Optimus

Engineering with Character

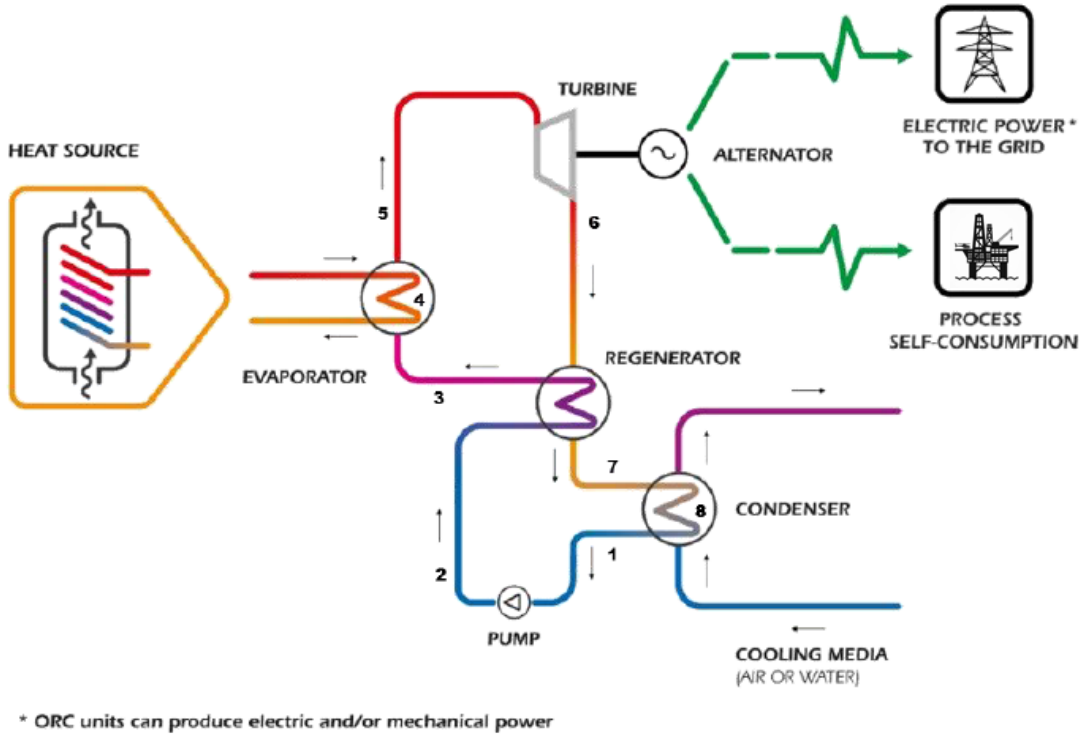
A well-established, ***highly experienced, specialist consultancy and engineering*** *company, Optimus combines decades of* ***proven expertise*** *and* ***strategic insight*** *to deliver* ***simple, responsive*** *and* ***cost-effective solutions*** *for the energy industry*

Contents

- Value proposition and impact: Organic Rankine Cycle
- Technology maturity
- Commercialisation
- Challenges
- Our ask from the audience

Value proposition and impact: Organic Rankine Cycle

- Waste heat is recovered from compressor turbines
- Used to preheat and vapourise organic working fluid
- Vapourised fluid drives turbines to produce electric power
- Flows through a regenerator where it preheats an organic fluid
- It is then condensed and cooled by a cooling water circuit
- Organic working fluid is pumped into the regenerator and the evaporator, completing the closed cycle operation
- Suitable for conditions with lower boiling point and high vapour pressures
- Utilising waste heat can significantly reduce fuel demand whilst operating efficiently
- Study on the Serica Bruce asset: reduction in CO2 121.08 metric tons equivalent per day best case scenario (0.5 kg/s nominal fuel mass flow), 387.45 metric tons equivalent per day worst case scenario (1.6 kg/s nominal fuel mass flow)



[Turboden Organic Rankine Cycle for biomass cogeneration: how it works - Bing video]

Value proposition and impact: Organic Rankine Cycle

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121 Metric Tons of Carbon Dioxide (CO_2) equivalent

This is equivalent to greenhouse gas emissions from:

26.1 gasoline-powered passenger vehicles driven for one year	300,530 miles driven by an average gasoline-powered passenger vehicle

This is equivalent to CO_2 emissions from:

13,624 gallons of gasoline consumed	11,893 gallons of diesel consumed
133,957 pounds of coal burned	1.6 tanker trucks' worth of gasoline
15.3 homes' energy use for one year	23.6 homes' electricity use for one year
0.669 railcars' worth of coal burned	280 barrels of oil consumed
4,944 propane cylinders used for home barbeques	0 coal-fired power plants in one year
0.0003 natural gas-fired power plants in one year	14,727,756 number of smartphones charged

https://www.epa.gov/

Value proposition and impact: Organic Rankine Cycle

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387 Metric Tons of Carbon Dioxide (CO_2) equivalent

This is equivalent to greenhouse gas emissions from:

83.5 gasoline-powered passenger vehicles driven for one year	961,729 miles driven by an average gasoline-powered passenger vehicle

This is equivalent to CO_2 emissions from:

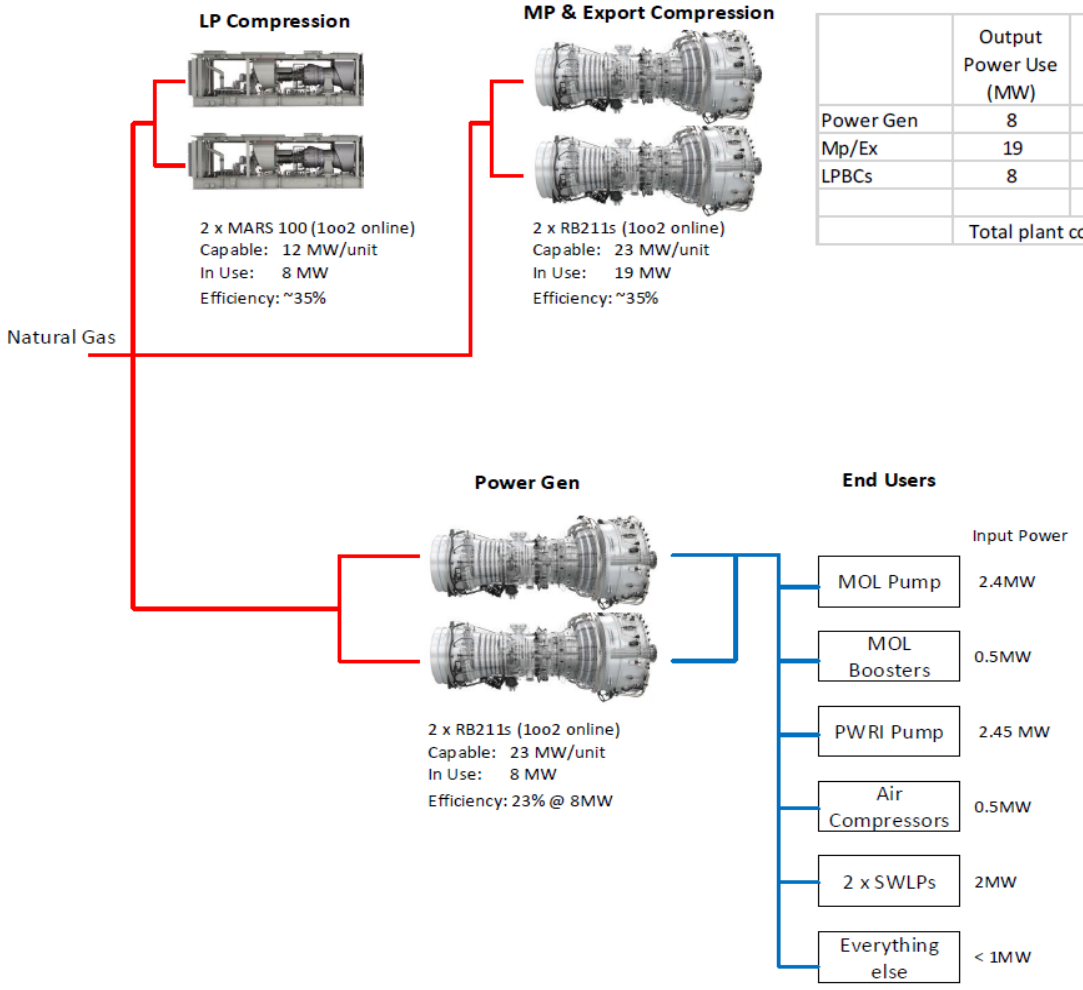
43,597 gallons of gasoline consumed	38,060 gallons of diesel consumed
428,678 pounds of coal burned	5.1 tanker trucks' worth of gasoline
48.8 homes' energy use for one year	75.4 homes' electricity use for one year
2.1 railcars' worth of coal burned	897 barrels of oil consumed
15,821 propane cylinders used for home barbeques	0.0001 coal-fired power plants in one year
0.001 natural gas-fired power plants in one year	47,130,364 number of smartphones charged

https://www.epa.gov/

CURRENT CONFIGURATION

Case study:
Serica Energy
Bruce Platform

Current



	Output Power Use (MW)	Efficiency	Input Power (MW)	
Power Gen	8	0.23	34.8	
Mp/Ex	19	0.35	54.3	
LPBCs	8	0.35	22.9	
	Total plant consumption		111.9	MW

PROPOSED CONFIGURATION

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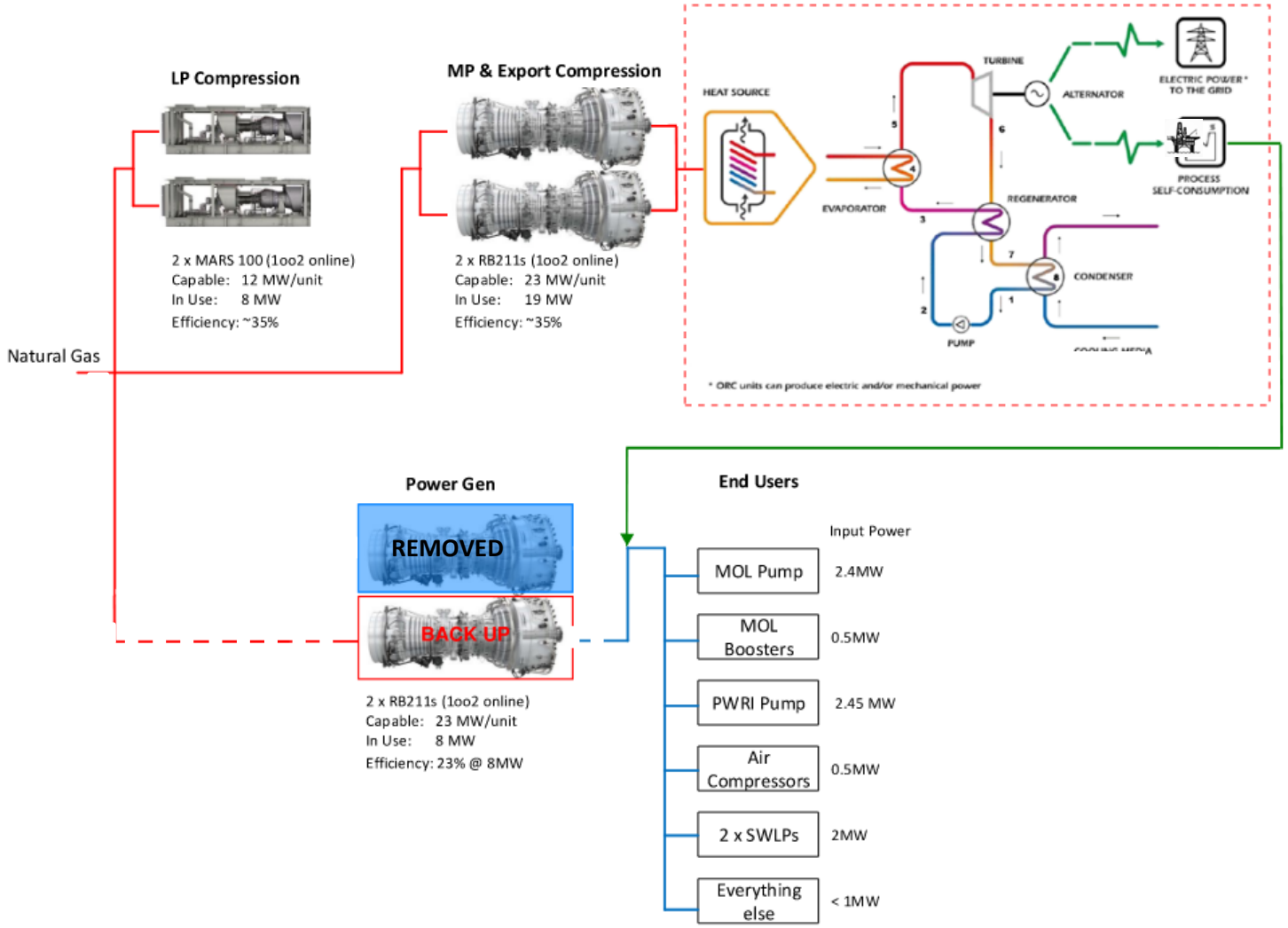
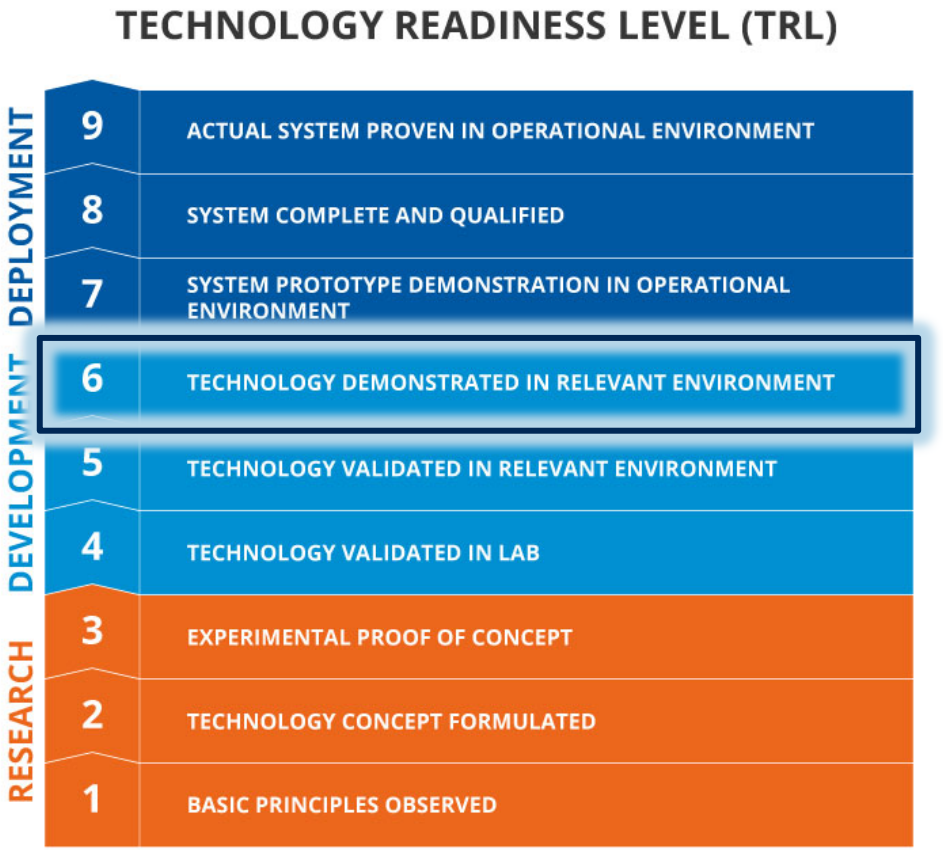
ORC UNIT IMPLEMENTED



Technology maturity

- Mature technology proposed for use in a new context
- ORC has yet to be utilised on offshore platforms due to predominance of conventional waste heat recovery units
- Organic Rankine cycle (ORC) has been used for years in waste heat recovery units, biomass power plants, geothermal plants, solar thermal power and wind thermal energy
  - Sarulla Geothermal Power Plant (330MW), Indonesia
  - Goodsprings (7MW)
  - Veyo project, Utah, USA (9MW)
  - NOA in Spain (5MW)



*Reference: https://www.ormat.com/en/projects/all/

Commercialisation

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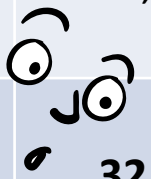
TITLE	CASE 1
Gas Price	70 p
Bruce RB211 fuel consumption	0.5 kg/s
Additional sales gas from not using RB211	4,677,474 £/year
Reduction in Carbon tax from not running RB211	954,586 £/year
Net additional cash flow per annum	**5,632,060** £/year

TITLE	CASE 2
Gas Price	140 p
Bruce RB211 fuel consumption	1.6 kg/s
Additional sales gas from not using RB211	29,935,836 £/year
Reduction in Carbon tax from not running RB211	3,054,674 £/year
Net additional cash flow per annum	**32,990,510** £/year

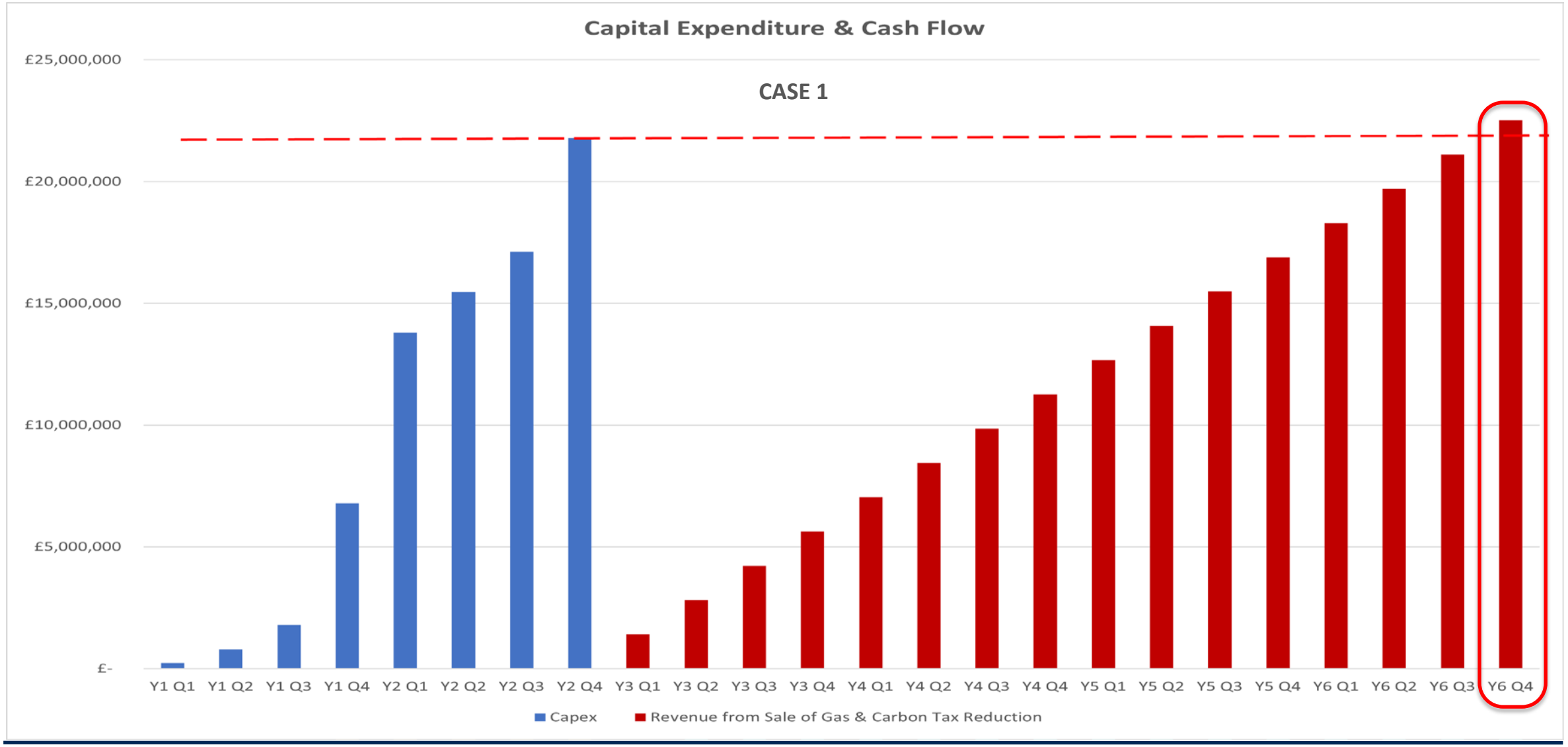


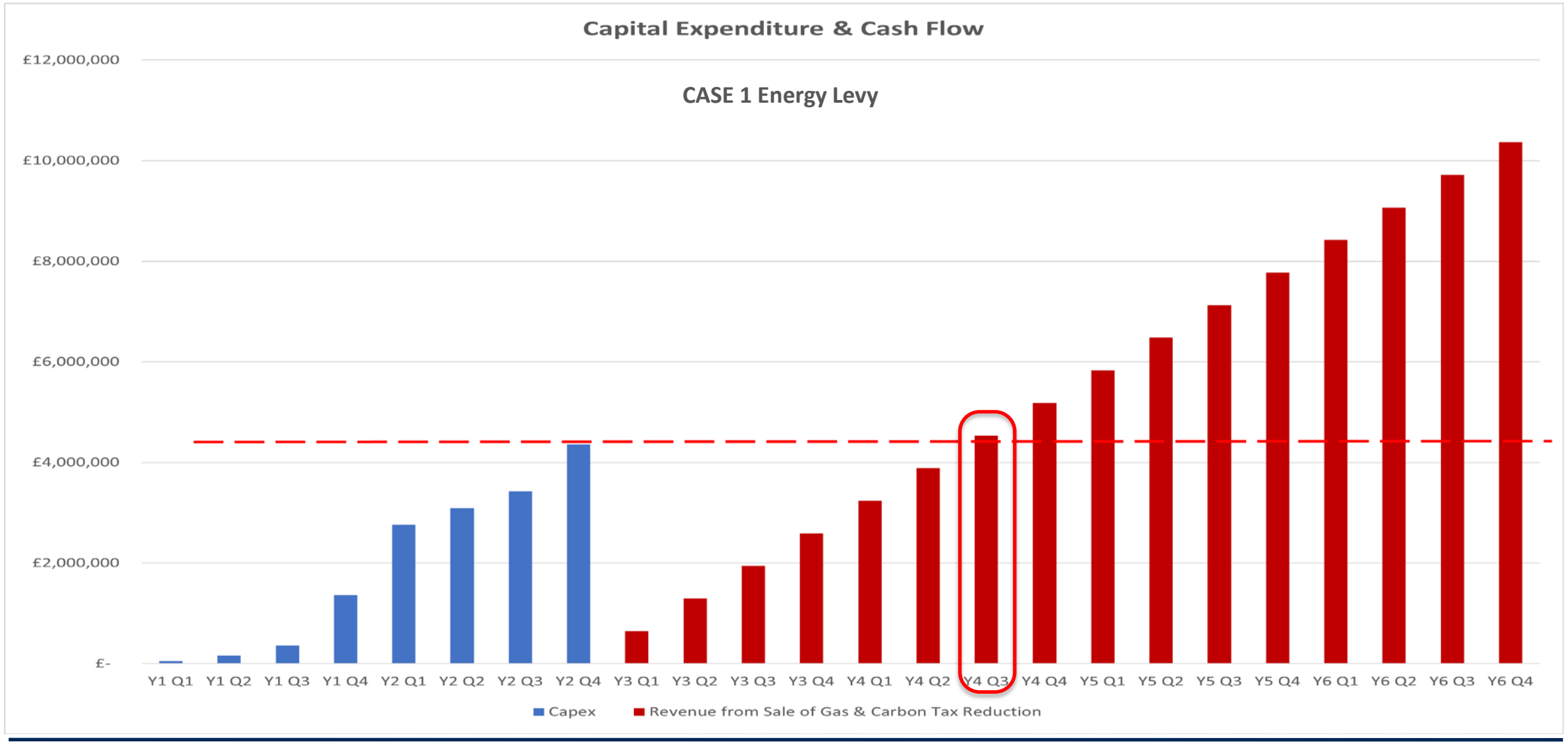
Commercialisation

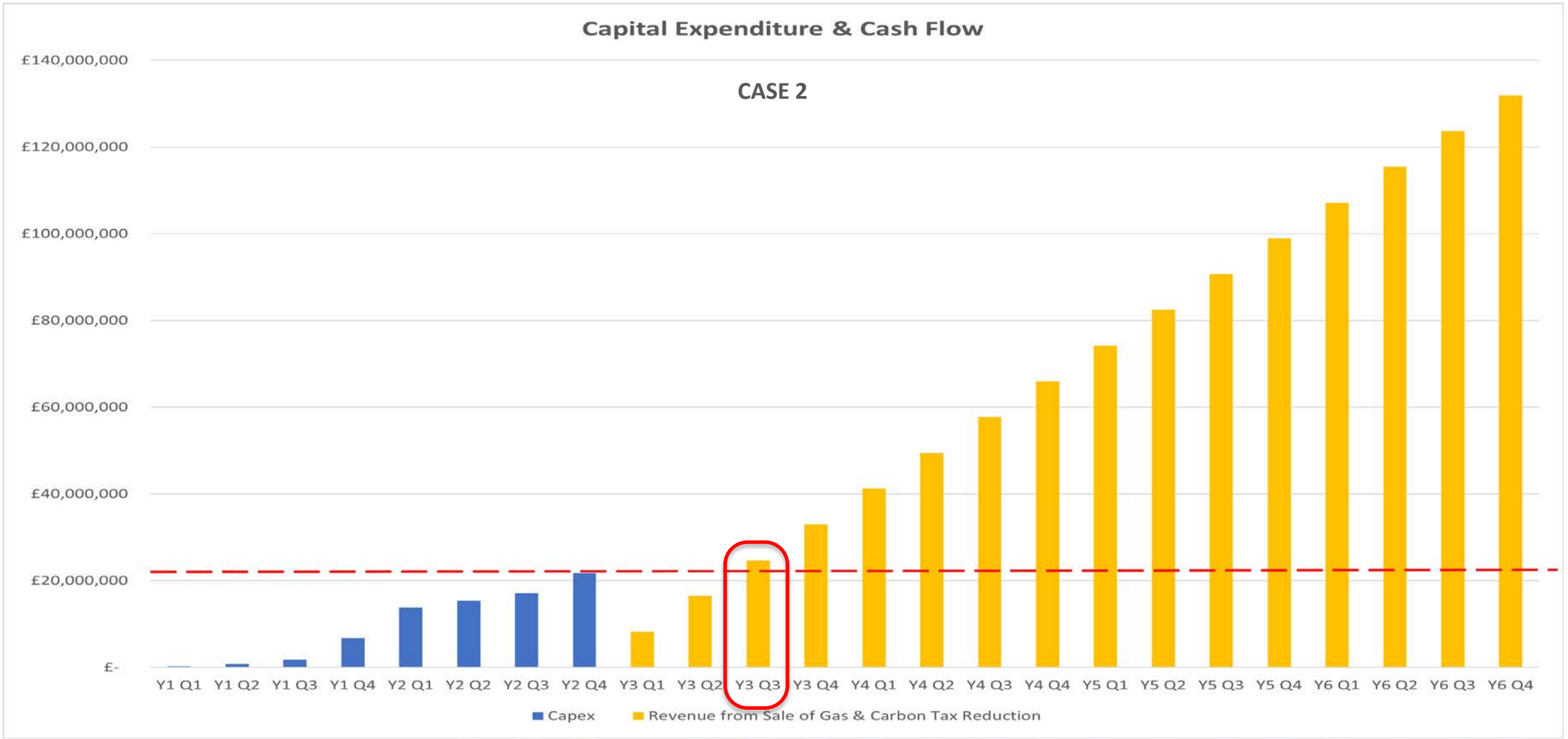
Optimus

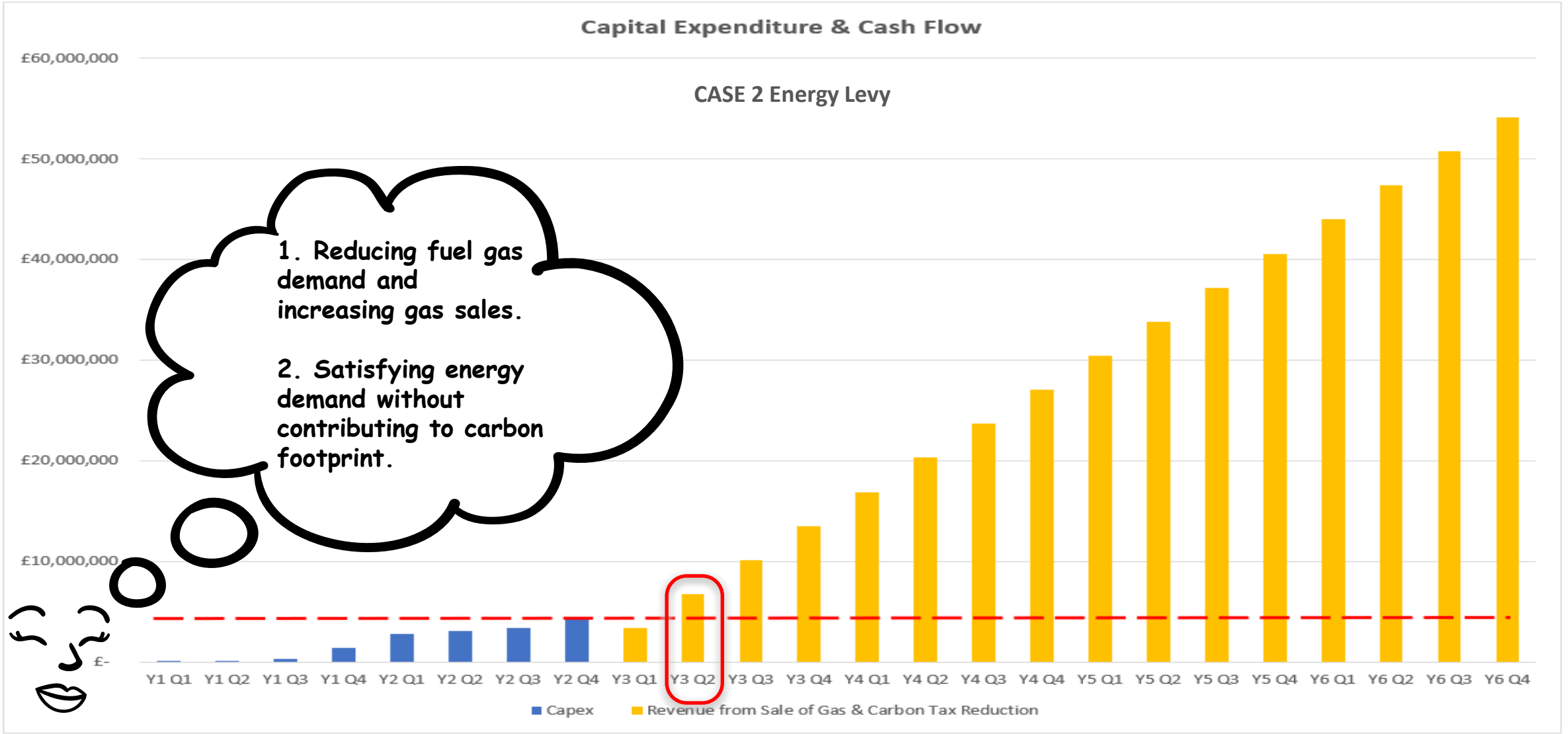
Title	CASE 1		CASE 2		UNITS	ASSUMPTIONS
Gas Price	70		140		BRITISH PENCE	
Bruce RB211 fuel consumption	0.5	1.6	0.5	1.6	Kg/s	Info provided by Serica Energy 20% RB211 Min flow
Additional sales gas from not using RB211	4,677,474	14,967,918	9,354,949	29,935,836	£/year	
Reduction in Carbon tax from not running RB211	954,586	3,054,674	954,586	3,054,674	£/year	£27/tonCO2e UK ETS: £80/tonCO2e CPS: £18/tonCO2e
Net additional cash flow per annum	**5,632,060**	**18,022,592**	**10,309,534**	**32,990,510**	**£/year**	

Commercialisation

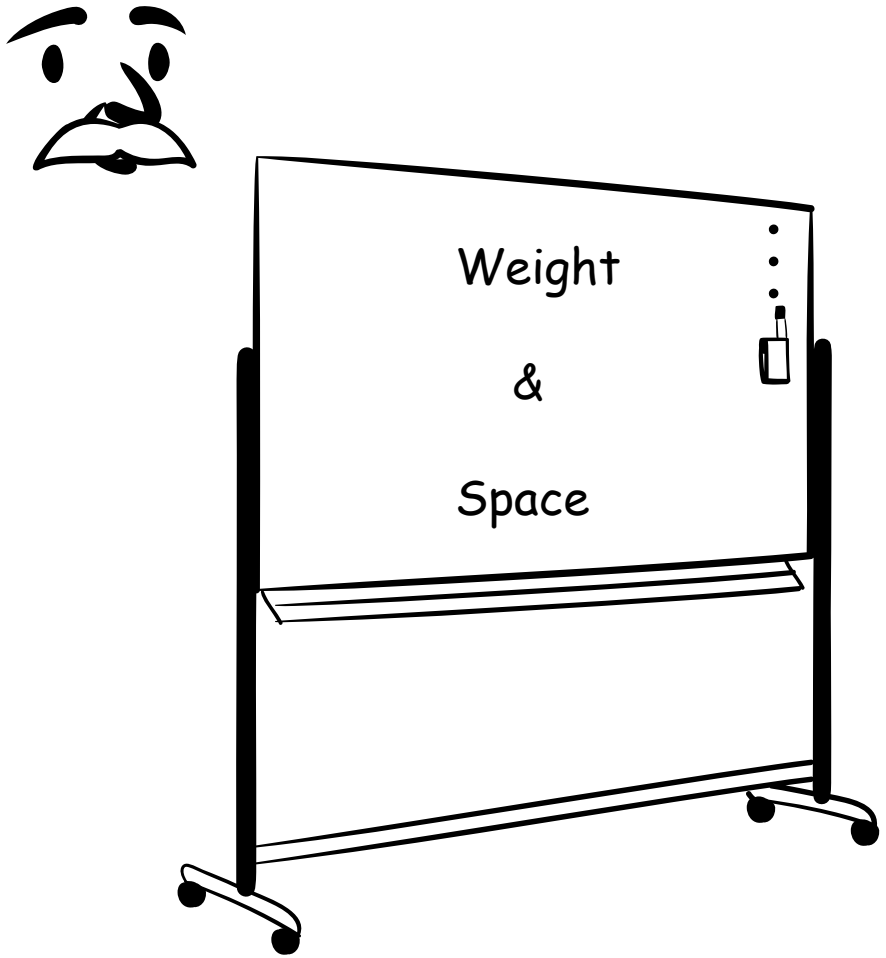



Capital Expenditure & Cash Flow
CASE 1 Energy Levy
£12,000,000
£10,000,000
£8,000,000
£6,000,000
£4,000,000
£2,000,000
£-
Y1 Q1
Y1 Q2
Y1 Q3
Y1 Q4
Y2 Q1
Y2 Q2
Y2 Q3
Y2 Q4
Y3 Q1
Y3 Q2
Y3 Q3
Y3 Q4
Y4 Q1
Y4 Q2
Y4 Q3
Y4 Q4
Y5 Q1
Y5 Q2
Y5 Q3
Y5 Q4
Y6 Q1
Y6 Q2
Y6 Q3
Y6 Q4
Capex
Revenue from Sale of Gas & Carbon Tax Reduction


Capital Expenditure & Cash Flow
CASE 2
£140,000,000
£120,000,000
£100,000,000
£80,000,000
£60,000,000
£40,000,000
£20,000,000
£-
Y1 Q1
Y1 Q2
Y1 Q3
Y1 Q4
Y2 Q1
Y2 Q2
Y2 Q3
Y2 Q4
Y3 Q1
Y3 Q2
Y3 Q3
Y3 Q4
Y4 Q1
Y4 Q2
Y4 Q3
Y4 Q4
Y5 Q1
Y5 Q2
Y5 Q3
Y5 Q4
Y6 Q1
Y6 Q2
Y6 Q3
Y6 Q4
Capex
Revenue from Sale of Gas & Carbon Tax Reduction


Capital Expenditure & Cash Flow
CASE 2 Energy Levy
£60,000,000
£50,000,000
£40,000,000
£30,000,000
£20,000,000
£10,000,000
£-
1. Reducing fuel gas demand and increasing gas sales.
2. Satisfying energy demand without contributing to carbon footprint.
Y1 Q1
Y1 Q2
Y1 Q3
Y1 Q4
Y2 Q1
Y2 Q2
Y2 Q3
Y2 Q4
Y3 Q1
Y3 Q2
Y3 Q3
Y3 Q4
Y4 Q1
Y4 Q2
Y4 Q3
Y4 Q4
Y5 Q1
Y5 Q2
Y5 Q3
Y5 Q4
Y6 Q1
Y6 Q2
Y6 Q3
Y6 Q4
Capex
Revenue from Sale of Gas & Carbon Tax Reduction

Challenges



- Decommissioning redundant equipment
- Plate heat exchangers to replace pre-heater and condenser to save weight and space.
- Create additional space / extension

Challenges - Global

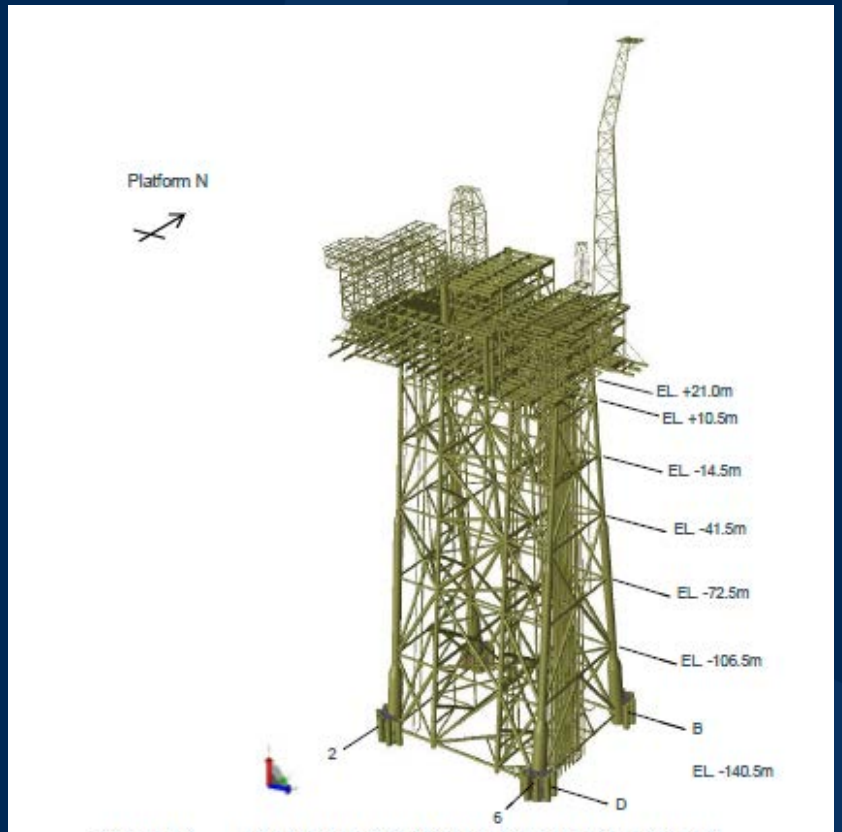
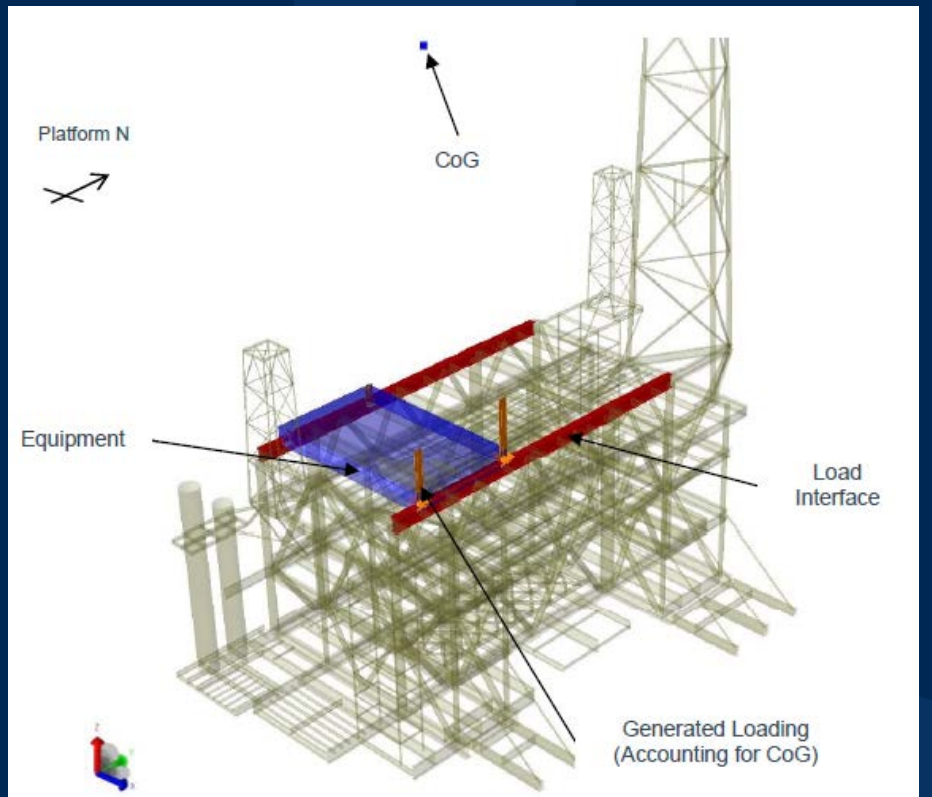


Figure 3-1 SESAM GeniE Global Analysis Model of Pipe 'B'

- The study will begin structural analysis using the Global Analysis Model which simulates the impact of the ORC on the platform.

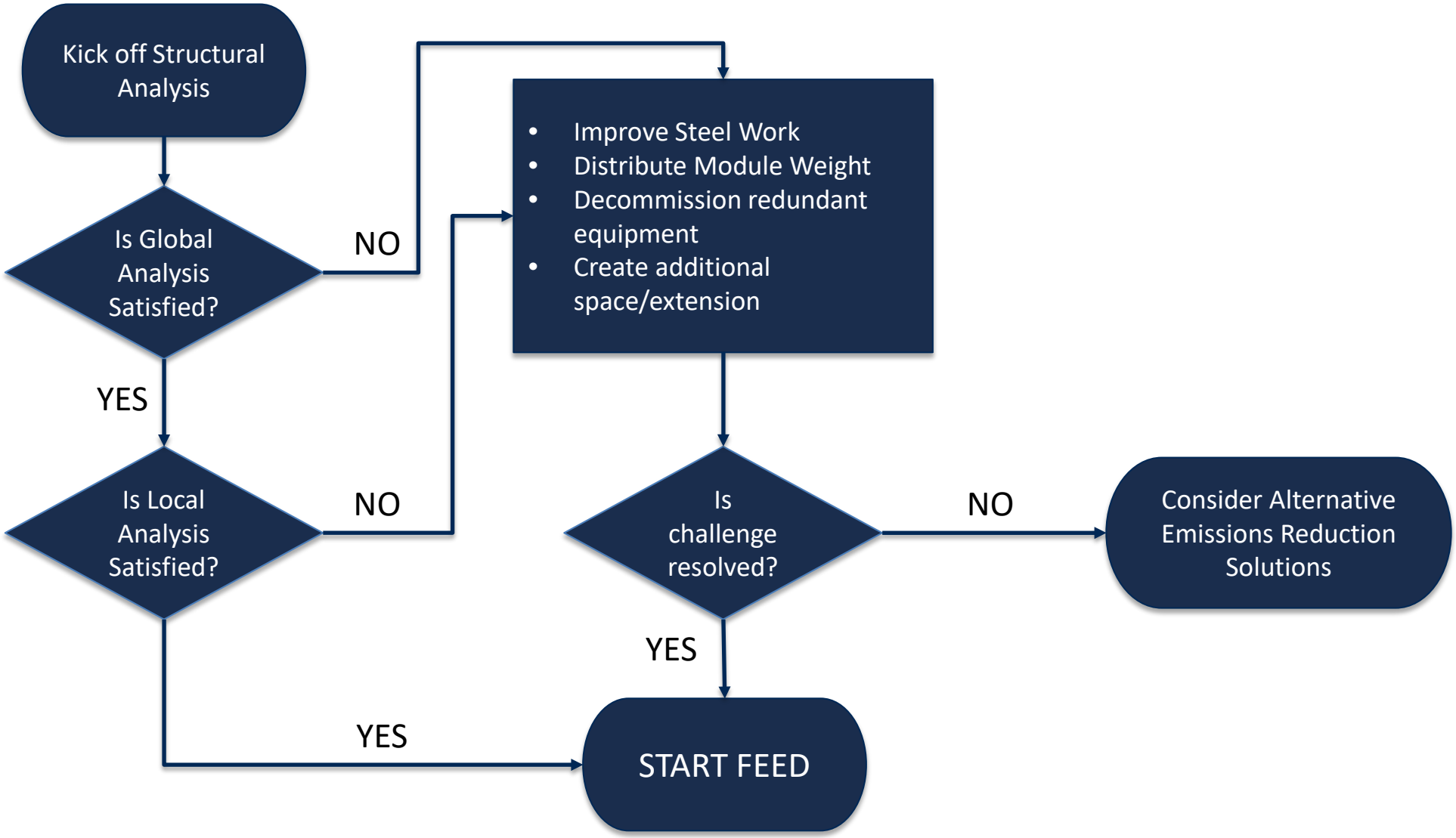
Challenges - Local

- Having confirmed suitability via the global model, a review using a local structural analysis can enable bypassing of weak points and identification of locations of adequate strength.



Example of Topside Equipment Loading ("Mod_DD_All_Dry_Pos_9")

Challenges – Structural Analysis decision flowchart



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Identify assets which merit investment in front end engineering in implementing the ORC unit

Sufficient remaining asset life or desire to extend it (Resilience)	✓
Extra Free Space and/or Redundant Equipment	✓
High Fuel Usage and Waste heat	✓
High CO_2 emission levels	✓
 Inefficient and unreliable compressors	✓

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PD&MS Group

Optimus

- Founded in 1999
- Engineering & consultancy to deliver from concept to decommissioning
- Focus on specialist engineering
- Consultancy – trusted advisor
- Front end professionals
- Structural authority
- Emission Reductions & Energy Transition
- c.80+ engineering and support personnel
- Acquired by PD&MS Group in 2022

PD&MS

- Founded in 2002
- Mid value capital projects, modifications & upgrade specialists
- Late life asset management & decommissioning specialists
- Production, drilling and onshore facilities
- Full multi discipline EPCC and O&M capability
- c.650 engineering and support personnel
- Tier 1 assurance at Tier 2 cost

Synergie Environ

- Founded in 2009
- Delivering carbon reduction
- Renewable concept to commissioning capability
- Energy efficiency
- Assess & optimize operations
- Cross industry perspective for diversity of thought
- c.50+ engineering and support personnel
- Acquired by PD&MS Group in 2021

Combining engineering & consultancy services to deliver from concept to decommissioning

Multi Discipline Engineering
Professional team of multi discipline engineers and designers delivering all traditional services, including process, structural, electrical, control, instrumentation, piping and mechanical.

Consultancy – Trusted Advisor
Providing Technical Authorities and subject matter experts to support the Operators team, including embedding key individuals into the client's organisation. Also, owner's engineer responsibilities to assure quality and minimise risk.

Front End Professionals
Successful track record and high calibre professionals to execute Feasibility, Concept and pre-FEED engineering studies to support both new developments and brownfield modification projects.

Specialist Engineering
The "go-to" specialists for challenging and complex engineering scopes requiring new solutions and innovation. Caisson specialists for "Assess – React – Repair/Mitigate – Removal & Replacement". Also, nich and specialist disciplines including "Decision & Risk" and "Technical Safety & Loss Prevention".

Structural Authority
All aspects of structural integrity management and support, including asset models, analysis, integrity assessments, Finite Element Analysis, concept, detail design, construction, 3-D scan surveys and modelling.

Emission Reductions & Energy Transition
Supporting clients to both reduce emissions from existing assets and in diversification into the growing new energy markets of offshore renewables, carbon capture & storage and hydrogen.

A well-established, highly experienced, specialist consultancy and engineering company, Optimus combines decades of proven expertise and strategic insight to deliver simple, responsive and cost-effective solutions for the energy industry