Options for Decarbonisation of Natural Gas

16th July 2020

Revision 0-79 – CCS Stakeholders Meeting

Introduction

Various options can be considered for the decarbonisation of natural gas to provide fuel via syngas

These include

- Methane steam reforming via a reformer followed by high temperature shift and PSA (conventional hydrogen production)
- Autothermal reforming (Generic)
- Convective reforming (Generic)
- JM Convective reforming followed by isothermal shift

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Conventional Reforming

Hydrogen plants are well proven

However, for this flowsheet CO2 has to be captured from fluegas which is less proven

Fluegas at atmospheric pressure

Large volumes of fluegas

Partial pressure of CO2 is in fluegas is low

Large solution flows

Therefore requires large columns and hence high CAPEX

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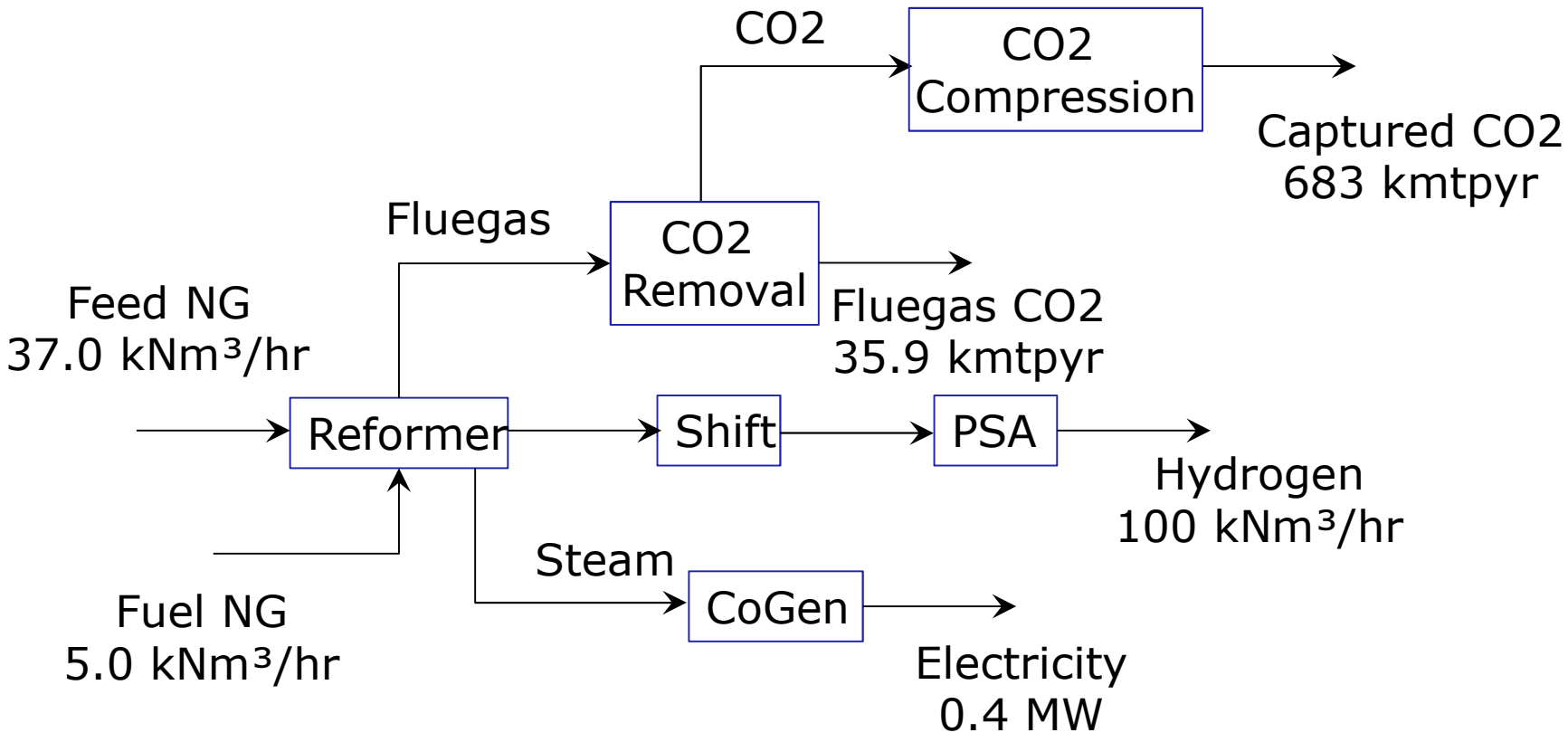
Conventional Reforming Block Diagram



Nat Gas Energy efficiency 73.3%
CAPEX circa £247 million

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Leading Concept Hydrogen (LCH) Process

Conventional LCH is based on JM's LCA and LCM process

Benefits of LCH

- Low methane in reformed gas which lowers CO2 emissions
- Low CO slip exit shift which lowers CO2 emissions
- CO2 captured from process at pressure so CO2 removal system is well proven and cheap v's SMR + CCS

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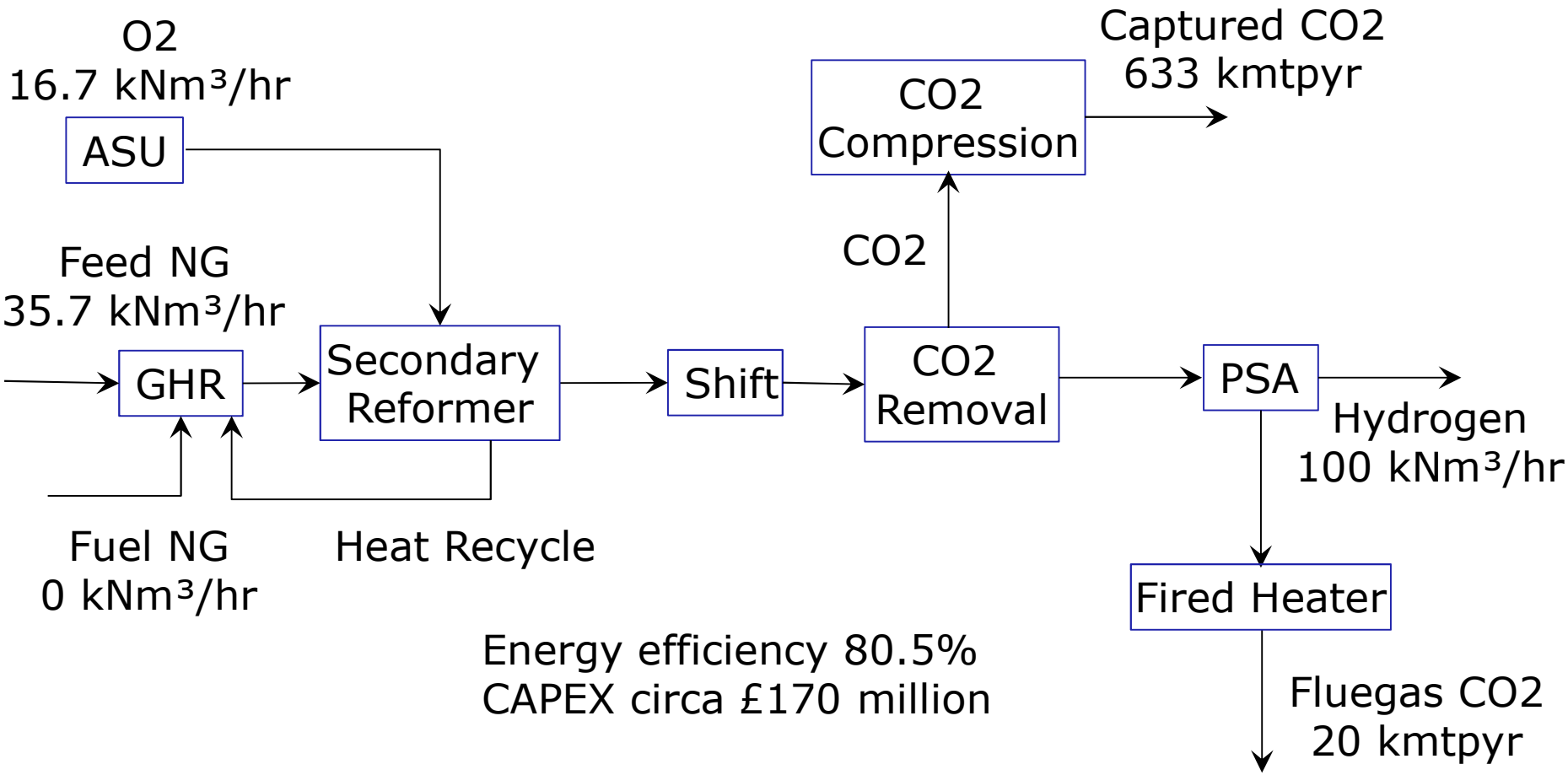
LCH Block Diagram for Fuel Electricity Import



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Comparison of Reforming Technologies

	Units	SMR 95% CCS	LCH
Feed Natural Gas	kNm³/hr	37.0	35.7
Fuel Natural Gas	kNm³/hr	5.0	0
Total Natural Gas	kNm³/hr	42.0	35.7
Natural Gas Energy (LCV)	MW	409	373
Hydrogen Production	kNm³/hr	100	100
Hydrogen Energy (LCV)	MW	300	300
Energy Efficiency	%	73.3	80.5
Power Import	MW	-0.4	18.5
CO2 Captured	kmt/year	683	632
CO2 Emitted	kmt/year	36	20
CO2 Captured	%	95	97
CAPEX	M £	247	151

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These numbers are provided for information and should be considered as indicative, but further work will be required to identify all opportunities for integration.