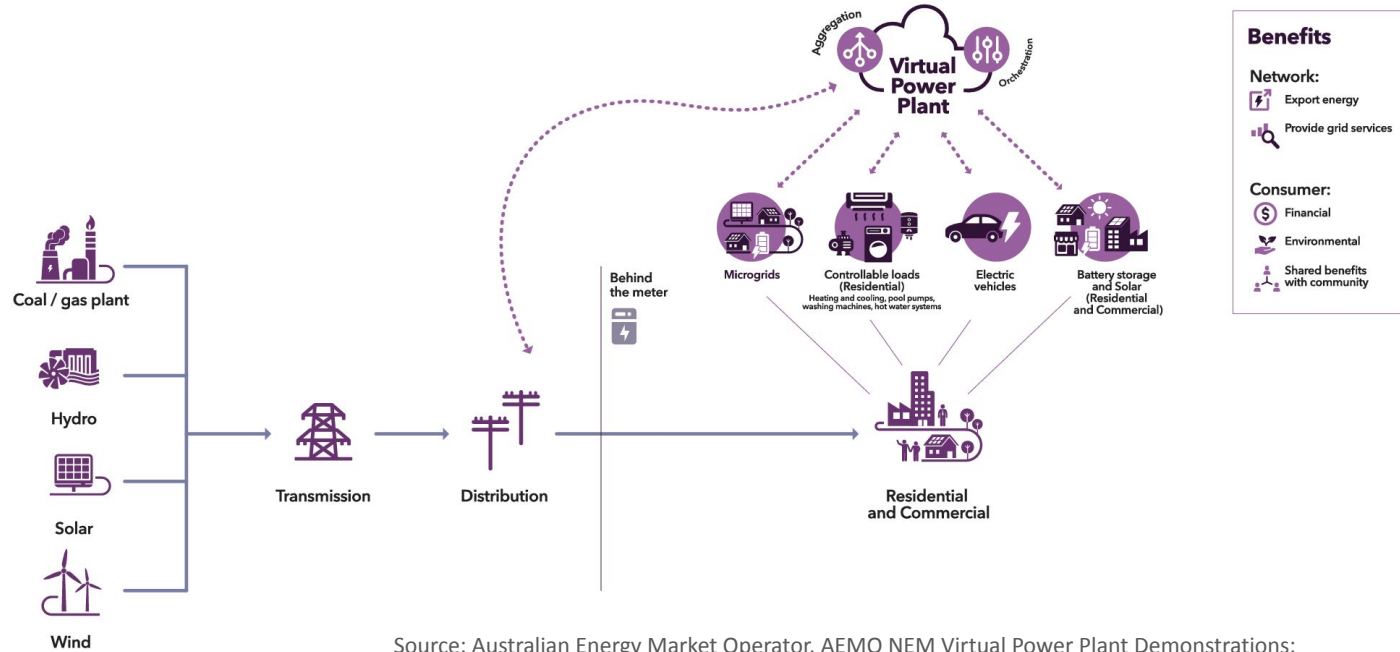


03 — VPPs coordinate small resources into one large one.

04 — They enable active consumer participation in the grid.





About Virtual Power Plants (VPPs) - a short introduction

Figure 1 Virtual Power Plants schematic overview




Source: Australian Energy Market Operator, AEMO NEM Virtual Power Plant Demonstrations: Knowledge Sharing Report #4, September 2021, p 17

About Virtual Power Plants (VPPs) - a short introduction

Classification	Types	Variations
Asset Types	 Generation	Renewable energy generation
		Fossil fuel energy generation
		Backup generation
	 Storage	Battery Energy Storage Systems (BESS)
		Mechanical/thermal storage
	 Demand	Smart appliances (e.g., water heaters, refrigerators or washing machines)
		Heating, ventilation, and air conditioning (HVAC) systems
		Water pumps
	 Hybrid	Electric vehicles (EVs)
		Minigrids
		Microgrids

Potential Grid Services		Energy services	N/A
		Capacity services	N/A
		Ancillary services	Frequency regulation
			Voltage compensation
			Operational management
			Black start services

Site Types		Commercial and Industrial	Commercial and Industrial facilities with high energy demands such as hospitals, commercial centres, industrial parks and transport infrastructure
		Residential	Homes or neighbourhoods
		Agricultural	Farms with flexible irrigation loads and/or generation DERs

Dan in a few words:

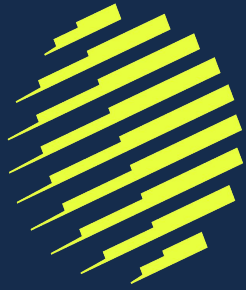
- Dan has over 25 years of experience spanning over 60 countries, currently helping to build **a fleet of virtual power plants across the globe** at Integrate to Zero
- Leading and advising on **climate and clean energy solutions** for philanthropy, governments and business across the world
- Fellow with the Pooled Fund on International Energy where he **focuses on grids and electrification**



Dan Hamza-Goodacre

Chief Energy Officer





**INTEGRATE
TO ZERO**

**Scale, readiness and
innovation**

integratetozero.org

[#IntegrateToZero](https://twitter.com/IntegrateToZero)

Scale

- \$6bn: 2025 VPP global market size
- \$1 trillion pa – C&I global flex market
- UK: 8GW of Flex/ 28 GW target 2030
- China: 50GW VPP target 2030
- USA: 38GW VPP capacity 2025

Assessing VPP Readiness

Category	Criteria
VPP resource availability	① Flexible CER capacity
	② Regulations, policies, and incentives for CER adoption
Flexibility needs	③ System flexibility needs
Market attractiveness	④ Power system structure and regulation
	⑤ VPP access to revenue streams and viable business cases
Regulatory environment	⑥ Regulations, policies, and incentives for VPP deployment
	⑦ Data protection and privacy concerns
Grid operation	⑧ VPP/CER integration
	⑨ Low-voltage (LV) network visibility

Country Rankings

1. Australia
2. France
3. UK
4. Chile
5. India
6. Brazil
7. South Africa
8. Colombia
9. Malaysia
10. Kenya
11. Indonesia
12. Nigeria

Innovation!

electrek ▾

GREEN ENERGY ELECTREK GREEN ENERGY BRIEF EGEN SOLAR POWER BATTERY S

Texans can now join a VPP and get 2 sonnen batteries at no upfront cost

 Michelle Lewis | Jan 22 2025 - 1:51 pm PT |  41 Comments



Image: sonnen

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ELSEVIER Electric Power Systems Research Volume 241, April 2025, 111403

Article preview
Abstract
Introduction
Section snippets
References (80)
Cited by (17)

Application and prospects of large AI models in virtual power plants

Danhao Wang^a, Daogang Peng^b,  Dongmei Huang^a

WhichEV BUYING ADVICE EV ANSWERS FEATURES NEWS REVIEWS

 octopus electric vehicles The home of electric leasing. Save up to 40% with Electric Dreams.

Home > News > Charging

Drive for Free: BYD and Octopus Launch UK's First Vehicle-to-Grid Package, Slashing Bills to Zero

 by William Morris — 27th June 2025 in Charging, News, Technology Reading Time: 4 mins read



The home of electric leasing
Save your employees up to 40% on the cost

Juan Esteban in a few words:

- Juan Esteban is an Electrical Engineer focusing on **Distributed Energy Resources (DER)** and **emerging energy horizons**
- Played a **key role in developing** Celsia's VPP orchestration projects, integrating solar assets, BESS, and demand response systems



Juan Esteban Bernate C.

Innovation Project
Implementation Engineer



Virtual Power Plant (VPP) - CELSIA



Celsia is a leading company in the energy sector with a presence in 5 countries in the region

Energy Services



Installed Capacity
1.464 MW ac



Energy generated
3.664 GWh



Customers
1.360.326



189 Substations **Dx**
16 Substations **Tx***

enerBit

Digital marketer and
technology provider

11 Departments 40.000 Customers

Asset Management



Installed Capacity
590 MW ac



Energy generated
1.085 GWh



Pipeline under
development
~730 MW PV + BESS



Phase 1 Objective

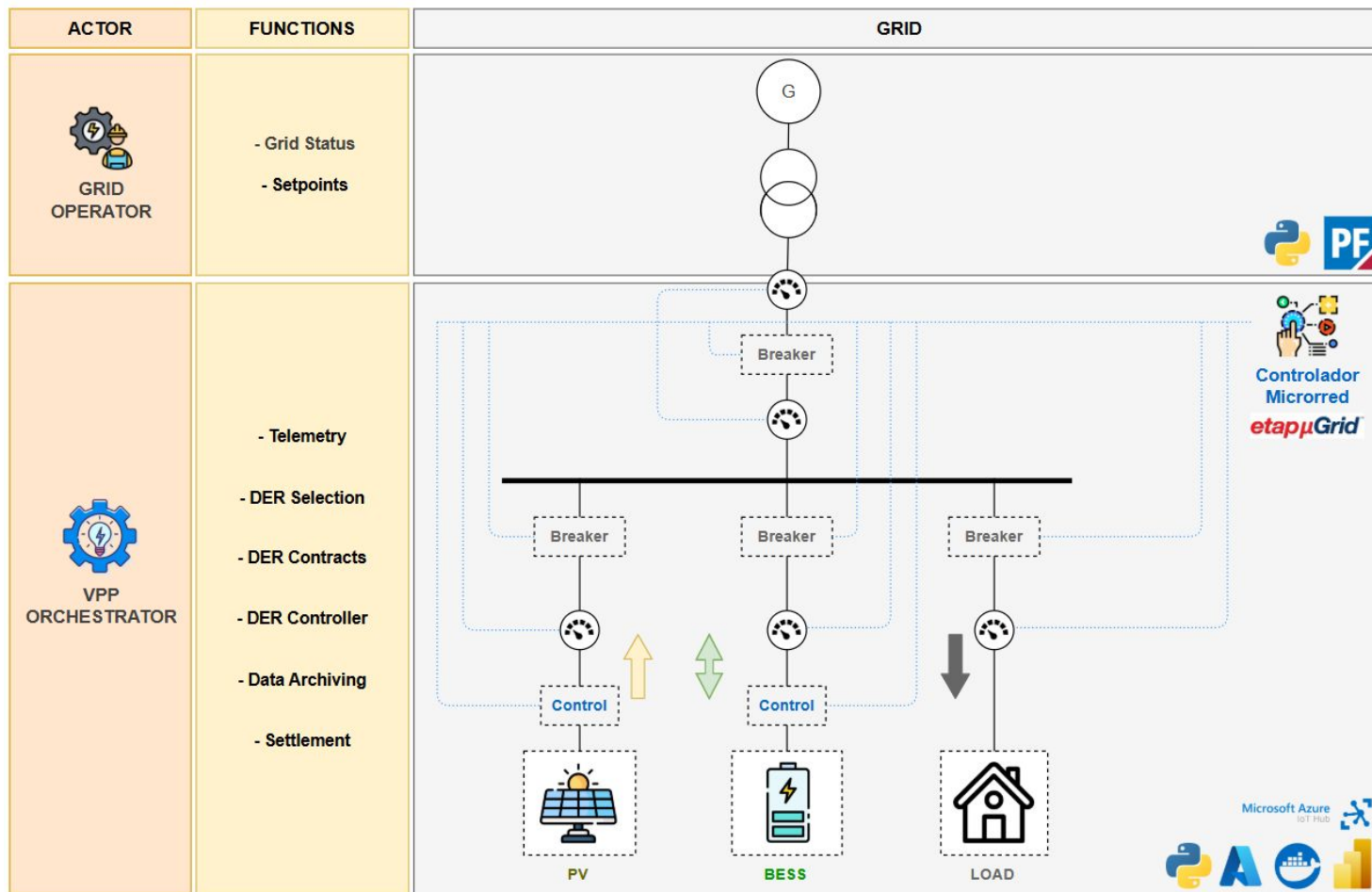
Develop a technological solution for the VPP orchestrator that allows for flexible management of energy supply and demand, facilitating direct interaction between participating DERs and the platform's central system.

Phase 2 Objective

Implement an advanced metering infrastructure that facilitates the aggregation and active participation of early adopters in the VPP, enabling the provision of demand management services in a scalable and highly efficient manner.

The logo for enerBit, with 'ener' in orange and 'Bit' in purple, set against a white background with a blue border.

Phase 1 Results



Phase 1 Results



VPP

Home / Negocios / VPP

Proyecto de exploración

Negocio : Retail Total: 10 Conectados: 0



Opal



Mostrar todos

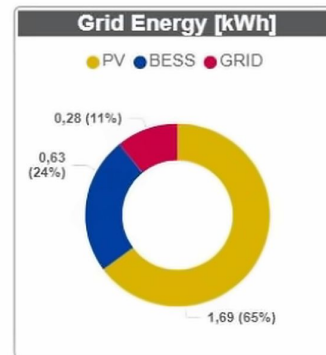
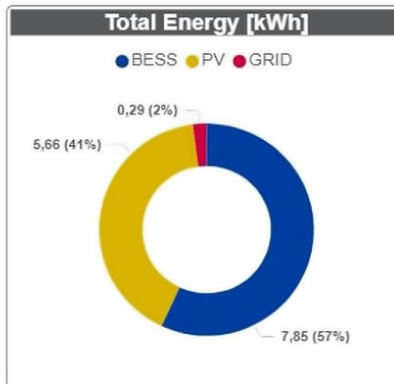
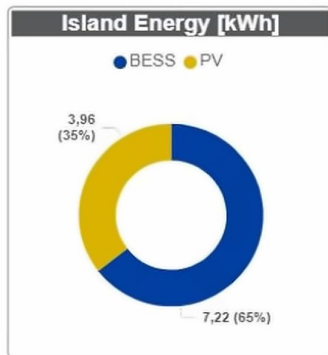
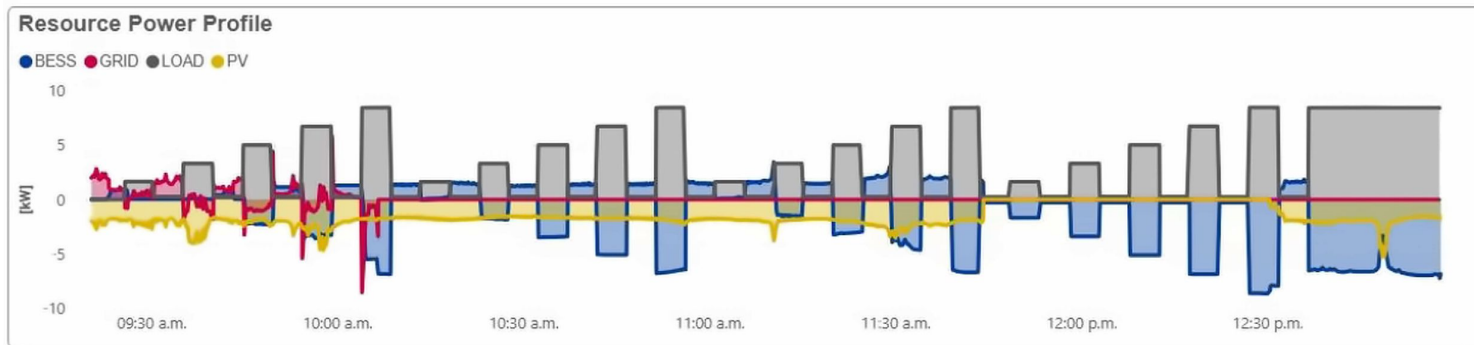


Dispositivos individuales



Nombre Dispositivo	Cliente	Tipos de dispositivos	Dirección de Esclavo	Gateway	
Simulador Bess Opal	Celsia	Medidor Bess Opal	1	bess_opal	
Simulador Solar Opal	Celsia	Medidor Solar Opal	1	solar_opal	
Simulador Carga Opal	Celsia	Medidor Carga Opal	1	carga_opal	
Simulador Totalizador Opal	Celsia	Medidor Solar Opal	1	totalizador_opal	

Phase 1 Results



Phase 2 progress **enerBit**



Interoperability Laboratory

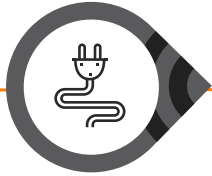
Validate the interoperability of meters from multiple manufacturers with our solution



Field deployment

Integration of a residential unit in the department of Tolima – Ibagué





2006

CREG Resolution 071: Defines voluntarily disconnectable demand as a mechanism to facilitate compliance with Firm Energy Obligations.



2010

CREG Resolution 063: Regulates the security ring of the reliability charge, establishing the contracts for voluntary disconnectable demand.

2018

CREG Resolution 098: Definition of mechanisms to incorporate storage systems due to the lack of transport networks



Law 1715: Regulates the integration of non-conventional renewable energies into the electrical system and defines demand response as changes in energy consumption in response to price signals or incentives.

2014



2021

CREG Resolution 143: Proposes the modernization of the spot market and includes the intraday market, crucial for the active management of energy supply and demand.
CREG Resolution 174: Regulating small-scale self-generation and distributed generation activities in the National Interconnected System.



2022

Resolution MME 40283: By which guidelines are established for the incorporation of DERs

2025

CREG Resolution 101072: Regulates operationally and commercially the energy communities, both in interconnected zones and non-interconnected zones.



2024

CREG Resolution 101 054: Establishes a transitional program of active participation of demand in the energy exchange



Tania in a few words:

- Tania is an Electrical Engineer with 10+ years of experience in power systems innovation, with a particular focus on **demand response, distributed energy resources, and VPPs** in Brazil
- Her VPP project received the **People's Choice Award** at the 2019 Energy & Innovation Awards in Finland
- Currently **leads ANEEL-regulated R&D initiatives** at Auren Energia and serves as Project Manager of both a residential and a retail-based VPP pilot



Tania Nalborczyk Leites

R&D and Innovation Consultant
& VPP Project Manager



VPP: Brazil's Experience

February 24th, 2026



Auren Energia is the 3rd largest generator and the biggest trader of renewable energy in Brazil



14
Wind
Power
Assets

3.2 GW
Installed
capacity

2055
Concession



20 Hydropower
Assets

4.7 GW
Installed
capacity

2056
Concession



05
Solar
power
assets

0.9 GW
Installed
capacity

2055
Concession



Trading
Top 1
Energy Trading
Company 2023

3.2+ million
of carbon
credits and
11+ million
iRECs

+1.500 Clientes
36 TWh Traded

8.8 GW

Installed capacity

3rd largest in Brazil
1st considering companies that
only invest in Renewables

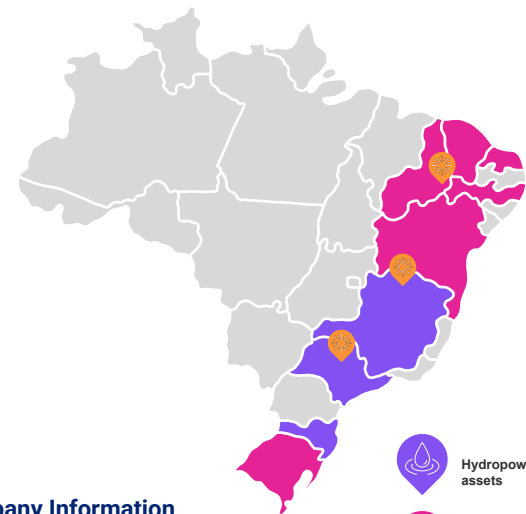
1.5 GW

Pipeline

New projects fueling
long-term growth

R\$ 30.8 billion

Enterprise
Value



Company Information

Trading Name
AUREN

Ticker
AURE3

Current Scenario of DR in Brazil

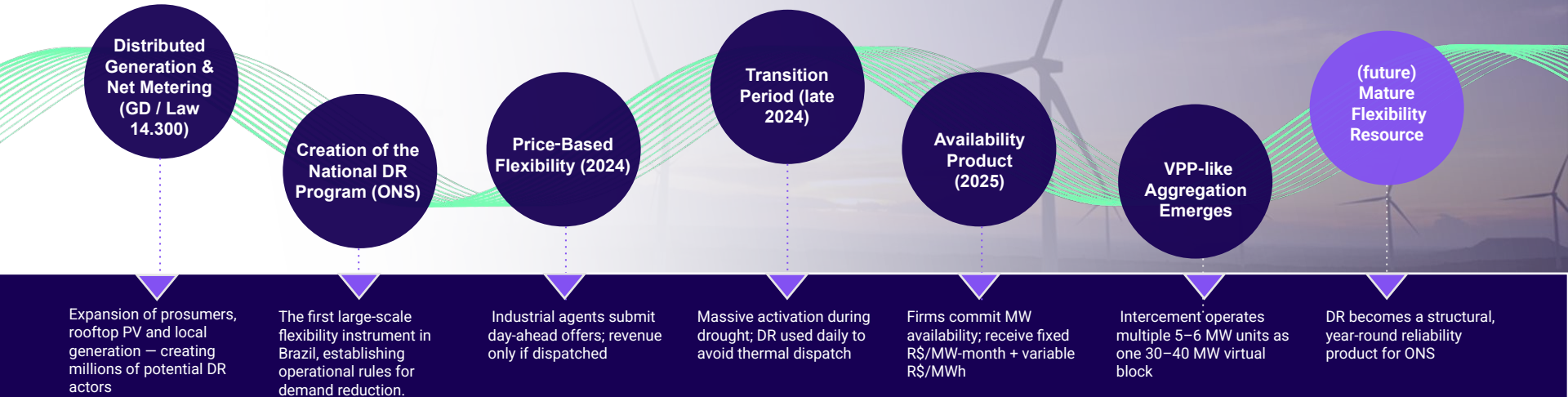
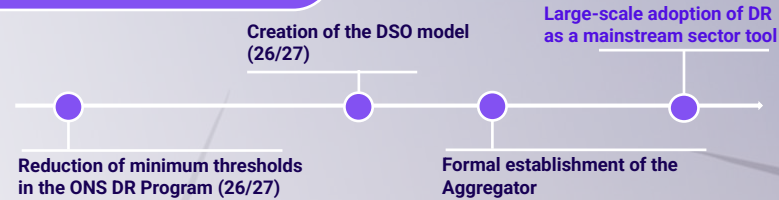


Context



Brazil's DR landscape has evolved rapidly: what began as sporadic, price-based reductions offered by large industrial consumers has transformed into a structured, competitive program with **defined products, minimum load blocks and multi-hour commitments**.

Next Steps



Current scenario of VPPs in Brazil



Context



44 GW

of installed solar DG capacity surpassed as of February 2026.



20%

curtailed of solar and wind generation in 2025, wasting ~BRL 6.5 billion (USD 1.23 billion)

Key trends shaping VPP development in Brazil:



Growth of distributed and intermittent resources: The rapid expansion of residential and commercial solar generation has increased system complexity and the need for distributed coordination.



Rising importance of flexibility: With a more dynamic grid, flexibility becomes a structural requirement, positioning VPPs as a relevant mechanism to aggregate and orchestrate small, scattered resources.



Aggregator role as the missing link: As highlighted by industry analyses, aggregators integrate distributed consumers and producers with the system operator, enabling VPPs to act as a collective, reliable grid resource.



Shift from passive to active consumers: increasingly frame consumers not only as energy users but as active participants capable of providing system-level services when coordinated through VPP structures.

Pilot Study on Demand Response in Brazil

Technical analysis of Demand Response (DR) operations in Brazil (2024–2025), assessing activation patterns, pricing behavior, regional dynamics and the emergence of aggregated multi-site VPP-like structures.



First Pilot in Brazil



105 MW

Largest single flexibility offer observed (Liasa, Jan/2025)



>70%

of national DR volume concentrated in the Southeast



Main Outputs

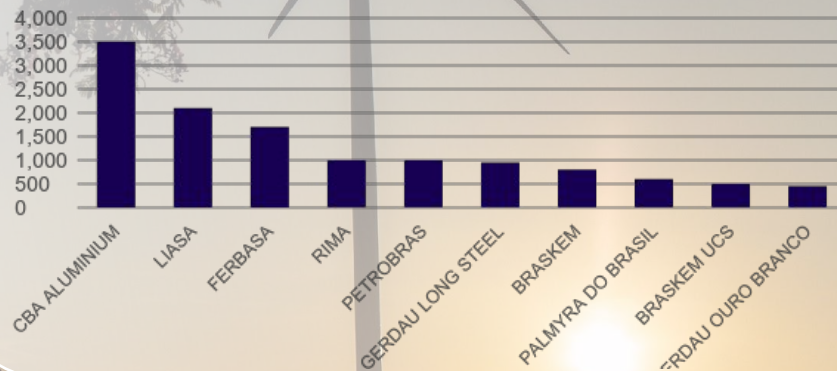
- Daily multi-agent dispatches during critical months (Aug–Oct 2024), with up to 15 agents dispatched simultaneously
- Coordinated multi-site reductions proving real VPP aggregation in practice
- High-value flex blocks providing rapid evening peak relief
- Structural use of DR year-round supporting reliability, voltage control and renewable integration



KPIs of de DR program

- Dataset: Jan/2024–Nov/2025 (ONS operational records)
- DR evolution: Price-based → Availability (capacity) by late 2025
- Peak window: >85% activations between 17h–22h (solar ramp-down)
- Aggregation case: Intercement operating 30–40 MW across multi-site units

Top 10 Agents by Total Offered Power Volume (Cumulative)



Residential Flexibility Pilot

Experimental pilot simulating the operation of a Residential Virtual Power Plant (VPP) to generate empirical evidence on flexibility and demand response.



Second Pilot in Brazil



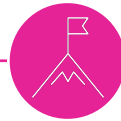
82.9 million households

Total addressable residential market for future VPP participation in Brazil



Main Scope

- Voluntary consumer participation activated through digital communication (WhatsApp), without automation, network injection, or contractual changes.
- Assessment of behavioral engagement, responsiveness and operational feasibility under real household conditions.



KPIs

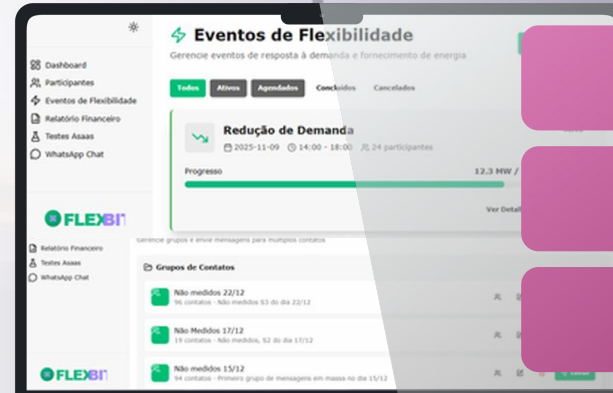
- 1,033 valid registrations captured nationally during recruitment.
- Participants: 130 total – 30 metered + 100 non-metered.
- Pilot period: Nov/2025 to Feb/2026 (event execution window).
- Geographic footprint: 3 pilot cities - São Paulo, Belo Horizonte and Florianópolis (metered group).

Next steps

March/26 | Consolidate findings and insights

May/26 | Share final results

March/26 | Send signals and collect results



Participant communication chatbot (WhatsApp)

Automation of incentive payments (Pix)

Event scheduling & segmentation engine

Residential Flexibility Pilot

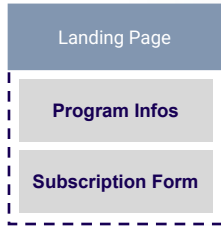


Second Pilot in Brazil



1. Participant Acquisition

Flow begins at the landing page with program information and interest form.



2. Selection & Categorization

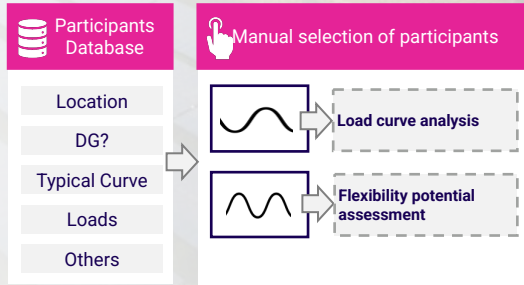
Participants with relevant characteristics are manually selected.



Monitored Indicators

- Acceptance rate by profile
- Average savings per event
- Average response time
- Aggregated flexible potential (kWh)
- Incentive efficiency (R\$/kWh avoided)
- Participation by customer type (metered / simple)

Residential VPP Management System



4. Offer Management

A frontend defines VPP parameters (limits, frequency, pricing boundaries).



6. Results & Evaluation

System analyzes acceptance patterns and response consistency to build indicators.

3. Data Integration

For metered clients, data is retrieved via partner cloud.



5. Client Interaction

Clients receive offers and indicate whether they would participate in a flexibility event.



Next Steps

The emerging roadmap for flexibility in Brazil: formalizing aggregators, addressing curtailment, and preparing DSOs for active grid operation



1. Consolidation of the Aggregator Role

Aggregators finally begin to take shape as formal market agents. A utility publicly positioned itself as a Demand Response Aggregator, launching a platform that allows consumers to participate directly with offers starting from 1 MW,



Notícia - 11/02/2026

Energia e Resposta da Demanda: tudo o que você precisa saber

Por que ser um Agregador de Resposta da Demanda é estratégico para a



2. Structural Curtailment Challenges Intensify

Curtailment reached 48.7 TWh (nearly 8% of national electricity consumption) and grew 300% in one year, with 2.86 TWh cut in January 2026 alone, showing this is a structural issue that will take years to resolve and increasing the need for demand-side flexibility.

Fonte: ONS, Agência Nacional de Energia Elétrica (ANEEL), Conselho Nacional de Energia Elétrica S/A (CNEEL)

Curtailment faz Brasil jogar fora quase 8% da energia que consome

Cortes de geração somam 48,7 TWh, volume 300% maior do que em janeiro de 2025

12 de fevereiro de 2026, às 15:11



União Solar de Jataizão, em Minas Gerais. Foto: Elina Henriques/OlharCinco



3. Expansion of DR into Low-Voltage Networks

With the upcoming DSO model and the shift toward distribution-level operational signals, Brazil moves toward enabling low-voltage DR and **local flexibility markets**. Distribution networks will increasingly operate as active system operators, requiring aggregation, coordination, and residential-level flexibility to manage local constraints.

Etapas e Cronograma

ONS Operador Nacional do Sistema Elétrico



Proposta ONS para execução do sandBox: 31 trimestre de 2026

Kit in a few words:

- Kit leads strategic initiatives at Octopus Energy, focusing on **increasing demand side flexibility** through incredible customer engagement
- Played a key role in developing and delivering **Octopus's world leading VPP** and has a particular interest in the **development of flexibility in new markets**, including LATAM



Kit Fitton

Global Strategy Manager





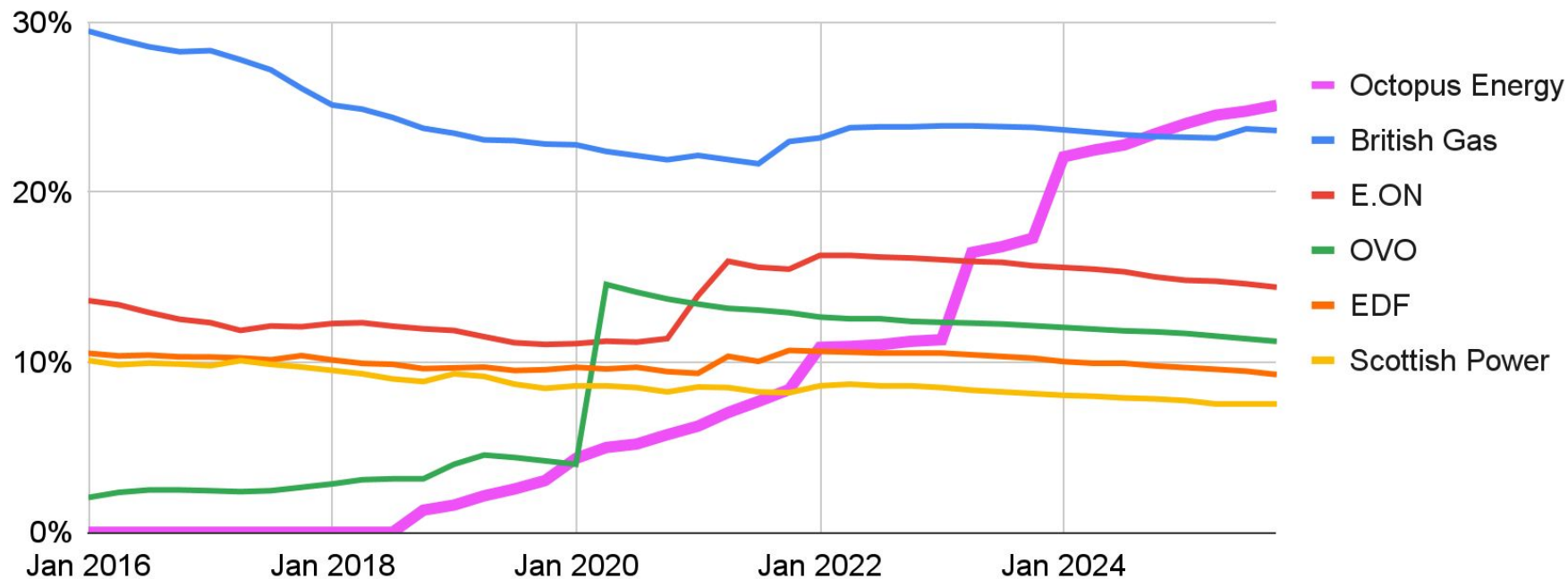
octopus energy

**A global energy
company using
technology to deliver
the energy transition
for the benefit of
customers**



After 9 years, the leading energy retail business in the UK, and still growing

UK residential energy supplier market share, %



**11 million
customers
around the
world**



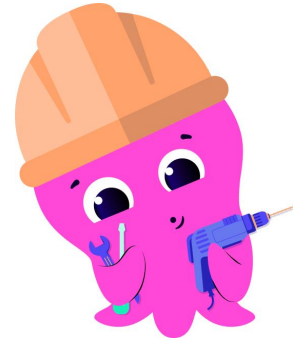
We've achieved this growth by delivering



**Outstanding
customer service**



Fair pricing



**Innovative products
that customers want**

But, onto VPPs...

#1

Campaigns



#2

Prices



#3

Automation



1. Campaigns

Campaigns involve asking
**customers to use more or less
electricity during a given period**

Saving Sessions

ACTION: Join the first of our Saving Sessions on 15th November, 5:00 PM to 6:00 PM



Octopus Energy <hello@octopus.energy>
to me ▾

Tue, 15 Nov 2022, 08:15



Scam warning: Fraudsters are pretending to be Ofgem. If you receive a call or email telling you to apply for your energy bill rebate, ignore it. We'll apply your rebate automatically as soon as you're entitled to it.



Kit Fitton

Account no. A-F4FDBF7F

31 BRIDUS MEAD, BLEWBURY, DIDCOT, OXFORDSHIRE

Hi Kit,

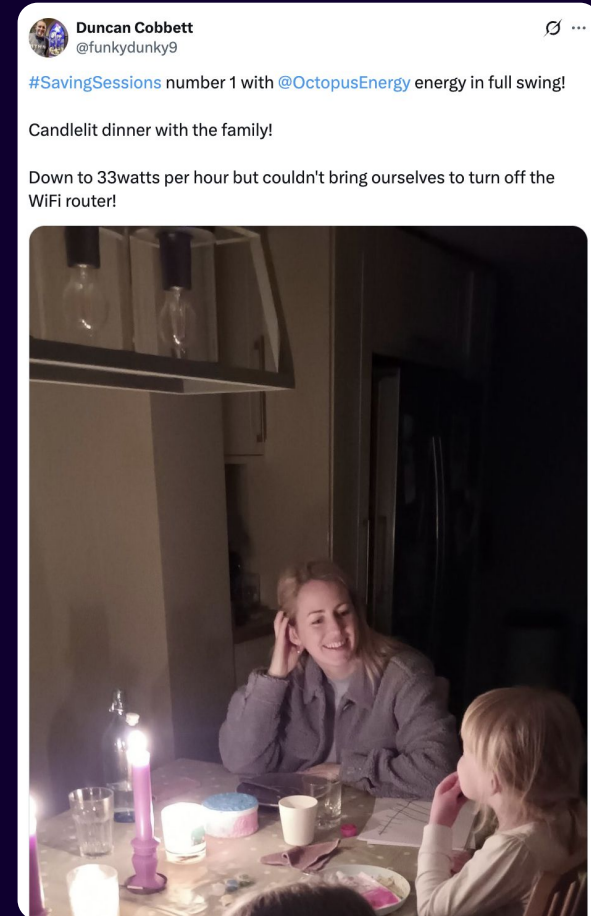
You'll earn 1800 OctoPoints – **that's £2.25 worth** – for every unit of electricity you cut down between 5:00 PM and 6:00 PM on 15th November.

Opt in now to save power and earn rewards in this Session. You'll go into a draw to win an extra 400,000 OctoPoints – that's £500 worth! – just for opting in.

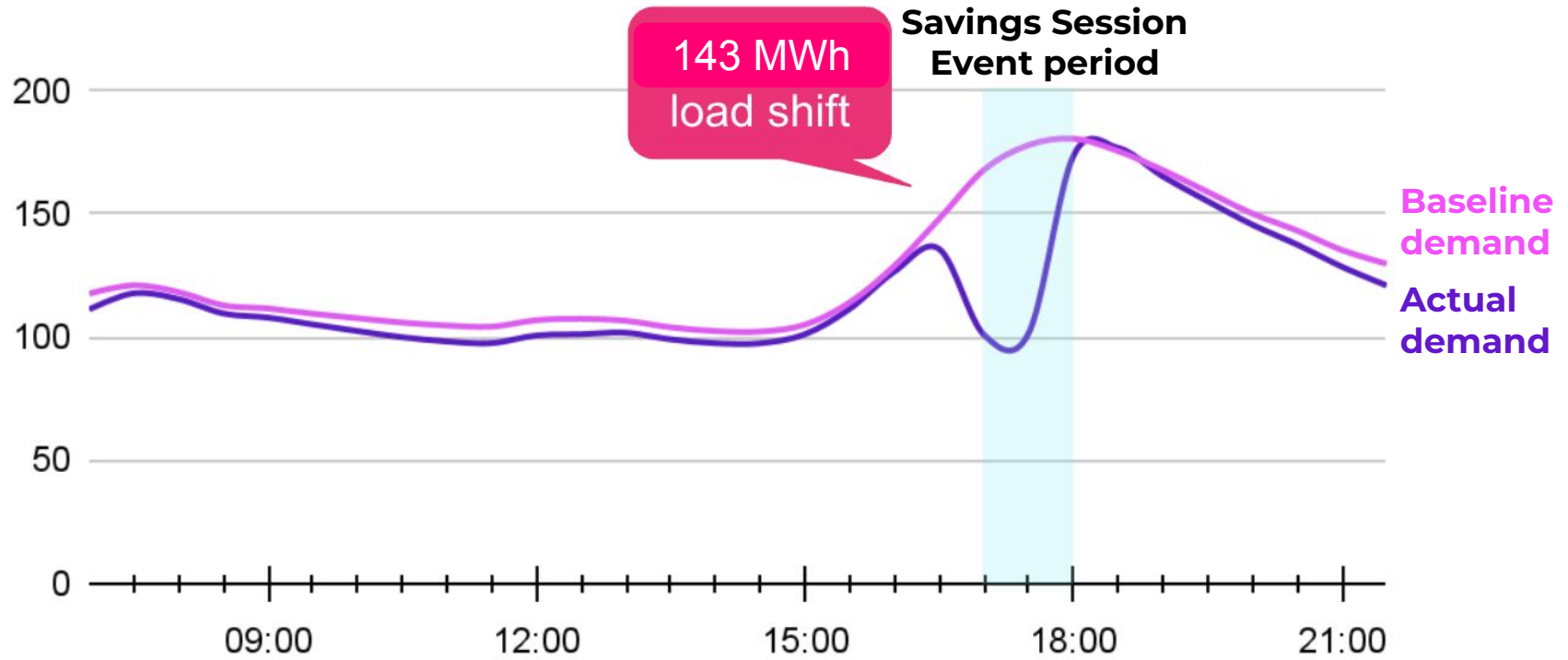
I'm in!

Important: **you need to opt in before the Session starts** if you want to earn rewards.

1.6m customers have participated

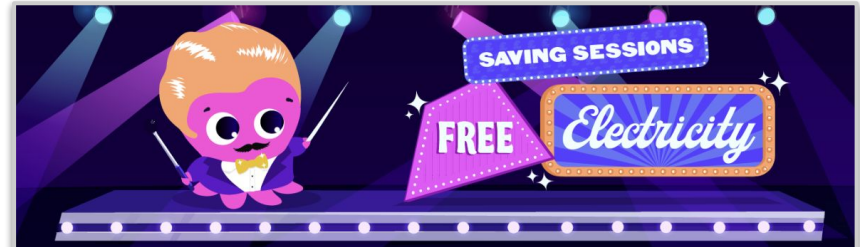


Electricity demand amongst Saving Session participants, MWh



Source: internal Octopus data

Free electricity when there is an excess of renewables on the grid



Hi Kit,

There's plenty of green power in the wires tomorrow, and you know what that means...

Free Electricity Session 2-3pm, Sunday 31st August!

Get ready to fill your boots

Plan to shift any electrified activity into that hour, be it hoovering, laundry or realistically, sitting in front of a fan. The power you'd normally use costs the same. **Any extra you use will be free!**

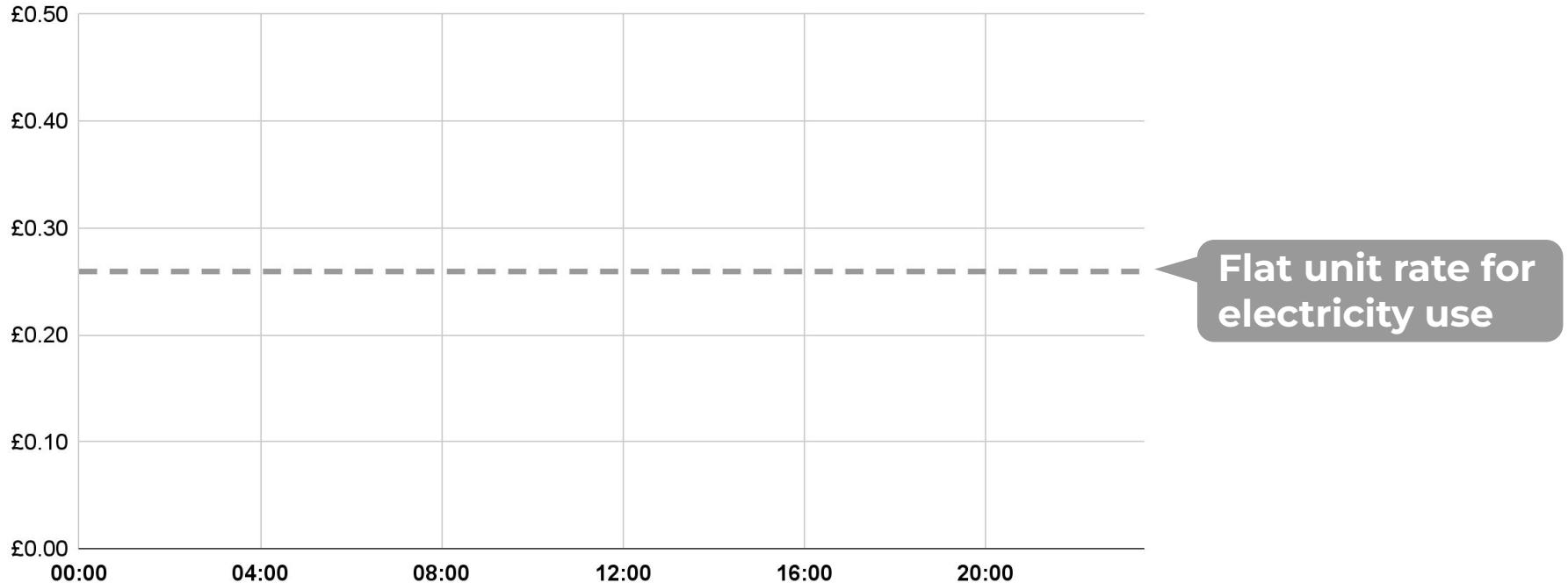
If you're an Intelligent Go or Intelligent Flux customer, you can now get your extra household power free as well as an hour's free charging credit. Head to the FAQs for more info on how it works for Intelligent customers.

So far, **you collectively used a whopping £504,570 of free electricity: that's enough to power the Large Hadron Collider for 12 hours!** Head to the FAQs below to find your personal results.

2. Prices

**Expose customers to price signals
and leave them to shape their
demand in response**

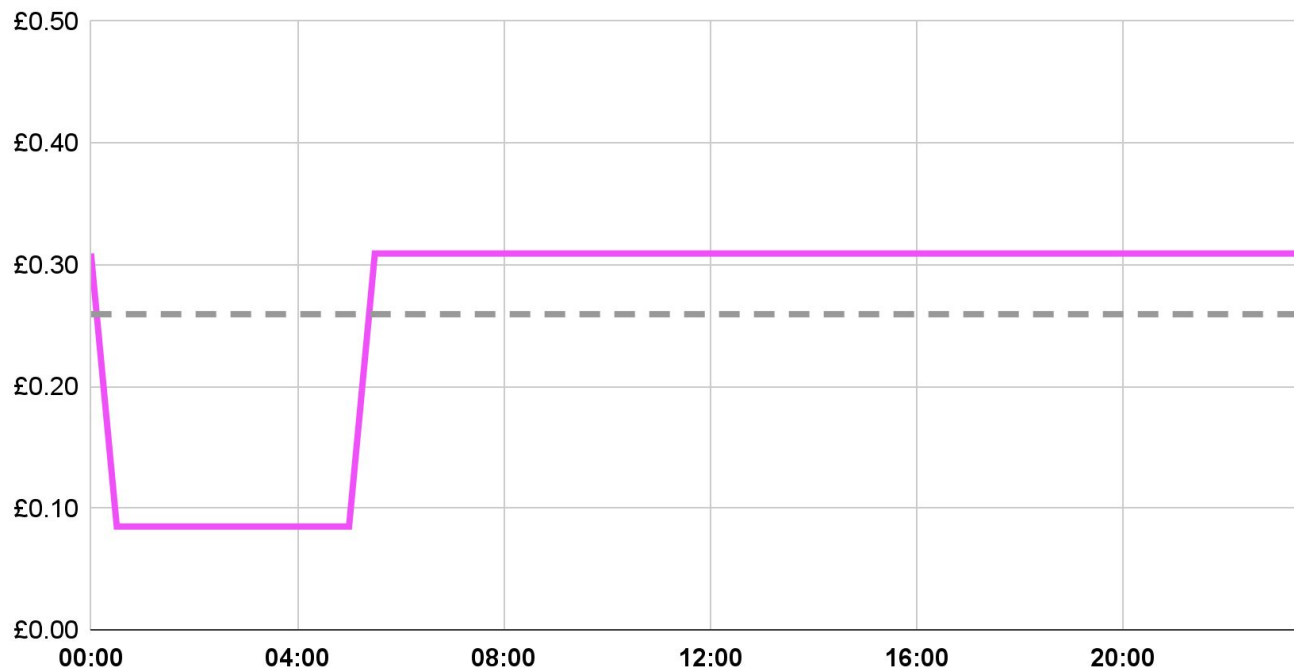
Typically customers pay a flat rate for electricity regardless of when they use it



**We can use prices to influence
when customers use electricity**

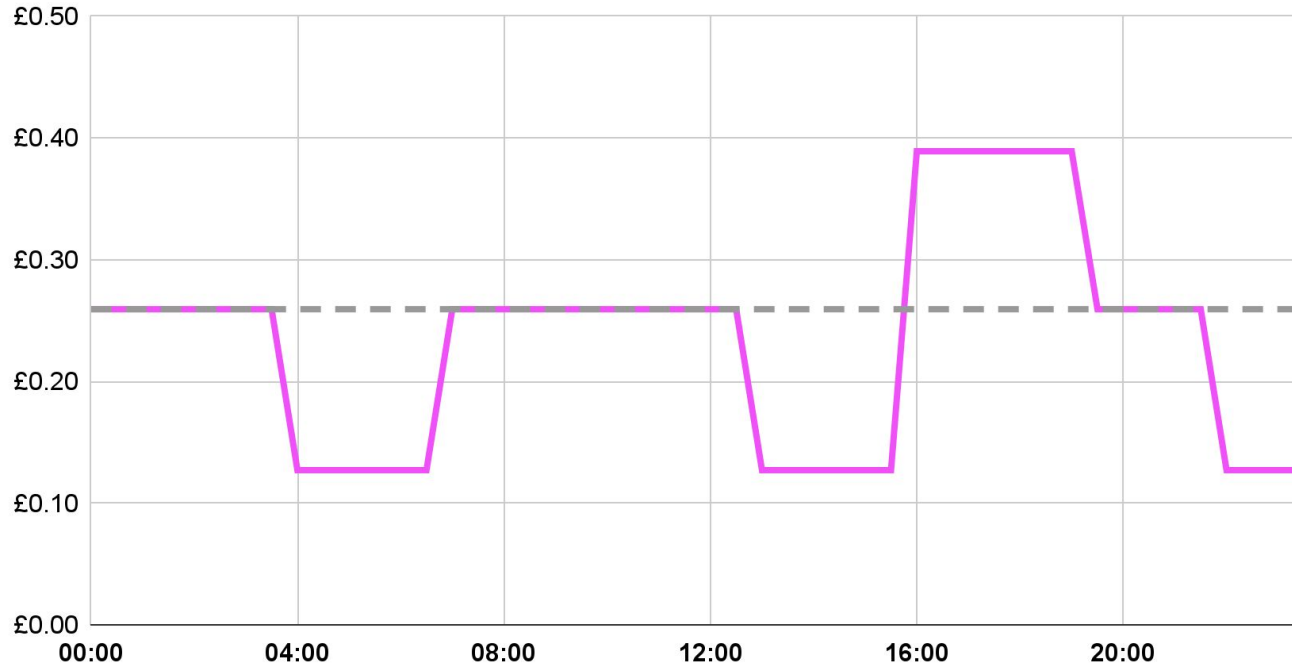
Time of use pricing

Octopus Go makes it cheaper for EV drivers who charge overnight



Cheap electricity overnight for EV charging

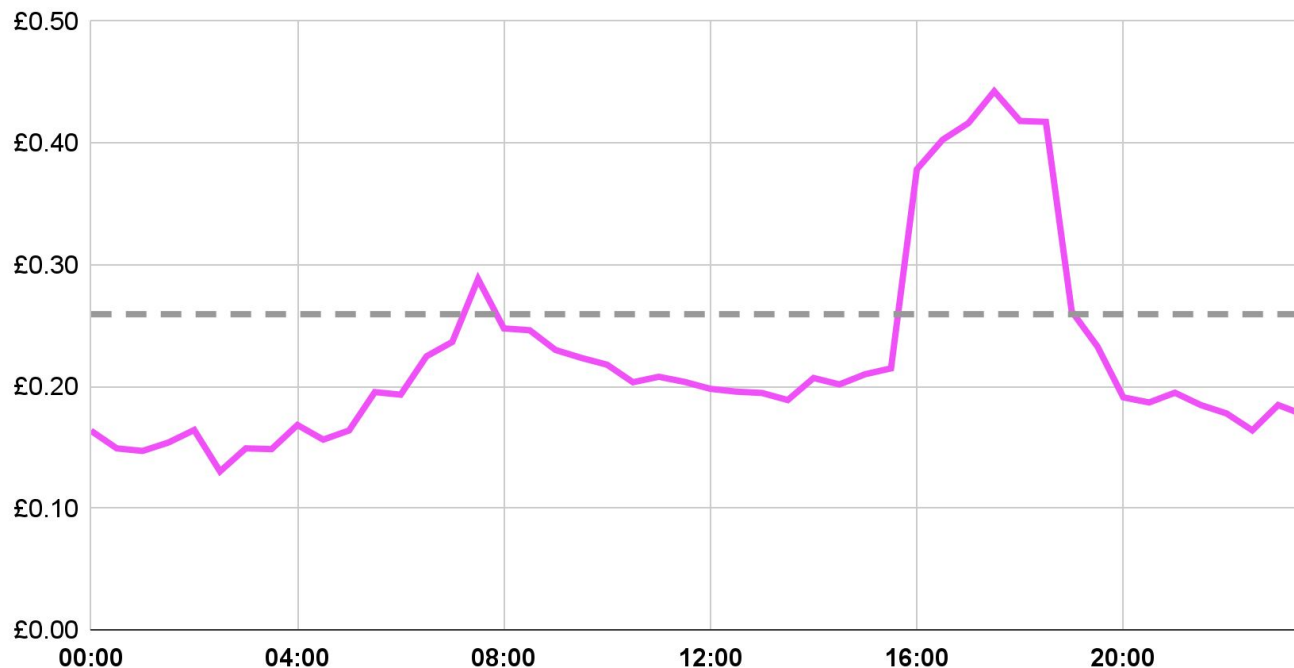
Octopus Cosy makes it cheaper for heat pump owners who avoid peak times



Cheap electricity outside peak times for heating

But these prices are static from day to day and don't reflect what is actually going on with the grid.

Octopus Agile reflects the spot price of electricity each day



30-minute pricing that changes from day to day

3. Automation

Automation involves taking direct control of devices in a customer's home and deciding when they should use electricity

EV



EV charger



Heating & cooling



Solar & battery



Note: includes integrations that are live and in development

Select the device you would like to integrate with

If you have multiple devices, just pick one.

Intelligent Octopus may only be able to connect to certain models.



Electric Vehicles



Chargers



Heat pumps



Thermostats



Hi Harry,

Let's get you set up

Car

Tesla



Model

Model 3 Standard Range +



Charger

Generic



Model

7kW



Authenticate device



Test charger connection

We've mapped your upcoming charge

[View charging schedule](#)

- ⚡ 22:00 - 23:00
- ⚡ 00:30 - 06:00
- ⚡ 06:00 - 06:30
- ⚡ 07:00 - 07:30

[ⓘ Charging explained](#)

Charging preferences

Charge limit **100%** [v](#)

Ready by time **07:30** [v](#)

Need to charge now? [Bump Charge](#)

Charging history

**A customer's EV charging
cost is reduced by 70%**

If they let Octopus control when their car charges

>400,000
connected
devices

>2.5 GW
of total
capacity

Zero Bills Homes
**No energy bills for
10 years.
Guaranteed**



#1

Campaigns



#2

Prices



#3

Automation



Requirements for delivering VPPs

- 1. Shift demand**
- 2. Measure impact**
- 3. Get rewarded**

1. Shift demand

Campaigns

Time of use prices

Connected devices
(e.g. EVs, AC)

2. Measure impact

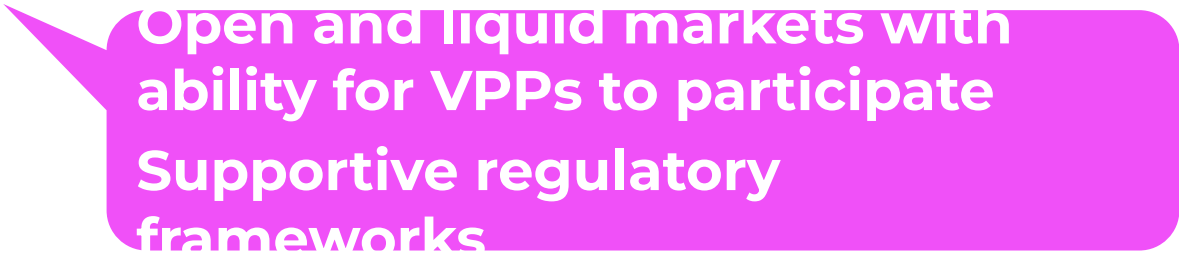
3. Get rewarded

- 1. Shift demand**
- 2. Measure impact**
- 3. Get rewarded**



Smart meters
Device-level
measurement

- 1. Shift demand**
- 2. Measure impact**
- 3. Get rewarded**



Open and liquid markets with
ability for VPPs to participate
Supportive regulatory
frameworks



Thank you.

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Questions & Answers

Do not miss our next events by
subscribing here:





Thank you!

**And please answer our
small survey!**

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