TIGRE TECHNOLOGIES LIMITED CS362

Feasibility Study: Integration of CCUS technology with a 200MW OCGT TiGRE™ Project located in the UK Southern North Sea

KKD1: Feasibility Study Report and Recommendations

Rob Hastings, CEO
March 16th 2020

Executive summary

The feasibility study has assessed whether applying CCUS to a TiGRE project will provide the lowest cost of energy (LCOE) with CO2 captured and sequestered while maintaining flexible and dispatchable power generation, relative to any other gas power generation CCUS option currently under consideration within the UK. A TiGRE™ project offers full and in situ vertical integration of the gas production, power production, CO2 capture, and sequestration activities.

The study has shown that a TiGRE™ gas to wires project does provide the lowest cost option to capture and sequester carbon while maintaining flexible and dispatchable power generation, relative to any other gas power generation CCUS option believed to be currently under consideration within the UK. TTL considered 3 possible options to capture, separate and sequester CO2:
Option 1: Chemical separation
Option 2: Post-combustion Cryogenic separation
Option 3: Oxyfuel generation

Option1 has been considered unviable when integrated into a TiGRE project and in an offshore environment due to its substantial weight and footprint, costly operations, low level of efficiencies and high latency of the overall system which does not lend itself to dispatchable and flexible power generation. Both Options 2 and 3 are considered both technically and commercially viable solutions and have been thoroughly assessed. Oxyfuel Power plants have a lower LCOE than a TiGRE™ OCGT power plant at load factors above 40%. This would suggest a TiGRE Oxyfuel power plant would not require CO2 subsidies to be competitive in the merchant power market for peaking plant. This suggests that the Oxyfuel concept has the highest investment returns even at relatively low load factors.

KKDs:

1. KKD1: The Feasibility Study Report and Recommendations [this report]
2. KKD2: The Basis of Design

KKD1:

This Report contains the final conclusions and recommendations of the Feasibility Study. Any follow-on work will be the subject of an additional work scope.

TiGRE Technologies Limited CS362
Feasibility Study Report and Recommendations

March 16th 2020

Date	**16.03.2020**	**Version 1.0**
Client	BEIS (Science & Innovation for Climate & Energy)	
Client Lead	Nick Bevan, Gordon Atkinson,	
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Contents

Glossary of Terms

Term	Description
BoD	Basis of Design
CAPEX	Capital Expenditure
ChemSep	Chemical Separation
CCUS	Carbon Capture and Underground Storage
CO2	Carbon dioxide
CVP	Commercial Value Proposition
EU ETS	European Union Energy Trading Scheme
EVP	Economic Value Proposition
GIIP	Gas Initially In Place. An estimate of Reservoir Gas at initial conditions prior to the start of any production
HAZID	Hazard Identification Study
H2O	Water
IRR	Internal Rate of Return
ITL	Indigo TiGRE Limted
LCOE	Levelised Cost of Energy

Term	Description
OCGT	Open Cycle Gas Turbine
OFGT	Oxyfuel Gas Turbine
O&M	Operations and Maintenance
OPEX	Operational Expenditure
Oxyfuel	The process of burning a fuel using pure oxygen instead of air as the primary oxidant
SEALS	Sequestered Emissions at Locational Source
SNS	Southern North Sea
TTL	TiGRE Technologies Ltd.
TiGRE	Transition to integrated Gas and Renewable Energy
TiGRESS	Transition to integrated Gas and Renewable Energy Simulation System

Context

This presentation comprises the final report of the Feasibility Study: *Integration of CCUS technology with a 200MW OCGT TiGRE™ Project located in the UK Southern North Sea*.

It follows on from the reports and presentations forming the submissions for Milestone 1 [submitted on 18.07.19] and Milestone 2 [submitted on 17.12.19], comprising the following key reports:

- Desktop Study to identify the most suitable Carbon Capture Technologies for application to TiGRE™ SEALS. Ref: CS362_CCUS Feasibility Study_METTL001/DS_MS1.0
- TiGRESS© Configuration and Analysis to incorporate TiGRE™ SEALS CCUS System report. Ref: CS362_CCUS Feasibility Study_TIGTTL001_RH1.0
- Feasibility Study - Completion of Reservoir Behavioural Characterisation & Analysis under TiGRE & CCUS Conditions dated 17 Dec 2019. Presentation slide pack prepared by Schlumberger: Ref: CCS_TiGRE_+Schlumberger+Report_17122019_Final(1).pdf
- Position Statement and Interpretation of the Schlumberger Report: Feasibility Study - Completion of Reservoir Behavioural Characterisation & Analysis under TiGRE & CCUS Conditions. Report prepared by Martin Energy Ltd: Ref: ME_Position_Statement & Interpretation_171219.pdf
- TiGRE Technologies Ltd CS362 Milestone2 Submission Slidepack. Presentation slide pack prepared by TTL: Ref: TiGRE Technologies Ltd CS362 Milestone2 Submission Slidepack 171219 – 1.0ah.pdf
- Production of CCUS Feasibility Study Basis of Design. Ref: CS362_CCUS Feasibility Study_METTL001/BOD_MS2.0.pdf
- Production of final report prepared by TTL: TiGRE_Technologies_Ltd_CS362_Milestone_3_final_report_mar20_0.2ah.pdf

This Report refers to and relies on the information contained within the aforementioned reports, which should be used as reference to this Report. Information and data from the previous reports are generally not repeated throughout this Report.

The purpose of this Report is defined within Milestone #3 and is set out on page 12.

High level summary

High Level Summary

This feasibility study has assessed whether applying CCUS to a TiGRE project will provide the lowest cost of energy (LCOE) with CO2 captured and sequestered while maintaining flexible and dispatchable power generation, relative to any other gas power generation CCUS option currently under consideration within the UK. A TiGRE™ project offers full and in situ vertical integration of the gas production, power production, CO_2 capture, and sequestration activities.

The study shows that a TiGRE™ gas to wires project does provide the lowest cost option to capture and sequester carbon while maintaining flexible and dispatchable power generation, relative to any other gas power generation CCUS option currently under consideration within the UK.

TTL considered 3 possible options to capture, separate and sequester CO2:
- Option 1: Chemical separation
- Option 2: Post-combustion Cryogenic separation
- Option 3: Oxyfuel generation

Option1 has been considered unviable when integrated into a TiGRE project and *in an offshore environment* due to its substantial weight and footprint, costly operations, low level of efficiencies and high latency of the overall system which does not lend itself to dispatchable and flexible power generation.

Both Options 2 and 3 are considered both technically and commercially viable solutions and have been thoroughly assessed.

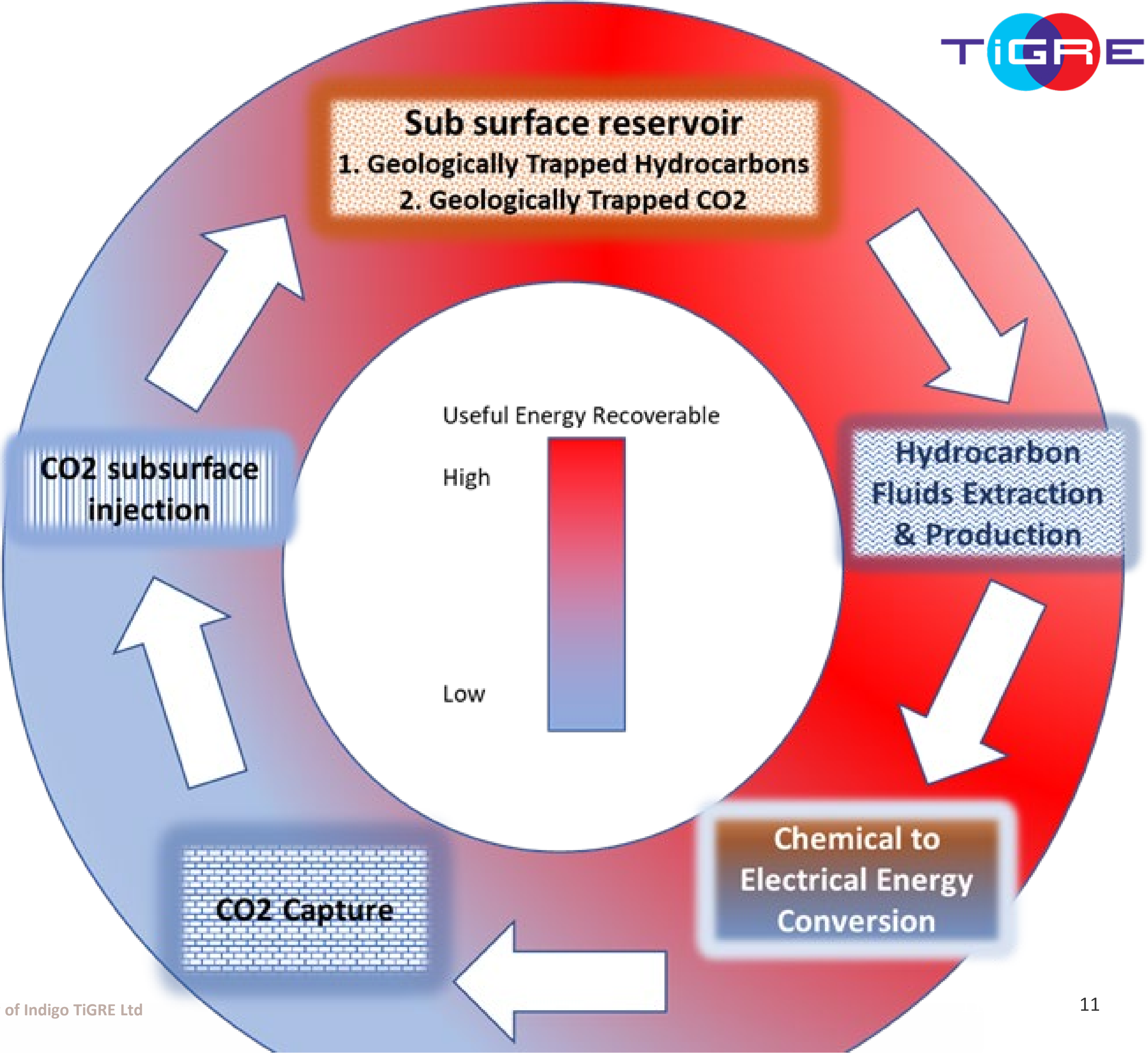
Oxyfuel Power plants have a lower LCOE than a TiGRE™ OCGT power plant at load factors above 40%. This would **suggest a TiGRE Oxyfuel power plant would not require CO2 subsidies to be competitive in the merchant power market for peaking plant**. This suggests that the OXYFuel concept has the highest investment returns even at relatively low load factors.

Introduction

TiGRE™ SEALS

Hydrocarbon Energy Extraction CO2 Closed Circuit

- TTL believe that a TiGRE™ gas to wires project provides the **lowest cost option** to capture and sequester carbon. A TiGRE^{TM} project **provides a unique opportunity to assess the feasibility of integrating conventional best-practice carbon capture and sequestration technology into a real-life integrated gas production and power station facility.**
- TTL's propriety carbon capture and sequestration concept, **TiGRE SEALS^{TM}** (Transition to integrated Gas and Renewable Energy Sequestered Emissions at Locational Source) provides an enhancement to the TiGRE™ power generation concept by adding CO2 capture and underground storage for the purposes of sequestering CO2 emissions from a TiGRE™ project.
- **A TiGRE™ project offers full and in situ vertical integration of the gas production, power production, CO_2 capture, and sequestration activities.**



Feasibility Study Objectives

The feasibility study is addressing whether it is technically feasible and commercially viable to integrate the TiGRE SEALS process into a generic TiGRE™ development project and is focusing on:

- Characterisation of specifically targeted natural gas reservoirs with respect to CO2 storage in a natural gas reservoir during production and under conditions produced by complete hydrocarbon lifecycle management (slide 9).
- The design modification of the TiGRE™ gas to wire concept to provide for the integrated SEALS process.
- TiGRE™ plus CCUS concept optimisation focusing on LCOE for near zero carbon electricity generation within the constraints of the existing offshore gas assets and production facilities.
- Determination of the expected capex & opex of the TiGRE™ SEALS plant required.
- Production of report and recommendation.

The aim of the feasibility study is to provide an answer to the hypothesis that applying CCUS to a TiGRE project will provide the lowest cost of energy (LCOE) with CO2 captured and sequestered while maintaining flexible and dispatchable power generation, relative to any other gas power generation CCUS option currently under consideration within the UK.

Milestone #3 Deliverables

Completion of high-level conceptual designs, cost reviews and reporting phases:

1. **Production of high-level conceptual designs to include:**
   - Preliminary layout & footprint of selected CCS options
   - Preliminary layout design of offshore topside modules & foundation facilities
   - Development of layout scale up rules
   - Initial assessment of operational requirements including manning requirements, logistics and bulk material management, access
   - Overview of construction methodology
   - High level HAZID
2. **Production of cost review to include:**
   - Level2 Capex cost estimate
   - Preliminary O&M cost estimate
   - Economic Value Proposition (EVP) definition for concept selections
   - TiGRESS© analysis on integrated TiGRE SEALS project

Feasibility study report and recommendations

This slidepack focuses on the production of the EVP review for the carbon separation and capture technologies under consideration, and comprises the final report and recommendation. The high-level conceptual design is presented in the accompanying Basis of Design (BoD) report (ref. CS362_CCUS Feasibility Study_METTL001/BOD_MS2.0.pdf).

Methodology used in Preparing the Report

This report presents the approach, analysis and findings of the economic and commercial characteristics of the technology options for CCUS with offshore power generation. The following methodology has been employed to deliver the Study objectives:

- TiGRE Technology Ltd's TiGRESS™ offshore power plant commercial modelling system has been modified to include CCUS processes. With these modifications TiGRESS™ has been used exclusively to construct the Economic Value Proposition and the Commercial Value Proposition for a fully integrated gas field production and electricity power station located offshore.
- A design case for a non CCUS, standard configuration 200MW TiGRE™ OCGT power plant has been constructed for the purposes of providing the counterfactual reference for the economic evaluation of the CCUS Concept Options.
- Analysis undertaken using TiGRESS™ includes market basedforecasting modelling and econometric analysis of the business model proposed by the concept.
- Econometric modelling undertaken using TiGRESS™ relies on gas production data and CO2 storage data produced under the deliverables of Milestone #2 of the Feasibility Study.
- Aspen Tech Inc. Aspen Project Economic Analysis software has been used to inform and produce capex and weight estimates of the CCUS concept options considered in this report. The standard TiGRESS™ capex modelling was used for the analysis of the TiGRE™ OCGT power plant.
- Commercial risk analysis has been evaluated using the Monte Carlo probability and risk analysis tool within TiGRESS™ to produce risk weighted IRR and LCOE at P20, P50 and P80 levels.

CCUS Options considered

Option 1:

Combined Cycle Gas Turbine Turbogenerators with post combustion CO2 Chemical Absorption processes using Amine or Chilled Ammonia, and CO2 liquification, pumping and storage.

Option 2:

Combined Cycle with CO2 enrichment processes and post combustion cryogenic capture of CO2 in solid phase for liquification, pumping and storage.

Option 3:

Oxyfuel direct combustion and expansion through a gas turbine with H2O as supplemental working fluid to capture and store liquid CO2.

Note: See slidepack submitted for Milestone2 dated Feb17th 2020 presenting output from the dynamic simulation model based on OCGT exhaust gas composition, pressures, temps & volumes to capture/sequester CO2 and the overall PFD and H&M Balance for CCUS options under consideration, ref: TiGRE_Technologies_Ltd_CS362_Milestone2_submission_slidepack_171219_1.2ah.pdf and the updated Basis of Design document, ref: CS362_CCUS Feasibility Study_METTL001/BOD_MS2.0.pdf

Concept Option 1: Chemical Separation

TiGRE SEALS™ CCGT power generation with post combustion chemical separation & underground storage of CO2

Concept Description

The TiGRE SEALS Chemical CO2 separation concept uses amine-based solvents to strip CO2 from the systems exhaust gasses and thereby separate the CO2 from compression and storage. Amine based CO2 capture is a relatively well understood technology and has been deployed in a number of configurations for gas sweating. The TiGRE SEALS outline concept using chemical separation is as follows:

Process

- Natural Gas production system using existing wells and producing reservoir. Natural gas is to be produced down to 1bar pressures at the production well head, and compressed to pressures >60bar for injection into the gas turbine and reheat after burners
- The primary electrical energy generation plant is based on TiGRE Combined Cycle Gas Turbine (CCGT) concept outlined above. The amount of exhaust gas reheat energy is lower (fuel flow rate reduced to 1kg/s) than that to achieve maximum CO2 concentrations in exhaust fluids, and there is no recycling of the exhaust gases for this concept. The objective is to achieve an overall saturation of CO2 of around 8% by mass within the exhaust, which was determined as the practical optimum relative to amine volumes required through the absorption process.
- The Chemical CO2 removal process consists of absorber and regenerator processes. DEAmine was selected as the working solvent based on a literature review to match the specific duty of the TiGRE concept. In particular, the key determining criteria relate to reducing the size of the process columns, and minimising degradation of the solvent given the cost of providing makeup solvent in the offshore location. In addition the process by products can be reduced and therefore also reducing the overhead of sludge removal from the offshore location.
- The relatively dry CO2 product is received from the separation plant for compression and further dehydration to get it to liquid phase in preparation for injection into the reservoir through the injection well(s).
- CO2 is discharged into the same subsurface reservoir which is producing the fuel gas in dense phase which provides the necessary gravity head to permit CO2 injection. CO2 largely remains in dense phase and has the effect of increasing reservoir pressure of time which assists natural gas production through re-pressurisation of the reservoir.

Concept Option 1: Continued

The Feasibility Study Project has determined that Concept Option 1 - using chemical separation processes to capture CO2 - is considered non-viable when integrated into a TiGRE project in an offshore environment.

In summary, this conclusion arises from the following findings:

- Excessive weight and footprint and the resulting high capital cost and construction risk implications.
- High cost and risk of offshore operations and management of large volumes of working fluids and contaminates.
- Relatively low levels of net electrical efficiencies resulting from the CO2 capture and storage energy overheads.
- High operational latency of the overall system resulting in reduced dispatchable and flexible power generation that is required to maximise economic value relative to the target peaking power markets.

The remainder of this Report is therefore focused on Concept Option 2 and Concept Option 3 as providing the highest potential viability to deliver the specified EVP of the Feasibility Study.

Concept Option 2: Cryogenic Separation

TiGRE SEALS™ CCGT power generation with post combustion cryogenic separation and underground storage of CO2

Concept Description

The TiGRE SEALS Post combustion cryogenic CO2 separation concept uses the TiGRE CCGT design configured to achieve maximum CO2 concentrations. The CO2 separation is achieved by cryogenic cooling of the exhaust gas stream to enable separation of CO2 in solid phase, followed by reheating to liquid phase at high pressure for reservoir storage through CO2 injection wells. As with the chemical separation process proposed above, this concept largely relies on conventional available technology, with the sole exception of the solid CO2 separator. Therefore the concept could be considered to be at above TRL7-8 apart from the single component for the separator which would be at TRL4.

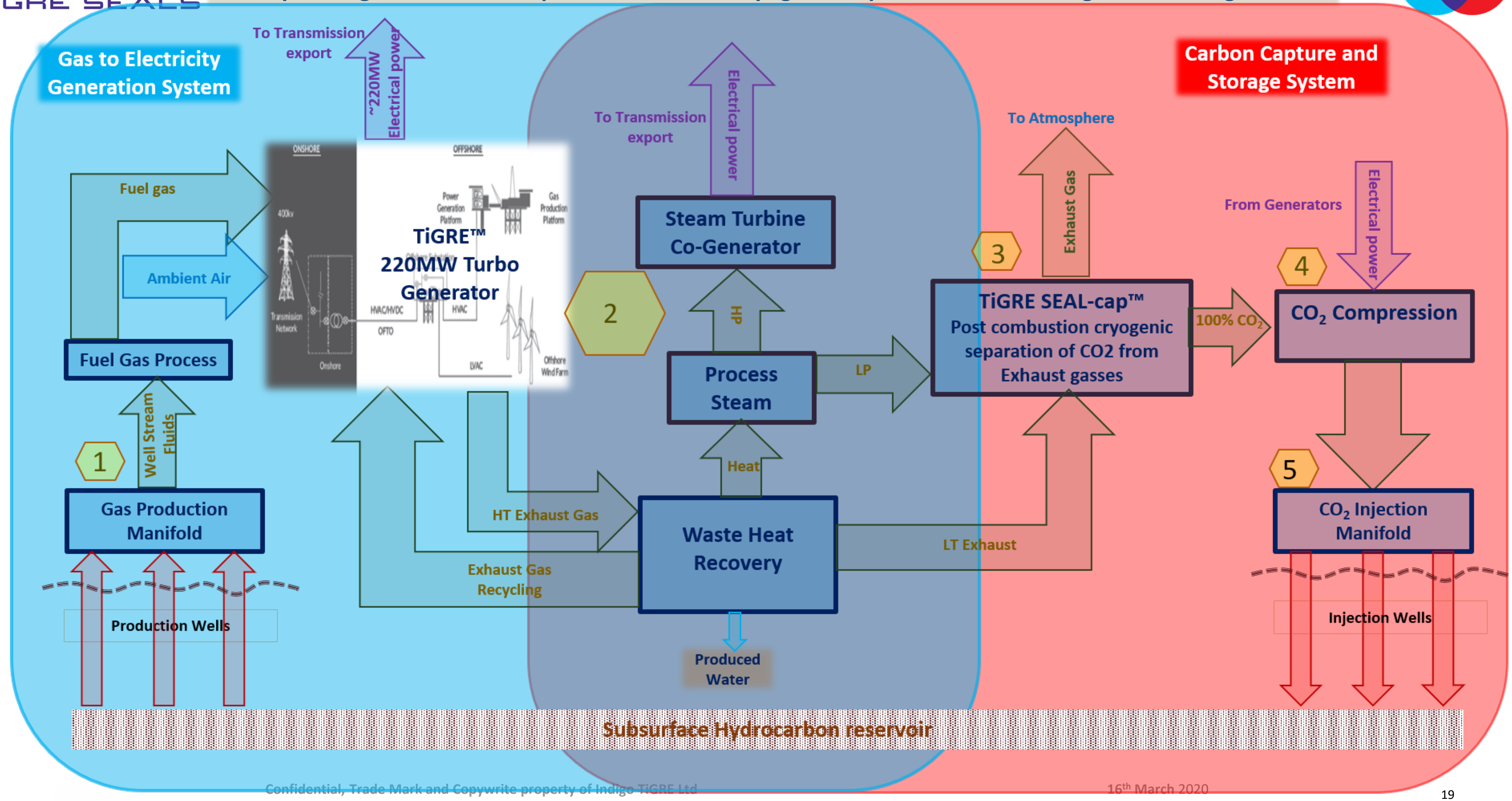
The TiGRE SEALS outline concept using post combustion cryogenic separation is as follows (refer to cartoon diagram of the process on the following page):

Process (see slide 17)

1. Natural Gas production system using existing wells and producing reservoir. Natural gas can be produced down to 1bar pressures at the production well head and compressed to pressures >60bar for injection into the gas turbine and reheat after burners.
2. The primary electrical energy generation plant consists of the basic concept outlined above defining the TiGRE CCGT system. The amount of exhaust gas reheat energy is maximised to full oxygen depletion and to achieve maximum CO2 concentrations, and there is maximum recycling of the exhaust gases to achieve the same purpose. The objective is to reach the maximum achievable overall saturation of CO2 of above 16.5% by mass, thereby achieving the lowest possible exhaust gas mass flow rate with the highest concentration of CO2.
3. The CO2 separation process requires significant dehydration, chilling and refrigeration of the exhaust gas to achieve a target temperature of -120C. Under this condition and partial pressures of CO2, CO2 will achieve greater than 97% freeze out, for mechanical separation, reheat to liquid phase and re-pressurising to around 60bar for storage.
4. Liquid CO2 is received from the separation process and storage can be achieved by high efficiency pumping.
5. CO2 is discharged into the same subsurface reservoir which is producing the fuel gas in dense phase which provides the necessary gravity head to permit CO2 injection. CO2 largely remains in dense phase and has the effect of increasing reservoir pressure of time which assists natural gas production through re-pressurisation of the reservoir.

TiGRE SEALS™ Option 2

CCGT power generation with post combustion cryogenic separation and underground storage of CO2



Gas to Electricity Generation System

Carbon Capture and Storage System

To Transmission export

~220MW Electrical power

Fuel gas

Ambient Air

Fuel Gas Process

Well Stream Fluids

1

Gas Production Manifold

Production Wells

TiGRE™ 220MW Turbo Generator

2

To Transmission export

Electrical power

Steam Turbine Co-Generator

HP

Process Steam

LP

Heat

HT Exhaust Gas

Exhaust Gas Recycling

Waste Heat Recovery

Produced Water

LT Exhaust

To Atmosphere

Exhaust Gas

3

TiGRE SEAL-cap™
Post combustion cryogenic separation of CO2 from Exhaust gasses

100% CO_2

From Generators

Electrical power

4

CO_2 Compression

5

CO_2 Injection Manifold

Injection Wells

Subsurface Hydrocarbon reservoir

Concept Option 3: Oxyfuel Generation

CO2 Sequestration With OxyFuel Combustion and Post Combustion Two Phase Separation

Concept Description

The TiGRE SEALS OxyFuel Direct Combustion concept uses cryogenic air separation to produce high purity oxygen for combustion with natural gas and steam as combustion temperature regulator and working fluid. The high-pressure high temperature exhaust gases are expanded through a turbine – generator to produce electrical power for export through a transmission system. A heat exchanger system extracts heat and condenses the low-pressure high temperature exhaust gases to allow water CO2 separation and heat recovery to preheat water to low temperature steam prior to recycling through the oxyfuel combustor. Produced CO2 is compressed to dense phase prior to injection into reworked natural gas production wells for the purpose of CO2 injection and storage.

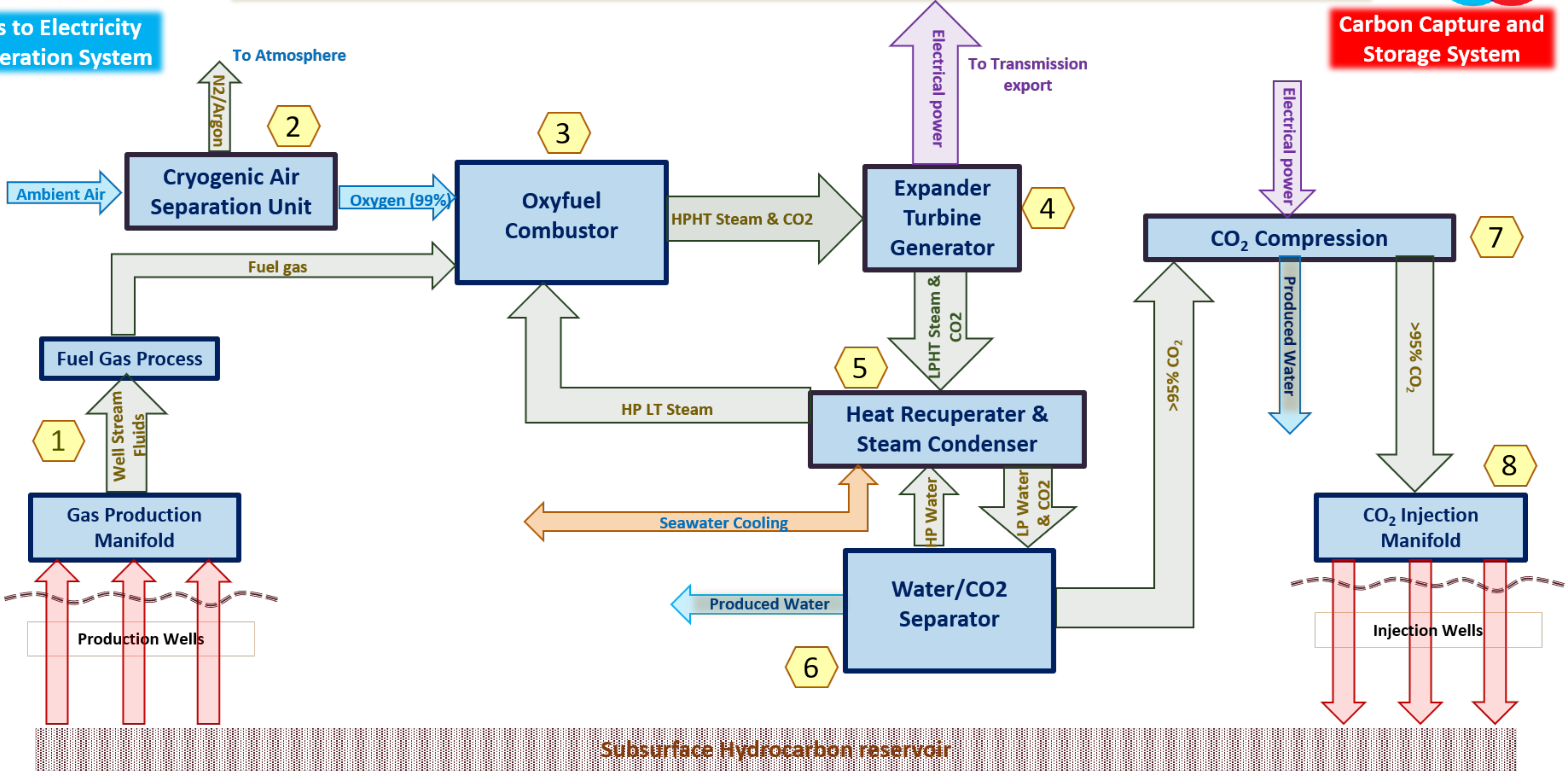
Process (see slide 19)

1. Natural Gas production system using existing wells and producing reservoir. Natural gas can be produced down to 1bar pressures at the production well head, and compressed to pressures >30bar for injection feed to the Oxyfuel Combustor
2. Cryogenic air separation system produces oxygen through a fractionation process. Nitrogen, Argon and other trace gases ate released by to atmosphere after recovering cold heat for the process.
3. An oxyfuel combustion process uses oxygen and natural gas as a combustion heat source mixed with low temperature high pressure steam as a temperature moderator and working fluid density increaser. Exhaust conditions are to be maintained below allowable Turbine inlet temperatures and fluid density & flow rates.
4. A multi-stage turbine expands the high pressure hot exhaust gas to low pressure producing work to drive an asynchronous, grid connected electrical generator.
5. A system of heat exchangers designed to extract heat from the exhaust gases to be used to preheat the returned condensed steam after CO2 has been separated from the steam/CO2 exhaust gas mix. Returned water is pumped to high pressure prior to preheating to vapour phase for reuse with the oxyfuel combustion process. Seawater cooling is used as the main cooling source for the exhaust gas condensed water prior to CO2/water prior to the separation process.
6. CO2 separation from water is managed through a first stage two phase separator followed by a second stage degasser process to extract remaining low concentrations of CO2 from the produced water prior to circulation back to the pumping and preheat cycle within the heat recuperation process. Excess produce water with less than 0.05% CO2 concentration is removed and discharged to maintain the design water mass flow in the recycled system.
7. Separated CO2 of concentrations of >98% from the process in (6) is compressed through a multi-stage process and cooled with seawater to drop into liquid phase. Compressors are electrically driven using power generated by the turbo-generators, and residual produced water is separated at each of the compression stages.
8. CO2 is discharged into the same subsurface reservoir which is producing the fuel gas in dense phase which provides the necessary gravity head to permit CO2 injection. CO2 largely remains in dense phase and has the effect of increasing reservoir pressure of time which assists natural gas production through re-pressurisation of the reservoir.

TiGRE SEALS™ Option 3
Oxyfuel Power Generation System with Sequestered Emissions at Locational Source

Gas to Electricity Generation System

Carbon Capture and Storage System



Generic Economic Modelling Assumptions

Future Power price curves are based on Jump Regression modelling using composite forecast data from:

- BEIS power and gas data
- National Grid power and gas data
- Elexon System power price data
- Historical market prices

Carbon price. Derived from Basic Regression model from:

- Historic prices weighted with policy targets

Capacity Payment. Based on:

- Derived from simple regression of average values consistent with current market prices of awarded capacity payment contracts

Electrical Transmission use of system charges (TNUoS Payment). Based on discussions and agreements with National Grid as (GBSO) to set price based on CION and regulatory requirements derived from the Energy Act 2008 as amended.

Inflation. Assumed to be a flat rate @ 2.5%

Equity Investment rates of return (Internal Rate of Return) for invested capital is assumed to be commensurate with the current risk perception of offshore power projects at 15% (nominal)

Assumed interest rates for debt are commensurate with the perceived equity risk and assumed to be 6.5% at a LTV gearing of 50% or less.

Basic CVP model is to assume entry to gasfield at nominal cost value and inherit all decommissioning liabilities.
i.e. value of gas is equal to cost of decommissioning. Gasfield can deliver 15mmscfd @ entry and is subeconomic to export

Cost of Opex is consolidated across both power station and gasfield operations

The economic analysis undertaken and presented in this report relies upon the reservoir characterisation and dynamic simulation modelling work undertaken by Schlumberger and presented in their report (ref. CCS_TiGRE+Schlumberger+Report_17122019_Final(1).pdf) submitted as part of Milestone #2.
A point of further clarification which arose from this study was regarding how well the generic reservoir modelling undertaken by Schlumberger reflected known Southern North Sea reservoir characteristics. A study of the latter is presented in the Appendices to this report.

OCGT Reference Base
OCGT without CCUS

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16th March 2020

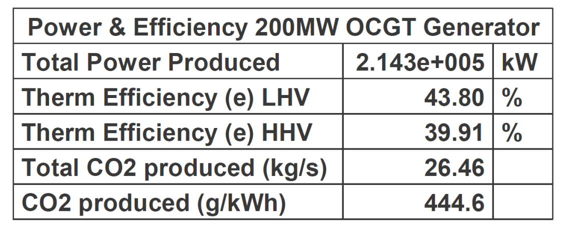
Feasibility Study Reference Base

TiGRE Open Cycle Gas Turbine (OCGT) 200MW Power Plant

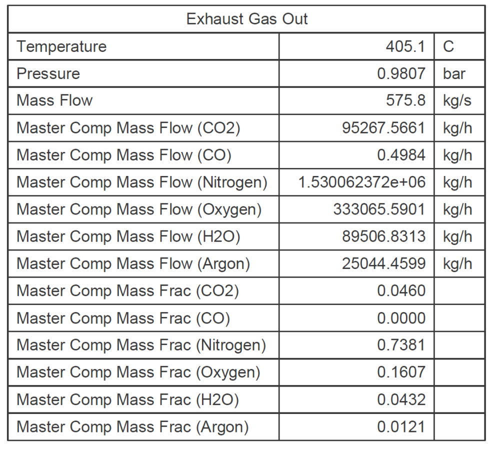
This Feasibility Study has used the standard TiGRE™ Base Concept as a counterfactual comparison for the evaluation of Concept Option to include CCUS. The economic and technical key features of the Reference Case concept can be summarized as follows:

- Capital cost of £0.75m per MW of installed capacity compared to a more conventional onshore located F9H Combined Cycle Gas Turbine co-generation power plant (CCGT) of £1.1m/MW.
- Net thermal efficiency of approx. 42% compared to Combined Cycle Gas Turbine co-generation power plant of of 35-60% depending on load factor.
- Fully dispatchable in response to market demand with system latency of less than 10mins to full load at maximum efficiency. Comparatively, a conventional CCGT system latency to full power and thermal efficiency is between 1 to 4 hours.
- Viable operating envelope of between 30% and 80% average annual Load Factor.
- Approximately 450g/kWh CO2 released, compared to CCGT at 250g/kWh at 100% load.
- LCOE range from £59.00/MWh to £60.50/MWh including full carbon costs at EU ETS rates across an economic load factor range of between 40% and 60%.

TiGRE™ OCGT Typical Performance Characteristics



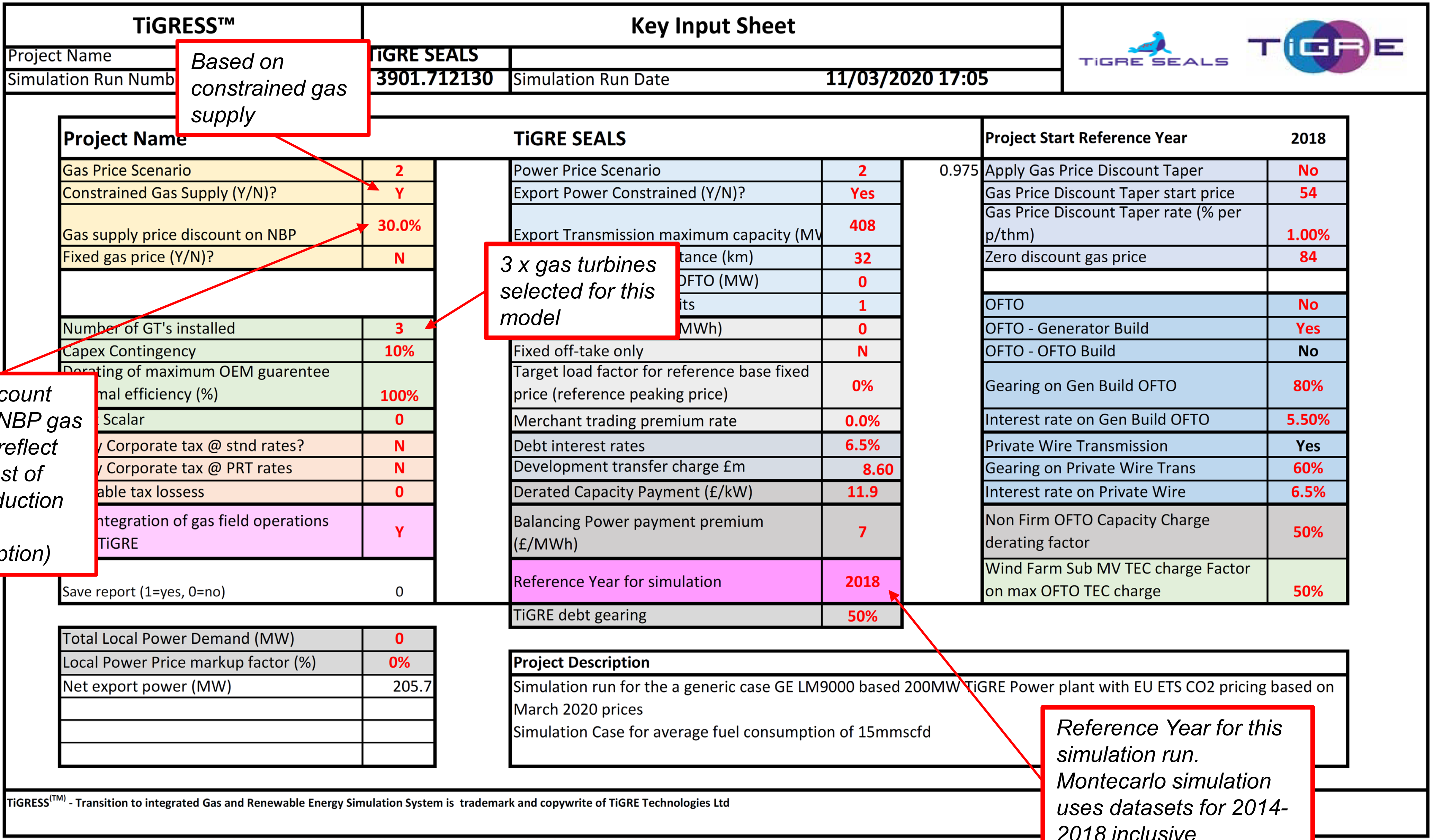
Power & Efficiency 200MW OCGT Generator		
Total Power Produced	2.143e+005	kW
Therm Efficiency (e) LHV	43.80	%
Therm Efficiency (e) HHV	39.91	%
Total CO2 produced (kg/s)	26.46	
CO2 produced (g/kWh)	444.6	



Exhaust Gas Out		
Temperature	405.1	C
Pressure	0.9807	bar
Mass Flow	575.8	kg/s
Master Comp Mass Flow (CO2)	95267.5661	kg/h
Master Comp Mass Flow (CO)	0.4984	kg/h
Master Comp Mass Flow (Nitrogen)	1.530062372e+06	kg/h
Master Comp Mass Flow (Oxygen)	333065.5901	kg/h
Master Comp Mass Flow (H2O)	89506.8313	kg/h
Master Comp Mass Flow (Argon)	25044.4599	kg/h
Master Comp Mass Frac (CO2)	0.0460	
Master Comp Mass Frac (CO)	0.0000	
Master Comp Mass Frac (Nitrogen)	0.7381	
Master Comp Mass Frac (Oxygen)	0.1607	
Master Comp Mass Frac (H2O)	0.0432	
Master Comp Mass Frac (Argon)	0.0121	

TiGRESS™ Model Run Key Inputs & Assumptions

OCGT Reference Base



TiGRESS™		**Key Input Sheet**	
Project Name	TiGRE SEALS		
Simulation Run Numb	3901.712130	Simulation Run Date	11/03/2020 17:05

Project Name **TiGRE SEALS**

Gas Price Scenario	2
Constrained Gas Supply (Y/N)?	Y
Gas supply price discount on NBP	30.0%
Fixed gas price (Y/N)?	N
Number of GT's installed	3
Capex Contingency	10%
Derating of maximum OEM guarentee mal efficiency (%)	100%
Scalar	0
Corporate tax @ stnd rates?	N
Corporate tax @ PRT rates	N
able tax lossess	0
ntegration of gas field operations TiGRE	Y
Save report (1=yes, 0=no)	0

Power Price Scenario	2	0.975
Export Power Constrained (Y/N)?	Yes	
Export Transmission maximum capacity (MV	408	
tance (km)	32	
FTO (MW)	0	
its	1	
MWh)	0	
Fixed off-take only	N	
Target load factor for reference base fixed price (reference peaking price)	0%	
Merchant trading premium rate	0.0%	
Debt interest rates	6.5%	
Development transfer charge £m	8.60	
Derated Capacity Payment (£/kW)	11.9	
Balancing Power payment premium (£/MWh)	7	
Reference Year for simulation	2018	
TiGRE debt gearing	50%	

Project Start Reference Year	**2018**
Apply Gas Price Discount Taper	No
Gas Price Discount Taper start price	54
Gas Price Discount Taper rate (% per p/thm)	1.00%
Zero discount gas price	84
OFTO	No
OFTO - Generator Build	Yes
OFTO - OFTO Build	No
Gearing on Gen Build OFTO	80%
Interest rate on Gen Build OFTO	5.50%
Private Wire Transmission	Yes
Gearing on Private Wire Trans	60%
Interest rate on Private Wire	6.5%
Non Firm OFTO Capacity Charge derating factor	50%
Wind Farm Sub MV TEC charge Factor on max OFTO TEC charge	50%

Total Local Power Demand (MW)	0
Local Power Price markup factor (%)	0%
Net export power (MW)	205.7

Project Description

Simulation run for the a generic case GE LM9000 based 200MW TiGRE Power plant with EU ETS CO2 pricing based on March 2020 prices

Simulation Case for average fuel consumption of 15mmscfd

TiGRESS[(TM)] - Transition to integrated Gas and Renewable Energy Simulation System is trademark and copywrite of TiGRE Technologies Ltd

Based on constrained gas supply

3 x gas turbines selected for this model

30% discount against NBP gas price to reflect lower cost of gas production (local consumption)

Reference Year for this simulation run. Montecarlo simulation uses datasets for 2014-2018 inclusive

TiGRESS™ Model Run Key Time Series Assumptions

OCGT Reference Base

TiGRESS™ | **Time Series Data**

Project Name **TiGRE SEALS**

Simulation Run Number **3901.680231** Simulation Run Date **11/03/2020 16:19**

		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
	Gas Production					**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
1	**Current Net export Gas Production Forecast (mmscfd)**	**0**	**0**	**51.2**	**44.7**	**15**	**15**	**14**	**14**	**13**	**13**	**12**	**12**	**12**	**11**	**11**	**11**	**10**	**10**	**10**	**9**	**9**	**9**	**9**	**8**
	Compression Fuel Gas Recovery	**0%**	**0%**	**0%**	**0%**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19.25%	Production Uplift					-	3.06	2.98	2.91	2.84	2.77	2.71	2.64	2.58	2.52	2.46	2.41	2.35	2.30	2.25	2.20	2.15	2.11	2.06	2.02
	Uplifted production rates (mmscfd)					15.0	17.6	17.1	16.6	16.1	15.7	15.2	14.8	14.3	13.9	13.5	13.1	12.8	12.4	12.0	11.7	11.4	11.0	10.7	10.4
	Production Variation Compound Factor					0.00	3.06	2.98	2.91	2.84	2.77	2.71	2.64	2.58	2.52	2.46	2.41	2.35	2.30	2.25	2.20	2.15	2.11	2.06	2.02
	Production rate difference (%)					0.0%	17.4%	17.5%	17.5%	17.6%	17.7%	17.8%	17.9%	18.0%	18.1%	18.2%	18.3%	18.4%	18.6%	18.7%	18.8%	18.9%	19.1%	19.2%	19.4%
30%	**Gas Price Discount Rate (%)**					**30.0%**	**30.0%**	**30.0%**	**30.0%**	**30.0%**	**30.0%**	**30.0%**	**30.0%**	**30.0%**	**30.0%**	**30.0%**	**30.0%**	**30.0%**	**30.0%**	**30.0%**	**30.0%**	**30.0%**	**30.0%**	**30.0%**	**30.0%**
												.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Power Production																								
	Number of GT											3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Total Power Rating											.737	205.737	205.737	205.737	205.737	205.737	205.737	205.737	205.737	205.737	205.737	205.737	205.737	205.737
	Surplus gas sales from export											6756	-51.5437	-52.4119	-53.28	-54.1482	-55.0163	-55.8845	-56.7526	-57.6208	-58.4889	-59.3571	-60.2252	-61.0934	-61.0934
	Marginal cost for export											3211	0.731042	0.749318	0.768051	0.787252	0.806933	0.827107	0.847784	0.868979	0.890703	0.912971	0.935795	0.95919	0.98317
	Net sales value of gas exported					-18.1867	-17.1265	-16.7035	-16.2342	-15.7171	-15.1506	-14.5332	-13.8631									5579	-3.86675	-2.49321	-1.02821
	Fiscal Assumptions																								
	Annual Interest rates (%)	0.25%	0.50%	0.75%	1.25%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%									50%	1.50%	1.50%	1.50%
2.50%	Annual CPI Index (Base 2016)	1.00	1.00	1.00	1.00	1.03	1.05	1.08	1.10	1.13	1.16	1.19	1.22									.52	1.56	1.60	1.64
	Wholesale Day Ahead Gas Price Index (1/10/16)																								
	LOW	**28.68**	**36.12**	**36.37**	**36.62**	**36.87**	**37.12**	**37.37**	**37.62**	**37.87**	**38.12**	**38.37**	**38.62**	**38.87**	**39.12**	**39.37**	**39.62**	**39.87**	**40.12**	**40.37**	**40.62**	**40.87**	**41.12**	**41.37**	**41.37**
2.50%	**CENTRAL**	**34.60**	**49.37**	**50.37**	**51.37**	**52.37**	**53.37**	**54.37**	**55.37**	**56.37**	**57.37**	**58.37**	**59.37**	**60.37**	**61.37**	**62.37**	**63.37**	**64.37**	**65.37**	**66.37**	**67.37**	**68.37**	**69.37**	**70.37**	**70.37**
	HIGH	**43.95**	**54.77**	**56.07**	**57.37**	**58.67**	**59.97**	**61.27**	**62.57**	**63.87**	**65.17**	**66.47**	**67.77**	**69.07**	**70.37**	**71.67**	**72.97**	**74.27**	**75.57**	**76.87**	**78.17**	**79.47**	**80.77**	**82.07**	**82.07**
	Wholesale Electricity SSP Index (1/10/16 = 1)																								
	LOW	**34.73**	**41.35**	**42.17**	**38.23**	**42.56**	**42.89**	**38.73**	**39.91**	**44.18**	**40.10**	**46.96**	**45.26**	**45.91**	**46.78**	**48.51**	**43.36**	**42.25**	**42.57**	**49.78**	**48.85**	**44.67**	**49.86**	**50.48**	**50.48**
2.50%	**CENTRAL**	**39.10**	**58.78**	**60.74**	**55.77**	**62.86**	**64.13**	**58.61**	**61.09**	**68.39**	**62.76**	**74.30**	**72.36**	**74.15**	**76.32**	**79.92**	**72.12**	**70.95**	**72.13**	**85.11**	**84.26**	**77.72**	**87.48**	**89.30**	**89.30**
	HIGH	**41.67**	**62.70**	**65.02**	**59.88**	**67.72**	**69.29**	**63.50**	**66.38**	**74.51**	**68.55**	**81.36**	**79.42**	**81.57**	**84.15**	**88.31**	**79.85**	**78.71**	**80.18**	**94.78**	**94.00**	**86.86**	**97.93**	**100.14**	**100.14**
	ETS Carbon Price (£/tn, nominal base 1/1/16)																								
	LOW	21.43	21.43	21.43	21.43	21.96	22.51	23.08	23.65	24.24	24.85	25.47	26.11	26.76	27.43	28.12	28.82	29.54	30.28	31.03	31.81	32.61	33.42	34.26	35.11
	CENTRAL	21.43	21.43	21.43	21.43	21.96	22.51	23.08	23.65	24.24	24.85	25.47	26.11	26.76	27.43	28.12	28.82	29.54	30.28	31.03	31.81	32.61	33.42	34.26	35.11
	HIGH	21.43	21.43	21.43	21.43	21.96	22.51	23.08	23.65	24.24	24.85	25.47	26.11	26.76	27.43	28.12	28.82	29.54	30.28	31.03	31.81	32.61	33.42	34.26	35.11
	UK CPS (£/kWh gas, nominal base 1/1/16)																								
	LOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-									-	-
	CENTRAL		-	-									-	-	-									-	-
	HIGH	-	-	-									-	-	-									-	-
	Fixed Gas Price																								
	LOW	28.68	36.12	36.									38.62	38.62	38.									41.07	41.07
	CENTRAL	34.60	49.37	50.									59.37	59.37	59.37	64.37	64.37	64.37	64.37	64.37	69.17	69.17	69.17	69.17	69.17
	HIGH	43.95	54.77	56.									67.77	67.77	67.77	74.27	74.27	74.27	74.27	74.27	80.51	80.51	80.51	80.51	80.51

Net Gas Production Rates resulting from lowered wellhead pressures from increased suction compression and additional routine well interventions

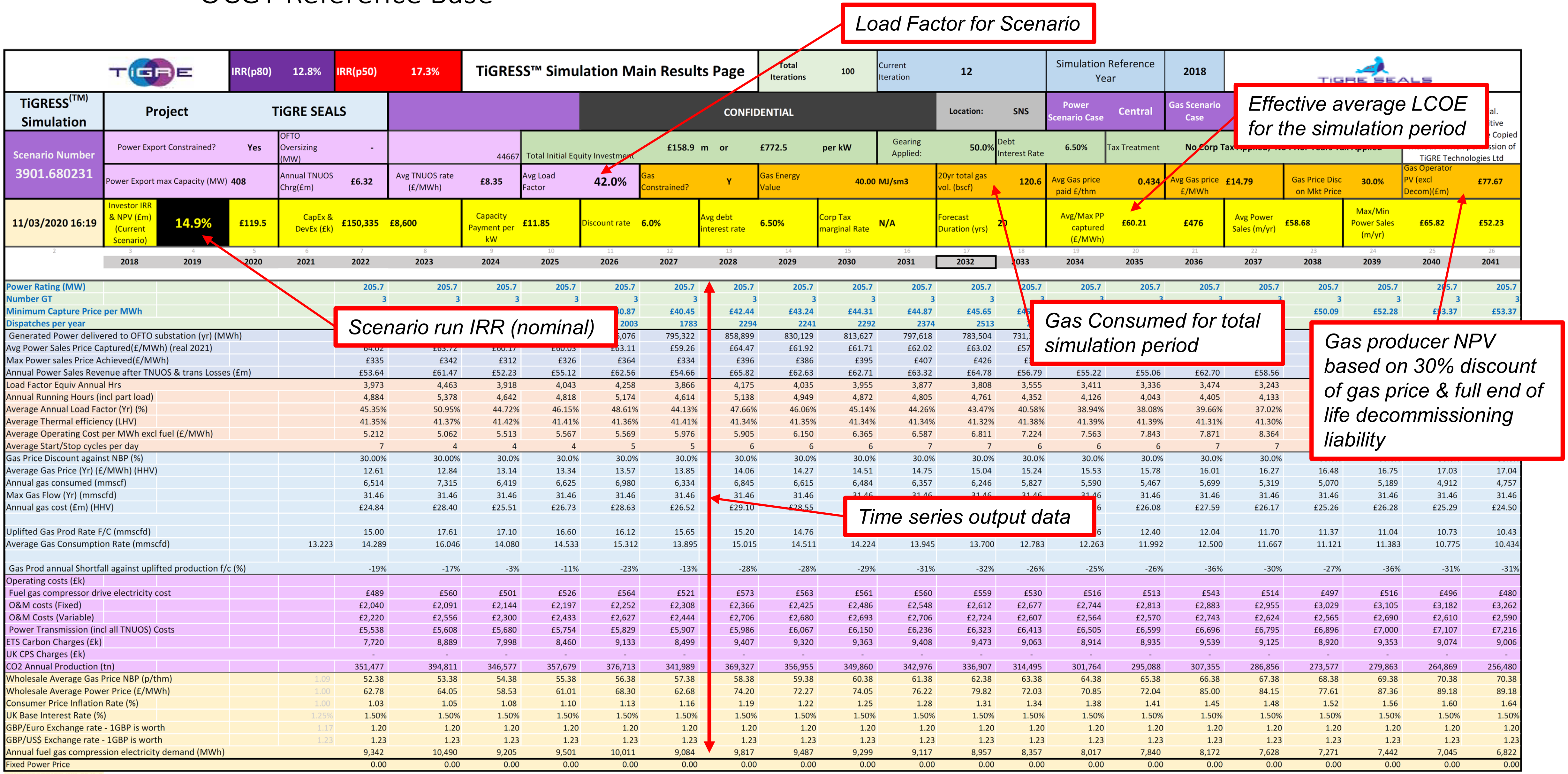
Gas Forecasts produced by annualised average of Jump Regression of NBP day ahead gas prices

Power Price Forecasts produced by annualised average of Jump Regression of NG SSP day ahead power prices

Carbon Price forecast based on EU ETS with straight line linear extrapolation indexed with inflation

TiGRESS™ Model Run Key Inputs & Assumptions

OCGT Reference Base



Load Factor for Scenario

Effective average LCOE for the simulation period

Scenario run IRR (nominal)

Gas Consumed for total simulation period

Gas producer NPV based on 30% discount of gas price & full end of life decommissioning liability

Time series output data

IRR(p80) 12.8%
IRR(p50) 17.3%

TiGRESS™ Simulation Main Results Page

Total Iterations 100
Current Iteration 12
Simulation Reference Year 2018

TiGRESS(TM) Simulation
Project TiGRE SEALS
CONFIDENTIAL
Location: SNS
Power Scenario Case Central
Gas Scenario Case

Scenario Number 3901.680231
Power Export Constrained? Yes
OFTO Oversizing (MW) -
44667
Total Initial Equity Investment £158.9 m or £772.5 per kW
Gearing Applied: 50.0%
Debt Interest Rate 6.50%
Tax Treatment No Corp Tax
TiGRE Technologies Ltd

Power Export max Capacity (MW) 408
Annual TNUOS Chrg(£m) £6.32
Avg TNUOS rate (£/MWh) £8.35
Avg Load Factor 42.0%
Gas Constrained? Y
Gas Energy Value 40.00 MJ/sm3
20yr total gas vol. (bscf) 120.6
Avg Gas price paid £/thm 0.434
Avg Gas price £/MWh £14.79
Gas Price Disc on Mkt Price 30.0%
Gas Operator PV (excl Decom)(£m) £77.67

11/03/2020 16:19
Investor IRR & NPV (£m) (Current Scenario) 14.9% £119.5
CapEx & DevEx (£k) £150,335 £8,600
Capacity Payment per kW £11.85
Discount rate 6.0%
Avg debt interest rate 6.50%
Corp Tax marginal Rate N/A
Forecast Duration (yrs) 20
Avg/Max PP captured (£/MWh) £60.21 £476
Avg Power Sales (m/yr) £58.68
Max/Min Power Sales (m/yr) £65.82 £52.23

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Power Rating (MW)					205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7
Number GT					3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Minimum Capture Price per MWh					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£40.45	£42.44	£43.24	£44.31	£44.87	£45.65	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£50.09	£52.28	£53.37	£53.37
Dispatches per year					[illegible]	[illegible]	[illegible]	[illegible]	2003	1783	2294	2241	2292	2374	2513	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Generated Power delivered to OFTO substation (yr) (MWh)					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	795,322	858,899	830,129	813,627	797,618	783,504	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Avg Power Sales Price Captured(£/MWh) (real 2021)					[illegible]	[illegible]	[illegible]	[illegible]	£63.11	£59.26	£64.47	£61.92	£61.71	£62.02	£63.02	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Max Power sales Price Achieved(£/MWh)					£335	£342	£312	£326	£364	£334	£396	£386	£395	£407	£426	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Annual Power Sales Revenue after TNUOS & trans Losses (£m)					£53.64	£61.47	£52.23	£55.12	£62.56	£54.66	£65.82	£62.63	£62.71	£63.32	£64.78	£56.79	£55.22	£55.06	£62.70	£58.56	[illegible]	[illegible]	[illegible]	[illegible]
Load Factor Equiv Annual Hrs					3,973	4,463	3,918	4,043	4,258	3,866	4,175	4,035	3,955	3,877	3,808	3,555	3,411	3,336	3,474	3,243	[illegible]	[illegible]	[illegible]	[illegible]
Annual Running Hours (incl part load)					4,884	5,378	4,642	4,818	5,174	4,614	5,138	4,949	4,872	4,805	4,761	4,352	4,126	4,043	4,405	4,133	[illegible]	[illegible]	[illegible]	[illegible]
Average Annual Load Factor (Yr) (%)					45.35%	50.95%	44.72%	46.15%	48.61%	44.13%	47.66%	46.06%	45.14%	44.26%	43.47%	40.58%	38.94%	38.08%	39.66%	37.02%	[illegible]	[illegible]	[illegible]	[illegible]
Average Thermal efficiency (LHV)					41.35%	41.37%	41.42%	41.41%	41.36%	41.41%	41.34%	41.35%	41.34%	41.34%	41.32%	41.38%	41.39%	41.39%	41.31%	41.30%	[illegible]	[illegible]	[illegible]	[illegible]
Average Operating Cost per MWh excl fuel (£/MWh)					5.212	5.062	5.513	5.567	5.569	5.976	5.905	6.150	6.365	6.587	6.811	7.224	7.563	7.843	7.871	8.364	[illegible]	[illegible]	[illegible]	[illegible]
Average Start/Stop cycles per day					7	4	4	4	5	5	6	6	6	7	7	6	6	6	7	7	[illegible]	[illegible]	[illegible]	[illegible]
Gas Price Discount against NBP (%)					30.00%	30.00%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	[illegible]	[illegible]	[illegible]	[illegible]
Average Gas Price (Yr) (£/MWh) (HHV)					12.61	12.84	13.14	13.34	13.57	13.85	14.06	14.27	14.51	14.75	15.04	15.24	15.53	15.78	16.01	16.27	16.48	16.75	17.03	17.04
Annual gas consumed (mmscf)					6,514	7,315	6,419	6,625	6,980	6,334	6,845	6,615	6,484	6,357	6,246	5,827	5,590	5,467	5,699	5,319	5,070	5,189	4,912	4,757
Max Gas Flow (Yr) (mmscfd)					31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46
Annual gas cost (£m) (HHV)					£24.84	£28.40	£25.51	£26.73	£28.63	£26.52	£29.10	£28.55	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£26.08	£27.59	£26.17	£25.26	£26.28	£25.29	£24.50
Uplifted Gas Prod Rate F/C (mmscfd)					15.00	17.61	17.10	16.60	16.12	15.65	15.20	14.76	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12.40	12.04	11.70	11.37	11.04	10.73	10.43
Average Gas Consumption Rate (mmscfd)				13.223	14.289	16.046	14.080	14.533	15.312	13.895	15.015	14.511	14.224	13.945	13.700	12.783	12.263	11.992	12.500	11.667	11.121	11.383	10.775	10.434
Gas Prod annual Shortfall against uplifted production f/c (%)					-19%	-17%	-3%	-11%	-23%	-13%	-28%	-28%	-29%	-31%	-32%	-26%	-25%	-26%	-36%	-30%	-27%	-36%	-31%	-31%
Operating costs (£k)																								
Fuel gas compressor drive electricity cost					£489	£560	£501	£526	£564	£521	£573	£563	£561	£560	£559	£530	£516	£513	£543	£514	£497	£516	£496	£480
O&M costs (Fixed)					£2,040	£2,091	£2,144	£2,197	£2,252	£2,308	£2,366	£2,425	£2,486	£2,548	£2,612	£2,677	£2,744	£2,813	£2,883	£2,955	£3,029	£3,105	£3,182	£3,262
O&M Costs (Variable)					£2,220	£2,556	£2,300	£2,433	£2,627	£2,444	£2,706	£2,680	£2,693	£2,706	£2,724	£2,607	£2,564	£2,570	£2,743	£2,624	£2,565	£2,690	£2,610	£2,590
Power Transmission (incl all TNUOS) Costs					£5,538	£5,608	£5,680	£5,754	£5,829	£5,907	£5,986	£6,067	£6,150	£6,236	£6,323	£6,413	£6,505	£6,599	£6,696	£6,795	£6,896	£7,000	£7,107	£7,216
ETS Carbon Charges (£k)					7,720	8,889	7,998	8,460	9,133	8,499	9,407	9,320	9,363	9,408	9,473	9,063	8,914	8,935	9,539	9,125	8,920	9,353	9,074	9,006
UK CPS Charges (£k)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2 Annual Production (tn)					351,477	394,811	346,577	357,679	376,713	341,989	369,327	356,955	349,860	342,976	336,907	314,495	301,764	295,088	307,355	286,856	273,577	279,863	264,869	256,480
Wholesale Average Gas Price NBP (p/thm)				1.09	52.38	53.38	54.38	55.38	56.38	57.38	58.38	59.38	60.38	61.38	62.38	63.38	64.38	65.38	66.38	67.38	68.38	69.38	70.38	70.38
Wholesale Average Power Price (£/MWh)				1.00	62.78	64.05	58.53	61.01	68.30	62.68	74.20	72.27	74.05	76.22	79.82	72.03	70.85	72.04	85.00	84.15	77.61	87.36	89.18	89.18
Consumer Price Inflation Rate (%)				1.00	1.03	1.05	1.08	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.38	1.41	1.45	1.48	1.52	1.56	1.60	1.64
UK Base Interest Rate (%)				1.25%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
GBP/Euro Exchange rate - 1GBP is worth				1.17	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
GBP/US$ Exchange rate - 1GBP is worth				1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23
Annual fuel gas compression electricity demand (MWh)					9,342	10,490	9,205	9,501	10,011	9,084	9,817	9,487	9,299	9,117	8,957	8,357	8,017	7,840	8,172	7,628	7,271	7,442	7,045	6,822
Fixed Power Price					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TiGRESS™ Model Run Project Profit & Loss Statement

OCGT Reference Base

Primary Income Stream Derived from 1/2hrly SSP merchant power sales. Supplementary income from Capacity payments

Fuel gas costs based on 30% discount of NBP day ahead price

Decommissioning reserve charge to the P&L – based on rising fund and bond for balance

Carbon taxes (mostly derived from EU ETS charged below the EBITDA line) but are considered an operating cost which is included in cash flow

Profit & Loss Statement Sim **Gas and Renewable Energy Simulation System**

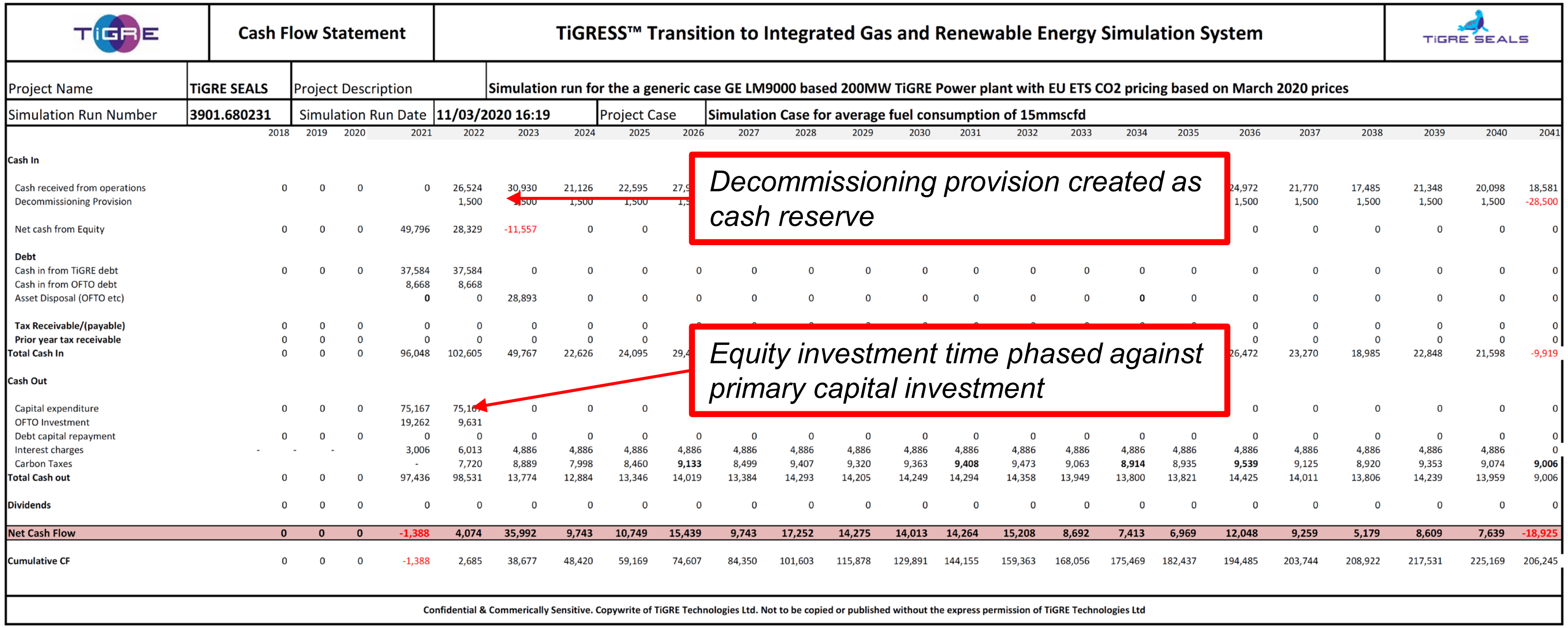
Project Name **TiGRE SEALS** Project Description Sim **r plant with EU ETS CO2 pricing based on March 2020 prices**

Simulation Run Number **3901.680231** Simulation Run Date **11/03/2020 16:19** Project Case **Simulation Case for average fuel consumption of 15mmscfd**

			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Income	**72**						65.62	75.20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	77.47	79.26	69.48	67.56	67.37	76.71	71.65	65.88	72.49	70.36	68.16
Power Sales - Export	1.00			-	-	-	53,636	61,468	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	63,323	64,785	56,795	55,223	55,064	62,702	58,563	53,849	59,250	57,511	55,713
Power Sales - Local	0	0%					-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	-	-	-	-	-
Gas Export Sales	0						-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	-	-	-	-	-
Physical Balancing Power Premium (bas	7					-	5,722	6,427	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5,583	5,485	5,120	4,912	4,804	5,003	4,670	4,454	4,556	4,312	4,175
Other (Capacity Payment)		2,438	-	-	-	-	2,438	2,438	2,438	2,438	2,438	2,438	2,438	2,438	2,438	2,438	2,438	2,438	2,438	2,438	2,438	2,438	2,438	2,438	2,438	2,438
Total Income			-	-	-	-	61,796	70,334	60,309	63,379	71,130	62,660	74,272	70,876	70,840	71,345	72,707	64,352	62,574	62,305	70,144	65,671	60,741	66,244	64,261	62,326
Operating Expenses																										
Fuel gas costs	1		-	-	-	-	24,844	28,398	25,508	26,728	28,635	26,520	29,101	28,551	28,449	28,359	28,393	26,849	26,258	26,078	27,591	26,171	25,261	26,283	25,294	24,503
Purchased Power supplies	0						-	-	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	-	-	-
Startup & Fuel Gas Compression Power Cost			-	-	-	-	502	588	539	581	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	712	712	724	786	763	757	805	793	787
O&M costs (Fixed)			-	-	-	-	2,091	2,197	2,308	2,425	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,783	3,974	4,175	4,387	4,609	4,842	5,087	5,345
O&M Costs (Variable)			-	-	-	-	2,276	2,686	2,477	2,686	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,534	3,631	3,973	3,896	3,904	4,195	4,172	4,244
Power Transmission Costs			-	-	-	-	2,769	2,804	5,680	5,754	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6,505	6,599	6,696	6,795	6,896	7,000	7,107	7,216
Subtotal Opex			-	-	-	-	32,482	36,673	36,512	38,174	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	40,791	41,006	43,221	42,012	41,426	43,127	42,453	42,095
Total Admin Expenses		600	-	-		-	600	600	600	600	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	600	600	600	600	600	600	600	600	600
Decommissioning provision costs							690	630	570	510	450	390	330	270	210	150	90	30	- 30	- 90	- 150	- 210	- 270	- 330	- 390	- 450
Decommissioing provision		30,000					1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Total Operating Costs			-	-	-	-	35,272	39,403	39,182	40,784	43,172	41,033	44,226	43,895	44,078	44,287	44,641	43,211	42,861	43,016	45,171	43,902	43,256	44,897	44,163	43,745
EBITDA			**-**	**-**	**-**	**-**	**26,524**	**30,930**	**21,126**	**22,595**	**27,958**	**21,628**	**30,046**	**26,981**	**26,761**	**27,058**	**28,066**	**21,142**	**19,713**	**19,289**	**24,972**	**21,770**	**17,485**	**21,348**	**20,098**	**18,581**
							26.5	30.9	21.1	22.6	28.0	21.6	30.0	27.0	26.8	27.1	28.1	21.1	19.7	19.3	25.0	21.8	17.5	21.3	20.1	18.6
Interest Charges			-	-	-	3,006	6,013	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	-
Carbon taxes							7,720	8,889	7,998	8,460	9,133	8,499	9,407	9,320	9,363	9,408	9,473	9,063	8,914	8,935	9,539	9,125	8,920	9,353	9,074	9,006
Depreciation			-	-	-	-	4,721	8,961	7,517	7,517	7,517	7,517	7,517	7,517	7,517	7,517	7,517	7,517	7,517	7,517	7,517	7,517	7,517	7,517	7,517	7,517
Net Operating Profit			**-**	**-**	**-**	**- 3,006**	**8,070**	**8,195**	**726**	**1,732**	**6,422**	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	**1,604**	**- 2,048**	**3,031**	**242**	**- 3,838**	**- 408**	**- 1,378**	**2,059**
Tax Allowance			-	-	-	75,167	-	-	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	-	-
Net Taxable profits			-	-	-	- 78,174	8,070	8,195	726	1,732	6,422	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,604	- 2,048	3,031	242	- 3,838	- 408	- 1,378	2,059
Tax Receivable/(payable)		0.0%	-	-	-	-	-	-	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	-	-
Profit after Tax			-	-	-	- 3,006	8,070	8,195	726	1,732	6,422	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,604	- 2,048	3,031	242	- 3,838	- 408	- 1,378	2,059
Deferred Tax Credit account			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tax refund against prior years tax paid			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Remaining prior years Tax Capacity		-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tax cash benefit recievable			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dividends		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TiGRESS™ Model Run Project Cash Flow & Balance Sheet Statements

OCGT Reference Base



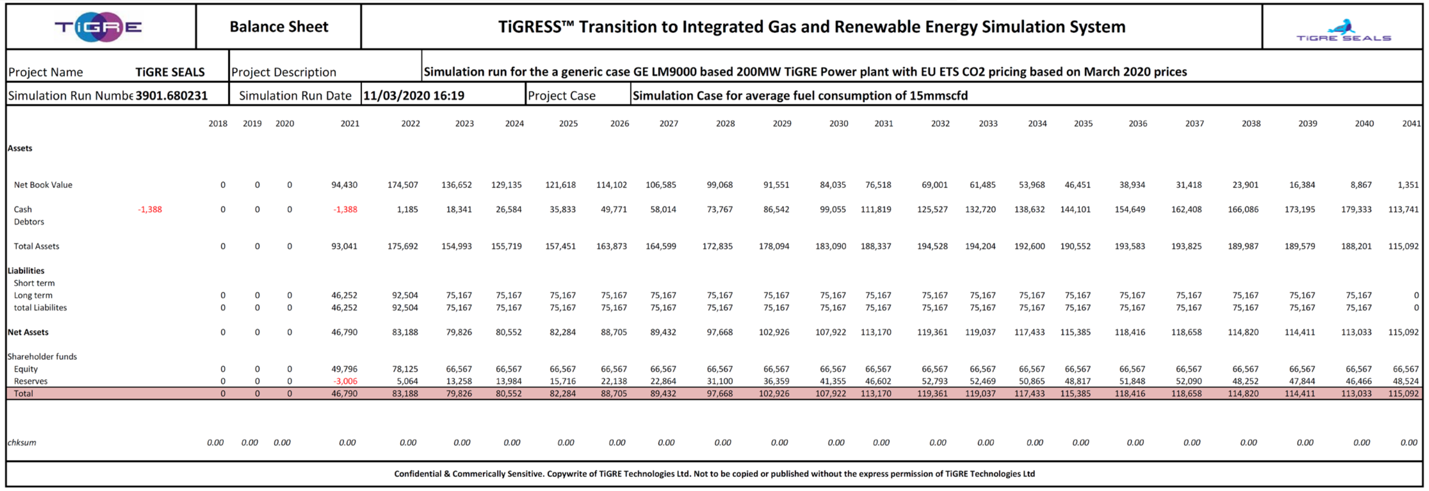
TiGRE	Cash Flow Statement	TiGRESS™ Transition to Integrated Gas and Renewable Energy Simulation System	TiGRE SEALS

Project Name	TiGRE SEALS	Project Description	**Simulation run for the a generic case GE LM9000 based 200MW TiGRE Power plant with EU ETS CO2 pricing based on March 2020 prices**
Simulation Run Number	**3901.680231**	Simulation Run Date **11/03/2020 16:19**	Project Case **Simulation Case for average fuel consumption of 15mmscfd**

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Cash In																								
Cash received from operations	0	0	0	0	26,524	30,930	21,126	22,595	27,9										24,972	21,770	17,485	21,348	20,098	18,581
Decommissioning Provision					1,500	1,500	1,500	1,500	1,5										1,500	1,500	1,500	1,500	1,500	-28,500
Net cash from Equity	0	0	0	49,796	28,329	-11,557	0	0											0	0	0	0	0	0
Debt																								
Cash in from TiGRE debt	0	0	0	37,584	37,584	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash in from OFTO debt				8,668	8,668																			
Asset Disposal (OFTO etc)				**0**	0	28,893	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0
Tax Receivable/(payable)	0	0	0	0	0	0	0	0											0	0	0	0	0	0
Prior year tax receivable	0	0	0	0	0	0	0	0											0	0	0	0	0	0
Total Cash In	0	0	0	96,048	102,605	49,767	22,626	24,095	29,4										26,472	23,270	18,985	22,848	21,598	-9,919
Cash Out																								
Capital expenditure	0	0	0	75,167	75,16	0	0	0											0	0	0	0	0	0
OFTO Investment				19,262	9,631																			
Debt capital repayment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest charges	-	-	-	3,006	6,013	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	4,886	0
Carbon Taxes				-	7,720	8,889	7,998	8,460	**9,133**	8,499	9,407	9,320	9,363	**9,408**	9,473	9,063	**8,914**	8,935	**9,539**	9,125	8,920	9,353	9,074	**9,006**
Total Cash out	0	0	0	97,436	98,531	13,774	12,884	13,346	14,019	13,384	14,293	14,205	14,249	14,294	14,358	13,949	13,800	13,821	14,425	14,011	13,806	14,239	13,959	9,006
Dividends	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Cash Flow	**0**	**0**	**0**	**-1,388**	**4,074**	**35,992**	**9,743**	**10,749**	**15,439**	**9,743**	**17,252**	**14,275**	**14,013**	**14,264**	**15,208**	**8,692**	**7,413**	**6,969**	**12,048**	**9,259**	**5,179**	**8,609**	**7,639**	**-18,925**
Cumulative CF	0	0	0	-1,388	2,685	38,677	48,420	59,169	74,607	84,350	101,603	115,878	129,891	144,155	159,363	168,056	175,469	182,437	194,485	203,744	208,922	217,531	225,169	206,245

Decommissioning provision created as cash reserve

Equity investment time phased against primary capital investment



TiGRE	Balance Sheet	TiGRESS™ Transition to Integrated Gas and Renewable Energy Simulation System	TiGRE SEALS

Project Name	**TiGRE SEALS**	Project Description	**Simulation run for the a generic case GE LM9000 based 200MW TiGRE Power plant with EU ETS CO2 pricing based on March 2020 prices**
Simulation Run Numbe	**3901.680231**	Simulation Run Date **11/03/2020 16:19**	Project Case **Simulation Case for average fuel consumption of 15mmscfd**

		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Assets																									
Net Book Value		0	0	0	94,430	174,507	136,652	129,135	121,618	114,102	106,585	99,068	91,551	84,035	76,518	69,001	61,485	53,968	46,451	38,934	31,418	23,901	16,384	8,867	1,351
Cash	-1,388	0	0	0	-1,388	1,185	18,341	26,584	35,833	49,771	58,014	73,767	86,542	99,055	111,819	125,527	132,720	138,632	144,101	154,649	162,408	166,086	173,195	179,333	113,741
Debtors																									
Total Assets		0	0	0	93,041	175,692	154,993	155,719	157,451	163,873	164,599	172,835	178,094	183,090	188,337	194,528	194,204	192,600	190,552	193,583	193,825	189,987	189,579	188,201	115,092
Liabilities																									
Short term																									
Long term		0	0	0	46,252	92,504	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	0
total Liabilites		0	0	0	46,252	92,504	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	75,167	0
Net Assets		0	0	0	46,790	83,188	79,826	80,552	82,284	88,705	89,432	97,668	102,926	107,922	113,170	119,361	119,037	117,433	115,385	118,416	118,658	114,820	114,411	113,033	115,092
Shareholder funds																									
Equity		0	0	0	49,796	78,125	66,567	66,567	66,567	66,567	66,567	66,567	66,567	66,567	66,567	66,567	66,567	66,567	66,567	66,567	66,567	66,567	66,567	66,567	66,567
Reserves		0	0	0	-3,006	5,064	13,258	13,984	15,716	22,138	22,864	31,100	36,359	41,355	46,602	52,793	52,469	50,865	48,817	51,848	52,090	48,252	47,844	46,466	48,524
Total		0	0	0	46,790	83,188	79,826	80,552	82,284	88,705	89,432	97,668	102,926	107,922	113,170	119,361	119,037	117,433	115,385	118,416	118,658	114,820	114,411	113,033	115,092
chksum		*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*

TiGRE SEALS

TiGRE

TiGRESS™ Model Run Levelised Cost of Energy

OCGT Reference Base

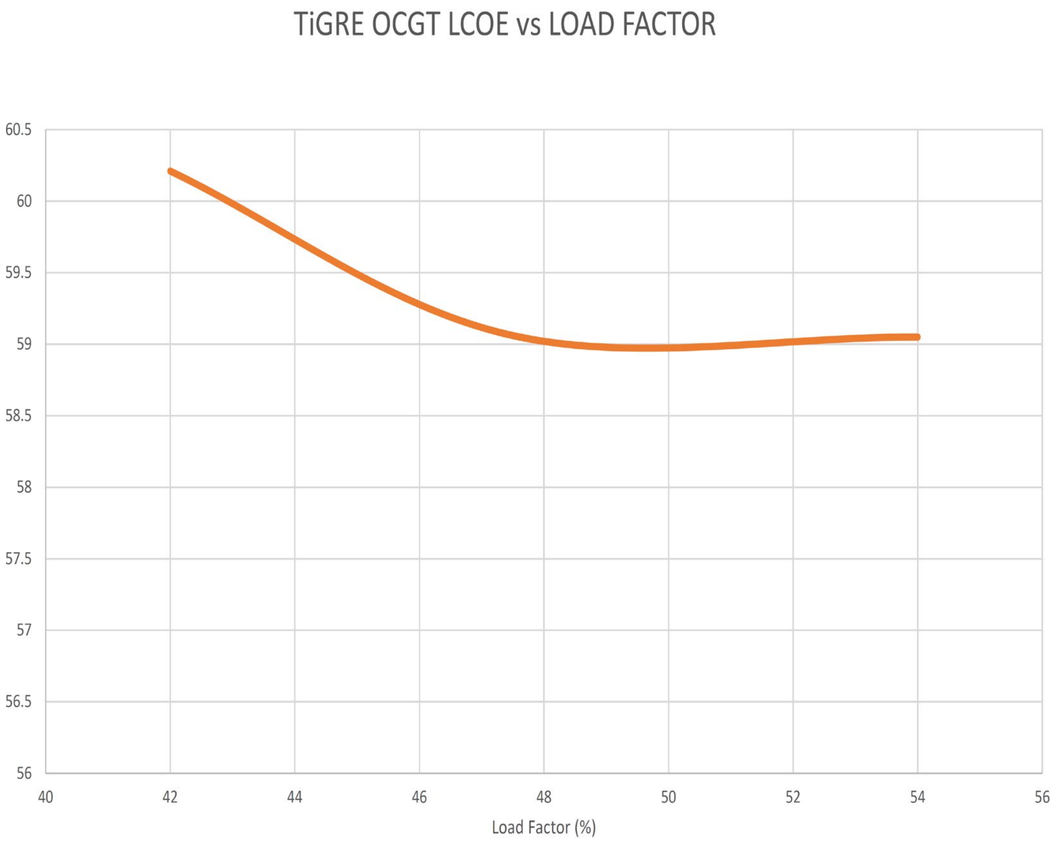
Full risk-based Monte Carlo Simulation to provide probabilistic determination (at P50) of the levelized cost of energy (LCEO)

Key variables used for sensitivity analysis and risk profiles:

- Capex (range +30%; -10% of base Capex estimate)
- Opex (range ±30%)
- Power & Gas Prices (Based on high/central/low spark spread range built into the Jump Regression model)
- Thermal Efficiency of GT's (range ±30% of OEM HHV reported efficiency curves)
- Gas production performance (range +10%;-30% of operator predicted gas production forecast)

Core TiGRESS™ functionality is to run multi scenarios for different economic bases (full trading year of 1/2hr trading periods). 100 scenarios simulations for each reference year between 2014-2018 created to produce a median of the five years as the model reference case.

Model results indicate that the LCOE is relatively independent of the Load Factor and based on the MC output the P50 LCOE is between £59.00/MWh and £60.5/MWh with an EVP to produce an equity investment return of 15%IRR.



Concept Option 2
Cryogenic Separation

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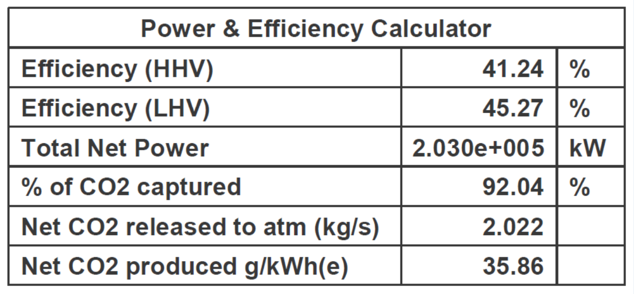
Feasibility Study Concept Option 2

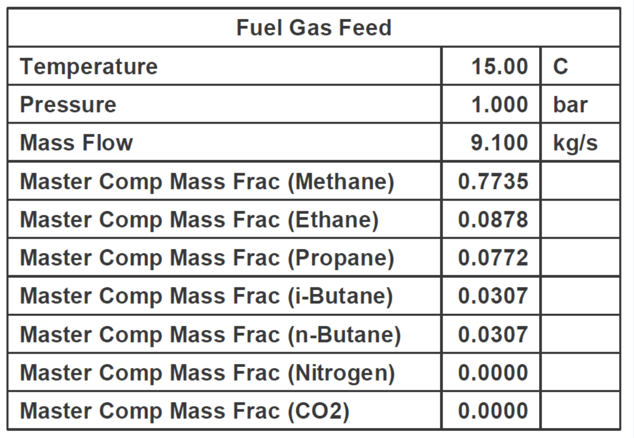
TiGRE Post Combustion Cryogenic CO2 Separation & Storage 200MW Power Plant

The Feasibility Study has modelled and evaluated the concept option set out above which uses cryogenic separation of CO2 prior to underground storage. The economic and technical key features of the CryoSep concept option can be summarized as follows:

- Capital cost are 84% higher than OCGT Reference Case (RC).
- Net thermal efficiency is similar to OCGT(RC).
- System Latency is increased by less than 30mins over OCGT(RC) to full efficiency & therefore within 1/2hr trading period & fully dispatchable to market demand.
- CO2 emissions of 93% less than that of OCGT(RC).
- Viable operating envelope between 42% and 56% average annual Load Factor.
- LCOE range from £47/MWh (56%LF) to £77/MWh (42%LF).

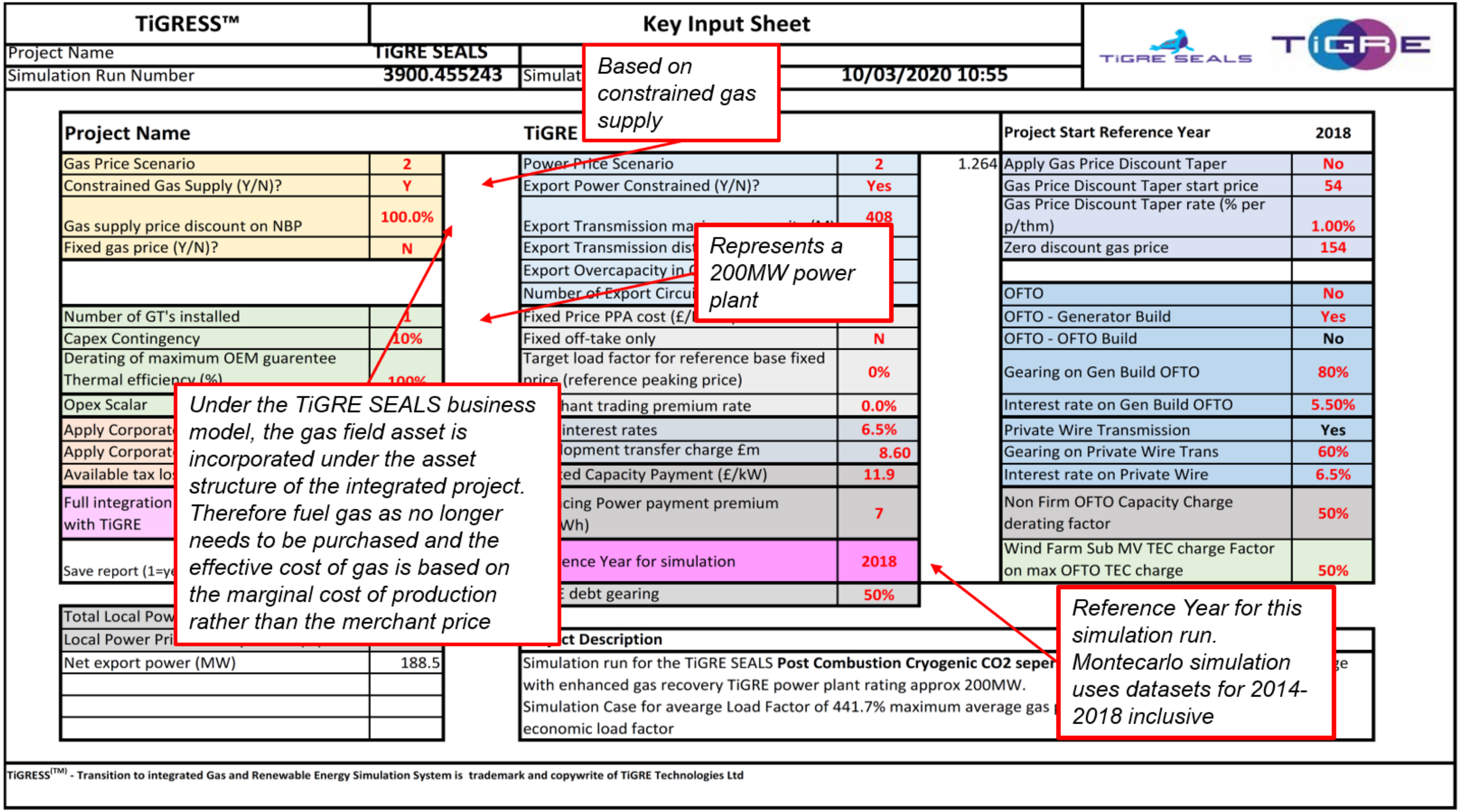


Power & Efficiency Calculator		
Efficiency (HHV)	41.24	%
Efficiency (LHV)	45.27	%
Total Net Power	2.030e+005	kW
% of CO2 captured	92.04	%
Net CO2 released to atm (kg/s)	2.022	
Net CO2 produced g/kWh(e)	35.86	



Fuel Gas Feed		
Temperature	15.00	C
Pressure	1.000	bar
Mass Flow	9.100	kg/s
Master Comp Mass Frac (Methane)	0.7735	
Master Comp Mass Frac (Ethane)	0.0878	
Master Comp Mass Frac (Propane)	0.0772	
Master Comp Mass Frac (i-Butane)	0.0307	
Master Comp Mass Frac (n-Butane)	0.0307	
Master Comp Mass Frac (Nitrogen)	0.0000	
Master Comp Mass Frac (CO2)	0.0000	

Feasibility Study Concept Option 2



TiGRESS™		Key Input Sheet	
Project Name	TiGRE SEALS		
Simulation Run Number	3900.455243	Simulat	10/03/2020 10:55

Project Name **TiGRE**

Gas Price Scenario	2
Constrained Gas Supply (Y/N)?	Y
Gas supply price discount on NBP	100.0%
Fixed gas price (Y/N)?	N
Number of GT's installed	1
Capex Contingency	10%
Derating of maximum OEM guarentee Thermal efficiency (%)	100%
Opex Scalar	
Apply Corporat	
Apply Corporat	
Available tax los	
Full integration with TiGRE	
Save report (1=ye	

Power Price Scenario	2	1.264
Export Power Constrained (Y/N)?	Yes	
Export Transmission ma	408	
Export Transmission dist		
Export Overcapacity in C		
Number of Export Circui		
Fixed Price PPA cost (£/		
Fixed off-take only	N	
Target load factor for reference base fixed price (reference peaking price)	0%	
hant trading premium rate	0.0%	
interest rates	6.5%	
lopment transfer charge £m	8.60	
ted Capacity Payment (£/kW)	11.9	
cing Power payment premium Wh)	7	
ence Year for simulation	2018	
E debt gearing	50%	

Project Start Reference Year	2018
Apply Gas Price Discount Taper	No
Gas Price Discount Taper start price	54
Gas Price Discount Taper rate (% per p/thm)	1.00%
Zero discount gas price	154
OFTO	No
OFTO - Generator Build	Yes
OFTO - OFTO Build	No
Gearing on Gen Build OFTO	80%
Interest rate on Gen Build OFTO	5.50%
Private Wire Transmission	Yes
Gearing on Private Wire Trans	60%
Interest rate on Private Wire	6.5%
Non Firm OFTO Capacity Charge derating factor	50%
Wind Farm Sub MV TEC charge Factor on max OFTO TEC charge	50%

Total Local Pow	
Local Power Pri	
Net export power (MW)	188.5

ct Description

Simulation run for the TiGRE SEALS **Post Combustion Cryogenic CO2 seper** ge with enhanced gas recovery TiGRE power plant rating approx 200MW. Simulation Case for avearge Load Factor of 441.7% maximum average gas economic load factor

TiGRESS(TM) - Transition to integrated Gas and Renewable Energy Simulation System is trademark and copywrite of TiGRE Technologies Ltd

Based on constrained gas supply

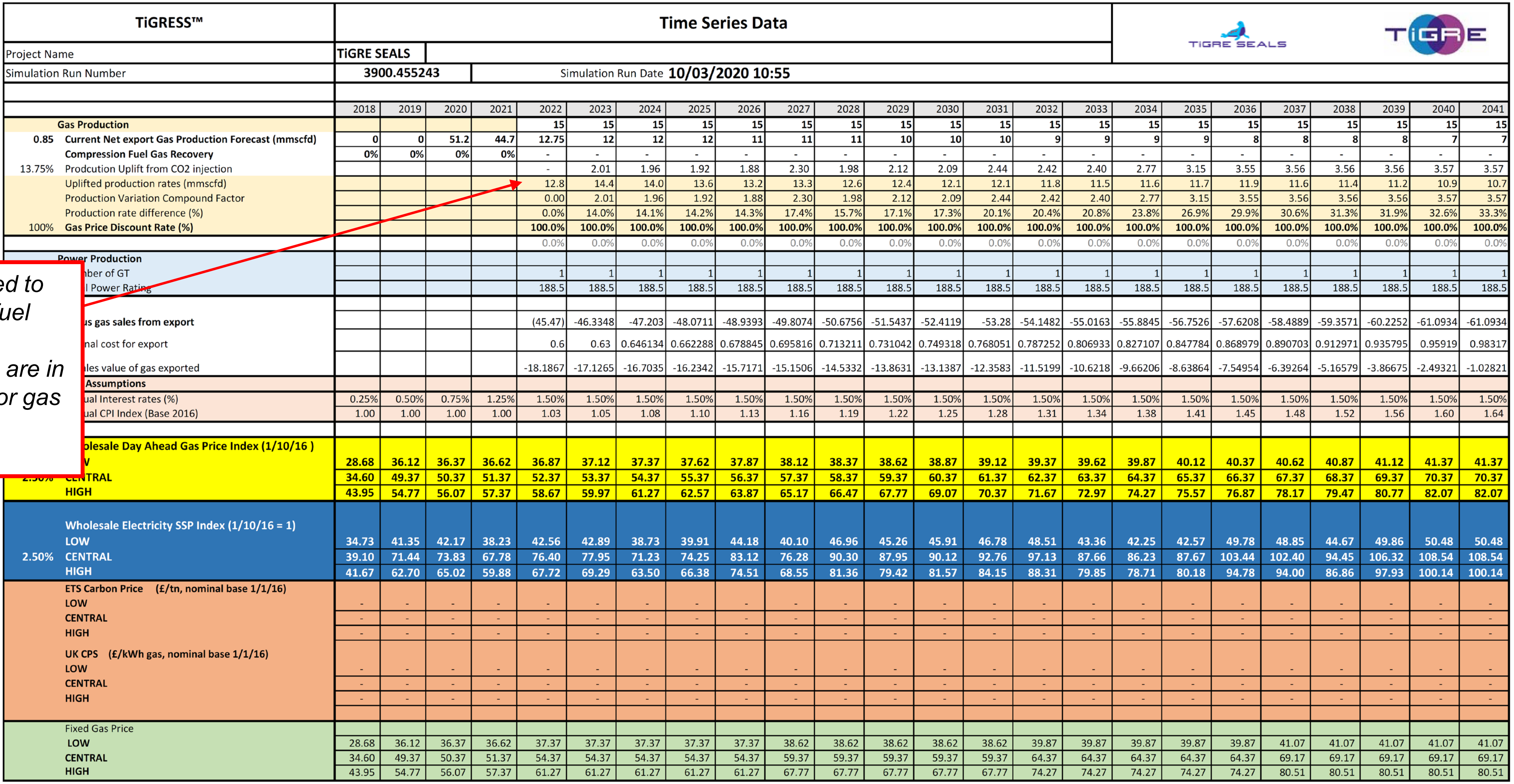
Represents a 200MW power plant

Under the TiGRE SEALS business model, the gas field asset is incorporated under the asset structure of the integrated project. Therefore fuel gas as no longer needs to be purchased and the effective cost of gas is based on the marginal cost of production rather than the merchant price

Reference Year for this simulation run. Montecarlo simulation uses datasets for 2014-2018 inclusive

Feasibility Study Concept Option 2

The TiGRE™ CryoSep Power Plant Time series input data and assumptions to achieve a 42% Load Factor condition for the power plant



TiGRESS™ | **Time Series Data**

Project Name | **TiGRE SEALS**

Simulation Run Number | **3900.455243** | Simulation Run Date **10/03/2020 10:55**

		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
	Gas Production					**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
0.85	**Current Net export Gas Production Forecast (mmscfd)**	**0**	**0**	**51.2**	**44.7**	**12.75**	**12**	**12**	**12**	**11**	**11**	**11**	**10**	**10**	**10**	**9**	**9**	**9**	**9**	**8**	**8**	**8**	**8**	**7**	**7**
	Compression Fuel Gas Recovery	**0%**	**0%**	**0%**	**0%**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13.75%	Prodcution Uplift from CO2 injection					-	2.01	1.96	1.92	1.88	2.30	1.98	2.12	2.09	2.44	2.42	2.40	2.77	3.15	3.55	3.56	3.56	3.56	3.57	3.57
	Uplifted production rates (mmscfd)					12.8	14.4	14.0	13.6	13.2	13.3	12.6	12.4	12.1	12.1	11.8	11.5	11.6	11.7	11.9	11.6	11.4	11.2	10.9	10.7
	Production Variation Compound Factor					0.00	2.01	1.96	1.92	1.88	2.30	1.98	2.12	2.09	2.44	2.42	2.40	2.77	3.15	3.55	3.56	3.56	3.56	3.57	3.57
	Production rate difference (%)					0.0%	14.0%	14.1%	14.2%	14.3%	17.4%	15.7%	17.1%	17.3%	20.1%	20.4%	20.8%	23.8%	26.9%	29.9%	30.6%	31.3%	31.9%	32.6%	33.3%
100%	**Gas Price Discount Rate (%)**					**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
						0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Power Production																								
	ber of GT					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	l Power Rating					188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5
	s gas sales from export					(45.47)	-46.3348	-47.203	-48.0711	-48.9393	-49.8074	-50.6756	-51.5437	-52.4119	-53.28	-54.1482	-55.0163	-55.8845	-56.7526	-57.6208	-58.4889	-59.3571	-60.2252	-61.0934	-61.0934
	nal cost for export					0.6	0.63	0.646134	0.662288	0.678845	0.695816	0.713211	0.731042	0.749318	0.768051	0.787252	0.806933	0.827107	0.847784	0.868979	0.890703	0.912971	0.935795	0.95919	0.98317
	les value of gas exported					-18.1867	-17.1265	-16.7035	-16.2342	-15.7171	-15.1506	-14.5332	-13.8631	-13.1387	-12.3583	-11.5199	-10.6218	-9.66206	-8.63864	-7.54954	-6.39264	-5.16579	-3.86675	-2.49321	-1.02821
	Assumptions																								
	ual Interest rates (%)	0.25%	0.50%	0.75%	1.25%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
	ual CPI Index (Base 2016)	1.00	1.00	1.00	1.00	1.03	1.05	1.08	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.38	1.41	1.45	1.48	1.52	1.56	1.60	1.64
	olesale Day Ahead Gas Price Index (1/10/16)																								
	V	**28.68**	**36.12**	**36.37**	**36.62**	**36.87**	**37.12**	**37.37**	**37.62**	**37.87**	**38.12**	**38.37**	**38.62**	**38.87**	**39.12**	**39.37**	**39.62**	**39.87**	**40.12**	**40.37**	**40.62**	**40.87**	**41.12**	**41.37**	**41.37**
2.50%	**CENTRAL**	**34.60**	**49.37**	**50.37**	**51.37**	**52.37**	**53.37**	**54.37**	**55.37**	**56.37**	**57.37**	**58.37**	**59.37**	**60.37**	**61.37**	**62.37**	**63.37**	**64.37**	**65.37**	**66.37**	**67.37**	**68.37**	**69.37**	**70.37**	**70.37**
	HIGH	**43.95**	**54.77**	**56.07**	**57.37**	**58.67**	**59.97**	**61.27**	**62.57**	**63.87**	**65.17**	**66.47**	**67.77**	**69.07**	**70.37**	**71.67**	**72.97**	**74.27**	**75.57**	**76.87**	**78.17**	**79.47**	**80.77**	**82.07**	**82.07**
	Wholesale Electricity SSP Index (1/10/16 = 1)																								
	LOW	**34.73**	**41.35**	**42.17**	**38.23**	**42.56**	**42.89**	**38.73**	**39.91**	**44.18**	**40.10**	**46.96**	**45.26**	**45.91**	**46.78**	**48.51**	**43.36**	**42.25**	**42.57**	**49.78**	**48.85**	**44.67**	**49.86**	**50.48**	**50.48**
2.50%	**CENTRAL**	**39.10**	**71.44**	**73.83**	**67.78**	**76.40**	**77.95**	**71.23**	**74.25**	**83.12**	**76.28**	**90.30**	**87.95**	**90.12**	**92.76**	**97.13**	**87.66**	**86.23**	**87.67**	**103.44**	**102.40**	**94.45**	**106.32**	**108.54**	**108.54**
	HIGH	**41.67**	**62.70**	**65.02**	**59.88**	**67.72**	**69.29**	**63.50**	**66.38**	**74.51**	**68.55**	**81.36**	**79.42**	**81.57**	**84.15**	**88.31**	**79.85**	**78.71**	**80.18**	**94.78**	**94.00**	**86.86**	**97.93**	**100.14**	**100.14**
	ETS Carbon Price (£/tn, nominal base 1/1/16)																								
	LOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	CENTRAL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	HIGH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	UK CPS (£/kWh gas, nominal base 1/1/16)																								
	LOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	CENTRAL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	HIGH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fixed Gas Price																								
	LOW	28.68	36.12	36.37	36.62	37.37	37.37	37.37	37.37	37.37	38.62	38.62	38.62	38.62	38.62	39.87	39.87	39.87	39.87	39.87	41.07	41.07	41.07	41.07	41.07
	CENTRAL	34.60	49.37	50.37	51.37	54.37	54.37	54.37	54.37	54.37	59.37	59.37	59.37	59.37	59.37	64.37	64.37	64.37	64.37	64.37	69.17	69.17	69.17	69.17	69.17
	HIGH	43.95	54.77	56.07	57.37	61.27	61.27	61.27	61.27	61.27	67.77	67.77	67.77	67.77	67.77	74.27	74.27	74.27	74.27	74.27	80.51	80.51	80.51	80.51	80.51

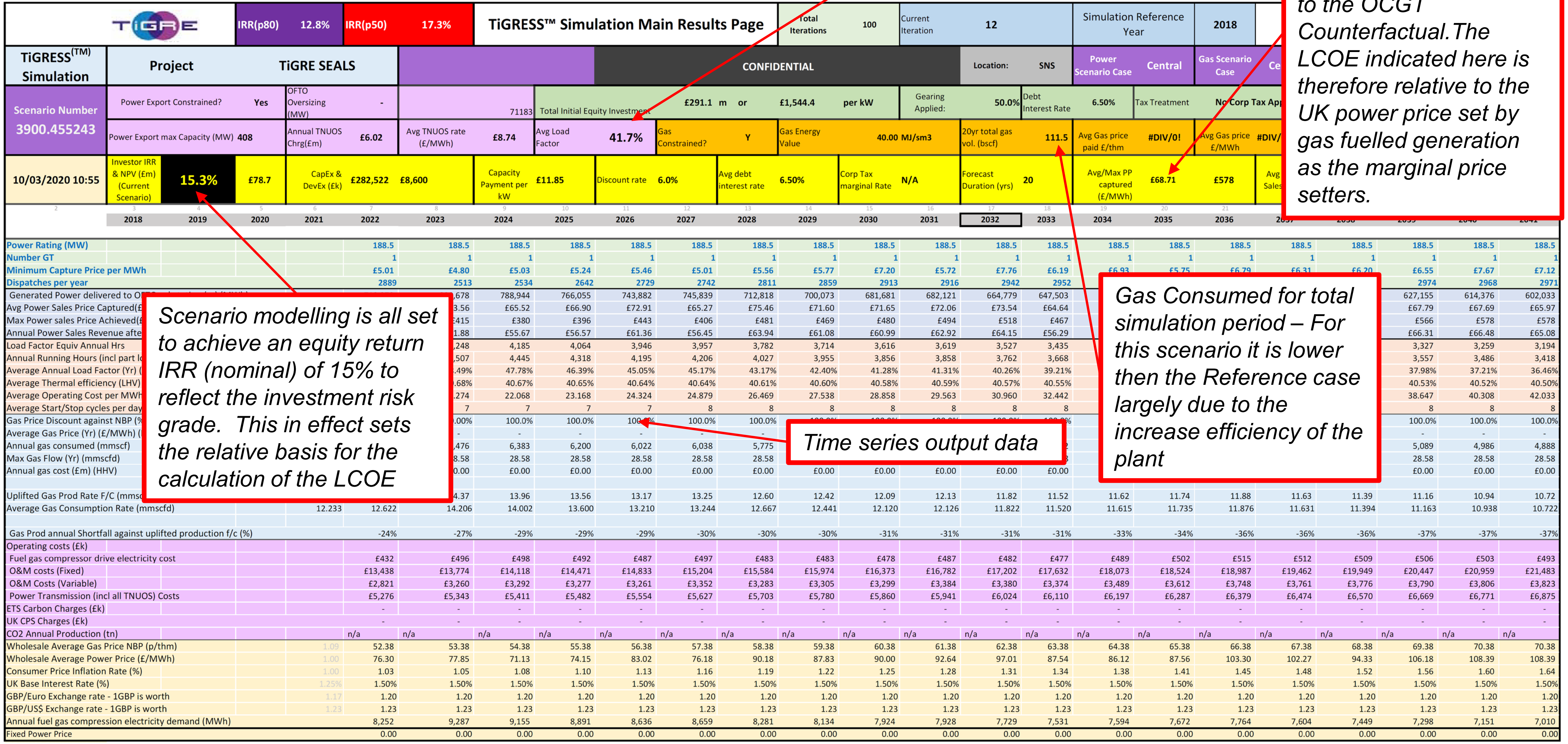
Gas production profile reduced to reflect the 42% Load Factor fuel Gas requirement. These gas production demand forecasts are in line with the potential range for gas production as modelled by Schlumberger.

Feasibility Study Concept Option 2

The TiGRE™ CryoSep Power Plant Time Model Results for a 42% Load Factor condition for the power plant

Load Factor for Scenario

By basing the economics of the investment on a common IRR, the model in effect creates a calculate LCOE relative to the OCGT Counterfactual.The LCOE indicated here is therefore relative to the UK power price set by gas fuelled generation as the marginal price setters.



IRR(p80) 12.8% | IRR(p50) 17.3% | **TiGRESS™ Simulation Main Results Page** | Total Iterations 100 | Current Iteration 12 | Simulation Reference Year 2018

TiGRESS(TM) Simulation | **Project** **TiGRE SEALS** | **CONFIDENTIAL** | Location: SNS | Power Scenario Case Central | Gas Scenario Case Ce

Scenario Number 3900.455243 | Power Export Constrained? Yes | OFTO Oversizing (MW) - | 71183 | Total Initial Equity Investment £291.1 m or £1,544.4 per kW | Gearing Applied: 50.0% | Debt Interest Rate 6.50% | Tax Treatment No Corp Tax App

Power Export max Capacity (MW) 408 | Annual TNUOS Chrg(£m) £6.02 | Avg TNUOS rate (£/MWh) £8.74 | Avg Load Factor 41.7% | Gas Constrained? Y | Gas Energy Value 40.00 MJ/sm3 | 20yr total gas vol. (bscf) 111.5 | Avg Gas price paid £/thm #DIV/0! | Avg Gas price £/MWh #DIV/

10/03/2020 10:55 | Investor IRR & NPV (£m) (Current Scenario) 15.3% £78.7 | CapEx & DevEx (£k) £282,522 £8,600 | Capacity Payment per kW £11.85 | Discount rate 6.0% | Avg debt interest rate 6.50% | Corp Tax marginal Rate N/A | Forecast Duration (yrs) 20 | Avg/Max PP captured (£/MWh) £68.71 £578 | Avg Sales

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Power Rating (MW)					188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5	188.5
Number GT					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Minimum Capture Price per MWh					£5.01	£4.80	£5.03	£5.24	£5.46	£5.01	£5.56	£5.77	£7.20	£5.72	£7.76	£6.19	£6.93	£5.75	£6.79	£6.31	£6.20	£6.55	£7.67	£7.12
Dispatches per year					2889	2513	2534	2642	2729	2742	2811	2859	2913	2916	2942	2952	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2974	2968	2971
Generated Power delivered to O					[illegible]	,678	788,944	766,055	743,882	745,839	712,818	700,073	681,681	682,121	664,779	647,503	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	627,155	614,376	602,033
Avg Power Sales Price Captured(£					[illegible]	3.56	£65.52	£66.90	£72.91	£65.27	£75.46	£71.60	£71.65	£72.06	£73.54	£64.64	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£67.79	£67.69	£65.97
Max Power sales Price Achieved(£					[illegible]	415	£380	£396	£443	£406	£481	£469	£480	£494	£518	£467	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£566	£578	£578
Annual Power Sales Revenue afte					[illegible]	1.88	£55.67	£56.57	£61.36	£56.45	£63.94	£61.08	£60.99	£62.92	£64.15	£56.29	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£66.31	£66.48	£65.08
Load Factor Equiv Annual Hrs					[illegible]	,248	4,185	4,064	3,946	3,957	3,782	3,714	3,616	3,619	3,527	3,435	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,327	3,259	3,194
Annual Running Hours (incl part l					[illegible]	,507	4,445	4,318	4,195	4,206	4,027	3,955	3,856	3,858	3,762	3,668	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,557	3,486	3,418
Average Annual Load Factor (Yr) (					[illegible]	.49%	47.78%	46.39%	45.05%	45.17%	43.17%	42.40%	41.28%	41.31%	40.26%	39.21%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	37.98%	37.21%	36.46%
Average Thermal efficiency (LHV)					[illegible]	.68%	40.67%	40.65%	40.64%	40.64%	40.61%	40.60%	40.58%	40.59%	40.57%	40.55%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	40.53%	40.52%	40.50%
Average Operating Cost per MWh					[illegible]	.274	22.068	23.168	24.324	24.879	26.469	27.538	28.858	29.563	30.960	32.442	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	38.647	40.308	42.033
Average Start/Stop cycles per day					[illegible]	7	7	7	7	8	8	8	8	8	8	8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	8	8
Gas Price Discount against NBP (%					[illegible]	.00%	100.0%	100.0%	100.0%	100.0%	100.0%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100.0%	100.0%	100.0%
Average Gas Price (Yr) (£/MWh) (					[illegible]	-	-	-	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-
Annual gas consumed (mmscf)					[illegible]	,476	6,383	6,200	6,022	6,038	5,775	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5,089	4,986	4,888
Max Gas Flow (Yr) (mmscfd)					[illegible]	8.58	28.58	28.58	28.58	28.58	28.58	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	28.58	28.58	28.58
Annual gas cost (£m) (HHV)					[illegible]	0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£0.00	£0.00	£0.00
Uplifted Gas Prod Rate F/C (mmsc					[illegible]	4.37	13.96	13.56	13.17	13.25	12.60	12.42	12.09	12.13	11.82	11.52	11.62	11.74	11.88	11.63	11.39	11.16	10.94	10.72
Average Gas Consumption Rate (mmscfd)				12.233	12.622	14.206	14.002	13.600	13.210	13.244	12.667	12.441	12.120	12.126	11.822	11.520	11.615	11.735	11.876	11.631	11.394	11.163	10.938	10.722
Gas Prod annual Shortfall against uplifted production f/c (%)					-24%	-27%	-29%	-29%	-29%	-30%	-30%	-30%	-31%	-31%	-31%	-31%	-33%	-34%	-36%	-36%	-36%	-37%	-37%	-37%
Operating costs (£k)																								
Fuel gas compressor drive electricity cost					£432	£496	£498	£492	£487	£497	£483	£483	£478	£487	£482	£477	£489	£502	£515	£512	£509	£506	£503	£493
O&M costs (Fixed)					£13,438	£13,774	£14,118	£14,471	£14,833	£15,204	£15,584	£15,974	£16,373	£16,782	£17,202	£17,632	£18,073	£18,524	£18,987	£19,462	£19,949	£20,447	£20,959	£21,483
O&M Costs (Variable)					£2,821	£3,260	£3,292	£3,277	£3,261	£3,352	£3,283	£3,305	£3,299	£3,384	£3,380	£3,374	£3,489	£3,612	£3,748	£3,761	£3,776	£3,790	£3,806	£3,823
Power Transmission (incl all TNUOS) Costs					£5,276	£5,343	£5,411	£5,482	£5,554	£5,627	£5,703	£5,780	£5,860	£5,941	£6,024	£6,110	£6,197	£6,287	£6,379	£6,474	£6,570	£6,669	£6,771	£6,875
ETS Carbon Charges (£k)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UK CPS Charges (£k)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2 Annual Production (tn)					n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Wholesale Average Gas Price NBP (p/thm)				1.09	52.38	53.38	54.38	55.38	56.38	57.38	58.38	59.38	60.38	61.38	62.38	63.38	64.38	65.38	66.38	67.38	68.38	69.38	70.38	70.38
Wholesale Average Power Price (£/MWh)				1.00	76.30	77.85	71.13	74.15	83.02	76.18	90.18	87.83	90.00	92.64	97.01	87.54	86.12	87.56	103.30	102.27	94.33	106.18	108.39	108.39
Consumer Price Inflation Rate (%)				1.00	1.03	1.05	1.08	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.38	1.41	1.45	1.48	1.52	1.56	1.60	1.64
UK Base Interest Rate (%)				1.25%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
GBP/Euro Exchange rate - 1GBP is worth				1.17	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
GBP/US$ Exchange rate - 1GBP is worth				1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23
Annual fuel gas compression electricity demand (MWh)					8,252	9,287	9,155	8,891	8,636	8,659	8,281	8,134	7,924	7,928	7,729	7,531	7,594	7,672	7,764	7,604	7,449	7,298	7,151	7,010
Fixed Power Price					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

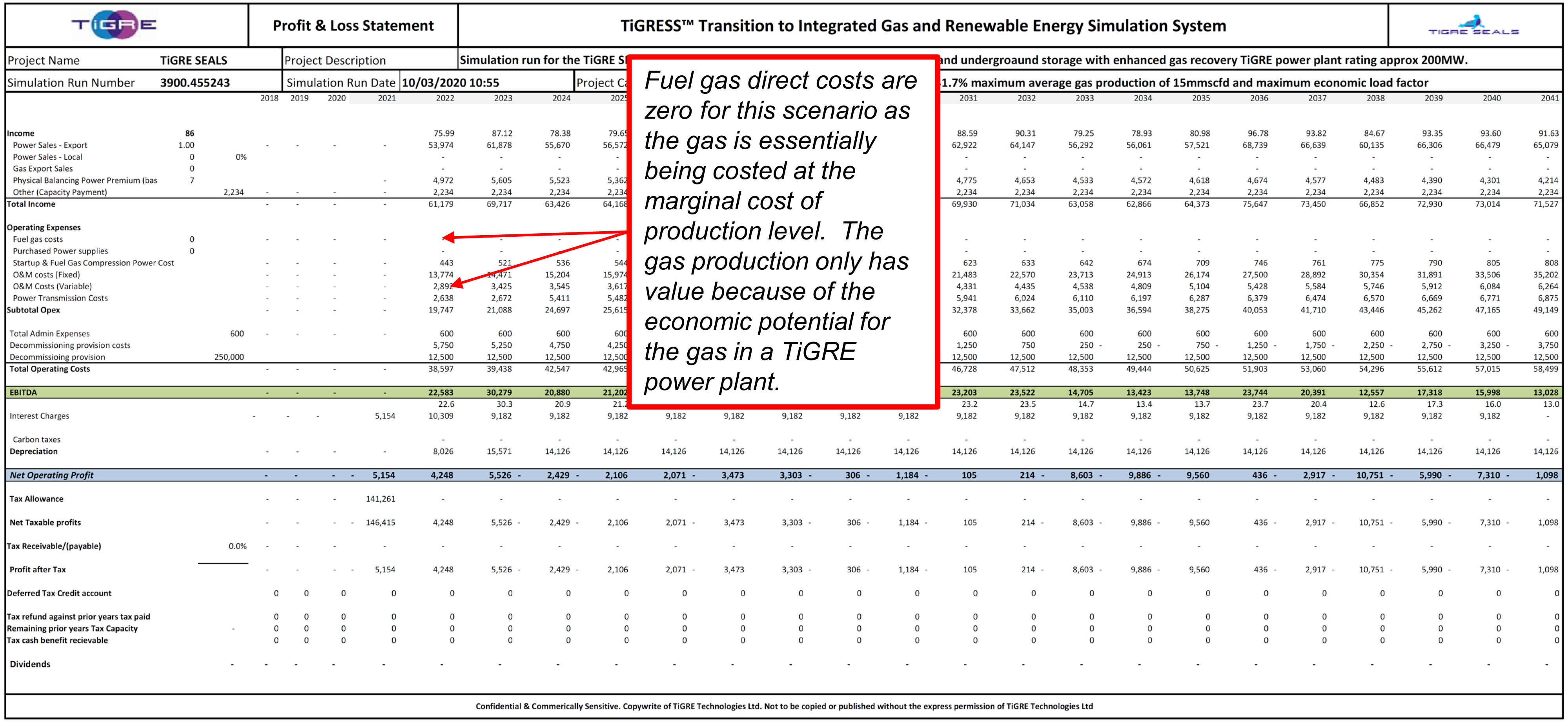
Scenario modelling is all set to achieve an equity return IRR (nominal) of 15% to reflect the investment risk grade. This in effect sets the relative basis for the calculation of the LCOE

Time series output data

Gas Consumed for total simulation period – For this scenario it is lower then the Reference case largely due to the increase efficiency of the plant

Feasibility Study Concept Option 2

The TiGRE™ CryoSep Power Plant Time Model Financial Results for a 42% Load Factor condition for the power plant



Profit & Loss Statement

TiGRESS™ Transition to Integrated Gas and Renewable Energy Simulation System

Project Name **TiGRE SEALS** | Project Description | **Simulation run for the TiGRE S**

and undergroaund storage with enhanced gas recovery TiGRE power plant rating approx 200MW.

Simulation Run Number **3900.455243** | Simulation Run Date **10/03/2020 10:55** | Project Ca

1.7% maximum average gas production of 15mmscfd and maximum economic load factor

			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Income	**86**						75.99	87.12	78.38	79.6						88.59	90.31	79.25	78.93	80.98	96.78	93.82	84.67	93.35	93.60	91.63
Power Sales - Export	1.00		-	-	-	-	53,974	61,878	55,670	56,572						62,922	64,147	56,292	56,061	57,521	68,739	66,639	60,135	66,306	66,479	65,079
Power Sales - Local	0	0%					-	-	-	-						-	-	-	-	-	-	-	-	-	-	-
Gas Export Sales	0						-	-	-	-						-	-	-	-	-	-	-	-	-	-	-
Physical Balancing Power Premium (bas	7					-	4,972	5,605	5,523	5,362						4,775	4,653	4,533	4,572	4,618	4,674	4,577	4,483	4,390	4,301	4,214
Other (Capacity Payment)		2,234	-	-	-	-	2,234	2,234	2,234	2,234						2,234	2,234	2,234	2,234	2,234	2,234	2,234	2,234	2,234	2,234	2,234
Total Income			-	-	-	-	61,179	69,717	63,426	64,168						69,930	71,034	63,058	62,866	64,373	75,647	73,450	66,852	72,930	73,014	71,527
Operating Expenses																										
Fuel gas costs	0		-	-	-	-	-	-	-	-						-	-	-	-	-	-	-	-	-	-	-
Purchased Power supplies	0						-	-	-	-						-	-	-	-	-	-	-	-	-	-	-
Startup & Fuel Gas Compression Power Cost			-	-	-	-	443	521	536	544						623	633	642	674	709	746	761	775	790	805	808
O&M costs (Fixed)			-	-	-	-	13,774	14,471	15,204	15,974						21,483	22,570	23,713	24,913	26,174	27,500	28,892	30,354	31,891	33,506	35,202
O&M Costs (Variable)			-	-	-	-	2,892	3,425	3,545	3,617						4,331	4,435	4,538	4,809	5,104	5,428	5,584	5,746	5,912	6,084	6,264
Power Transmission Costs			-	-	-	-	2,638	2,672	5,411	5,482						5,941	6,024	6,110	6,197	6,287	6,379	6,474	6,570	6,669	6,771	6,875
Subtotal Opex			-	-	-	-	19,747	21,088	24,697	25,615						32,378	33,662	35,003	36,594	38,275	40,053	41,710	43,446	45,262	47,165	49,149
Total Admin Expenses		600	-	-	-	-	600	600	600	600						600	600	600	600	600	600	600	600	600	600	600
Decommissioning provision costs							5,750	5,250	4,750	4,250						1,250	750	250	-250	-750	-1,250	-1,750	-2,250	-2,750	-3,250	-3,750
Decommissioing provision		250,000					12,500	12,500	12,500	12,500						12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500
Total Operating Costs			-	-	-	-	38,597	39,438	42,547	42,965						46,728	47,512	48,353	49,444	50,625	51,903	53,060	54,296	55,612	57,015	58,499
EBITDA			**-**	**-**	**-**	**-**	**22,583**	**30,279**	**20,880**	**21,202**						**23,203**	**23,522**	**14,705**	**13,423**	**13,748**	**23,744**	**20,391**	**12,557**	**17,318**	**15,998**	**13,028**
							22.6	30.3	20.9	21.2						23.2	23.5	14.7	13.4	13.7	23.7	20.4	12.6	17.3	16.0	13.0
Interest Charges			-	-	-	5,154	10,309	9,182	9,182	9,182	9,182	9,182	9,182	9,182	9,182	9,182	9,182	9,182	9,182	9,182	9,182	9,182	9,182	9,182	9,182	-
Carbon taxes							-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Depreciation			-	-	-	-	8,026	15,571	14,126	14,126	14,126	14,126	14,126	14,126	14,126	14,126	14,126	14,126	14,126	14,126	14,126	14,126	14,126	14,126	14,126	14,126
Net Operating Profit			**-**	**-**	**-**	**-5,154**	**4,248**	**5,526**	**-2,429**	**-2,106**	**2,071**	**-3,473**	**3,303**	**-306**	**-1,184**	**-105**	**214**	**-8,603**	**-9,886**	**-9,560**	**436**	**-2,917**	**-10,751**	**-5,990**	**-7,310**	**-1,098**
Tax Allowance			-	-	-	141,261	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Net Taxable profits			-	-	-	-146,415	4,248	5,526	-2,429	-2,106	2,071	-3,473	3,303	-306	-1,184	-105	214	-8,603	-9,886	-9,560	436	-2,917	-10,751	-5,990	-7,310	-1,098
Tax Receivable/(payable)		0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Profit after Tax			-	-	-	-5,154	4,248	5,526	-2,429	-2,106	2,071	-3,473	3,303	-306	-1,184	-105	214	-8,603	-9,886	-9,560	436	-2,917	-10,751	-5,990	-7,310	-1,098
Deferred Tax Credit account			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tax refund against prior years tax paid			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Remaining prior years Tax Capacity		-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tax cash benefit recievable			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dividends		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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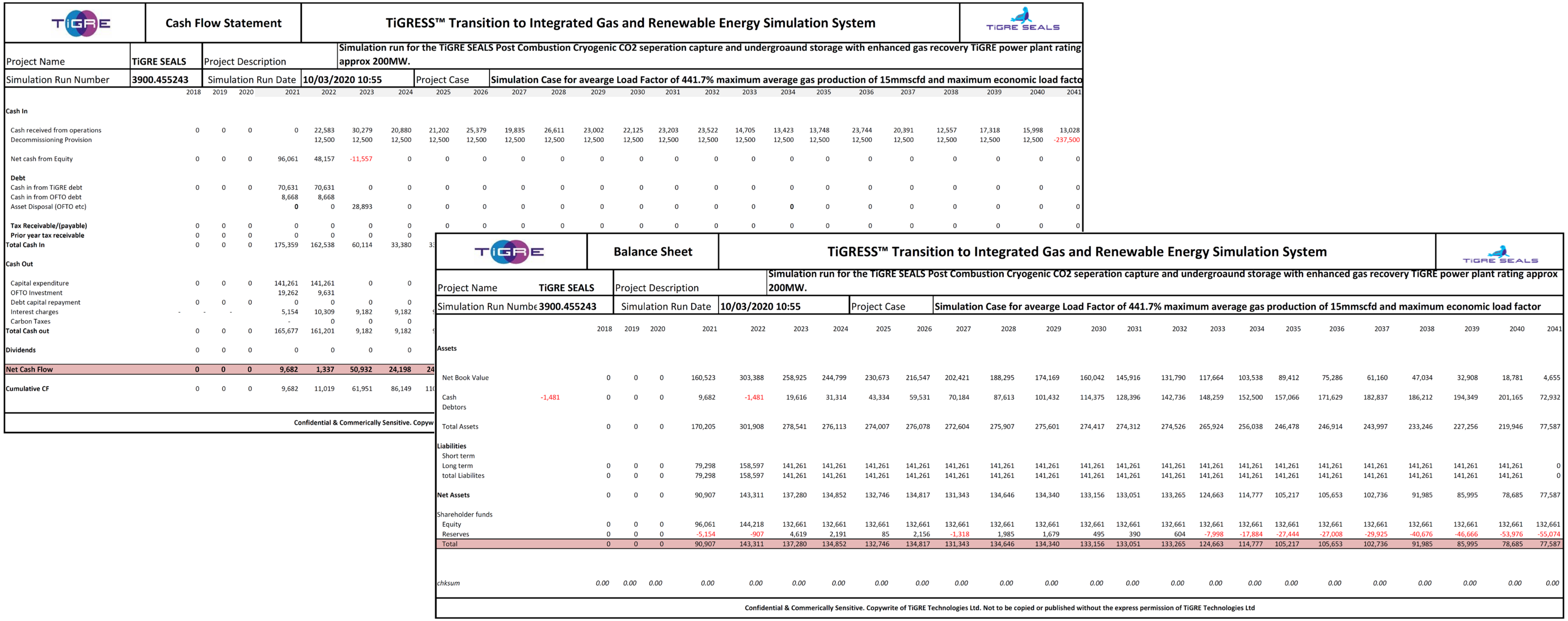
Fuel gas direct costs are zero for this scenario as the gas is essentially being costed at the marginal cost of production level. The gas production only has value because of the economic potential for the gas in a TiGRE power plant.

Feasibility Study Concept Option 2

The TiGRE™ CryoSep Power Plant Time Model Financial Results for a 42% Load Factor condition for the power plant



Cash Flow Statement | **TiGRESS™ Transition to Integrated Gas and Renewable Energy Simulation System**

Project Name	**TiGRE SEALS**	Project Description	**Simulation run for the TiGRE SEALS Post Combustion Cryogenic CO2 seperation capture and undergroaund storage with enhanced gas recovery TiGRE power plant rating approx 200MW.**
Simulation Run Number	**3900.455243**	Simulation Run Date	**10/03/2020 10:55**
Project Case	**Simulation Case for avearge Load Factor of 441.7% maximum average gas production of 15mmscfd and maximum economic load facto**		

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Cash In																								
Cash received from operations	0	0	0	0	22,583	30,279	20,880	21,202	25,379	19,835	26,611	23,002	22,125	23,203	23,522	14,705	13,423	13,748	23,744	20,391	12,557	17,318	15,998	13,028
Decommissioning Provision					12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	-237,500
Net cash from Equity	0	0	0	96,061	48,157	-11,557	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Debt																								
Cash in from TiGRE debt	0	0	0	70,631	70,631	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash in from OFTO debt				8,668	8,668																			
Asset Disposal (OFTO etc)				**0**	0	28,893	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0
Tax Receivable/(payable)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prior year tax receivable	0	0	0	0	0	0	0																	
Total Cash In	0	0	0	175,359	162,538	60,114	33,380																	
Cash Out																								
Capital expenditure	0	0	0	141,261	141,261	0	0																	
OFTO Investment				19,262	9,631																			
Debt capital repayment	0	0	0	0	0	0	0																	
Interest charges	-	-	-	5,154	10,309	9,182	9,182																	
Carbon Taxes				-	0	0	0																	
Total Cash out	0	0	0	165,677	161,201	9,182	9,182																	
Dividends	0	0	0	0	0	0	0																	
Net Cash Flow	**0**	**0**	**0**	**9,682**	**1,337**	**50,932**	**24,198**																	
Cumulative CF	0	0	0	9,682	11,019	61,951	86,149																	

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Balance Sheet | **TiGRESS™ Transition to Integrated Gas and Renewable Energy Simulation System**

Project Name	**TiGRE SEALS**	Project Description	**Simulation run for the TiGRE SEALS Post Combustion Cryogenic CO2 seperation capture and undergroaund storage with enhanced gas recovery TiGRE power plant rating approx 200MW.**
Simulation Run Numbe	**3900.455243**	Simulation Run Date	**10/03/2020 10:55**
Project Case	**Simulation Case for avearge Load Factor of 441.7% maximum average gas production of 15mmscfd and maximum economic load factor**		

		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Assets																									
Net Book Value		0	0	0	160,523	303,388	258,925	244,799	230,673	216,547	202,421	188,295	174,169	160,042	145,916	131,790	117,664	103,538	89,412	75,286	61,160	47,034	32,908	18,781	4,655
Cash	-1,481	0	0	0	9,682	-1,481	19,616	31,314	43,334	59,531	70,184	87,613	101,432	114,375	128,396	142,736	148,259	152,500	157,066	171,629	182,837	186,212	194,349	201,165	72,932
Debtors																									
Total Assets		0	0	0	170,205	301,908	278,541	276,113	274,007	276,078	272,604	275,907	275,601	274,417	274,312	274,526	265,924	256,038	246,478	246,914	243,997	233,246	227,256	219,946	77,587
Liabilities																									
Short term																									
Long term		0	0	0	79,298	158,597	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	0
total Liabilites		0	0	0	79,298	158,597	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	141,261	0
Net Assets		0	0	0	90,907	143,311	137,280	134,852	132,746	134,817	131,343	134,646	134,340	133,156	133,051	133,265	124,663	114,777	105,217	105,653	102,736	91,985	85,995	78,685	77,587
Shareholder funds																									
Equity		0	0	0	96,061	144,218	132,661	132,661	132,661	132,661	132,661	132,661	132,661	132,661	132,661	132,661	132,661	132,661	132,661	132,661	132,661	132,661	132,661	132,661	132,661
Reserves		0	0	0	-5,154	-907	4,619	2,191	85	2,156	-1,318	1,985	1,679	495	390	604	-7,998	-17,884	-27,444	-27,008	-29,925	-40,676	-46,666	-53,976	-55,074
Total		0	0	0	90,907	143,311	137,280	134,852	132,746	134,817	131,343	134,646	134,340	133,156	133,051	133,265	124,663	114,777	105,217	105,653	102,736	91,985	85,995	78,685	77,587
chksum		*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*

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Concept Option 3

Oxyfuel Generation

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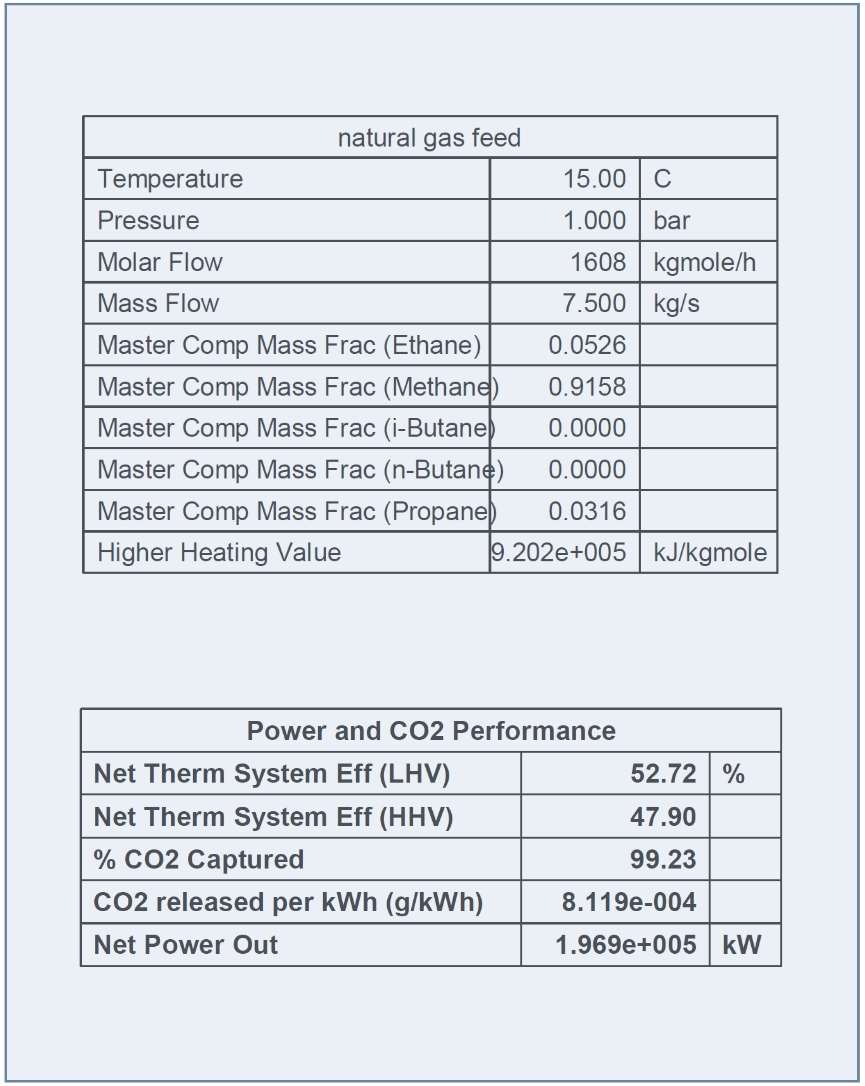
Feasibility Study Concept Option 3

The TiGRE™ OxyFuel Power Plant Summary

- Capital cost 42% higher than OCGT Reference Case.
- Net thermal efficiency 10% higher than OCGT(RC).
- System Latency increased by less than 30mins over OCGT(RC) to full efficiency & therefore within 1/2hr trading period & fully dispatchable to market demand.
- Practically Zero CO2 released.
- Viable operating envelope between 42% and 56% average annual Load Factor.
- LCOE range from £45.31/MWh (56%LF) to £55.43/MWh (42%LF).



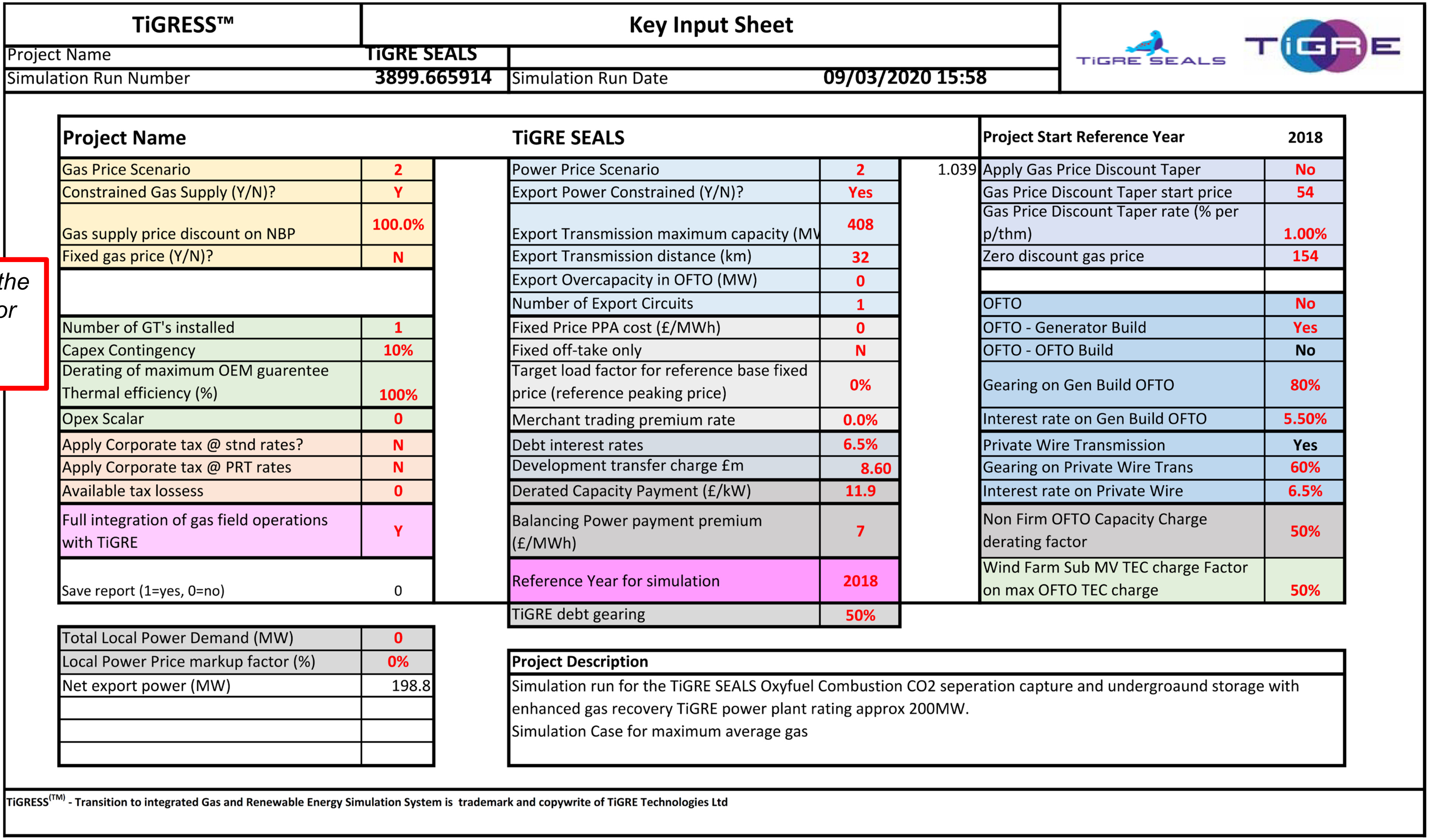
natural gas feed		
Temperature	15.00	C
Pressure	1.000	bar
Molar Flow	1608	kgmole/h
Mass Flow	7.500	kg/s
Master Comp Mass Frac (Ethane)	0.0526	
Master Comp Mass Frac (Methane)	0.9158	
Master Comp Mass Frac (i-Butane)	0.0000	
Master Comp Mass Frac (n-Butane)	0.0000	
Master Comp Mass Frac (Propane)	0.0316	
Higher Heating Value	9.202e+005	kJ/kgmole

Power and CO2 Performance		
Net Therm System Eff (LHV)	**52.72**	**%**
Net Therm System Eff (HHV)	**47.90**	
% CO2 Captured	**99.23**	
CO2 released per kWh (g/kWh)	**8.119e-004**	
Net Power Out	**1.969e+005**	**kW**

Feasibility Study Concept Option 3

The TiGRE™ OxyFuel Power Plant Key Assumptions

Simulation inputs are the same as those used for the TiGRE CryoSep simulations



TiGRESS™		Key Input Sheet	
Project Name	TiGRE SEALS		
Simulation Run Number	3899.665914	Simulation Run Date	09/03/2020 15:58

Project Name		TiGRE SEALS			Project Start Reference Year	2018
Gas Price Scenario	2	Power Price Scenario	2	1.039	Apply Gas Price Discount Taper	No
Constrained Gas Supply (Y/N)?	Y	Export Power Constrained (Y/N)?	Yes		Gas Price Discount Taper start price	54
Gas supply price discount on NBP	100.0%	Export Transmission maximum capacity (MV	408		Gas Price Discount Taper rate (% per p/thm)	1.00%
Fixed gas price (Y/N)?	N	Export Transmission distance (km)	32		Zero discount gas price	154
		Export Overcapacity in OFTO (MW)	0			
		Number of Export Circuits	1		OFTO	No
Number of GT's installed	1	Fixed Price PPA cost (£/MWh)	0		OFTO - Generator Build	Yes
Capex Contingency	10%	Fixed off-take only	N		OFTO - OFTO Build	No
Derating of maximum OEM guarentee Thermal efficiency (%)	100%	Target load factor for reference base fixed price (reference peaking price)	0%		Gearing on Gen Build OFTO	80%
Opex Scalar	0	Merchant trading premium rate	0.0%		Interest rate on Gen Build OFTO	5.50%
Apply Corporate tax @ stnd rates?	N	Debt interest rates	6.5%		Private Wire Transmission	Yes
Apply Corporate tax @ PRT rates	N	Development transfer charge £m	8.60		Gearing on Private Wire Trans	60%
Available tax lossess	0	Derated Capacity Payment (£/kW)	11.9		Interest rate on Private Wire	6.5%
Full integration of gas field operations with TiGRE	Y	Balancing Power payment premium (£/MWh)	7		Non Firm OFTO Capacity Charge derating factor	50%
Save report (1=yes, 0=no)	0	Reference Year for simulation	2018		Wind Farm Sub MV TEC charge Factor on max OFTO TEC charge	50%
		TiGRE debt gearing	50%			

Total Local Power Demand (MW)	0
Local Power Price markup factor (%)	0%
Net export power (MW)	198.8

Project Description

Simulation run for the TiGRE SEALS Oxyfuel Combustion CO2 seperation capture and undergroaund storage with enhanced gas recovery TiGRE power plant rating approx 200MW.
Simulation Case for maximum average gas

Feasibility Study Concept Option 3

The TiGRE™ OxyFuel Power Plant Time Series Data 43% Load factor

TiGRESS™ — **Time Series Data**

Project Name **TiGRE SEALS**

Simulation Run Number **3899.665914** Simulation Run Date **09/03/2020 15:58**

		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
	Gas Production					**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
	Current Net export Gas Production Forecast (mmscfd)	**0**	**0**	**51.2**	**44.7**	**11.25**	**11**	**11**	**10**	**10**	**10**	**9**	**9**	**9**	**9**	**8**	**8**	**8**	**8**	**7**	**7**	**7**	**7**	**7**	**6**
	Compression Fuel Gas Recovery	**0%**	**0%**	**0%**	**0%**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.50%	Prodcution Uplift from CO2 injection					-	0.94	0.93	0.92	0.91	1.12	1.08	1.26	1.26	1.66	1.66	1.67	2.09	2.52	2.96	2.99	3.01	3.03	3.05	3.07
	Uplifted production rates (mmscfd)					11.3	11.9	11.5	11.2	10.9	10.8	10.4	10.4	10.1	10.2	10.0	9.7	9.9	10.1	10.3	10.1	9.9	9.7	9.6	9.4
	Production Variation Compound Factor					0.00	0.94	0.93	0.92	0.91	1.12	1.08	1.26	1.26	1.66	1.66	1.67	2.09	2.52	2.96	2.99	3.01	3.03	3.05	3.07
	Production rate difference (%)					0.0%	7.9%	8.1%	8.2%	8.4%	10.4%	10.3%	12.2%	12.5%	16.2%	16.7%	17.2%	21.1%	25.0%	28.7%	29.5%	30.3%	31.1%	31.9%	32.8%
100%	**Gas Price Discount Rate (%)**					**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
						0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Power Production																								
	Number of GT					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
						198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8
						(45.47)	-46.3348	-47.203	-48.0711	-48.9393	-49.8074	-50.6756	-51.5437	-52.4119	-53.28	-54.1482	-55.0163	-55.8845	-56.7526	-57.6208	-58.4889	-59.3571	-60.2252	-61.0934	-61.0934
						0.6	0.63	0.646134	0.662288	0.678845	0.695816	0.713211	0.731042	0.749318	0.768051	0.787252	0.806933	0.827107	0.847784	0.868979	0.890703	0.912971	0.935795	0.95919	0.98317
						-18.1867	-17.1265	-16.7035	-16.2342	-15.7171	-15.1506	-14.5332	-13.8631	-13.1387	-12.3583	-11.5199	-10.6218	-9.66206	-8.63864	-7.54954	-6.39264	-5.16579	-3.86675	-2.49321	-1.02821
			0.50%	0.75%	1.25%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
2.50%	Annual CPI Index (Base 2016)	1.00	1.00	1.00	1.00	1.03	1.05	1.08	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.38	1.41	1.45	1.48	1.52	1.56	1.60	1.64
	Wholesale Day Ahead Gas Price Index (1/10/16)																								
	LOW	**28.68**	**36.12**	**36.37**	**36.62**	**36.87**	**37.12**	**37.37**	**37.62**	**37.87**	**38.12**	**38.37**	**38.62**	**38.87**	**39.12**	**39.37**	**39.62**	**39.87**	**40.12**	**40.37**	**40.62**	**40.87**	**41.12**	**41.37**	**41.37**
2.50%	**CENTRAL**	**34.60**	**49.37**	**50.37**	**51.37**	**52.37**	**53.37**	**54.37**	**55.37**	**56.37**	**57.37**	**58.37**	**59.37**	**60.37**	**61.37**	**62.37**	**63.37**	**64.37**	**65.37**	**66.37**	**67.37**	**68.37**	**69.37**	**70.37**	**70.37**
	HIGH	**43.95**	**54.77**	**56.07**	**57.37**	**58.67**	**59.97**	**61.27**	**62.57**	**63.87**	**65.17**	**66.47**	**67.77**	**69.07**	**70.37**	**71.67**	**72.97**	**74.27**	**75.57**	**76.87**	**78.17**	**79.47**	**80.77**	**82.07**	**82.07**
	Wholesale Electricity SSP Index (1/10/16 = 1)																								
	LOW	**34.73**	**41.35**	**42.17**	**38.23**	**42.56**	**42.89**	**38.73**	**39.91**	**44.18**	**40.10**	**46.96**	**45.26**	**45.91**	**46.78**	**48.51**	**43.36**	**42.25**	**42.57**	**49.78**	**48.85**	**44.67**	**49.86**	**50.48**	**50.48**
2.50%	**CENTRAL**	**39.10**	**58.72**	**60.69**	**55.71**	**62.80**	**64.07**	**58.55**	**61.03**	**68.33**	**62.70**	**74.23**	**72.29**	**74.08**	**76.25**	**79.84**	**72.05**	**70.88**	**72.07**	**85.03**	**84.18**	**77.64**	**87.39**	**89.22**	**89.22**
	HIGH	**41.67**	**62.70**	**65.02**	**59.88**	**67.72**	**69.29**	**63.50**	**66.38**	**74.51**	**68.55**	**81.36**	**79.42**	**81.57**	**84.15**	**88.31**	**79.85**	**78.71**	**80.18**	**94.78**	**94.00**	**86.86**	**97.93**	**100.14**	**100.14**
	ETS Carbon Price (£/tn, nominal base 1/1/16)																								
	LOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	CENTRAL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	HIGH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	UK CPS (£/kWh gas, nominal base 1/1/16)																								
	LOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	CENTRAL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	HIGH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fixed Gas Price																								
	LOW	28.68	36.12	36.37	36.62	37.37	37.37	37.37	37.37	37.37	38.62	38.62	38.62	38.62	38.62	39.87	39.87	39.87	39.87	39.87	41.07	41.07	41.07	41.07	41.07
	CENTRAL	34.60	49.37	50.37	51.37	54.37	54.37	54.37	54.37	54.37	59.37	59.37	59.37	59.37	59.37	64.37	64.37	64.37	64.37	64.37	69.17	69.17	69.17	69.17	69.17
	HIGH	43.95	54.77	56.07	57.37	61.27	61.27	61.27	61.27	61.27	67.77	67.77	67.77	67.77	67.77	74.27	74.27	74.27	74.27	74.27	80.51	80.51	80.51	80.51	80.51

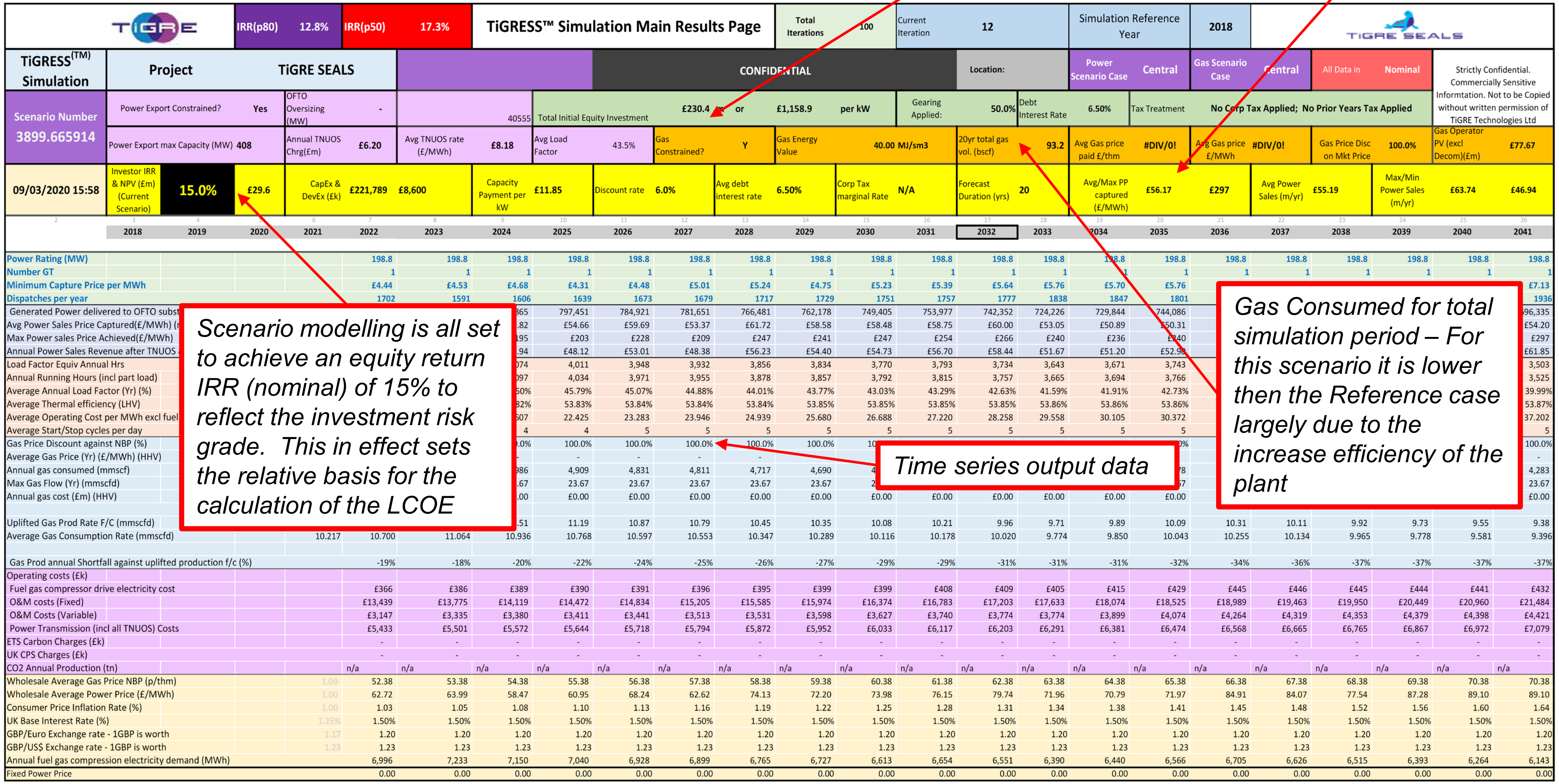
Fuel gas production matches gas demand for the OxyFuel Power plant running at 43% Load factor for this scenario

Feasibility Study Concept Option 3

The TiGRE™ OxyFuel Power Plant Time Model Results for a 42% Load Factor condition for the power plant

Load Factor for Scenario

OxyFuel Power Plant produce the lowest LCOE for a 43% Load factor (i.e approx. 1mmscfd gas supply)



TiGRESS™ Simulation Main Results Page
IRR(p80) 12.8%
IRR(p50) 17.3%
Total Iterations 100
Current Iteration 12
Simulation Reference Year 2018
TiGRESS(TM) Simulation
Project TiGRE SEALS
CONFIDENTIAL
Location:
Power Scenario Case Central
Gas Scenario Case Central
All Data in Nominal
Strictly Confidential. Commercially Sensitive Informtation. Not to be Copied without written permission of TiGRE Technologies Ltd
Scenario Number 3899.665914
Power Export Constrained? Yes
OFTO Oversizing (MW) -
40555
Total Initial Equity Investment £230.4 m or £1,158.9 per kW
Gearing Applied: 50.0%
Debt Interest Rate 6.50%
Tax Treatment No Corp Tax Applied; No Prior Years Tax Applied
Power Export max Capacity (MW) 408
Annual TNUOS Chrg(£m) £6.20
Avg TNUOS rate (£/MWh) £8.18
Avg Load Factor 43.5%
Gas Constrained? Y
Gas Energy Value 40.00 MJ/sm3
20yr total gas vol. (bscf) 93.2
Avg Gas price paid £/thm #DIV/0!
Avg Gas price £/MWh #DIV/0!
Gas Price Disc on Mkt Price 100.0%
Gas Operator PV (excl Decom)(£m) £77.67
09/03/2020 15:58
Investor IRR & NPV (£m) (Current Scenario) 15.0% £29.6
CapEx & DevEx (£k) £221,789 £8,600
Capacity Payment per kW £11.85
Discount rate 6.0%
Avg debt interest rate 6.50%
Corp Tax marginal Rate N/A
Forecast Duration (yrs) 20
Avg/Max PP captured (£/MWh) £56.17 £297
Avg Power Sales (m/yr) £55.19
Max/Min Power Sales (m/yr) £63.74 £46.94

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Power Rating (MW)					198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8	198.8
Number GT					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Minimum Capture Price per MWh					£4.44	£4.53	£4.68	£4.31	£4.48	£5.01	£5.24	£4.75	£5.23	£5.39	£5.64	£5.76	£5.70	£5.76	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£7.13
Dispatches per year					1702	1591	1606	1639	1673	1679	1717	1729	1751	1757	1777	1838	1847	1801	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1936
Generated Power delivered to OFTO subst	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	797,451	784,921	781,651	766,481	762,178	749,405	753,977	742,352	724,226	729,844	744,086	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Avg Power Sales Price Captured(£/MWh) (r	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£54.66	£59.69	£53.37	£61.72	£58.58	£58.48	£58.75	£60.00	£53.05	£50.89	£50.31	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£54.20
Max Power sales Price Achieved(£/MWh)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£203	£228	£209	£247	£241	£247	£254	£266	£240	£236	£240	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£297
Annual Power Sales Revenue after TNUOS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£48.12	£53.01	£48.38	£56.23	£54.40	£54.73	£56.70	£58.44	£51.67	£51.20	£52.90	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£61.85
Load Factor Equiv Annual Hrs	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,011	3,948	3,932	3,856	3,834	3,770	3,793	3,734	3,643	3,671	3,743	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,503
Annual Running Hours (incl part load)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,034	3,971	3,955	3,878	3,857	3,792	3,815	3,757	3,665	3,694	3,766	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,525
Average Annual Load Factor (Yr) (%)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	45.79%	45.07%	44.88%	44.01%	43.77%	43.03%	43.29%	42.63%	41.59%	41.91%	42.73%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	39.99%
Average Thermal efficiency (LHV)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	53.83%	53.84%	53.84%	53.84%	53.85%	53.85%	53.85%	53.85%	53.86%	53.86%	53.86%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	53.87%
Average Operating Cost per MWh excl fuel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	22.425	23.283	23.946	24.939	25.680	26.688	27.220	28.258	29.558	30.105	30.372	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	37.202
Average Start/Stop cycles per day	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	4	5	5	5	5	5	5	5	5	5	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5
Gas Price Discount against NBP (%)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100.0%	100.0%	100.0%	100.0%	100.0%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100.0%
Average Gas Price (Yr) (£/MWh) (HHV)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
Annual gas consumed (mmscf)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,909	4,831	4,811	4,717	4,690	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,283
Max Gas Flow (Yr) (mmscfd)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	23.67	23.67	23.67	23.67	23.67	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	23.67
Annual gas cost (£m) (HHV)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£0.00
Uplifted Gas Prod Rate F/C (mmscfd)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.19	10.87	10.79	10.45	10.35	10.08	10.21	9.96	9.71	9.89	10.09	10.31	10.11	9.92	9.73	9.55	9.38
Average Gas Consumption Rate (mmscfd)				10.217	10.700	11.064	10.936	10.768	10.597	10.553	10.347	10.289	10.116	10.178	10.020	9.774	9.850	10.043	10.255	10.134	9.965	9.778	9.581	9.396
Gas Prod annual Shortfall against uplifted production f/c (%)					-19%	-18%	-20%	-22%	-24%	-25%	-26%	-27%	-29%	-29%	-31%	-31%	-31%	-32%	-34%	-36%	-37%	-37%	-37%	-37%
Operating costs (£k)																								
Fuel gas compressor drive electricity cost					£366	£386	£389	£390	£391	£396	£395	£399	£399	£408	£409	£405	£415	£429	£445	£446	£445	£444	£441	£432
O&M costs (Fixed)					£13,439	£13,775	£14,119	£14,472	£14,834	£15,205	£15,585	£15,974	£16,374	£16,783	£17,203	£17,633	£18,074	£18,525	£18,989	£19,463	£19,950	£20,449	£20,960	£21,484
O&M Costs (Variable)					£3,147	£3,335	£3,380	£3,411	£3,441	£3,513	£3,531	£3,598	£3,627	£3,740	£3,774	£3,774	£3,899	£4,074	£4,264	£4,319	£4,353	£4,379	£4,398	£4,421
Power Transmission (incl all TNUOS) Costs					£5,433	£5,501	£5,572	£5,644	£5,718	£5,794	£5,872	£5,952	£6,033	£6,117	£6,203	£6,291	£6,381	£6,474	£6,568	£6,665	£6,765	£6,867	£6,972	£7,079
ETS Carbon Charges (£k)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UK CPS Charges (£k)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2 Annual Production (tn)					n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Wholesale Average Gas Price NBP (p/thm)				1.09	52.38	53.38	54.38	55.38	56.38	57.38	58.38	59.38	60.38	61.38	62.38	63.38	64.38	65.38	66.38	67.38	68.38	69.38	70.38	70.38
Wholesale Average Power Price (£/MWh)				1.00	62.72	63.99	58.47	60.95	68.24	62.62	74.13	72.20	73.98	76.15	79.74	71.96	70.79	71.97	84.91	84.07	77.54	87.28	89.10	89.10
Consumer Price Inflation Rate (%)				1.00	1.03	1.05	1.08	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.38	1.41	1.45	1.48	1.52	1.56	1.60	1.64
UK Base Interest Rate (%)				1.25%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
GBP/Euro Exchange rate - 1GBP is worth				1.17	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
GBP/US$ Exchange rate - 1GBP is worth				1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23
Annual fuel gas compression electricity demand (MWh)					6,996	7,233	7,150	7,040	6,928	6,899	6,765	6,727	6,613	6,654	6,551	6,390	6,440	6,566	6,705	6,626	6,515	6,393	6,264	6,143
Fixed Power Price					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

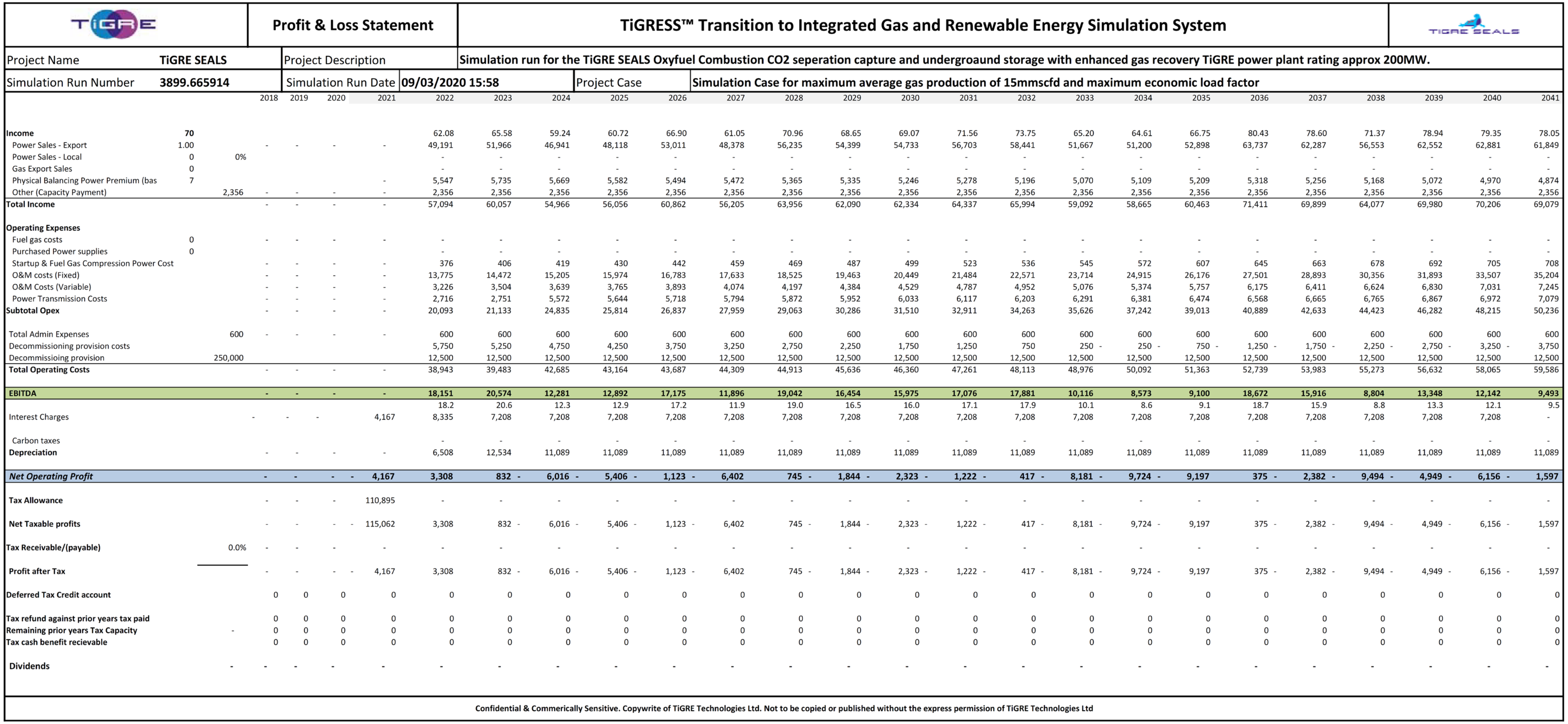
Scenario modelling is all set to achieve an equity return IRR (nominal) of 15% to reflect the investment risk grade. This in effect sets the relative basis for the calculation of the LCOE

Time series output data

Gas Consumed for total simulation period – For this scenario it is lower then the Reference case largely due to the increase efficiency of the plant

Feasibility Study Concept Option 3

The TiGRE™ OxyFuel Power Plant Model Profit and Loss Account for a 43% Load Factor condition for the power plant



Profit & Loss Statement

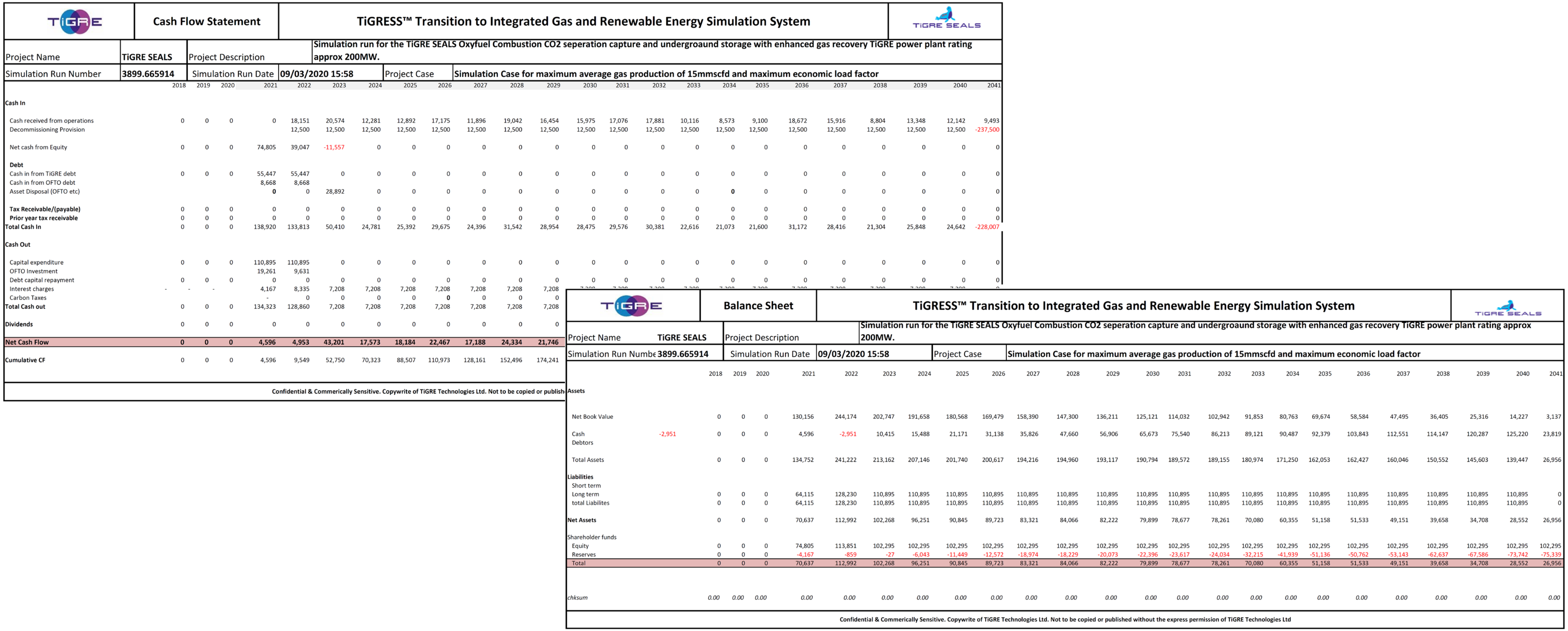
TiGRESS™ Transition to Integrated Gas and Renewable Energy Simulation System

Project Name **TiGRE SEALS**
Project Description **Simulation run for the TiGRE SEALS Oxyfuel Combustion CO2 seperation capture and undergroaund storage with enhanced gas recovery TiGRE power plant rating approx 200MW.**
Simulation Run Number **3899.665914**
Simulation Run Date **09/03/2020 15:58**
Project Case **Simulation Case for maximum average gas production of 15mmscfd and maximum economic load factor**

			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Income	**70**						62.08	65.58	59.24	60.72	66.90	61.05	70.96	68.65	69.07	71.56	73.75	65.20	64.61	66.75	80.43	78.60	71.37	78.94	79.35	78.05
Power Sales - Export	1.00		-	-	-	-	49,191	51,966	46,941	48,118	53,011	48,378	56,235	54,399	54,733	56,703	58,441	51,667	51,200	52,898	63,737	62,287	56,553	62,552	62,881	61,849
Power Sales - Local	0	0%					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gas Export Sales	0						-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Physical Balancing Power Premium (bas	7					-	5,547	5,735	5,669	5,582	5,494	5,472	5,365	5,335	5,246	5,278	5,196	5,070	5,109	5,209	5,318	5,256	5,168	5,072	4,970	4,874
Other (Capacity Payment)		2,356	-	-	-	-	2,356	2,356	2,356	2,356	2,356	2,356	2,356	2,356	2,356	2,356	2,356	2,356	2,356	2,356	2,356	2,356	2,356	2,356	2,356	2,356
Total Income			-	-	-	-	57,094	60,057	54,966	56,056	60,862	56,205	63,956	62,090	62,334	64,337	65,994	59,092	58,665	60,463	71,411	69,899	64,077	69,980	70,206	69,079
Operating Expenses																										
Fuel gas costs	0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Purchased Power supplies	0						-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Startup & Fuel Gas Compression Power Cost			-	-	-	-	376	406	419	430	442	459	469	487	499	523	536	545	572	607	645	663	678	692	705	708
O&M costs (Fixed)			-	-	-	-	13,775	14,472	15,205	15,974	16,783	17,633	18,525	19,463	20,449	21,484	22,571	23,714	24,915	26,176	27,501	28,893	30,356	31,893	33,507	35,204
O&M Costs (Variable)			-	-	-	-	3,226	3,504	3,639	3,765	3,893	4,074	4,197	4,384	4,529	4,787	4,952	5,076	5,374	5,757	6,175	6,411	6,624	6,830	7,031	7,245
Power Transmission Costs			-	-	-	-	2,716	2,751	5,572	5,644	5,718	5,794	5,872	5,952	6,033	6,117	6,203	6,291	6,381	6,474	6,568	6,665	6,765	6,867	6,972	7,079
Subtotal Opex			-	-	-	-	20,093	21,133	24,835	25,814	26,837	27,959	29,063	30,286	31,510	32,911	34,263	35,626	37,242	39,013	40,889	42,633	44,423	46,282	48,215	50,236
Total Admin Expenses		600	-	-	-	-	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
Decommissioning provision costs							5,750	5,250	4,750	4,250	3,750	3,250	2,750	2,250	1,750	1,250	750	250	- 250	- 750	- 1,250	- 1,750	- 2,250	- 2,750	- 3,250	- 3,750
Decommissioing provision		250,000					12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500
Total Operating Costs			-	-	-	-	38,943	39,483	42,685	43,164	43,687	44,309	44,913	45,636	46,360	47,261	48,113	48,976	50,092	51,363	52,739	53,983	55,273	56,632	58,065	59,586
EBITDA			**-**	**-**	**-**	**-**	**18,151**	**20,574**	**12,281**	**12,892**	**17,175**	**11,896**	**19,042**	**16,454**	**15,975**	**17,076**	**17,881**	**10,116**	**8,573**	**9,100**	**18,672**	**15,916**	**8,804**	**13,348**	**12,142**	**9,493**
							18.2	20.6	12.3	12.9	17.2	11.9	19.0	16.5	16.0	17.1	17.9	10.1	8.6	9.1	18.7	15.9	8.8	13.3	12.1	9.5
Interest Charges			-	-	-	4,167	8,335	7,208	7,208	7,208	7,208	7,208	7,208	7,208	7,208	7,208	7,208	7,208	7,208	7,208	7,208	7,208	7,208	7,208	7,208	-
Carbon taxes							-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Depreciation			-	-	-	-	6,508	12,534	11,089	11,089	11,089	11,089	11,089	11,089	11,089	11,089	11,089	11,089	11,089	11,089	11,089	11,089	11,089	11,089	11,089	11,089
Net Operating Profit			**-**	**-**	**-**	**- 4,167**	**3,308**	**832**	**- 6,016**	**- 5,406**	**- 1,123**	**- 6,402**	**745**	**- 1,844**	**- 2,323**	**- 1,222**	**- 417**	**- 8,181**	**- 9,724**	**- 9,197**	**375**	**- 2,382**	**- 9,494**	**- 4,949**	**- 6,156**	**- 1,597**
Tax Allowance			-	-	-	110,895	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Net Taxable profits			-	-	-	- 115,062	3,308	832	- 6,016	- 5,406	- 1,123	- 6,402	745	- 1,844	- 2,323	- 1,222	- 417	- 8,181	- 9,724	- 9,197	375	- 2,382	- 9,494	- 4,949	- 6,156	- 1,597
Tax Receivable/(payable)		0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Profit after Tax			-	-	-	- 4,167	3,308	832	- 6,016	- 5,406	- 1,123	- 6,402	745	- 1,844	- 2,323	- 1,222	- 417	- 8,181	- 9,724	- 9,197	375	- 2,382	- 9,494	- 4,949	- 6,156	- 1,597
Deferred Tax Credit account			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tax refund against prior years tax paid			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Remaining prior years Tax Capacity		-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tax cash benefit recievable			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dividends		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Feasibility Study Concept Option 3

The TiGRE™ OxyFuel Power Plant Model Profit and Loss Account for a 43% Load Factor condition for the power plant



Cash Flow Statement

TiGRESS™ Transition to Integrated Gas and Renewable Energy Simulation System

Project Name **TiGRE SEALS**
Project Description **Simulation run for the TiGRE SEALS Oxyfuel Combustion CO2 seperation capture and undergroaund storage with enhanced gas recovery TiGRE power plant rating approx 200MW.**
Simulation Run Number **3899.665914**
Simulation Run Date **09/03/2020 15:58**
Project Case **Simulation Case for maximum average gas production of 15mmscfd and maximum economic load factor**

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Cash In																								
Cash received from operations	0	0	0	0	18,151	20,574	12,281	12,892	17,175	11,896	19,042	16,454	15,975	17,076	17,881	10,116	8,573	9,100	18,672	15,916	8,804	13,348	12,142	9,493
Decommissioning Provision					12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	-237,500
Net cash from Equity	0	0	0	74,805	39,047	-11,557	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Debt																								
Cash in from TiGRE debt	0	0	0	55,447	55,447	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash in from OFTO debt				8,668	8,668																			
Asset Disposal (OFTO etc)				**0**	0	28,892	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0
Tax Receivable/(payable)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prior year tax receivable	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Cash In	0	0	0	138,920	133,813	50,410	24,781	25,392	29,675	24,396	31,542	28,954	28,475	29,576	30,381	22,616	21,073	21,600	31,172	28,416	21,304	25,848	24,642	-228,007
Cash Out																								
Capital expenditure	0	0	0	110,895	110,895	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OFTO Investment				19,261	9,631																			
Debt capital repayment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest charges	-	-	-	4,167	8,335	7,208	7,208	7,208	7,208	7,208	7,208	7,208												
Carbon Taxes				-	0	0	0	0	**0**	0	0	0												
Total Cash out	0	0	0	134,323	128,860	7,208	7,208	7,208	7,208	7,208	7,208	7,208												
Dividends	0	0	0	0	0	0	0	0	0	0	0	0												
Net Cash Flow	**0**	**0**	**0**	**4,596**	**4,953**	**43,201**	**17,573**	**18,184**	**22,467**	**17,188**	**24,334**	**21,746**												
Cumulative CF	0	0	0	4,596	9,549	52,750	70,323	88,507	110,973	128,161	152,496	174,241												

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Balance Sheet

TiGRESS™ Transition to Integrated Gas and Renewable Energy Simulation System

Project Name **TiGRE SEALS**
Project Description **Simulation run for the TiGRE SEALS Oxyfuel Combustion CO2 seperation capture and undergroaund storage with enhanced gas recovery TiGRE power plant rating approx 200MW.**
Simulation Run Numbe **3899.665914**
Simulation Run Date **09/03/2020 15:58**
Project Case **Simulation Case for maximum average gas production of 15mmscfd and maximum economic load factor**

		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Assets																									
Net Book Value		0	0	0	130,156	244,174	202,747	191,658	180,568	169,479	158,390	147,300	136,211	125,121	114,032	102,942	91,853	80,763	69,674	58,584	47,495	36,405	25,316	14,227	3,137
Cash	-2,951	0	0	0	4,596	-2,951	10,415	15,488	21,171	31,138	35,826	47,660	56,906	65,673	75,540	86,213	89,121	90,487	92,379	103,843	112,551	114,147	120,287	125,220	23,819
Debtors																									
Total Assets		0	0	0	134,752	241,222	213,162	207,146	201,740	200,617	194,216	194,960	193,117	190,794	189,572	189,155	180,974	171,250	162,053	162,427	160,046	150,552	145,603	139,447	26,956
Liabilities																									
Short term																									
Long term		0	0	0	64,115	128,230	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	0
total Liabilites		0	0	0	64,115	128,230	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	110,895	0
Net Assets		0	0	0	70,637	112,992	102,268	96,251	90,845	89,723	83,321	84,066	82,222	79,899	78,677	78,261	70,080	60,355	51,158	51,533	49,151	39,658	34,708	28,552	26,956
Shareholder funds																									
Equity		0	0	0	74,805	113,851	102,295	102,295	102,295	102,295	102,295	102,295	102,295	102,295	102,295	102,295	102,295	102,295	102,295	102,295	102,295	102,295	102,295	102,295	102,295
Reserves		0	0	0	-4,167	-859	-27	-6,043	-11,449	-12,572	-18,974	-18,229	-20,073	-22,396	-23,617	-24,034	-32,215	-41,939	-51,136	-50,762	-53,143	-62,637	-67,586	-73,742	-75,339
Total		0	0	0	70,637	112,992	102,268	96,251	90,845	89,723	83,321	84,066	82,222	79,899	78,677	78,261	70,080	60,355	51,158	51,533	49,151	39,658	34,708	28,552	26,956
chksum		*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*

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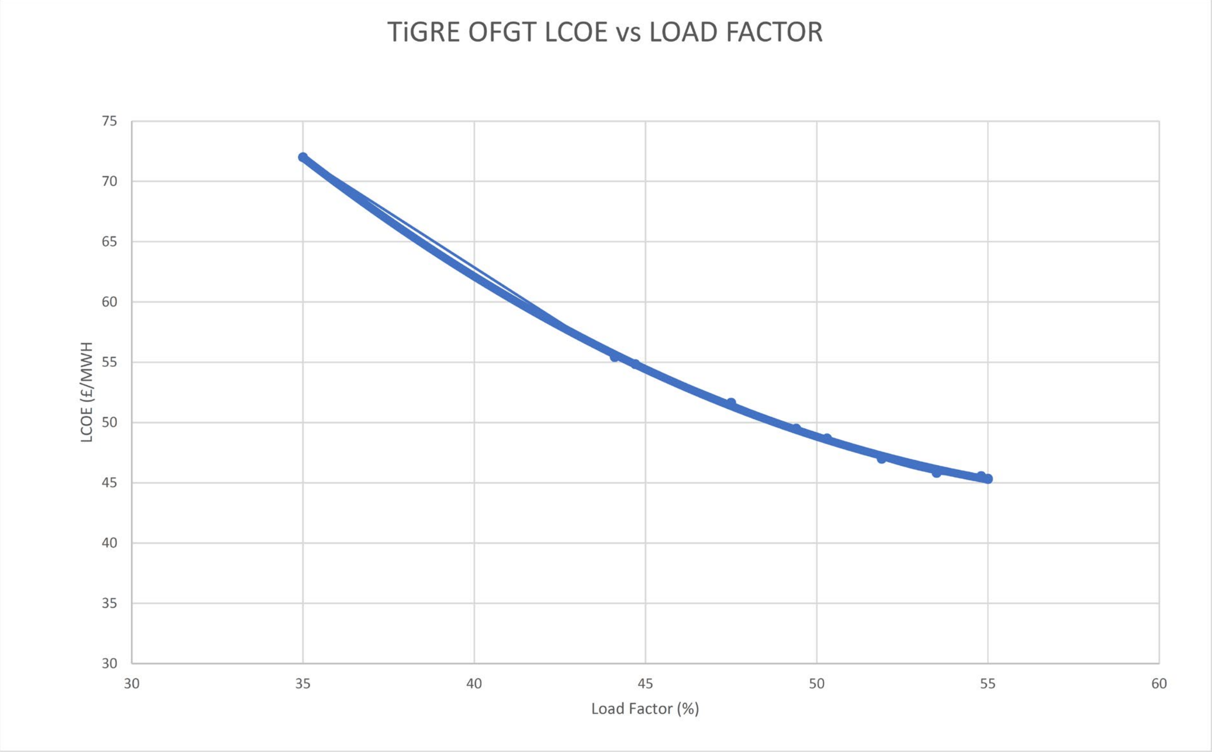
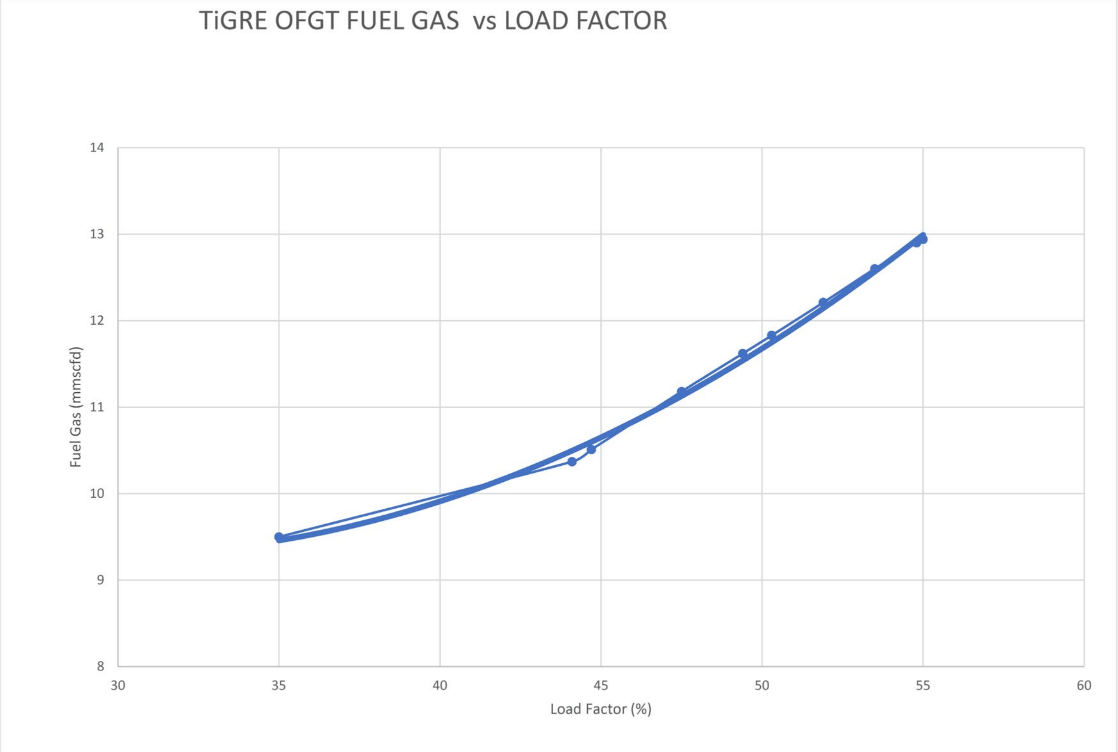
Feasibility Study Concept Option 3

The TiGRE™ OxyFuel Power Plant Analysis of LCOE and Fuel Gas Consumption against and Load Factor

The LCOE has relatively high sensitivity to load factor. This mainly results from the increasing recovery on marginal costs with higher load factor rates. Oxyfuel Power plants have a lower LCOE than a TiGRE™ OCGT power plant at load factors above 40%. This would suggest a TiGRE Oxyfuel power plant would not require CO2 subsidies to be competitive in the merchant power market for peaking plant.

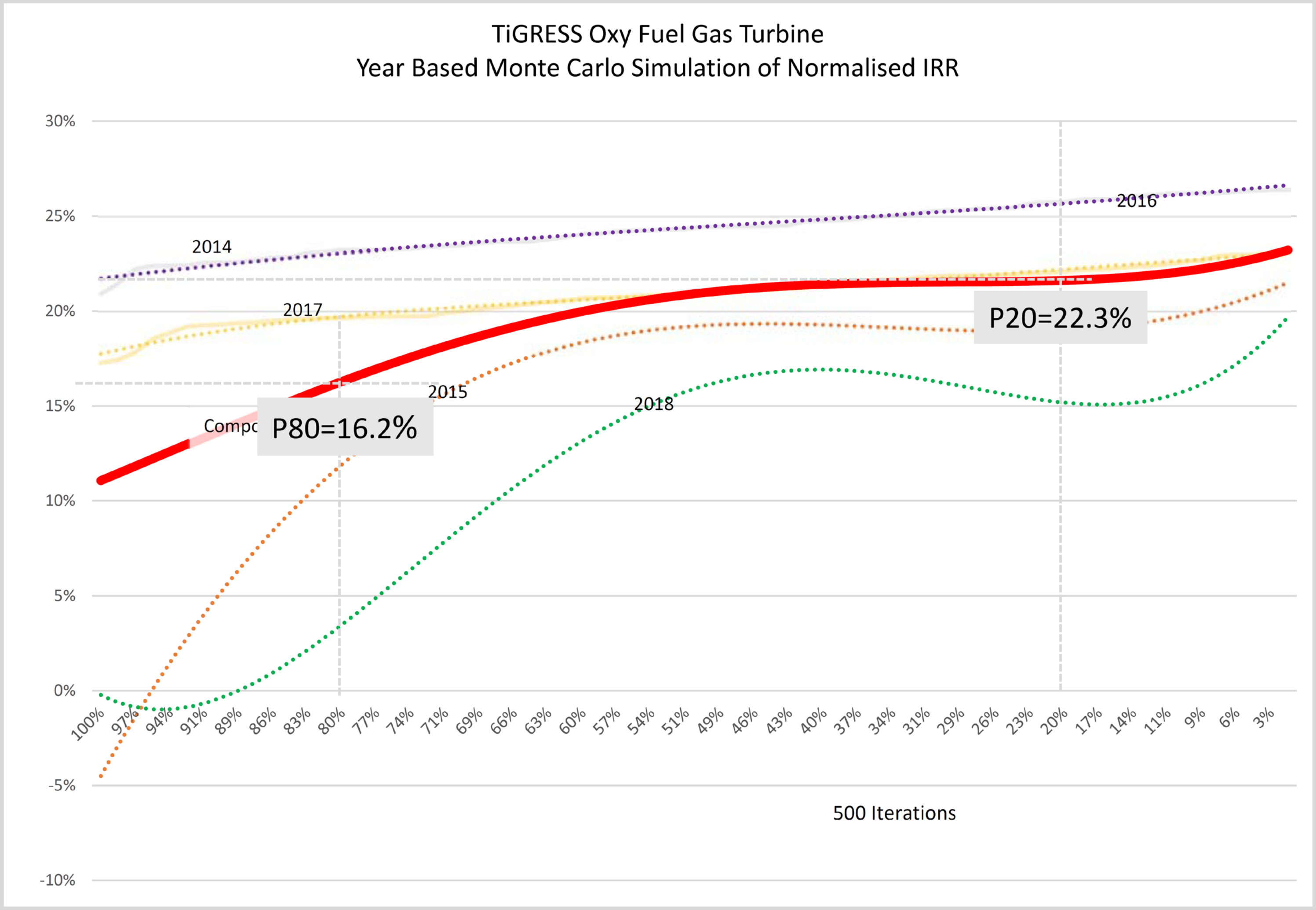
- Based on 2014-2018yrs
- Monte Carlo simulation P50 & P80





Feasibility Study Concept Option 3

The TiGRE™ CryoSep Power Plant Analysed for 42% Load factor with a full distribution of risks across the main components of the plant


TiGRESS Oxy Fuel Gas Turbine
Year Based Monte Carlo Simulation of Normalised IRR

The TiGRESS™ Monte Carlo risk analysis system was used to calculate and illustrate the range of probabilistic outcomes using 5 years of simulation data (see report CS362_CCUS Feasibility Study_TIGTTL001_RH1.0 relating to the system operation of the TiGRESS™ Monte Carlo Simulation modelling). There is a high degree of IRR variation which very much depends on the relative spark spreads for each year and sensitivities with capex and opex cost ranges.

As can be seen based on 500 scenario simulations the P20 IRR is 22.3% and the P80 IRR is 16.2%. A 20% IRR has P50 probability. This suggests that the OXYFuel concept has the highest investment returns even at relatively low load factors.

Conclusions and Key Findings

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16th March 2020

Conclusions

	Reference Base OCGT without CCUS	Concept Option 2: Cryogenic Separation	Concept Option 3: Oxyfuel Generation
Power out (MW)	214	203	**197**
Operational complexity	Simple	Complex and novel technology required	**Novel technology. Relatively simple at scale and in an offshore environment**
TRL (estimated)	9	7-8	**7**
Capital cost per installed MW (£m/MW)	0.75	1.38 (84% higher than RC)	**1.065** **(42% higher than RC)**
Net Thermal Efficiency (%)	42	42	**52**
Response time to full dispatch	<10mins	<30mins	**<30mins**
Load Factor (viable operating envelope) (%)	30-80	42-56	**42-56**
CO2 released (g/kWh)	450	31.5	**<1**
LCOE range (P50) (£/MWh)	59-60.50* 40-60% LF	47-77 42-56LF	**45.31-55.43** **42-56%LF**
IRR @ P50	15.0	15.0	**20.0**

** Includes full CO2 costs at EU ETS rates.*

Key Findings

- Depleted Gas Reservoirs can be used for medium levels CO2 storage while improving economic recovery of hydrocarbons.
- Gas field assets can have significant life extension opportunities of approximately 20years by employing the TiGRE SEALS CCUS concept options contemplated by this Study.
- The study has theoretically proven that it is possible to continue to produce hydrocarbons from an existing subsurface reservoir, convert these to commercially useful electrical power and capture CO2 to be stored back into the original source reservoir. The study has further shown that this has significant potential economic advantage compared to other more conventional CCUS processes currently being considered.
- The study has shown that by producing CO2 as a liquid product from the capture process and storing it in dense phase within the reservoir provides the opportunity to enhance gas recovery through re-pressurisation of the hydrocarbon reservoir.
- **The study has shown that the concept of producing hydrocarbons, converting to electrical energy, capturing and storing CO2 in a closed circuit provides an technically and economically viable method for a fully contained and managed CO2 lifecycle**.

Recommendations

- The study has identified two commercial and technically viable solutions at TRL7 and above which can be delivered to market within four years.
- To deliver to this timeline, the following further work would be required:

  - Further development of the materials and mechanical design of the expander turbine consistent with the thermodynamic and fluid mechanic characteristics of both the CryoSep and Oxyfuel concept processes.
  - Heat exchanger designs for components within the post-combustion stages of the CryoSep and Oxyfuel concept processes to maximise efficiency of heat recuperation and condensation systems at lowest capital cost.
  - Subsurface reservoir modelling to understand the geomechanical and thermodynamic behaviours including Joule Thompson effects within the reservoir structures whilst undertaking CO2 sequestration as contemplated by the study.