



Towards 2030

An Electricity System Operator for Great Britain's Energy Future

nationalgrid**ESO**

Stepping up to the challenge

As the legally separate Electricity System Operator for Great Britain, we are privileged to sit at the heart of the energy system, running the electricity network safely and efficiently while enabling and accelerating progress towards a net zero energy future. This also means that, together with our stakeholders, we are responsible for tackling some of Great Britain's most pressing energy challenges.

The world of energy is undergoing fundamental transformation. Cleaner forms of energy like wind and solar are increasingly replacing traditional fossil fuel generation; energy storage is becoming mainstream and consumers are increasingly becoming more active in making energy choices, for example through the electric vehicles and solar panels they buy.

Those changes will continue as the industry evolves over the next decade towards 2030 and beyond. It will become increasingly challenging to maintain the delivery of reliable affordable energy – and as Great

Britain's Electricity System Operator, we will need to evolve to meet this challenge.

The path ahead for energy is both exciting and uncertain, and we must navigate this together as an industry. In sharing our vision for the future with you, we hope to stimulate the conversation across the Great Britain energy landscape.

We look forward to your reflections on this document and continuing towards 2030, together.

Fintan Slye

Director, GB Electricity System Operator



The journey to a net zero future has already started; this document builds on our Future Energy Scenarios to identify what a decarbonised **2050 energy landscape** might look like, and uses this to help us understand the **energy system of 2030**.

The next decade towards 2030 is vital and the decisions we take today will pave the way to a new energy era. Our **focus areas** will guide us in this journey to deliver value to energy consumers into the future.



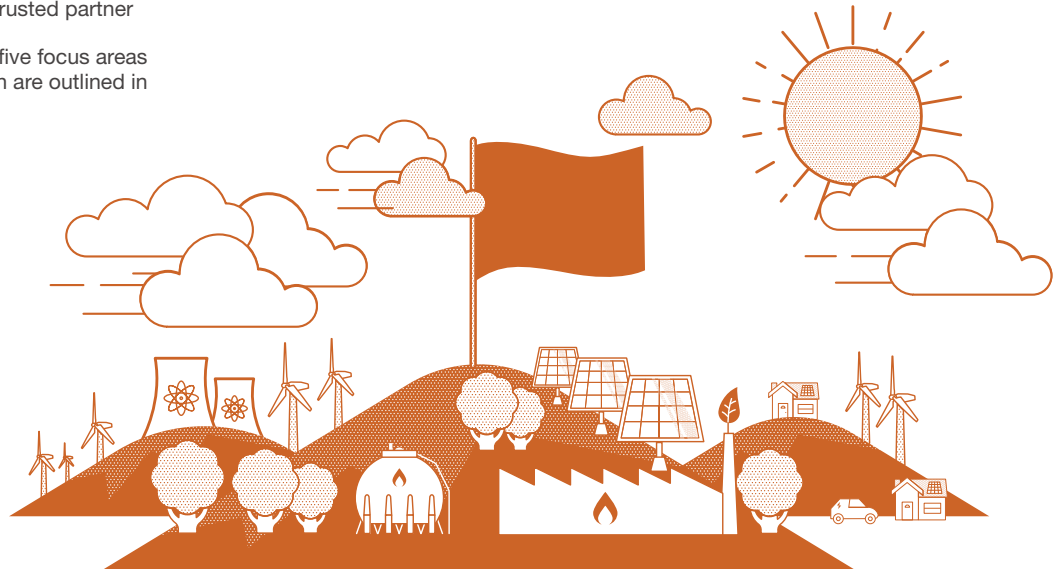
Our Mission

We enable the transformation to a sustainable energy system and ensure the delivery of reliable, affordable energy for all consumers

Success in 2025 looks like:

- An electricity system that can operate carbon free
- A whole system strategy that supports net zero by 2050
- Competition everywhere
- The Electricity System Operator is a trusted partner

To achieve our mission, we have set out five focus areas for the Electricity System Operator, which are outlined in this document.



The 2050 net zero energy landscape*

The energy industry has a clear goal for 2050: a net zero society where our relationship with energy has changed. We will have gone from being consumers to prosumers – generating and storing our own clean energy to use when we need it, or selling it back into the network when we don't.

Our homes and businesses will be heated by a combination of technologies including district heating, heat pumps and hydrogen boilers, and will be far more thermally efficient. Petrol and diesel vehicles will be a thing of the past; our cars will be electric and commercial vehicles

(e.g. HGVs) powered by either electricity or hydrogen.

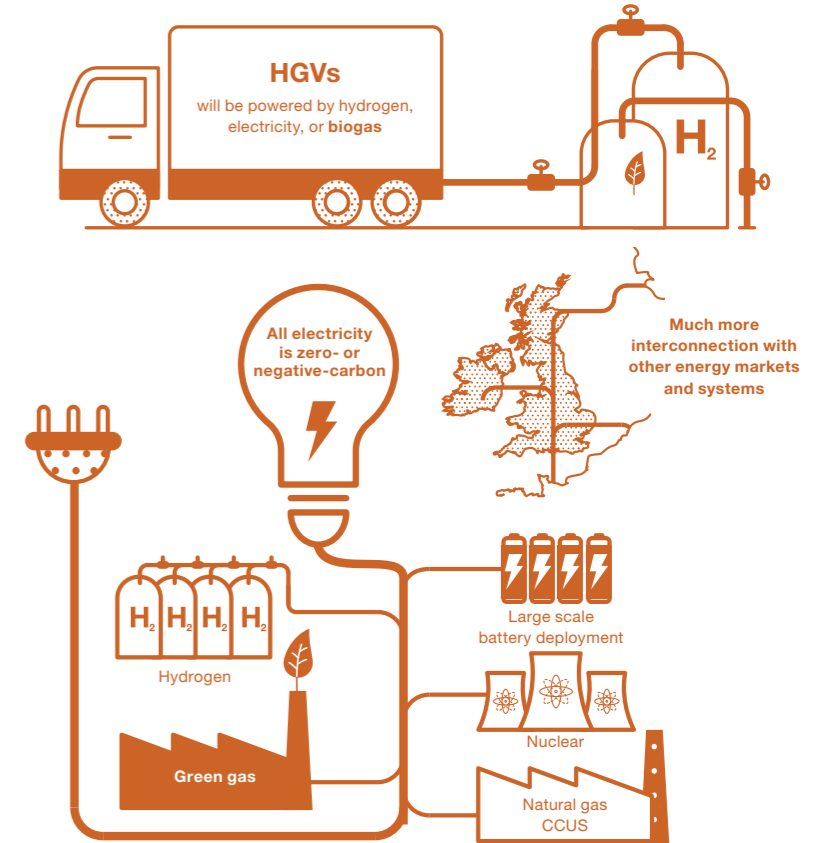
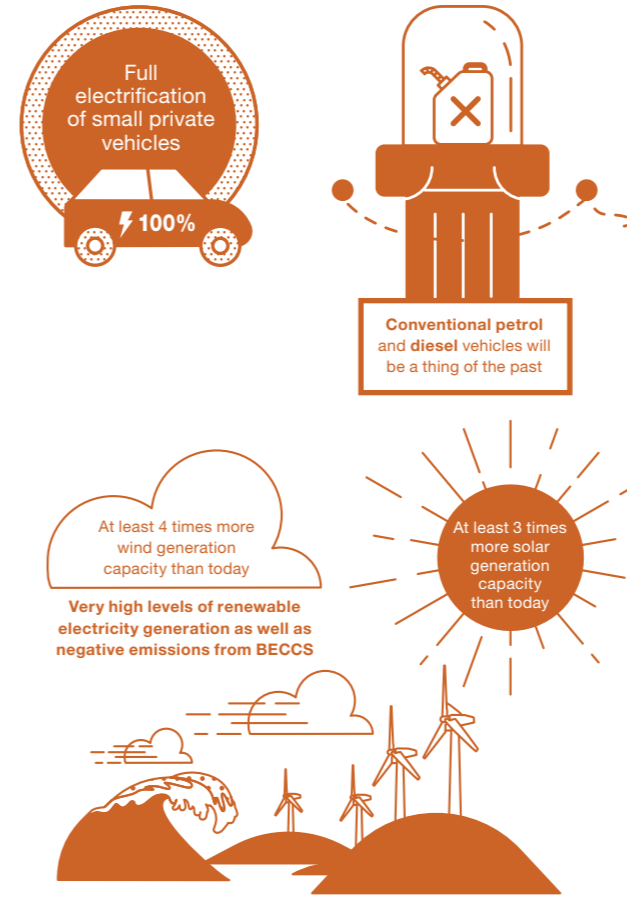
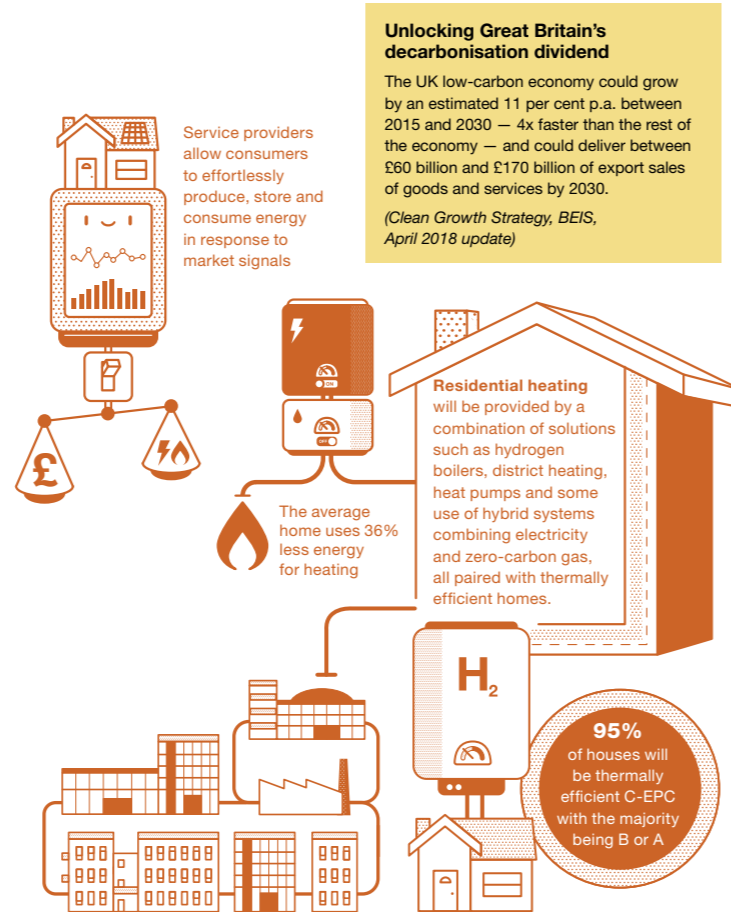
Our energy infrastructure will have fundamentally changed too. Much of our energy will come from renewables, backed by nuclear and zero-carbon gas. Flexible local energy networks will be the norm, coupled with large-scale use of storage that releases energy when and where it's needed.

The benefits for society are huge, but achieving this will require a radically new systemic approach and our roles as Electricity System Operator at the heart of the energy revolution will need to evolve.

The global benefits a low carbon energy system

By 2050, energy system decarbonisation efforts will add 19 million jobs and \$52 trillion to global GDP, increasing the GDP of Northern and Western Europe by 1.25 per cent and 2.5 per cent respectively. It will also generate a 15% increase in global welfare and reduce negative health effects caused by local air pollution by 60%.

(International Renewable Energy Agency, A Roadmap to 2050)



*This view of the 2050 landscape is based on the net zero sensitivity in FES 2019



2030: a time of transition

What will the world of energy look like by 2030? Let's fast-forward to what we believe will be a critical period for us.

We are supporting the fundamental change across industry that is required to thrive in this new environment, driving innovation and harnessing emerging technologies to deliver flexible and responsive infrastructure and meet the challenge of decarbonisation head on.

Increasingly, we no longer think in terms of gas and electricity as separate systems; we plan and manage our electricity networks to be smarter, welcoming new players who want to connect to the networks, and providing a transparent and efficient market-driven environment where everyone can contribute to the new world of energy.

In the background, energy policy is changing as government focuses on its environmental targets. New market regulations are coming into play with much stronger emphasis placed on flexibility, reliability and competition.

The impact on electricity system operations is enormous. And we will play a crucial role in delivering the new energy landscape, although we cannot do it without cross-industry collaboration and the innovation and expertise of our stakeholders and partners.

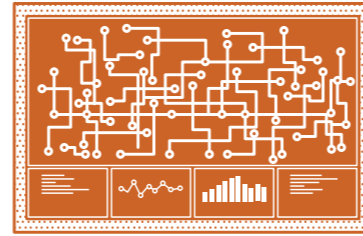
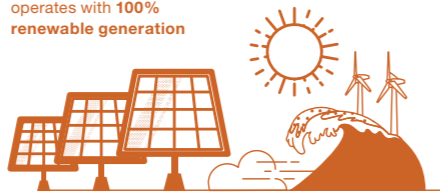
Delivering value with a smart, flexible whole energy system

Between £3.2 billion and £4.7 billion of benefit could be realised per year, through integrating high levels of flexibility such as interconnectors, demand-side response and storage across the whole energy system.

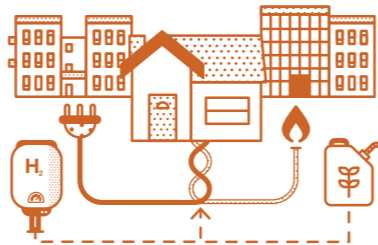
This will require a deep understanding of the capability of our network infrastructure. It will also require flexible and intelligent operation across all networks, with market mechanisms which are open to any asset or service which can support grid stability and security.

(Roadmap for Flexibility Services to 2030, a report to the Committee on Climate Change, May 2017)

Electricity system regularly operates with **100% renewable generation**



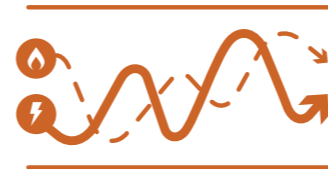
All electricity networks are actively managed
Distribution system operation is the norm and all networks are actively managed in real time



Network operations, planning and investment
Smart flexible networks, intelligent monitoring and commercial solutions enable optimisation of planning and investment across the whole energy system



Competitive markets are designed and operated to ensure efficient and reliable operability, balancing supply and demand on the electricity system



Risk and resilience is managed across the whole energy system. System event readiness, management and recovery is integrated across electricity transmission and distribution networks



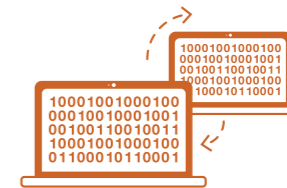
Large volumes of **long-term energy storage** are available



Artificial intelligence and machine learning are commonplace across all players in the industry, including vehicle charging, appliances, market participation and system operation. Critical functions such as system balancing always have human involvement

Doing more with less: operating the whole electricity system with open, efficient markets.

Active distribution system operation and the optimisation of planning and investment across the whole electricity system will reduce consumer cost by minimising the need for network build. It will also open up markets to a larger and more diverse range of flexibility providers, such as low-carbon generation, improving liquidity and efficiency of markets. Overall, this will lower bills and reduce environmental damage.



Data is shared openly wherever possible to inform competitive and efficient markets, enable innovation and inform change across industry



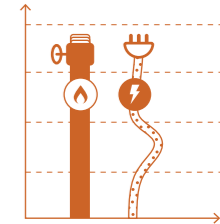
Codes, frameworks and governance that facilitate competitive and efficient electricity markets are developed, as the pace of change increases and the number of market participants grows



New commercial frameworks and markets support whole electricity system flexibility and operability, as well as potential new vectors (hydrogen, CO₂)



Policy direction on the decarbonisation of heat has been set and the first commercial deployments of new technology will be rolling out



Consistency across networks for customers

A consistent and co-ordinated customer connection process is used across electricity transmission and distribution networks

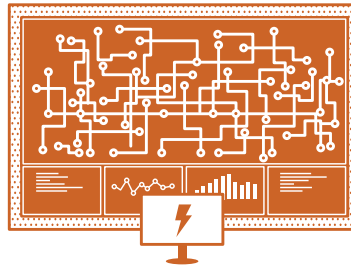
Connection requirements are aligned across transmission and distribution networks

Towards 2030: our focus areas

We have shared our vision for how we see the future of energy developing over the next decade and towards 2050. It is both exciting and enormously challenging to deliver and as Electricity System Operator for Great Britain, we are perfectly placed to lead the industry into a new era for energy.

As the industry transforms we believe our role at its heart must also evolve as we call on innovative technologies, open markets and new ways of working. We have therefore identified five focus areas that will underpin the Electricity System Operator of the future:

1. The engineering transformation: ensuring reliable, secure system operation to deliver energy when consumers need it



We will keep the lights on, maintaining today's reliability levels through regular periods of zero carbon electricity and highly dynamic demand. We will ensure our control centres remain resilient, flexible and agile, with the ability to keep pace with the changing energy system.

Ongoing operation activities will be coupled with a focus on innovation, ensuring we can always meet evolving operability challenges in the face of a transforming energy landscape.

We take security of supply seriously and work to support the government in ensuring that Great Britain can meet its energy needs. This means that we take a leading role in ensuring that electricity markets, networks and frameworks in Great Britain, and our interconnected markets, are efficient and fit for a changing energy future.

Spotlight Initiative

Carbon-free operation of Great Britain's electricity network by 2025

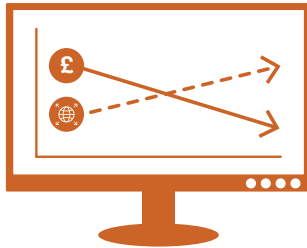
We aim to have the capability to operate a 100% zero-carbon electricity system for Great Britain by 2025. This will require a transformation in the approach to real time operations, as well as in the markets which underpin the provision of generation, capacity, and the products which enable electricity system balancing and operability.

This will also require re-thinking operation of the gas system, as high volumes of renewable energy drives increased and accelerated demand variability in power generation from zero-carbon gas. New approaches to real-time operations, predictive modelling, and commercial tools will be required to operate the gas network securely and reliably.

We are investing to harness new methods in data science and automation, reviewing system standards and requirements, and reviewing commercial products, markets, and frameworks in collaboration with partners from across and beyond the energy industry.



2. The market transformation: unlocking consumer value through competition



We are driven to delivering efficient outcomes for consumers and never forget that everything we do has an impact on consumer energy bills. Consumers spend over £35 billion* through electricity balancing services, wholesale and capacity markets every year, and we believe that these markets can deliver more efficient outcomes and benefits for consumers.

We will maximise consumer benefit by facilitating competitive markets and managing system costs. And a key focus is enabling whole system flexibility through the markets we operate.

Our balancing markets are estimated** to have the potential to deliver £3.2 billion to £4.7 billion of annual consumer benefits in a 2030 system meeting a carbon emissions target of 50gCO₂/kW. We will decarbonise and distribute those markets, and will also transform access to the Capacity Market, to help achieve the UK's commitment to net zero emissions by 2050.

The diversity of participants in our markets is growing, and where there are hundreds of participants today, there will be thousands engaging in our markets in 2030. These markets must work for everyone – new players and current stakeholders alike – and we will take a leading role in the design of efficient electricity markets that do exactly this. Driving competition through opening access to the market mechanisms that we manage is a key outcome, and we aim to use a market 'sandbox' approach to accelerate the change in these markets.

We seek the best whole system solutions, working across transmission, distribution, gas and electricity networks to deliver

energy to Great Britain's homes and businesses as efficiently as possible.

We will continue to manage our internal operating costs and investments tightly, keeping consumer value at the heart of everything we do.

Spotlight Initiative

Driving competition in networks

We estimate that our 2018/19 network development recommendations could save consumers between £1.85 billion and £2.67 billion over the next eleven years.

Over the next ten years, we will further optimise the tens of billions of pounds of whole network spend across electricity and gas, finding the most cost-efficient solutions to network issues.

This means building on our deep understanding of whole energy system operability and creating market mechanisms which allow any technology or service to provide solutions to network problems. Opening up these markets will spur innovation and drive competition. This will translate to lower bills for consumers, improved reliability, and benefits for society as a whole by minimising disruption to communities through avoided building of infrastructure.

(National Grid ESO analysis)



3. The sustainability transformation: enabling and supporting the drive towards a sustainable whole energy future



Delivering a net zero energy system by 2050 is central to our strategy and we will act as a key enabler for change.

We will use our unique position in the industry to help Great Britain meet net zero through driving debate and collaborative action across the energy sector.

We will also act as an enabler of innovation across the industry, working with our network and industry partners to explore new opportunities to deliver value across the transmission and distribution boundaries of the whole energy system.

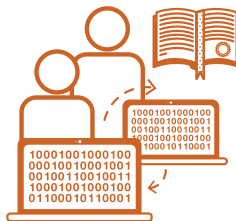
Spotlight Initiative

Supporting the drive towards a low-carbon whole energy system

We will support key decision-makers to deliver a credible and operable whole energy pathway, and will also proactively support the development of informed and ambitious policy that delivers the net zero emissions target.

Setting the pathway to a decarbonised future will go beyond reducing environmental damage, and will support industry in innovation and long term investment decisions that accelerate progress towards a sustainable whole energy system.

4. The smart transformation: driving innovation and increased participation across the energy landscape



We will provide exceptional customer service which creates opportunities and supports those who connect to the network and participate in electricity markets.

It is our duty to make sure all participants understand how we operate the system, and its rules and processes, so that

they can play a full and active role in enhancing the reliability and value of the whole energy system to consumers.

We will be transparent in what we do, enabling competition and fostering innovation by sharing accessible, machine-readable data openly with industry participants wherever possible, through our data portal. We will put a particular emphasis on collaborating with network companies to build a whole system view of planning and operations.

Championing efficient and effective governance is something that we strive for, as we believe that it underpins the rapid change required to meet the UK 2050 net zero target. We will put a particular emphasis on collaborating and sharing data with network companies to build a whole system view.

Spotlight Initiative

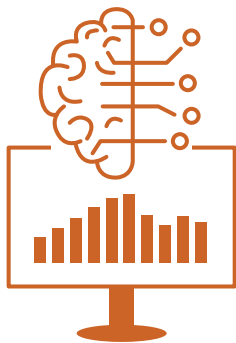
Efficient electricity markets for everyone

We are trialling an auction platform that enables closer to real-time procurement in balancing service markets for all providers, including low- or zero-carbon power generation and demand side flexibility. The initial platform is in trial and expected to deliver up to £6m of benefit annually.

Further rollout will widen participation and create clearer price signals, driving more competition. This will in turn deliver lower bills than would otherwise be the case and reduce environmental damage.

(National Grid ESO analysis)

5. The capability transformation: developing the right people and systems to deliver the future



We must attract, develop, and retain the people who will realise our 2030 ambition through their talent, skill and passion. The way that we work as an organisation, both internally and with our stakeholders across industry, must be flexible, proactive, and with consumer value in mind at all times. We will empower our people to drive change while understanding and communicating what it will mean for all participants across the whole energy system.

A key focus will be continuing to build the capability of our people and systems to unlock value from the growing quantity and complexity of data and

data tools. Data underpins every element of our role and our ability to realise its value will only grow in importance.

In particular, we will leverage the value of extensive automation, greater use of artificial intelligence and enhanced training and simulation, to deal with the vast amount of data needed to run the electricity system.

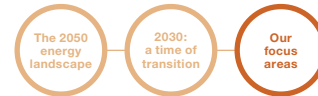
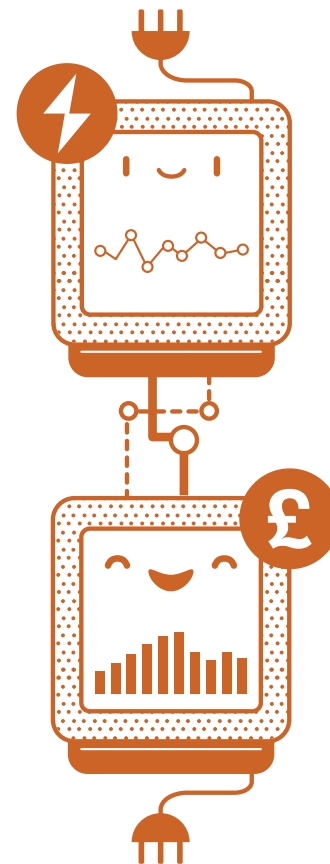
Spotlight Initiative

Open data wherever possible

Artificial intelligence has the potential to create £232 billion* of value in the UK economy by 2030 and in the energy industry, data availability will be the driver for change.

We will provide open, automated, and machine-readable data wherever possible. Our data will be presumed open, with access only ever being restricted to mitigate security, privacy, legal or consumer impact risks.

We will champion open data sharing and governance across the energy industry, as data access improves market efficiency and creates the conditions for innovation across industry, thereby lowering consumer bills and delivering benefits to society as a whole.





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