Green H₂ injection into the NTS (1)

The potential for Green H₂ into the NTS

- There is material potential to reduce CO₂ emissions by injecting H₂ into to the National Grid Gas (NGG) National Transmission System and displacing natural gas
- NGG are progressing studies with the support of the HSE to allow potential of 5% H₂ by 2025
- The NTS provides flexibility to inject H₂ and not go outside any Calorific Value limits
- To put that in context, 5% H₂ by volume is equal to around 16 TWh/annum of H₂. After 10 years there is around 6 TWh/annum of biomethane and so having the flexibility to add this much H₂ would be a great way to start the market

A typical Green H₂ project

- A 3 MW electrolysers using renewable electricity will produce a maximum rate of around 450 scmh of H₂ which would be 14 million kWh of H₂ in a year (assuming 65% efficiency and 80% load factor)
- The renewable energy can be produced from wind, solar and batteries
- In Germany Greenpeace Energy sells Green H₂ injected into the Transmission Grid in Northern Germany to natural gas consumers in Berlin, with a Guarantee of Origin system linking the kWh off Green H₂ injected to the kWh of natural gas consumed. This NGG project aims to develop this option for UK consumers
- 16 TWh/annum of Green H₂ would represent 1,136 projects sized at 3 MW or 110 projects at 30 MW



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Green H₂ injection into the NTS (2)

What We Are Doing

- Create a technical regime for green hydrogen injection into the NTS that allows Green H₂ injection at the lowest capital and operating cost
- Investigate the possibility of a blending regime for Green H₂ that uses Artificial Intelligence and Digital Twin Technology to manage the blending ratio rather than sample points and chromatographs
- Demonstrate the benefits of a H₂ Guarantee of Origin System to link Green H₂ input to natural gas supplies to existing gas customers
- Review the economics of green H₂ production and injection into the NTS and identify regime changes to support
- Review the NTS in Scotland as a means to transport Green H₂ made from surplus electricity in the SSEN Transmission Grid
- Identify potential sites for pilot project (s)

The Team

• National Grid Gas, CNG Services Ltd, Centrica, Element Energy and Scottish and Southern Electricity Networks

Benefits

- Facilitate the creation of a Green H₂ in to the NTS market with potential of 16 TWh/annum of Green H₂ by 2030
- Demonstrate the market interest for H₂ Guarantee of Origin
- Develop the Green H₂ injection supply chain and provide a simple contractual template for commercial roll out by NGG
- Facilitate the development of the 450 bar H₂ for fuel cell trucks and buses based on the back-stop utilisation option of H₂ injection into the NTS



NTS Hot Tap





Green H₂ injection into the NTS (3)

About the Strategic Innovation Fund:

The purpose of Ofgem's Strategic Innovation Fund is to support network innovation that will contribute to achieving Net Zero rapidly and at lowest cost; deliver real net benefits to network companies, energy users and consumers; and help the UK to become a 'Silicon Valley' of energy. It aims to work with other public funders of innovation so that activities appropriately funded by energy users and consumers are coordinated with activities funded by Government. The Fund is delivered in partnership with Innovate UK.

About Ofgem:

Ofgem is Britain's independent energy regulator. Their role is to protect consumers now and in the future by working to deliver a greener, fairer energy system. They do this by:

- Working with Government, industry and consumer groups to deliver a net zero economy at the lowest cost to consumers
- Stamping out sharp and bad practice, ensuring fair treatment for all consumers, especially the vulnerable
- Enabling competition and innovation, which drives down prices and results in new products and services for consumers

About Innovate UK:

Innovate UK is the UK's innovation agency, part of UK Research and Innovation. It drives productivity and economic growth by supporting businesses to develop and realise the potential of new ideas, including those from the UK's world-class research base.



High Pressure Gas Transmission Connection and Pipeline Services





ENGINEERING NET ZERO THROUGH RENEWABLE GASES

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CNG SERVICES LTD



CNGServicesLimited (CSL) provides consultancy, design and build services to the biomethane, power generation, Compressed Natural Gas (CNG), hydrogen and gas production industry, all focused on reducing Greenhouse Gas (GHG) emissions. This brochure is focussed on our high pressure gas transmission connection and pipeline services. Please visit our website at **cngservices.co.uk** for our full range of services.

CSL is an ISO 9001, 14001 and 45001 approved company and has also achieved Achilles certification for consultancy, design and construction services. CSL is GIRS accredited for design and project management for gas

connections below 7bar and has been certified as a competent design organisation for high pressure UK onshore natural gas works by DNVGL for gas connection and pipeline design above 7 bar.

	Lloyd's Register	Working together for a safer world	DNV·GL
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OVDB	CNG Services Ltd.		CL. SF
<u> </u>	has been awarded Full Accreditat This accreditation enables the client b	ion against the above noted scheme. o tender for the following work activities:	This is to certify that CMC Services Limited has undergone a Competent Design Authority Organisational Structural Audio to 12 th July 2018 and successfully demanstrated it has applicative processes and procedures in place to undertake UK onshore natural gas design works with the Internet discributions.
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	Project N	lanagement	b. Ovil/Structural Engineering
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			d. Instrumentation Engineering
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			Competent Design Authority Email: Robert.Cameron@drvgl.com
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High Pressure Gas Transmission Connection and Pipeline Services

CSL has developed a strong team of specialists for high pressure gas transmission connection and pipeline services for pressures up to 85 bar.

We deliver projects that involve the design, construction, testing, commissioning and maintenance of assets for gas networks and third party operators.

Projects are managed through to full completion and involve all stages of the pipeline lifecycle, including but not limited to:

Detailed Design

Asset handover

- Feasibility Studies
- Environmental Statements
- Conceptual Design
- Testing
- Commissioning

Construction

- Maintenance & operation
- Legislative & technical compliance

We can also deliver pipeline duty holder operator, emergency and maintenance responsibilities to ensure private pipelines are in full compliance with HSE, GS(M)R, PSR and PSSR requirements.

Since 2014 we have designed and constructed over 30 high pressure above 7 bar projects adopted by Gas Network Operators (GNOs) and private pipeline operators, including connecting to the high pressure Local Transmission (LTS) and National Transmission Systems (NTS).



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High-pressure connections provide the benefit of better entry network capacity and also reduced compression costs where higher pressures are required for CNG usage.

Our preferred approach is to offer the connection and pipeline works under a self lay process where CSL manages the design and construction of the assets for the network operator to adopt. This provides the customer with a more competitive quote, improved timelines and greater transparency. At the same time we can also provide design and construction services for the



client's interconnecting high pressure pipework enabling better efficiency by using joint design and construction resources.

Innovation is a critical part of the design process, case studies include:

- Holkham Biomethane Injection CSL designed and constructed the first LTS (19 bar) "Self Lay" Biomethane connection including design and construction of the LTS under pressure connection and entry facilities including an ROV, RTU and secure compound which were then adopted by the Network operator Cadent.
- Leyland Bio-CNG filling station CSL designed and constructed the first UK LTS (32 bar) Bio-CNG Filling Station connection
- Raynham Farms Biomethane Injection CSL designed and constructed the first UK LTS (19 bar) Reinforced Thermoplastic (RTP) pipeline for high pressure gas transmission with a 1.5 km pipeline constructed saving 2 months in construction time and cost compared to a steel pipeline.



LTS CASE STUDIES



Project: Raynham Biomethane (19 bar) Client: Cadent (formerly National Grid) Connection Type: LTS Entry

Concept: Innovation project to demonstrate the safe use of Reinforced Thermoplastc Pipe (RTP) for 19 bar biomethane injection into an LTS network.

Completion: 2015



Project: Leyland CNG Station (32 bar) Client: CNG Fuels & Cadent / National Grid Connection Type: LTS Exit

Concept: To carry out a "Self lay" connection onto the LTS and connect an unregulated meter installation and compressors for a new CNG HGV filling station.

Completion: 2016

Project Outcomes:

- CSL successfully designed and installed a 1.4km HexelOne RTP pipeline for biomethane injection into the LTS network. Previously the only accepted material for high pressure pipelines was steel.
- Using RTP enabled significant reductions in costs, including fabrication and installation time as well as avoiding corrosion issues from steel.
- The equivalent steel pipeline would have taken 2 months to fabricate and lay compared to 1 week for the RTP welding and pipelaying element.
- IGEM standard TD/19 was developed following the trial to allow the use of RTP for gas transmission pipelines up to 100 bar in the UK.



Project Outcomes:

- CSL designed and constructed a Minimum Offtake Connection (MOC) to a 24" LTS pipeline under the "Self Lay" process) for Cadent adoption, as well as customer HP meter inlet and outlet pipework.
- CSL identified significant compression cost savings by taking gas from the LTS network and supplying unregulated. CSL presented the case to the HSE to gain exemption - causing industry rules to change.
- A detailed analysis and risk assessment was performed to eliminate the requirement of an ROV.



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LTS CASE STUDIES



Project: Bonby Biomethane Project (37 bar) **Client:** UK biomethane developer and operator **Connection Type:** LTS Entry

Concept: Design and construction of a pipeline connection between the AD plant and the nearest LTS pipeline which was 7 Km away by the most cost effective option.

Completion: 2018

Project Outcomes:

- CSL successfully designed and constructed a Minimum Entry Connection (MEC) at the LTS 7 Km away from the AD plant including an ROV, RTU and Cadent compound for adoption under the "Self Lay" process.
- CSL also designed and constructed a remote customer compressor compound and 7km 125mm PE 7 bar gas pipeline between the AD Plant and remote compound, including HV supply and fibre optic communications.





Project: Erdington CNG Station (19 bar) Client: CNG Fuels

Connection Type: LTS Exit

Concept: To connect a new CNG station to the existing LTS network by the most cost effective method.

Completion: 2020

Project Outcomes:

- CSL successfully designed and constructed a 19 bar steel MOC under the "Self Lay" process utilising an existing redundant 3" connection to a 24" LTS pipeline connecting to a customer unregulated meter skid.
- CSL also designed and constructed the customer HP connection pipework including 120m of 90mm HexelOne RTP meter outlet and steel HP twin compressor inlet pipework.



LTS CASE STUDIES



Project: Barnes Farm Biomethane (70 bar) Client: UK biomethane developer and operator Connection Type: LTS Entry

Concept: Design and construction of a pipeline connection between the AD plant and the LTS by the most cost effective means.

Completion: 2019



Project: Euston Biomethane Client: UK biomethane developer and operator Connection Type: LTS Exit

Concept: Design and construction of a pipeline connection between the AD plant and the nearest LTS pipeline which was 6 Km away by the most cost effective option.

Installation: 2015

Project Outcomes:

- CSL successfully designed and constructed a 600m 70 bar 4" steel biomethane injection LTS pipeline under the "Self Lay" process with underpressure connection to an existing 24" steel LTS pipeline.
- CSL also designed and constructed the customer facilities which include twin reciprocating compressors, the customer HP steel outlet, GEU, ROV and RTU.



Project Outcomes:

- CSL successfully designed and constructed an MEC at the LTS 6 Km away from the AD plant by modifying pipework at an existing AGI including a new ROV and modification of an existing RTU for adoption under a "Self Lay" process.
- CSL also designed and constructed a remote customer compressor compound and 6km 125mm PE 7 bar gas pipeline between the AD Plant and remote compound, including HV supply and fibre optic communications.



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NTS CASE STUDIES



Project: Fordoun CNG Mother Station (84 bar) **Client:** UK CNG developer and operator

Concept: Connect a CNG "Mother station" to the NTS including trialling the first "self-lay" NTS connection. CSL developed the concept of a "Virtual pipeline" to deliver greener energy to remote Scottish Distilleries.

Completion: 2015

Project Outcomes:

- CSL designed and constructed an MOC 900m away from the CNG daughter station by modification of an existing NTS block valve under a "Self Lay" process. This was the first "Self-lay" connection to the NTS.
- A detailed analysis and risk assessment was performed to eliminate the requirement of an ROV providing significant whole life cost benefits and UK policy change.
- CSL designed and constructed a 900m 3" steel customer private pipeline incl ROV and is the pipeline operator under a Safety Case Exemption developed by CSL.
- CSL designed and constructed the 300 bar compression "Mother station" and 4 decanting "Daughter stations" at the Distilleries including specifying the 300 bar storage trailers.





Project: Somerset Farm Biomethane (75 bar) Client: UK biomethane developer and operator

Concept: Design and construction of a pipeline connection between the AD plant and the NTS. This was the first NTS Biomethane connection

Completion: August 2020

Project Outcomes:

- Design and construction of a 3" steel 1km private gas pipeline & fibre optic communications from the AD plant boundary to a new NTS MEC at an existing block valve site. CSL is the private pipeline operator under a Safety Case developed by CSL.
- CSL design and construction of HP customer compressor outlets from twin reciprocating compressors and 150m of 6" 75 bar Soluforce RTP meter outlet pipework to a boundary ROV compound. This was the first UK use of Soluforce RTP pipe at 75bar.



NTS CASE STUDIES



Project: Theddlethorpe NTS Injection Pipeline (70 bar)

Client: UK onshore gas operator

Concept: Divert an existing onshore gas pipeline and connect to the NTS to allow for gas injection.

Project Outcomes:

- Design and construction of a 700m private injection pipeline, including 4" RTP Soluforce and 250NB/100NB steel with modification of an existing 10" onshore gas pipeline and connection to a new NTS MEC at an existing block valve.
- RTP pipeline installed by Horizontal Directional Drilling (HDD) up to 6m deep under multiple drainage culverts.
- This was the first UK NTS rated RTP private Gas Network transmission pipeline.



Completion: 2021

POWER GENERATION



Project: Power generation project (37 bar)

Client: UK power generator

Connection Type: LTS Exit

Concept: To provide a temporary pressure reduction station pending further site development

Completion: 2019

Project Outcomes:

- CSL successfully designed and installed a modular pressure reduction system to a metered LTS supply
- A range of assessments were required to determine the suitability of the system for the UK gas industry.
- The system is separated into a filtration/pre-heating module and a metering/pressure reduction module.
- The units have been in operational for 3 years in their current position and continue to be relied upon with a full maintenance programme in place.





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