



SUSTAINABLE GAS TECHNOLOGY



Renewable Energy Storage for the Future

Analyse of the potential of H2 injection in the DK natural grid and
and technical barriers



The project purpose is to define and demonstrate the extent to which the Danish gas distribution system can be used as infrastructure and energy storage for an energy system - fully or partly - based on hydrogen.

Both practical and theoretical considerations are included in the assessment and the economic consequences of a grid conversion from natural gas into hydrogen are compared to a shift from natural gas into renewable energy via electricity and biomass.



Both gas transportation and gas end use are included in the project.

The project is executed in cooperation between DGC, the natural gas distribution companies HMN, DONG Energy and Natural Fyn and the TSO Energinet.dk.

The project is supported (40%) by the Danish research programme EUDP

The project is divided into three phases:

Phase I: Gas system and gas appliance's suitability for hydrogen

Phase II: Design of demonstration project (small grid system)

Phase III: Demonstration of the operation of gas networks with hydrogen

Phase I & II are currently under development.

Phase III was planned to be executed at the end of Phase II, but will not be started at the moment due to the costs involved.



Project structure Phase 1

Phase I: the gas system and the gas appliance's suitability for hydrogen

WP1.1 Review and categorization of materials and components in the Danish gas distribution system.

WP1.2 Review and categorization of domestic gas appliances & commercial, industrial and transport sector.

WP1.3 Safety critical parameters of hydrogen and NG mixtures

WP1.4 Identification of critical components and appliances, which - at a given % hydrogen in natural gas - must either be replaced, adjusted and / or tested and approved before a demonstration.

WP1.5 Regulatory requirements related to hydrogen addition to natural gas system

WP1.6 Assessment of technical and economic feasibility of the conversion of the gas system for operation respectively. 2%, 10% and 100% hydrogen.



Project structure. Phase2

Phase II: Design of demonstration project

WP2.1 Selection of a site

WP2.2 Analysis of the system and gas appliances incl. installation for safety & technical trouble-free operation.

WP2.3 Test Program for the network (leak) and appliances (inspection)

WP2.4 Defining possible lab-testing of critical components and equipment in operation with hydrogen-NG mixtures

WP2.5 Design of the mixing station and the control and monitoring of the gas composition

WP2.6 Establishment of the demonstration program (hydrogen% and control).

WP2.7 Agreements and requirements for safety monitoring

WP2.8 Establishment of legal and business relationship between the distribution company, clients and other stakeholders

WP2.9 Budget and application demonstration project.



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Few selected results

(more extended results will be presented once the reports are published)



WP1.1 Review and categorization of materials and components in the Danish gas distribution system.

Arttype	Art	Varenummer	Varebetegnelse
Komponent	MR komponenter	458	Ventiler,kugleventil m. flanger,ANSI 150
Komponent	MR komponenter	459	Ventiler,kugleventil m. flanger,ANSI 300
Komponent	MR komponenter	461	Ventiler,kugleventil m. flanger,ANSI 300
Komponent	MR komponenter	463	Afblæsningsventil, 4 bar
Komponent	MR komponenter	479	Sikkerhedsafspærregningsventil, ANSI 300 4"
Komponent	MR komponenter	480	Sikkerhedsafspærregningsventil ANSI 150
Komponent	MR komponenter	481	Sikkerhedsafspærregningsventil DN 80
Komponent	MR komponenter	482	Sikkerhedsafspærregningsventil DN 100
Komponent	MR komponenter	488	Pilotventil type ZSC 2002
Komponent	MR komponenter	490	Regulator axial flow m. Z/ZSC piloter
Komponent	MR komponenter	492	Regulator axial flow m. piloter ANSI 300
Komponent	MR komponenter	493	Regulator axial flow ANSI 300, DN 100
Komponent	MR komponenter	554	Regulatorer, Direxi 200, DN 50
Komponent	MR komponenter	789	Filter 2" med flanger
Komponent	MR komponenter	916	Kuglehane, u/filter, m/flanger PN 10
Komponent	MR komponenter	920	Butterflyventil flangeindspænding
Komponent	Ventiler	1963	Kugleventil,3",m.fl.CL300,full bore
Komponent	Ventiler	1964	Kugleventil,4",m.fl.CL300,full bore
Komponent	Ventiler	1966	Kugleventil,6",m.fl.CL150,full bore
Komponent	Ventiler	1967	Kugleventil,8",m.fl.CL150,full bore
Komponent	MR komponenter	1970	Pilot type RP-MD (styrepilot)
Komponent	MR komponenter	1974	Måler, turbine, Qmax.2500 MZ200,m.NF10
Komponent	MR komponenter	2127	Pilot type RV-MD (fortrykpilot)
Komponent	MR komponenter	2145	Sikkerhedsafb.I.FIORIENTINI,VS/AM 56
Element	Trykbeholder	2156	Filter,3",CL300 5.000Nm3/h m.patron
Element	Trykbeholder	2159	Filter,4",CL300,10.000Nm3/h m.patron
Element	Trykbeholder	2160	Forvarmer,4"/3",CL300 10.000-FAM GRIESER
Komponent	MR komponenter	2163	Regulator DN80/54,RR100 m.switch, cl300
Komponent	MR komponenter	2240	Manometer,0 - 6bar,1/2" BSP, nedad
Komponent	MR komponenter	2241	Manometer,0-60bar,1/2" BSP, nedad
Komponent	MR komponenter	2244	Regulator 2" m.SAV Florentini reflux
Komponent	MR komponenter	2305	Differenstrykmanometer, Wika, 0-2,5 bar



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WP1.2 Review and categorization of domestic gas appliances & commercial, industrial and transport sector.

*Tabel 3 Opdeling af gasapparater på forskellige typer efter anvendelse og indreguleringsprincip (Danmark)*

Hoved-gruppe	Betegnelse	Under-gruppe	Karakteristika	Indregulering og bemærkninger	Antal
1	Gasblæseluftbrændere	A	<120 kW	Gas/luft forhold	28559
		B	>120 kW (med Driftpersonale)	Gas/luft forhold	15824
2	Gaskedel og forrådsvandvarmere	C	Gulvkedel og forrådsvandvarmer	Dysetryk (atmosfærisk brænder)	2804
		C/D			280
		D	Gulvkedel og forrådsvandvarmer	Dysetryk (atmosfærisk brænder)	3713
		E	Gennemstrømningskedel	Dysetryk (atmosfærisk brænder)	15699
		E/F			1853
		F	Gennemstrømningskede I	Dysetryk (atmosfærisk brænder)	94587
		G	Gennemstrømningskedel	Gas/luft forhold	38847
		H	Gennemstrømningskedel	Gas/luft forhold	14490
		I	Kondenserende kedel	Dysetryk premix	4572
		K	Kondenserende kedel	Gas/luft forhold	132118
		L	Kondenserende kedel	Automatisk gas/luft styring (scot)	61026
3	Gasradiatorer/pejse	M	Gasradiatorer/pejse	Dysetryk (atmosfærisk brænder)	1371
		N	Gasradiatorer/pejse	Dysetryk (atmosfærisk brænder)	558



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Hoved-gruppe	Betegnelse	Under-gruppe	Karakteristika	Indregulering og bemærkninger	Antal
4	Kaloriefere/strålerør	O	Kaloriefere/strålerør	Dysetryk (atmosfærisk brænder)	2222
		P	Kaloriefere/strålerør	Dysetryk (atmosfærisk brænder)	1057
		Q	Kaloriefere/strålerør	Gas/luft forhold	2797
		R	Kaloriefere/strålerør	Gas/luft forhold	4948
5	Køkkenudstyr husholdning	S	Komfurbrændere og grill	Dysetryk (atmosfærisk brænder)	45070
		T	Gasovn	Dysetryk (atmosfærisk brænder)	5
6	Storkøkken udstyr	U	Komfurbrændere	Dysetryk (atmosfærisk brænder)	2535
		V	Grillbrændere	Dysetryk (atmosfærisk brænder)	7
		W	Gasovn	Dysetryk (atmosfærisk brænder)	2
		X	Gasovn	Dysetryk (atmosfærisk brænder)	81
7	Vaskeriudstyr	Y	Tørretumblere	Dysetryk (atmosfærisk brænder)	2098
		Z	Vandopvarmning (Damp/hedvand)	Dysetryk (atmosfærisk brænder)	11
8	Proces	Æ	Højtemperaturovne	Gas/luft forhold	189
		Ø	Tørreovne(lavtemperatur)	Gas/luft forhold	793
		Å	Håndværktøj	Dysetryk (atmosfærisk brænder)	35
		ÅÅ	Diverse åbne brændersystemer	Dysetryk (atmosfærisk brænder)	2252
9	Special komponenter og diverse	YY	-	Bundsenbrændere og fakler	198
10	Gasmotorer	MT	Alle gasmotorer	pr indgang i energiproducenttælling	495
11	Gasturbiner	TU	Alle gasturbiner	pr indgang i energiproducenttælling	30
12	Ukendt type	ZZ	-	ukendt	1323



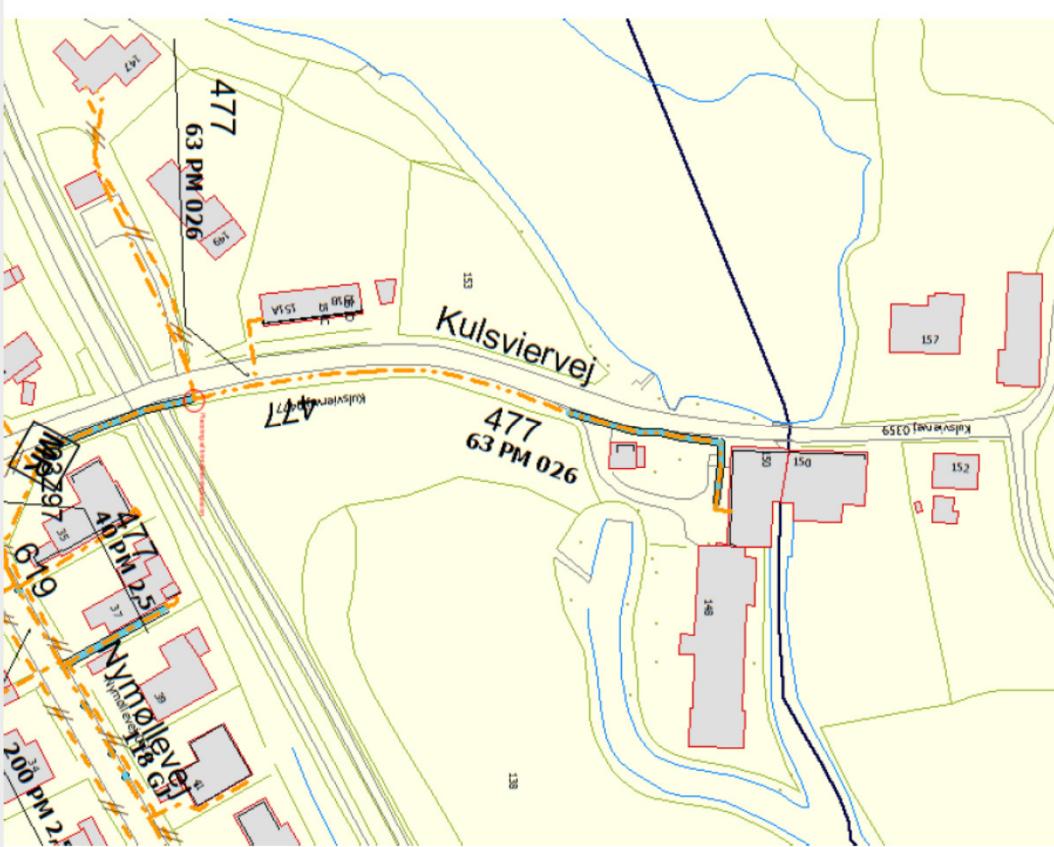
WP1.4 Identification of critical components and appliances

Certain batches of electrofusion fittings are leaking with hydrogen, and would need a replacement.

No test have been carried out with appliances. We rely on DGC previous tests (boilers; cookers) from NATURALHY & HIPs project results and further investigations (DOMHYDRO, etc.)



WP2.1 Selection of a site



Several adapted sites that can be isolated from the main grid have been identified.

Details on the appliances (type/ number etc.) installed have also be gathered.



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