Future of Gas

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Future of Gas

Our gas infrastructure assets

Gas distribution
North Eastern United States

36,000 miles
of natural gas pipeline in
New York, Massachusetts, Rhode Island

3.6 million
gas accounts

Gas transmission
Great Britain

7,630 km
high-pressure pipe

24
compressor stations

504
above-ground installations

8
connected
distribution networks

Assets by segment
as at 31 March 2020

1 Net assets excluding debt/funding balances
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Why gas matters

Gas has a role in decarbonising industry, heavy goods vehicles and shipping.

UK
22 million homes using gas
implies conversion of
0.2 million homes
every week from
2025 to 2050 to decarbonise

US
3.6 million gas accounts
implies conversion of
2.3 million homes
every week

Research backs a balanced approach
- Future energy scenarios
- Committee on Climate Change
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Working with US policy makers

Collaborating with NYC Mayor’s Office and Con Edison
- Analytical assessment
- Portfolio of solutions to be carbon neutral
- Gas networks can be reimagined
- Existing infrastructure key to reaching net zero

Balancing long term and near term focus
- Need to invest for safety and reliability
- Continue to work with Regulators
  - Multi year settlements
  - Protection against cost pressures
  - Incentives to create value for customers
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Working with UK policy makers

Recent policy announcements
- Highlighted wider role gas needs to play
- Collaboration led to fast pace of development
- Recognise gas has a critical role
  - Energy security
  - Economic contribution
- Scaling up of hydrogen by 2030
- Faster development of CCS

Clear focus on
- Balance of technologies being needed
- Decarbonised gas and electricity complementing each other
- Addressing the challenges of all our gas assets
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Summary

• Gas has a key role accelerating progress to net zero
• Working collaboratively with all key stakeholders
• Investment levels becoming evident
• Proud of the achievements to date
Grid Guide to the Future of Gas

Cordi O’Hara
Chief Operating Officer, US Gas Business
US Gas Business overview

### Gas demand and growth

**Design-Day Peak Gas Demand** (Bbtu)

<table>
<thead>
<tr>
<th>Service Territory</th>
<th>Winter ‘20/’21</th>
<th>Projected ‘20–’25 CAGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downstate NY</td>
<td>2,774</td>
<td>2.3%</td>
</tr>
<tr>
<td>Upstate NY</td>
<td>898</td>
<td>0.9%</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>1,404</td>
<td>2.1%</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>383</td>
<td>2.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5,458</strong></td>
<td><strong>2.0%</strong></td>
</tr>
</tbody>
</table>

Demand growth driven primarily by customer conversions to gas, new households, and increases in business and economic activity (e.g. construction of new commercial space).

36,000
Miles of natural gas pipeline in New York, Massachusetts, Rhode Island

3.6 million
Gas accounts

Gas accounts

36,000 Miles of natural gas pipeline in New York, Massachusetts, Rhode Island

Gas accounts

Downstate NY
Upstate NY
Massachusetts
Rhode Island
Total

Winter ‘20/’21
‘20–’25 CAGR
2,774
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2.0%

Demand growth driven primarily by customer conversions to gas, new households, and increases in business and economic activity (e.g. construction of new commercial space).
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US Northeast decarbonization goals

Massachusetts:
- **Global Warming Solutions Act of 2008:** Calls for 80% reduction in GHG emissions below statewide 1990 levels by 2050
- Executive action has committed MA to net-zero by 2050

New York:
- **Climate Leadership and Community Protection Act (CLCPA) of 2019:** Calls for an 85% reduction in GHG emissions by 2050

Rhode Island:
- Non-binding goals for GHG emissions reductions of 10% below 1990 levels by 2020; 45% by 2035; and 80% by 2050
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Our plans: net zero by 2050

Responsible Business Charter (UK/US)

- **Commitment:** Reduce Scope 3 GHG emissions for the electricity and gas we sell to our customers by 20% by 2030 from a 2016 baseline
- **Ambition:** Further reduce our Scope 3 emissions from selling gas to our customers beyond 2030 to be consistent with the targets set by the markets in which we operate (e.g. net zero by 2050)

NGUSA Net Zero by 2050 Ambition
(5 of 10 Pillars include the Future of Gas)

- Decarbonizing the gas network with renewable natural gas and hydrogen
- Integrating innovative technologies to decarbonize heat, incl. heat pumps and geothermal networks
- Reducing demand through energy efficiency and demand response
- Reducing methane emissions from our own gas network while working with the industry to reduce emissions through the entire value chain, and
- Investing in large scale carbon management technologies (e.g., CCS, offsets)
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Evolving US landscape

Gas network decarbonization

Level of interest, investment, and scale

- State decarbonization ambitions
- Academic / NGO studies
- Deep decarbonization pathway analysis
- Evolving gas business planning capabilities

Maturity

- Industry R&D
- Technology pilots / demos
- Nascent programs
- Regulatory and policy support for innovation
- Decarbonization pathway optionality

- Preferred decarbonization pathway alignment
- Regulatory and policy commitment
- Large-scale investment
- Gas business capability development
Today’s gas network as an energy network in transformation

Networks deliver molecules, and those molecules will look different in 2050 as we:

- Scale RNG from sustainable biomass feedstocks
  - Newtown Creek Wastewater Treatment Plan (Q2 2021)
  - NY RNG Interconnection Guidelines (in use)

- Lay the foundation for hydrogen use
  - NYSERDA/Stony Brook University Hydrogen Blending Demonstration Project (2019-2021)
  - Research Partnerships

- Create policy frameworks to support RNG and hydrogen
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Advancing the energy network of tomorrow

Aligning Internal Capabilities and Support

- Adoption of RNG interconnection standards
- Dedicated “Future of Heat” engineering group

Proposals:

- **Massachusetts**: Two Phase Project: (1) Hydrogen Blending Campus Study and (2) Network Hydrogen Blending Study (up to 1,000 customers)

- **New York**: Interconnection incentives for two projects annually and for central digester interconnection.
  - Multi-Use Hydrogen Facility, in partnership with Standard Hydrogen Corporation and located at an industrial site

- **Rhode Island**: Proposing amendment to the Advanced Gas Technology program to allow program to support decarbonization projects, including hydrogen

Next Steps:

- **All NG States**: RNG Procurement Program (1 to 5% of annual supply within 5 years)
- Building Policy Frameworks to Scale Supply, Demand, End-Use
- U.S. Department of Energy Research Project: HyBlend
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**Advancing the energy network of tomorrow: HyBlend**

**US DOE HyBlend Project (2020-2022)**

- NG playing a leadership role in this research effort which includes six national laboratories and twenty industry partners, including major utilities
  - Builds upon NG partnership with Stony Brook University founding the Institute of Gas Innovation and Technology

- $12.5 million hydrogen blending research project focused on eliminating technical barriers to blending hydrogen in natural gas pipelines

- Main research areas include:
  - **Hydrogen compatibility evaluation** of piping and pipelines, including metal and polymer materials;
  - **Life-cycle emissions analysis** of technologies using hydrogen and blends; and
  - **Techno-economic analysis** quantifying the costs and opportunities for hydrogen production and blending in the energy network
Grid Guide to the Future of Gas

Antony Green
Project Director – Hydrogen
Future of Gas in the UK Business

Repurposing UK gas transmission assets

HyNTS > Hydrogen into the National Transmission System is our programme of hydrogen research

Network Capacity

First results from a model of the NTS converted to hydrogen demonstrate that the current infrastructure can carry the required volumes of hydrogen in 2050.

Reinforcement will be required as hydrogen demand estimates grow.

Requirements will depend where hydrogen production is located.

Asset Readiness

Results from a first data request from our suppliers infer a high degree of readiness for hydrogen – full asset risk model required.
This ambitious programme is to build a hydrogen test facility from decommissioned assets at DNV GL Spadeadam to demonstrate the National Transmission System (NTS) can transport hydrogen.

The project will be delivered in three phases:

- **Phase 1a** - Offline Facility Build: May 2021 until Jan 2022
- **Phase 1b** - NTS Asset Testing: Jan 2022 until Sep 2022
- **Phase 1c** - Safety & Risk Impact: Feb 2022 until Mar 2023

The FutureGrid test facility will connect to the existing H21 distribution facility creating a representative UK Hydrogen Testing and Training Facility:
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Hy Street
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Hy Street
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FutureGrid aerial view
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**FutureGrid aerial view**
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Offline facility build

Constructing the test facility from decommissioned assets to provide a representative NTS in the most efficient and effective way.
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Offline facility build

**Phase 1a**
Constructing the test facility from decommissioned assets to provide a representative NTS in the most efficient and effective way.
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Offline facility build

Constructing the test facility from decommissioned assets to provide a representative NTS in the most efficient and effective way.
Offline facility build

Phase 1a

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Constructing the test facility from decommissioned assets to provide a representative NTS in the most efficient and effective way.
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Roadmap to live trials

Phase 1
NTS Hydrogen Test Facility
Build an offline hydrogen test facility using decommissioned assets to assess the impact that blends of hydrogen up to 100% will have, to facilitate the gas network transition to hydrogen

Duration: Apr 2021 – Apr 2023
NIC 2020 Bid

- Links to H21 distribution test facility
- Hydrogen ready transmission asset strategy - replace / reuse / update
- Hydrogen storage
- Hydrogen Asset Maintenance & Repair
- Hydrogen training
- Academic research & links

Phase 2
Deblending & Compression
Validate deblending technologies to separate hydrogen from natural gas and demonstrate its impact on operating compressors, to enable a flexible system transition to hydrogen.

Duration: 2022 - 2024

- Compressor technologies
  - Use of hydrogen to drive the turbines and gearing to meet the same compression rates as natural gas
- Deblending technologies
  - In collaboration with customer requirements such as transport, industry etc...

Phase 3
Third Party Testing & Collaboration

Duration: 2023 Onwards

- New technology integration
- Production solutions & integration
- Implementation focussed testing
- Links to Customers and use cases

HyNTS Live Trials

2% 100%
HyNTS
Project Union
Future of Gas in the UK Business

European hydrogen backbone

Guidehouse Study

11 National Transmission Operators

23,000km by 2040

75% conversion 25% new pipelines

€27-64bn build cost
Developing a UK hydrogen backbone

**Project Union** will review the potential phased repurposing of NTS pipelines to carry hydrogen and provide a hydrogen transmission 'backbone' for the UK.
Our hydrogen outlook

We want to be ready to begin a hydrogen conversion by 2026

We’re to build a full scale offline test facility
FutureGrid will demonstrate up to 100% H2 in NTS assets

We’re collaborating to develop our future plans
Through H2GAR with colleagues in Europe

NTS broadly has the capacity for 2050 hydrogen demand
We’re now modelling a wider range of scenarios

Conversion of the NTS to hydrogen is being evaluated
We’re evaluating our asset readiness

Conversion likely to begin with a hydrogen backbone
Project Union links the industrial clusters

Grangemouth
Teesside
Merseyside
Humberside
South Wales
Project Cavendish H2 Production

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Grid Guide to the Future of Gas

Martin Cook
Business Development Director
Future of Gas in the NGV Business

Hydrogen and CCUS in the Ten Point Plan

**Hydrogen**
- 5 GW of low carbon H2 capacity by 2030
- Hydrogen for power, transport, industry and homes.
- £240m for Net Zero Hydrogen
- A hydrogen ‘town’ before the end of the decade.
- H2 business models and revenue developed in 2021
- Finalise H2 business models in 2022

**CCUS**
- 10 MtCO₂/yr by 2030
- CCUS in 4 Industrial clusters, with 2 by mid-2020s
- £1bn investment through the CCS Infrastructure Fund by 2025
- Revenue mechanism for industrial carbon capture developed in 2021
- Finalise CCUS business models in 2022
Project Cavendish is a hydrogen project located at the Isle of Grain

- Strong consortium - key components of a hydrogen supply chain
- Aim to support creation of a new hydrogen economy that supports jobs and clean growth in SE England
- Demand initially from CCGT power stations and blending of H2 into existing gas networks
- Anchoring hydrogen in the region enables the build out of 100% hydrogen pipelines towards London
Isle of Grain

Offers unique advantages and provides key elements for a successful hydrogen project.
ZERO CARBON HUMBER

ZERO STARTS HERE
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**CCUS network**

NG is leading a project to develop and build a CCUS network in the Humber and Teesside regions of the UK.

- The government is supporting the development of solutions around the UK using a £130m fund.
- The Humber is the UK’s largest industrial cluster – with hard to decarbonise industries.
- It contributes £18bn to the UK economy, supports 55,000 manufacturing jobs, 25% of the country’s refinery production and >100 chemical and refinery companies.
- Decarbonising Teesside & the Humber would remove more than a third of UK’s industrial emissions.
- 2021 is a key year for continued development in particular developing business models to support this new industry.
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Humberside site map

Overall emissions of region:
almost 14 million tonnes* of CO₂ per year

* Combined industry and power emissions for the Humber and Teesside, excluding Drax Power Station
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Northern Endurance Partnership

Subsea CO₂ Store
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Coming up…

Watch out for our next live event in the **Grid Guide** to series, which will focus on the **Decarbonisation of Transport** in Quarter 2, 2021.