DEWSBURY POWER STATION CONSTRUCTION PROJECT

GROUP 14 – 1ST DELIVERY – 26/10/2020

GROUP MEMBERS

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AGENDA

1. ECONOMICS AND FINANCIALS
2. SENSITIVITY TO UPDATED OPPORTUNITY DRIVERS
3. RISK WEIGHTED OPPORTUNITY
4. QUALITATIVE ALIGNMENT
5. ALTERNATE AND VALUE ENGINEERING
6. PROJECT CHARTER

CONTEXTUALIZATION

- Iren SpA (Iren), an Italian multiutility operating in the production and distribution of energy and heating, is considering the potential acquisition of Utilities Operations Inc. (UO).

- UO is currently planning to build a CCGT (combined cycle gas turbine) plant in Dewsbury (UK) where Iren SpA will be the sponsoring organization of the project.

- This document presents the Business Case and the Project Charter for the initiating phase of the Dewsbury Power Station Construction Project. The Business Case is divided into five sections, as it can be seen in the agenda.

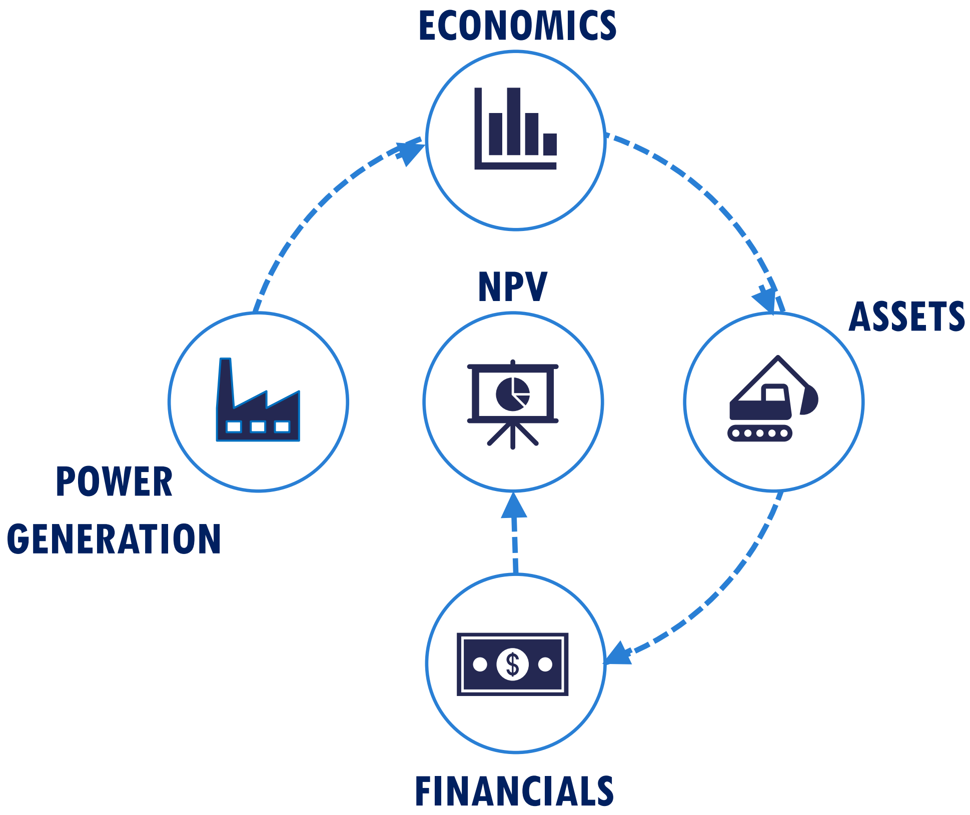
- The Business Case has been an input document for the Project Charter development. It outlines the scope, schedule, budget and deliverables of the project

ECONOMICS AND FINANCIALS

- Economic and financial analysis has been conducted to evaluate the profitability of the Dewsbury Power Station construction project through the NPV method.

- Quantitative evaluation of projects is based on the "time value of money" concept. Saying this, it was necessary to understand if for the F class type, the investment would have been attractive – when the NPV value is positive.

- The project evaluation took into consideration cash inflows and outflows over 20 years, as well as the power generation baseline data, operational and capital expenditure and tax data.



ECONOMICS AND FINANCIALS

POWER GENERATION + ECONOMICS

POWER GENERATION

Total energy that the CCGT plant will sell considering the data reported in the baseline opportunity

ITEM	INITIALS	VALUE
CONTRACTED POWER	CP	50
HOURS/YEAR OF PRODUCTION	h/year	8.760
CAPACITY FACTOR	CF	80%
CAPACITY DEGRADATION PER YEAR	CD	0,20%
AVERAGE POWER AVAILABILITY FACTOR	APA	98%
DISPATCH RATE	DR	100%
AUXILIARY REQUIREMENT	AR	2%

ECONOMICS

Economics analysis to evaluate the profitability of the project through the NPV method

ITEM	INITIALS	VALUE
OPERATIONAL COST VARIABLE	VOC £/MWh	4,65
OPERATING FEE	OF	1,50%
GAS PRICE	GP £/kWh	0,038
SENT OUT EFFICIENCY	SE	51%
HEAT RATE DEGRADATION	HRD	0,16%
OPERATIONAL COST FIXED	FOC £/MW	12.000

ECONOMICS AND FINANCIALS

ASSETS + FINANCIALS

ASSETS

CAPEX: sum of the construction and predevelopment costs distributed across the first three years of the project according to the profile reported in the baseline. It has been distributed with a yearly rate of 20%, 40% and 40%

ITEM	UNITS	VALUE
PRE-DEVELOPMENT COSTS	£	560.000
CONSTRUCTION COSTS	£	26.555.000
TOTAL CAPEX	£	27.115.000

FINANCIALS

To calculate the NPV of the project, considering 3 years for the plant construction and 25 years of energy production, it has been computed the yearly free cash flow (FCF).

Computing the discounted yearly cash flow, two cases have been taken into consideration:

a) Project will be financed by only equity investors, discounting the cash flow by the cost of the equity (15%);
b) Project will be financed in part with debt (70%) and in part with equity (30%), discounting the cashflow by the weighted average cost of capital, distinguishing the pre and post-tax cases.

Main values:

1) cost of debt: 8%
2) corporate tax rate: 19%

ECONOMICS AND FINANCIALS

NET PRESENT VALUE + RESULTS

NET PRESENT VALUE + RESULTS

When analyzing if the discounted present value of all future cash flows related to the project are positive, it is possible to understand if it is attractive.

The NPV was calculated taking into consideration two conditions:

1) the initial investment was considered as zero;
2) the discount rate was considered as cost of equity in the first case and the weighted average cost of capital (pre-tax) and post-tax in the second case.

NPV RESULTS

NPV	UNIT	VALUE
NPV (WITH COST OF EQUITY)	£	-26.401.742
NPV (WITH rWACC PRE-TAX)	£	-32.490.670
NPV (WITH rWACC POST-TAX)	£	-34.323.214

In all the cases the NPV obtained was negative. It happened mainly due to the fact that the yearly EBITDA is negative as well as the net revenues.

It means that the revenues generated by the plant are not able to cover the plant operational costs, and, therefore, the negative NPV of the project computed with the baseline data suggests to not invest in it.

SENSITIVITY TO UPDATED OPPORTUNITY DRIVERS

- It helps to determine which individual project risks or other sources of uncertainty has the most potential impact on project outcomes when correlating variations in the project's NPV with variations in costs and revenues.

CONSTRUCTION DRIVERS

- CAPACITY FACTOR
- FUEL PRICE
- SENT-OUT EFFICIENCY
- CONSTRUCTION COSTS
- PRE-DEVELOPMENT COSTS
- FEED-IN TARIFF

MAIN DRIVERS IDENTIFIED

- COST OF EQUITY
- COST OF DEBT
- CORPORATE TAX RATE

FINANCIAL DRIVERS

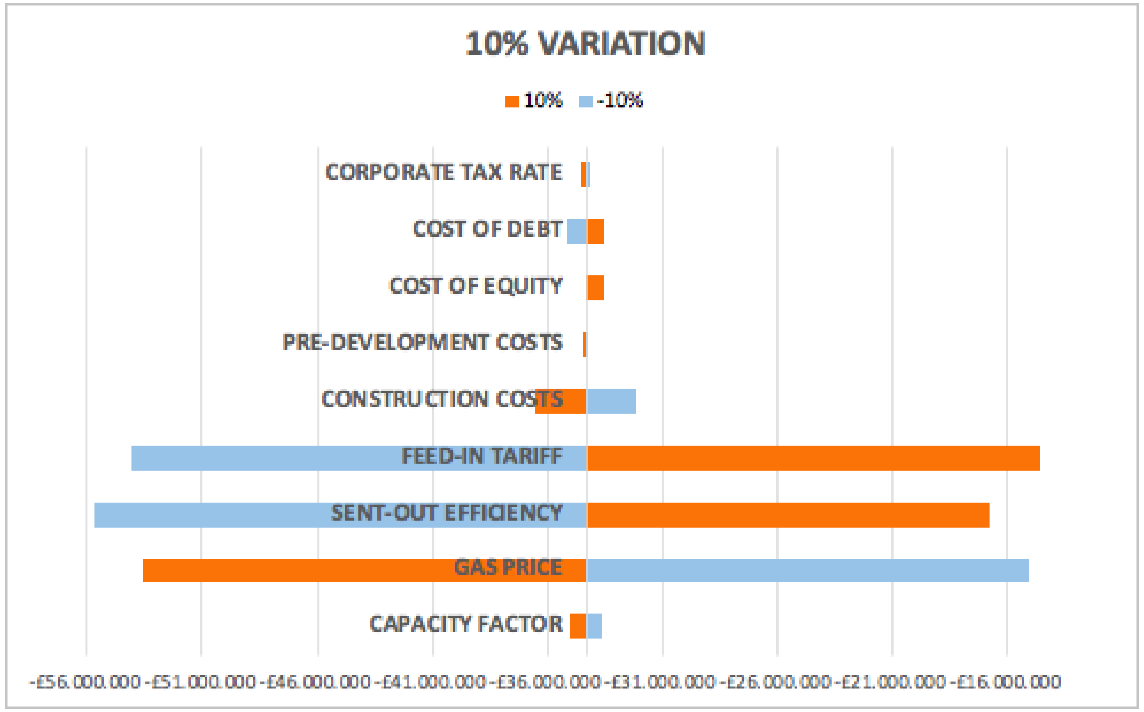
- Methods used to evaluate the sensitivity of the project's outcomes to the drivers:
    1) simulating a variation of ±10% and ±20% in single cost voices (while keeping all other costs constant);
    2) evaluating the best and worst scenarios based on actual historical fluctuations.

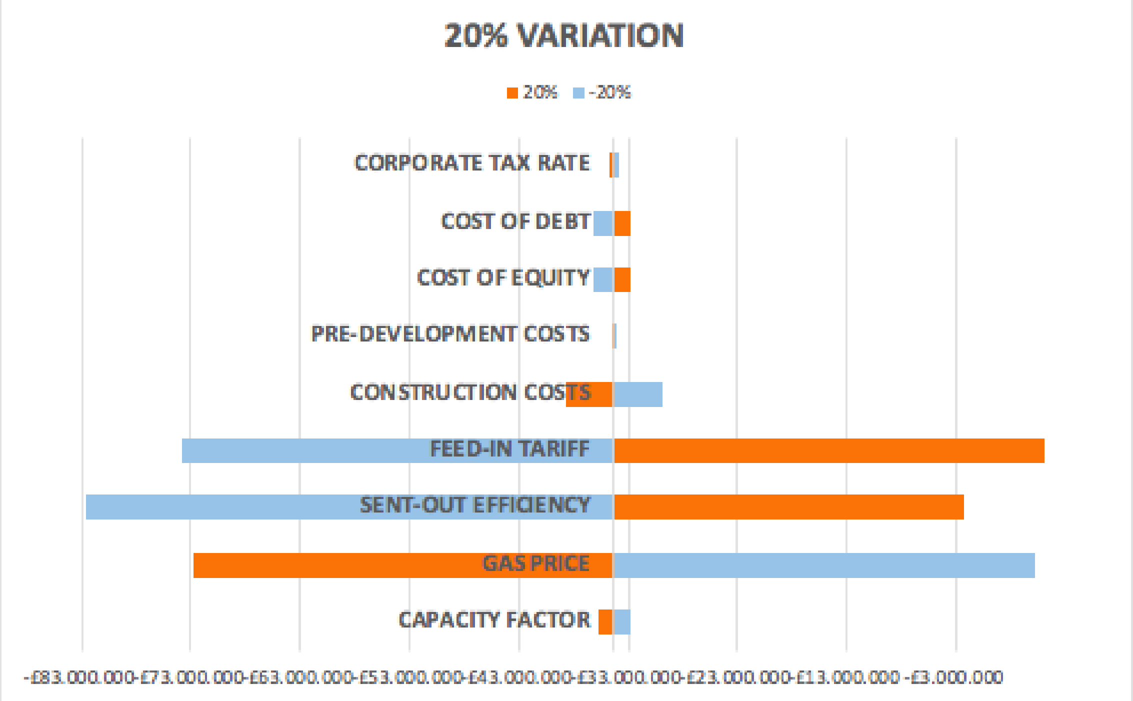
ECONOMICS AND FINANCIALS

NPV WITH DRIVERS VARIATION FOR CCGT-CHP – 10% AND 20% VARIATION

The graphs show that the NPV is mostly sensitive to the variations in gas price, feed-in tariff and sent-out efficiency, as they cause a large change in its value when compared to the changes due to variations in CAPEX and operational costs.

This can be done for instance by devoting effort to maintain the feed-in tariff and sent-out efficiency high, as well as using instruments like futures options to increase control over the changing gas price.





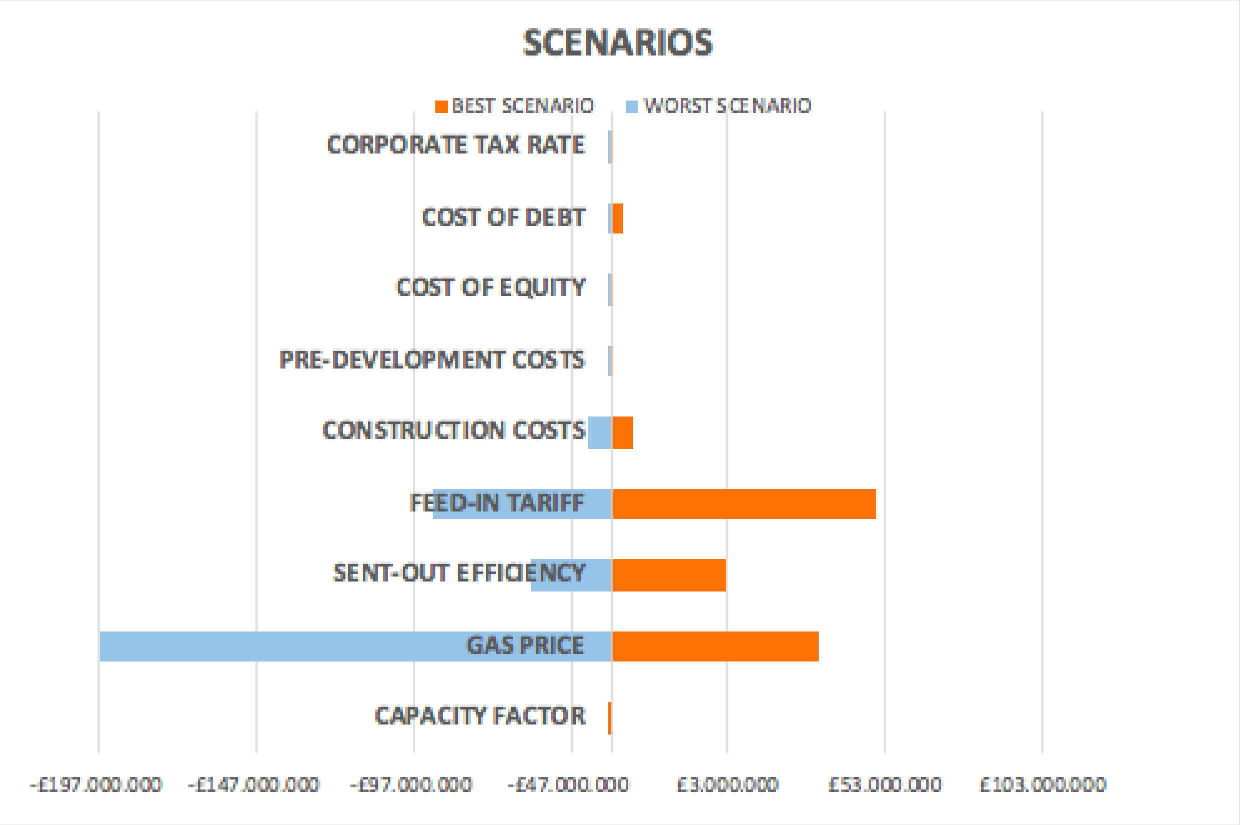
ECONOMICS AND FINANCIALS

NPV ESTIMATION IN THE BEST AND WORST SCENARIOS

This method represents a more appropriate prediction since the ranges being taken into account are less general and adapted to the single drivers.

In this way it becomes clearer that the possible fluctuations in the gas price and in the feed-in tariff could have a greater impact than previously expected and larger than the send-out efficiency's one.

It happens due to the possible variations in gas price and feed-in tariff exceed the considered ranges of ±10% and ±20%.



RISK WEIGHTED OPPORTUNITY

MAIN RISKS

	RISK	RISK SOURCE	EVENT	EFFECT	MAGNITUDE (%)	PROBABILITY	RISK (%)	RESERVE*
EXTERNAL	COST OVERRUNS	CONSTRUCTION COST, CUSTOM DUTIES AND IMMIGRATION POLICY	COVID 19, BREXIT AND LITERATURE EVIDENCIES	INCREASE IN CAPEX	34%	90%	30,67%	8.316.000
EXTERNAL	LEGAL	REGULATION OF FEED-IN TARIFF	SCARCITY OF ELECTRICITY SUPPLY IN THE UK	INCREASE IN REVENUES	42,86%	75%	32,14%	64.369.470
EXTERNAL	FUEL	GAS PRICE	**	DECREASE FUEL COST	-34,21%	50%	-17,11%	32.962.832
INTERNAL	TECHNICAL	PLANT EFFICIENCY	UNDERESTIMATION OF THE PLANT EFFICIENCY	DECREASE FUEL COST	-19%	75%	-14,29%	27.529.398

*: Values in GBP

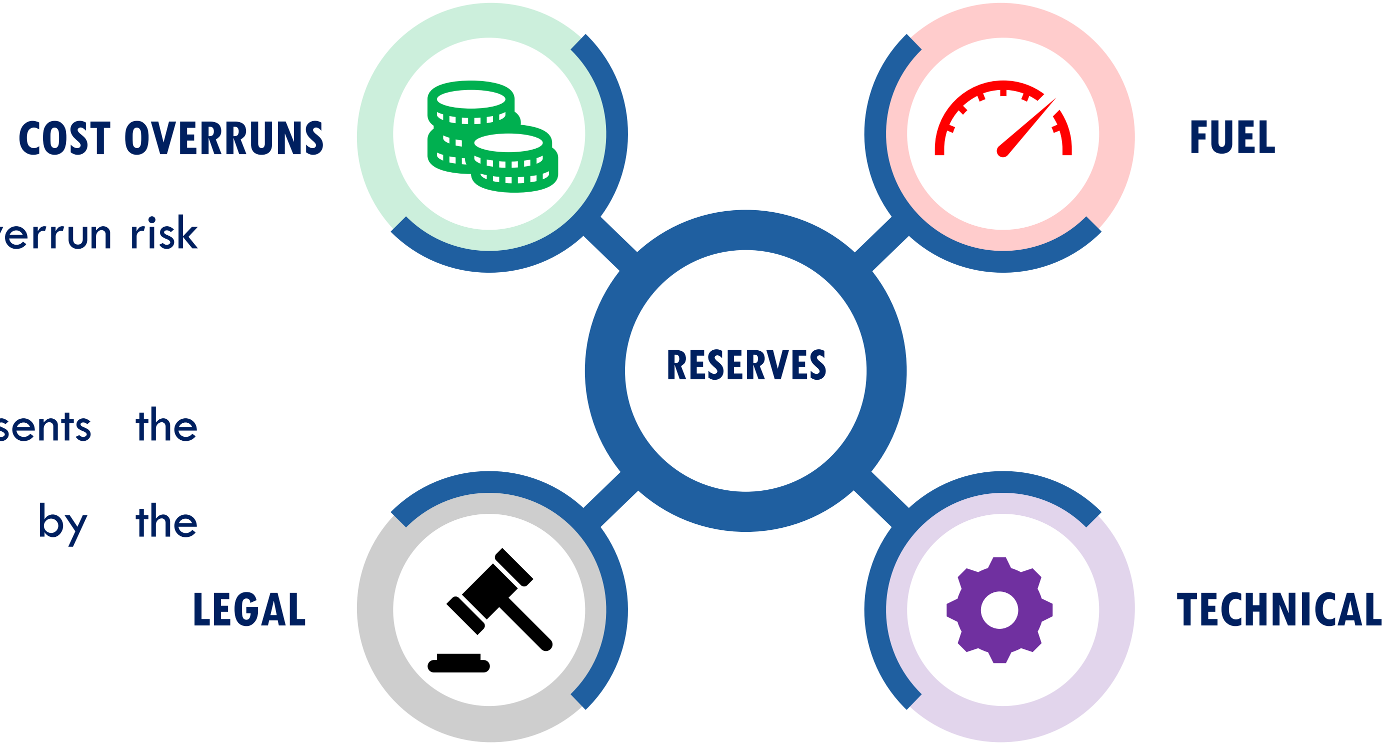
**: Explained in the specific slide about fuel

RISK WEIGHTED OPPORTUNITY

RESERVES

- The estimated capital reserves due to cost overrun risk are £ 8.316.000.

In the others cases the reserves represents the potential positive amount saved or gained by the operation management.



RISK WEIGHTED OPPORTUNITY

NPV RISK ADJUSTED

- To better understand the impact of the risks on the project it has been computed the risk adjusted value of each driver.

	BASELINE	POSSIBLE VALUE	RISK		
			VARIATION	PROBABILITY	RISK ADJUSTED DRIVER
FEED IN TARIFF (£/MWh)	80	114	34,286	75%	105,71
GAS PRICE (£/kWh)	0,038	0,025	-0,13	50%	0,0315
SENT OUT EFFICIENCY	51%	63%	12%	75%	60%
TOTAL CAPEX (£)	27.115.000	36.355.000	9.240.000	90%	35.431.000

- The computed NPV value of the project with these risk-adjusted values and rWACC (post-tax) is £ 79.115.658. In this case the positive value of the NPV suggests that the project is attractive.

QUALITATIVE ALIGNMENT

- In order to evaluate the strategic fit between Iren and UO, several tools have been used: PESTLE analysis, Porter's Diamond Model and SWOT analysis.
- To provide a quantification basis, it was also developed a scorecard based on the baseline data of the qualitative alignment between Iren strategic objectives and the Dewsbury Power Station Construction Project.

PESTLE analysis

Assessment of the external factors which may affect the Electrical Market in the UK

Porter's Diamond Model

Assessment of the UK fit with Iren SpA

SWOT analysis

Assessment of the characteristics coming from the acquisition of UO and their Dewsbury Power Station Construction Project

Scoring for the strategic fit

Degree assessment of strategic fit between the project and Iren SpA

QUALITATIVE ALIGNMENT

PESTLE ANALYSIS

ECONOMIC FACTORS

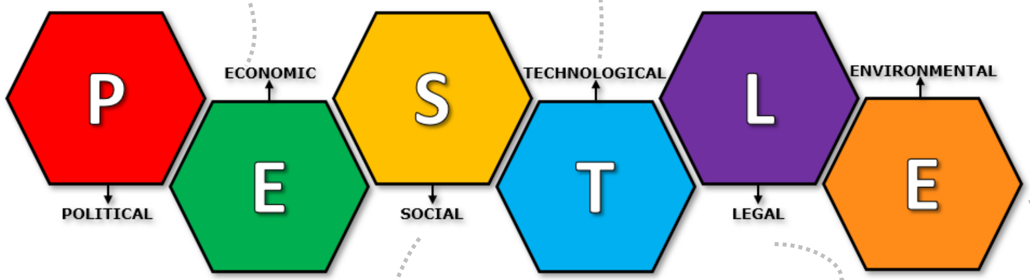
- UK GDP (+1,4% in 2019 vs. -8,2% in 2020 due to the COVID-19);
- Unemployment rate expected to increase in 2020;
- Inflation is expected to steadily fall down in 2020;
- Interest rate dropped to 0,1% in March/20;
- Exchange rate GPB/US$ reached the lowest value in 2020;

TECHNOLOGICAL FACTORS

- Thermal efficiency of CCGT plants;
- Newer equipment reducing production costs;
- Flexibility in the equipment (quicker ramp up time);
- Integration of batteries within existing gas plants (gas-battery hybrid);

ENVIRONMENTAL FACTORS

- Renewable energy in electricity production;
- Reduction of carbon emission by 80%;
- Technology development focusing on renewable energy;
- Carbon emissions tax;
- Solar generation;



POLITICAL FACTORS

- Brexit impacting importation of energy and resources to produce it (gas supplies);
- High uncertainty in future predictions, lowering investments;
- Continuous integration in the energy sector by the UK;
- Legislation regarding the climate change;

SOCIAL FACTORS

- COVID-19: closing production, promoting smart working, dropping the energy demand;
- Brexit: new political agreements limit the immigration through UK, affecting some sectors which need low-wage workers;

LEGAL FACTORS

- Smart Export Guarantee (SEG): initiative that will reward solar generators for electricity exported t the grid;

QUALITATIVE ALIGNMENT

PORTER'S DIAMOND MODEL

FIRM STRATEGY, STRUCTURE AND RIVALRY

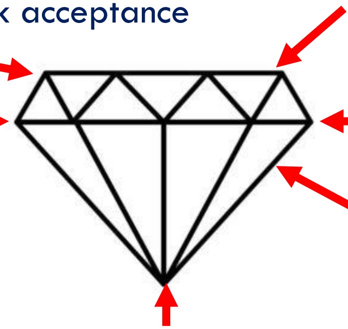
- Iren is looking for growth, sustainability, increasing customer base even by expanding in other territories, diversify the workforce by hiring young and diverse people and enhance digitalization
- UK and Italy have similarities in company culture, except for 'uncertainty avoidance', indeed in UK there is a higher risk acceptance

GOVERNMENT

- Uncertainty about EU regulations
- Decarbonisation by substituing existing plants with gas plants (26GW by 2030)

DEMAND CONDITIONS

- Gas covers 40% of the UK's power demand
- Temporary lower demand due to Covid19 lockdown (-19%)
- Lowering in demand due to warmer temperatures (-11%)



FACTOR CONDITIONS

- Long industry history
- Availability of raw material
- free market and ease of hiring workers and do business
- Ease of hiring young people, since UK employment in young age is much higher than Italy
- Land availability
- UK's CCGT are one of the most efficient in Europe

RELATED AND SUPPORT INDUSTRIES

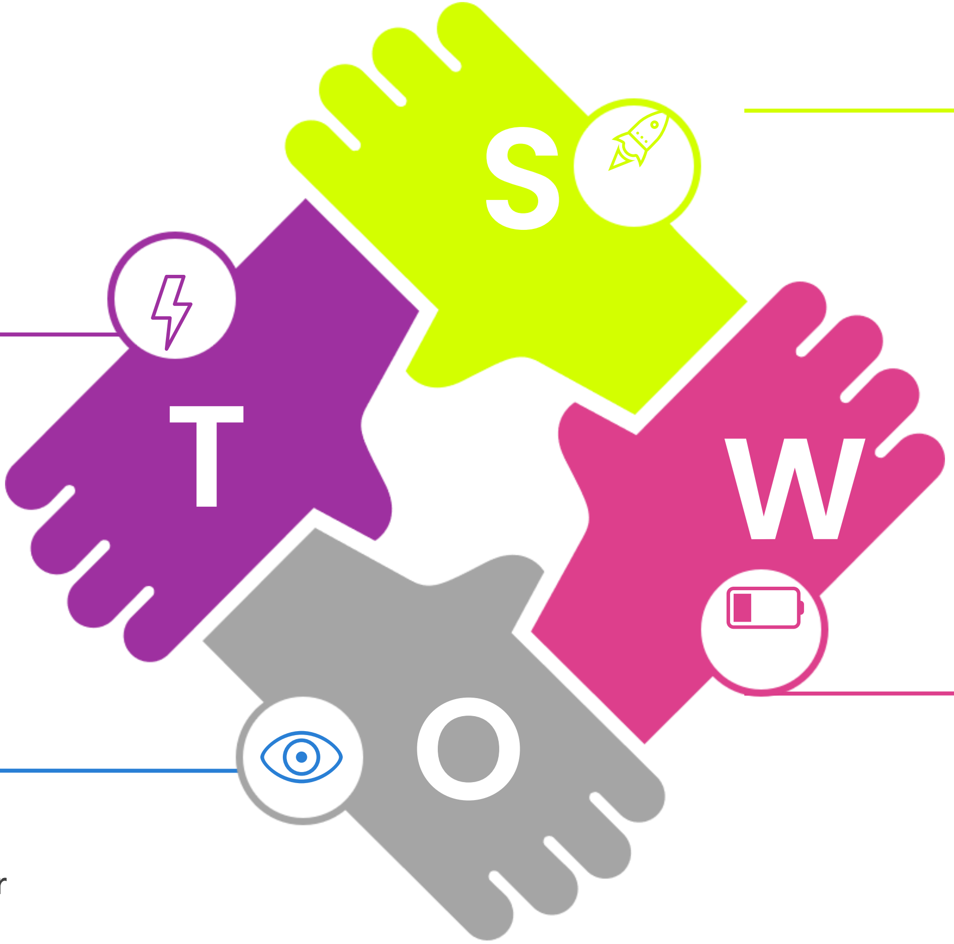
- Dewsbury is a small, low populated city, close to some major urban centres (Leeds and Bradford), to motorway and served by train transportation
- Dewsbury has low proximity with the grid and gas storages, while has relatively close proximity to few mine gas wells

CHANCE

- Brexit and Covid19 long term outcomes on prices and involved actors reactions
- Impact on demand due to sutanability awareness

QUALITATIVE ALIGNMENT

SWOT ANALYSIS



STRENGTHS

- Rising in digital investments 75% more
- Extend district heating systems (CHP technology)
- Growing infrastructure
- Increasing energy efficiency and sustainable projects
- Organic growth
- Full digital strategy for customers
- Reduction in the cost of debt + increase in revenue

WEAKNESSES

- Most of the employees are above the age of 50, with a difficulty when using new technologies

OPPORTUNITIES

- 5 years Tax Holiday
- 90% capital allowance for the first year
- Large MBA
- Customer base growth

THREATS

- Difficulty in supply chain (delivering resources to the UK costs more due to its location)
- UO use less efficient and sustainable technologies
- UO doesn't show any use of digital technology

QUALITATIVE ALIGNMENT

SCORING FOR THE STRATEGIC FIT OF F CLASS

- Considering the strategy of IREN and the external factors, it was computed the degree of strategic fit between the project and IREN. Since IREN will be acquiring the totality of UO shares, there must be a high degree of fit between the two.

- The end result for F-class score is 63%, which might not be optimal from the strategic point of view.

STRATEGIC OBJECTIVES	F-CLASS SCORE
CLIENTS	5
EFFICIENCY	2
PEOPLE	4
DIGITALIZATION	1
GROWTH	5
FLEXIBILITY	3
SUSTAINABILITY	2
SCORE	22
SCORE (%)	63%

ALTERNATE AND VALUE ENGINEERING

The Alternate and Value Engineering analysis has the aim to review current baseline technology considered as CCGT F-Class and evaluate alternatives.

	BASELINE		CCGT H CLASS		CCGT CHP MODE	
	Do Nothing	Best scenario	Do Nothing	Best scenario	Do Nothing	Best scenario
ECONOMIC						
NPV(r wacc after tax)	-£ 34.323.214,43	£ 123.447.183,98	£ 2.382.649,82	£ 147.595.778,89	-£ 83.292.927,16	£ 114.618.902,49
Normalization	21%	90%	37%	100%	0%	86%
QUALITATIVE ALIGNMENT						
Objectives:						
Clients	5	5	5	5	5	5
Efficiency	2	2	3	3	4	4
People	4	4	4	4	4	4
Digitalization	1	1	1	1	1	1
Growth	5	5	5	5	5	5
Flexibility	3	3	4	4	5	5
Sustainability	2	2	3	3	4	4
Sum	22	22	25	25	28	28
Normalization	0%	0%	50%	50%	100%	100%
TOTAL SCORE	15%	63%	41%	85%	30%	90%
TOTAL NORMALIZED SCORE	0%	64%	35%	93%	20%	100%

DO NOTHING SCENARIO:
It is considered the baseline data

BEST SCENARIO:
It is considered the best scenario data for the feed-in tariff, construction and pre-development costs and gas price.

BEST SCORE

PROJECT CHARTER

CONTEXT

CONTEXT

Iren SpA (Iren), an Italian multiutility operating in the production and distribution of energy and heating, is considering the potential acquisition of Utilities Operations Inc. (UO). Subsequently, UO will run as Iren SpA subsidiary in the UK. UO is currently planning to build a Power Station in Dewsbury (UK) and in this context Iren SpA is the sponsoring organization of the project.

PROJECT CHARTER

STAKEHOLDERS

STAKEHOLDERS

Name	Type	Position	Role	Requirements	Expectation	Influence	Classification
Office of Gas and Electricity Markets (Ofgem)	External	Public Authority	Regulate electricity and gas market	Market informations	Protect the interest of the customer	High	Key
Energy reseller	External	Company	Distribute energy to final customers	Create energy lines and buy energy from the productor	Agreements with the producer and customers	Medium	Key
Final users	External	Household and companies	Final customer of energy resellers	Demand for electricity and heat	Low prices	High	Context
Gas and Electricity market authority	External	Public Authority	Regulate electricity and gas market	Market informations	Protect the interest of the customer	Medium	Consultants
Gas suppliers	External	Company	Supply gas to the plant	Sell the gas	Supply agreements	Medium	Context
Iren	External	Company	Sponsor of the project	Analyze the feasibility of the project	The plant will be profitable	High	Key
Plant builder	External	Company	Build the plant	Workers and equipment	Build in the set times	Medium	Consultants
Equipment supplier	External	Company	Give the equipment to run the project	Equipment order	Be pay	Low	Context
Uk Parliament	External	Public Authority	Decide feed-in-tariff	Decide Feed-in-tariff	Encourage renewable energy	Low	Marginal
Utility Operation Inc	Internal	Company	Commissioner of the project	Sign off project decision	Moderate project environment	High	Key
Authority that approves the costruction of the project	External	Public Authority	Authority that verifies the feasibility and approves the costruction of the project	Project plan	Plant according to law	Medium	Context
Project Manager and his team	Internal	Person choosen by UO and Iren	Manage the project	Organize, plan and control the project	Succes of the project	High	Key

PROJECT CHARTER

BUSINESS NEEDS AND OBJECTIVES

BUSINESS NEEDS

The purpose of the project is to expand the power capacity of UO in England and, to this end, construct a brand-new power station using a CCGT CHP technology at Dewsbury in the UK.

BUSINESS OBJECTIVES

IREN PILLARS	STRATEGIC PLAN ELEMENT OF IREN	UO PROJECT BUSINESS OBJECTIVES
Efficiency and Sustainability	Develop a circular economy paradigm by bui lding new plants for treatment and recovery of selected material	Using a CHP CCGT technology, the plant will be able to produce both heat and electricity in a unique process being more efficient in terms of wastage and fuel use, therefore, more environment friendly and better compliance with regulator y requirements.
Growth and Clients	Increase the customer base outside the core territories	Revenues from delivering electricity to the UK national grid and from heat distri bution in the surroundings areas of the plant, with a 50MW CCGT CHP plant.
Digitalization and People	Enhancing competencies and reskilling exist ing employees	Training of the actual UO personnel to work in the new plant and hire new peopl e increasing the diversity generation (mostly young people, which are engaged in technology).

PROJECT CHARTER

ASSUMPTIONS

ASSUMPTIONS

- UO Dewsbury plant will run under full Iren policies and standards
- The external organizations which will deliver the plant have been already identified by UO
- The Project manager and his team have already been decided by UO and Iren
- Gas price is assumed to be around 0,025 £/kWh
- Feed-in tariff is assumed to be around 114 £/MWh
- Send-out efficiency of the plant is 41%
- Baseline data are assumed to be correct apart from gas price and feed-in tariff

PROJECT CHARTER

CONSTRAINTS + RISKS

CONSTRAINTS

- The project should be completed in 3 years, from 2021 to 2023
- Contracted plant power of the plant is 50 MW

  Plant technology CCGT-CHP with gas turbine fueled by natural gas
- Estimated Budget:

ITEM	UNITS	VALUE
CAPEX – PRE-LICENSING	£	1.080.000
CAPEX – REGULATORY	£	40.000
CAPEX – CONSTRUCTION AND EQUIPMENT	£	44.118.000
CAPEX - INFRASTRUCTURE	£	1.291.050

RISKS

- The main risk for the project is to incur in cost overruns due to: project delay caused by COVID-19, as well as an increase in the costs of supplies and labor due to Brexit. However, this won't be a capital risk and should not kill the project.

PROJECT CHARTER

DELIVERABLES

DELIVERABLES

- project management plan
- on site landscaping
- approval of the construction project by the authorities
- civil and building works
- a gas and steam turbine generator set
- a waste heat recovery boiler
- electrical equipment
- interconnection with a district heating infrastructure
- Services such as: design and engineering, set up and testing, training of UO personnel, maintenance assistance and documentation

PROJECT CHARTER

DELIVERABLES

PROJECT EVALUATION

Holding the assumptions the NPV for the Dewsbury Power Station Construction Project is £139.059.260,96 and the internal rate of return of the investment is 27%.

The positive outcome of this financial tool suggests that the investment is attractive and should therefore be pursued.

DEWSBURY POWER STATION CONSTRUCTION PROJECT

GROUP 14 – 2^{ND} DELIVERY – 21/12/2020

GROUP MEMBERS

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AGENDA

1. INTRODUCTION
2. EPCC – SCOPE OF WORK
3. WORK BREAKDOWN STRUCTURE
4. SEQUENCE OF ACTIVITIES
5. ORGANIZATIONAL BREAKDOWN STRUCTURE
6. ACTIVITIES DURATION
7. COSTS
8. COST AND TIME TRADE-OFF
9. RISK MANAGEMENT PLAN
10. BUDGET
11. CASH FLOW ANALYSIS
12. FINAL PROPOSAL

CONTEXTUALIZATION

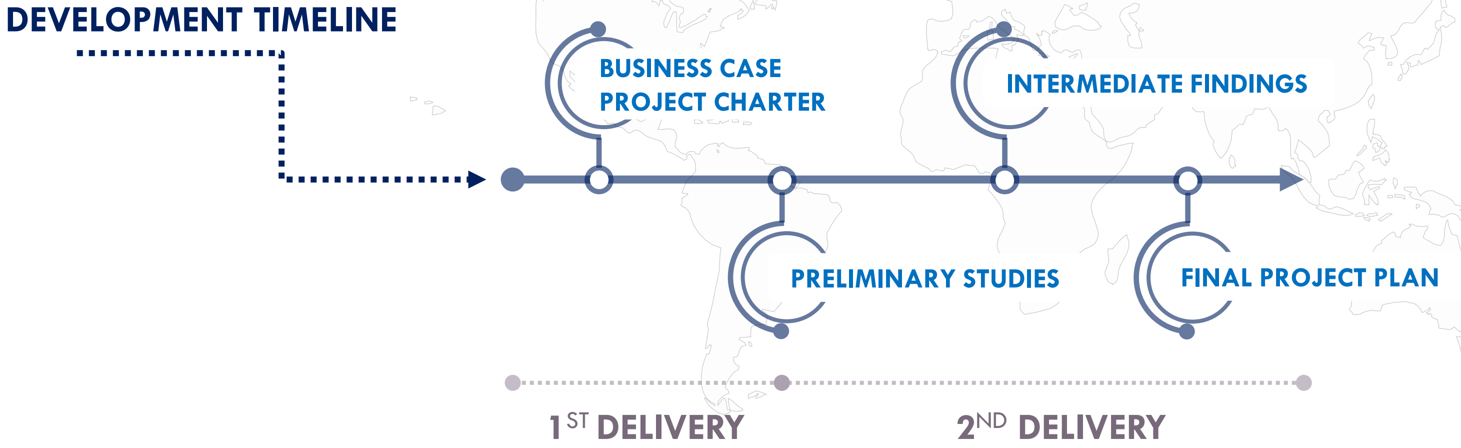
- Utilities and Operations Inc. (UO) seeks to expand its power capacity in England by building a Power Plant at the Dewsbury site in West Yorkshire.

- According to the Business Case formulation and the "2020 Dewsbury PP Project Charter", defined in the initiating phase of the project, the configuration of a CCGT CHP Power Plant has been chosen.

- UO intends to contract an external company for the provision of the EPCC services needed to realize the CCGT CHP Power Plant.

INTRODUCTION

The aim of this presentation is providing to UO the Contractor-side Construction Project Plan realized by the Consultant, highlighting the preliminary studies and intermediate findings which led to the definition of the final project plan.



EPCC SCOPE

- Provision of a 50 MW CCGT-CHP Power Plant in West Yorkshire, England
- Type of contract: Lumpsum Turnkey
- Parties involved: EPCC Contractor and UO, the owner
- Contractor will provide services of Engineering, Procurement, Construction and Commissioning
- Responsibility of these services on the Contractor

EPCC SCOPE

ENGINEERING SERVICE

- Preliminary studies and Basic Design;
- Permits and authorizations based on Basic design;
- Detailed Engineering documents for civil, structural and architectural works;
- Detailed Engineering documents for gas cycle, steam and thermal cycle, MV & HV electrical systems;
- Engineering integration of systems equipment for Gas Cycle, Steam and Thermal cycle and MV & HV electrical systems.

CONSTRUCTION SERVICE

- Site Installation
- Building and Civil Works, realized by a Subcontractor
- Erection and installation of the systems procured

PROCUMENT SERVICE

- Bill of materials and the RFP for civil structural and architectural services and for the provision of the supplies and systems;
- Receive, organize and coordinate distribution of all the proposals from suppliers and subcontractors;
- Select the subcontractor and suppliers;
- Arrange the transportation of the items from the suppliers manufacturing plant to the Owner.

COMMISSIONING SERVICE

- Commissioning, testing and warranty of the Dewsbury Power Plant before delivering the plant to the Owner.

EPCC SCOPE – OPTIONS

OPTIONS EVALUATED BY THE CONSULTANT

A

DIFFERENCES IN THE SCOPE

B

- The Contractor will select three Prime Vendors, one for each lot Gas, Thermal and Electrical
- Prime Vendors are responsible for the fabrication and turnkey delivery of the items

- Manufacturing of the items assigned to suppliers
- The Contractor will take charge of systems integration and manage the transportation of items from suppliers' plants to the Owner's plant
- Responsibility on the Contractor

EPCC – POTENTIAL SUPPLIERS AND VENDORS

OPTION A – POTENTIAL PRIME VENDORS

A

- **Siemens Energy Global GmbH for Gas Cycle System**
- **Ansaldo Energia S.p.A for Steam Cycle System**
- **Brush Electrical Machines Limited for MV & HV Electrical Cycle.**

OPTION B – POTENTIAL SUPPLIERS

B

- **Siemens Energy Global GmbH**
  - Gas Turbine
  - Gas treatment and compression station
  - Steam Turbine
- **Shanghai Boiler Works Co., Ltd**
  - HRSG
  - Stack
  - Steam boiler
  - Steam condenser
- **Schlee Refrigerating Equipment Manufacturing Co.**
  - Two cooling water towers
  - Water spilling pump station
- **DFC Pressure Vessel Manufacture Co., Ltd**
  - CHP Exchanger
  - CHP Reservoir and Pumping skid
- **Shanghai SMEC Enterprise Co., Ltd**
  - Generator and gear box
  - Transformer yard

FROM SCOPE TO ACTIVITIES

EPCC SCOPE OF WORK

DECOMPOSITION OF THE SCOPE

IN ORDER TO PLAN AND

MANAGE THE WORK

WORK BREAKDOWN STRUCTURE*

- ENGINEERING
- PROCUREMENT
- CONSTRUCTION
- COMMISSIONING
- MANAGEMENT

*STRUCTURE: FUNCTION-ORIENTED AT THE FIRST LEVEL

EPCC WBS – PROCUREMENT PHASE

OPTION A – PRIME VENDORS

A

- **Purchasing**
  - **Purchasing Civil Works**
  - **Purchasing Gas Cycle**
  - **Purchasing Thermal Cycle**
  - **Purchasing Electrical Cycle**
- **Gas Cycle Supply**
- **Steam Cycle Supply**
- **Electrical Cycle Supply**

Each one subdivided in a functional way into
- **Fabrication***
- **Transportation**

OPTION B – SUPPLIERS

B

- **Purchasing**
- **Fabrication***
- **Transportation**

Under each of them the work is subdivided based on the potential suppliers that will carry out these activities

* FABRICATION: MANUFACTURING AND SYSTEM INTEGRATION

EPCC OBS

OBS

- Points out the hierarchical relationships within the organization
- Highlights relevant interfaces with the project stakeholders
- Project manager responsible for the Engineering, Site and Procurement functions
- Purchasing agent in Procurement: interface between PM and Prime Vendors (A) or Subcontractors (B)
- Site manager reports to the Contractor project manager

OPTION A – PRIME VENDOR'S RESPONSIBILITIES

A

- **External transportation company**
- **Manufacturing suppliers**
- **System integration**

OPTION B – RESPONSIBILITIES

B

- **Procurement function responsibility: items provided by suppliers and external transportation company**
- **System integration performed by EPCC engineering team**

SEQUENCE OF ACTIVITIES

SEQUENCE CHARACTERISTICS

1. Creating a Dependency matrix for each option to understand predecessor and successor of each task

2. Represent graphically this relationship in a graph using a quantitative method named Network technique

BOTH THE OPTIONS ARE SEQUENCED IN THE SAME FOUR PHASES:

Engineering, Procurement, Construction and Commissioning

MAIN DIFFERENCES BETWEEN OPTIONS

- Purchasing and supply activities are divided by prime vendors in option A instead by suppliers in option B. This difference will lead also to a different critical path.

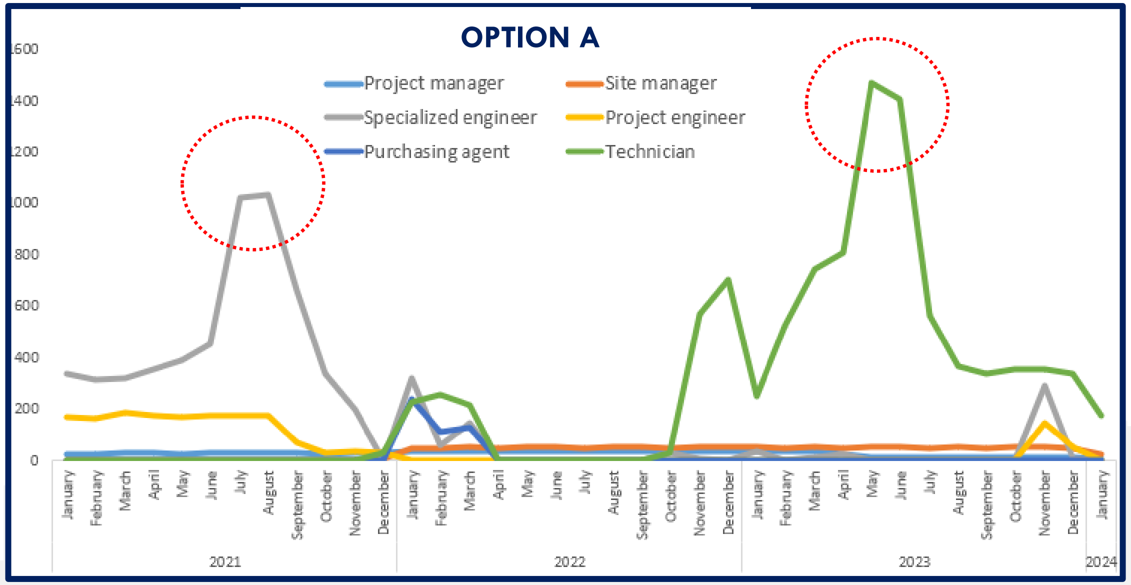
SCHEDULE – ACTIVITIES DURATION ESTIMATION

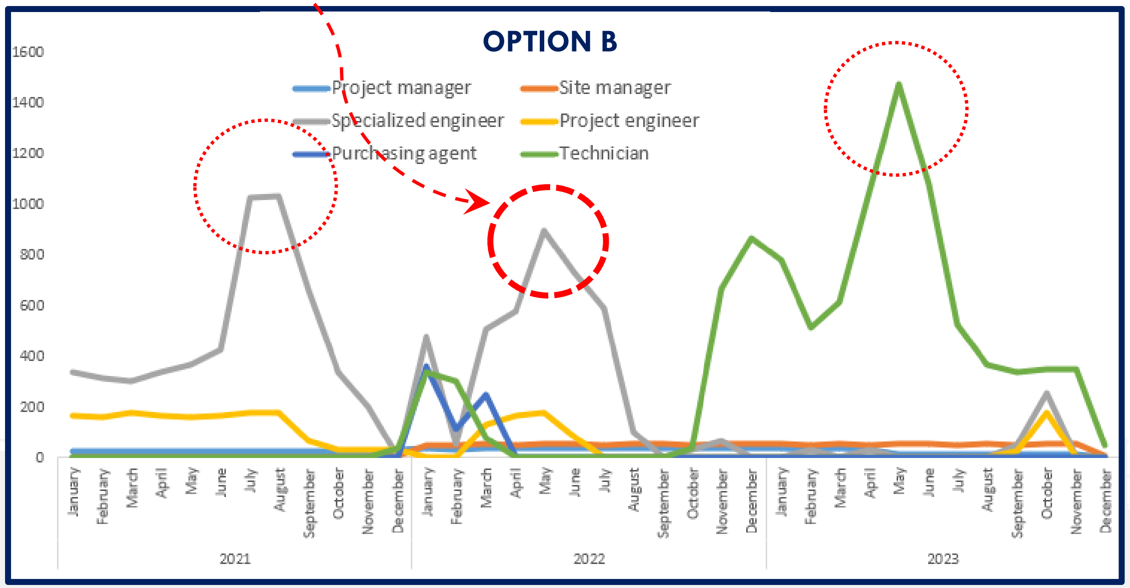
CALCULATION WORK H FOR BASIC DESIGN ACTIVITIES					
TASK NAME	RESOURCE NAME	WORK (hours)	WORK (hours) %	DURATION (working days)	# RESOURCE PER TEAM
BASIC DESIGN					
TOTAL BASIC DESIGN	Specialized engineer	1600	100%	100,00	2
	Project Engineer	800	100%	100,00	1
Basic Design Building& Civil works	Specialized engineer	276	17%	17,28	2
	Project Engineer	87	11%	10,83	1
Basic Design Gas Cycle System	Specialized engineer	503	31%	31,41	2
	Project Engineer	255	32%	31,85	1
Basic Design Steam Cycle System	Specialized engineer	410	26%	25,65	2
	Project Engineer	229	29%	28,66	1
Basic Design MV & HV Electrical System	Specialized engineer	410	26%	25,65	2
	Project Engineer	229	29%	28,66	1
TOTAL BASIC DESING (to verify the %)	Specialized engineer	1600		100	
	Project Engineer	800		100	
DETAILED DESIGN					
TOTAL DETAILED ENGINEERIN (to verify the %)	Specialized engineer	3820	100%		
	Project Engineer	628	100%		
Detailed Engineering Building& Civil works	Specialized engineer	660	17%	41,25	2
	Project Engineer	68	11%	8,50	1
Detailed Engineering Gas Cycle System	Specialized engineer	1200	31%	75,00	2
	Project Engineer	200	32%	25,00	1
Detailed Engineering Steam Cycle System	Specialized engineer	980	26%	61,25	2
	Project Engineer	180	29%	22,50	1
Detailed Engineering MV & HV Electrical System	Specialized engineer	980	26%	61,25	2
	Project Engineer	180	29%	22,50	1

- For both the options activities duration has been assigned by using the activity list, as well as for the resource assignment;
- Effort-driven tasks had the duration automatically computed by Microsoft Project based on the work hours performed by the assigned resource;
- For Basic Design each sub-task's workhours have been computed according to the proportions existing among the corresponding Detailed Engineering activities' workloads.

SCHEDULE – HR RESOURCES WORKLOAD

- **Project** and **Specialized Engineers**, **Purchasing Agents** and **Technicians** have the highest peaks of work hours in the three options at the same time frames due to their activity being tied to the amount of hours requested to complete a task and to the level of resources and overtime employed. The main difference is present in the option B, which represents the work hours to perform the system integration internally.





- **Project Manager**'s workload profile is constant and equally distributed along the project's duration. The same happens to the **Site Manager**'s workload profile: it is constant and equally distributed along the project's construction phase.

COSTS – PRELIMINARY BUDGET

OPTION A

DURATION

791 WORKING DAYS

BUDGET

ESTIMATION:
£ 43.851.638

OPTION B

DURATION

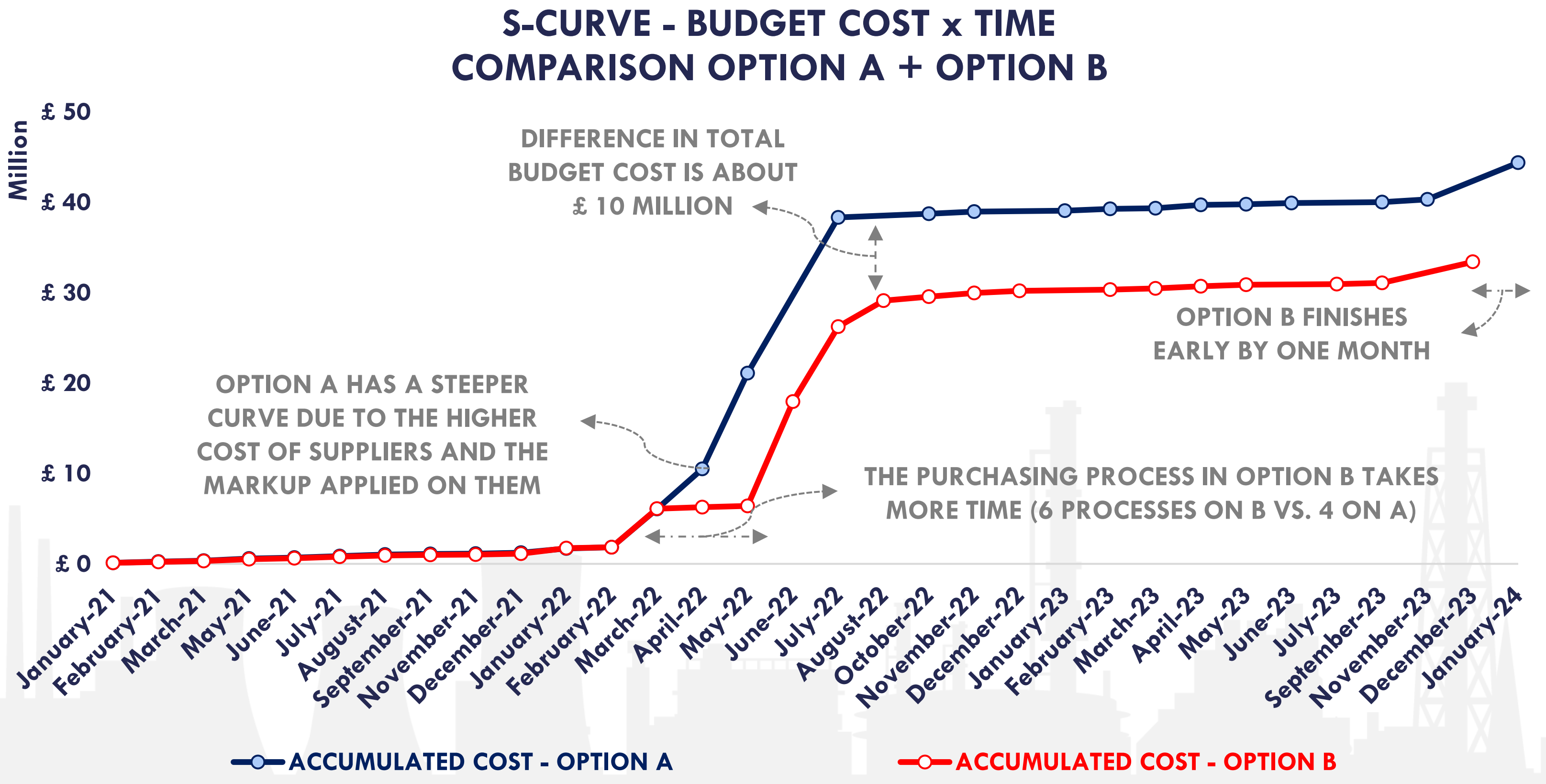
763 WORKING DAYS

BUDGET

ESTIMATION:
£ 32.391.356

BEST OPTION
£~10 MILLION LOWER THAN OPTION A, EVEN IF CONSIDERING THE CONTIGENCY AMOUNT

COSTS – S-CURVES - COMPARISON BETWEEN OPTION A AND B



THE TOTAL COST IS COMPOSED BY DIRECT COSTS PLUS INDIRECT COSTS (MOBILIZATION+OVERHEAD) PLUS CONTIGENCY COST

COST AND TIME TRADE-OFF

METHODS/SCENARIOS USED TO PERFORM CRASHING THE PROJECT

ALLOCATION OF EXTRA HUMAN RESOURCES

B.1.2: EXTRA RESOURCES CONSIDERING THAT TECHNICIANS HAVE A DECREASING PRODUCTIVITY CURVE

HUMAN RESOURCE OVERTIME

B.2.1: B.1.2 + OVERTIME BASIC DESIGN

B. 2.2: B.2.1 + OVERTIME PURCHSING

B. 2.3: B.2.2 + OVERTIME SYSTEM INTEGRATION

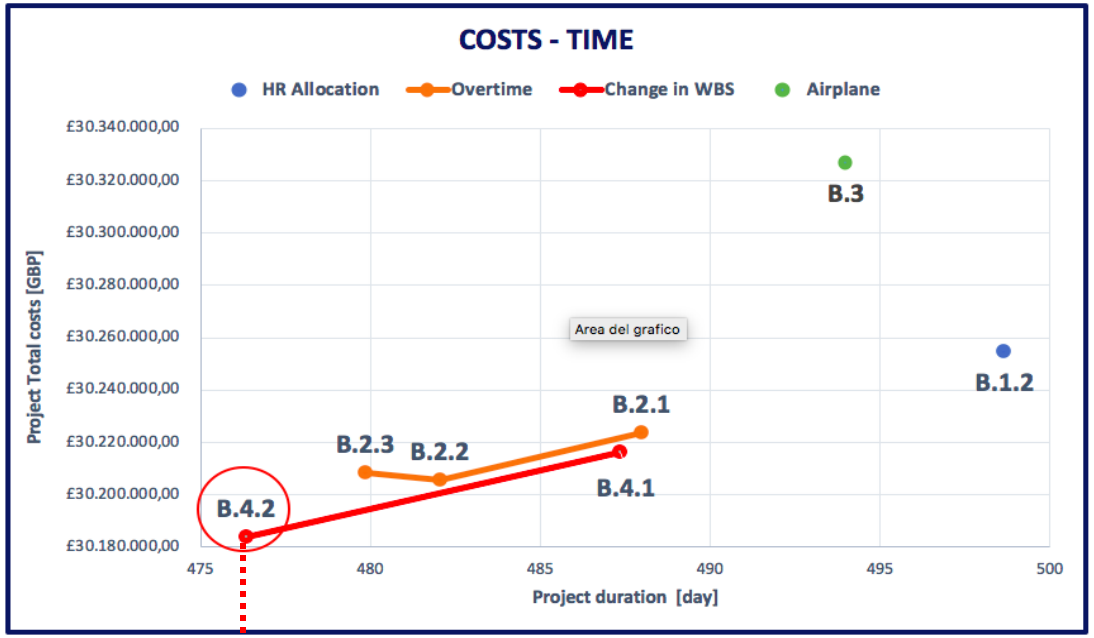
AIRPLANE TRANSPORTATION

B.3: ALTERNATE TRANSPORTATION OF THE STEAM TURBINES, TO DECREASE THE OVERALL PROJECT DURATION

CHANGES IN THE WBS

B.4.1: SEPARATE EXPEDITING AND TRANSPORTATION FOR GAS CYCLE AND STEAM TURBINE

B.4.2: B.4.1 + OVERTIME BASIC DESIGN



PARETO OPTIMAL EFFICIENT SOLUTION → DETERMINISTIC BEST-CASE SCENARIO

RISK MANAGEMENT PLAN – INTERNAL RISKS

TYPES OF RISK IDENTIFIED

- **Time-related risks:** affect the overall task/project duration
- **Cost-related risks:** task cost overruns

RISK BREAKDOWN MATRIX

- **Tool** utilized to assess risks in a quantitative way
- **2 distinct RBMs** which integrate the WBS with the RBS of the project

TOTAL EMV PER TASK

→ **EMV cost overrun of each risk + EMV of each time-related risk**

EMV cost overrun of each risk = Activity cost * risk score

EMV of each time-related risk = (Penalties by Owner – penalties by Subcontractors or Prime vendors) * expected project delay * 4,000£/day

RISK MANAGEMENT PLAN – EPCC SCOPE RISKS

RESPONSE MEASURES

EMV		Response
	LOWER OR EQUAL TO £ 4.000	RISK ACCEPTED
	BETWEEN £ 4.000 AND £ 200.000	MITIGATION ACTION
	OVER £ 200.000	PREVENTIVE ACTION

CONTINGECY

CONTINGENCY		
	VALUE	
EPCC ACTIVITIES	£	62.598
SUB CONTRACTS	£	177.550
SUPPLIES	£	1.156.861
INCREASE IN TIME	£	124.581
MITIGATION AND PREVENTIVE ACTIONS	£	884.162
PENALTIES BY OWNER	£	63.286
PENALTIES DUE BY SUBCONTRACTORS AND SUPPLIERS	£	63.062
TOTAL CONTINGENCY	£	2.405.752

TOTAL CONTINGENCY = Mitigation Action Costs + Residual EMV Risks = £2.405.750

RISK MANAGEMENT PLAN – FORCE MAJEURE RISKS

RISK DESCRIPTION	IMPACT DESCRIPTION	IMPACT LEVEL	PROBABILITY LEVEL	PRIORITY LEVEL	MITIGATION NOTES	OWNER	OWNER
Brief summary of the risk	What will happen if the risk is not mitigated or eliminated?	Rate 1 (LOW) to 5 (HIGH)	Rate 1 (LOW) to 5 (HIGH)	(IMPACT X PROBABILITY)	Suggestions for what can be done to lower or eliminate the impact or probability	Who's responsible? Who must pay in case the risk happens	Who's responsible? Who to address inside the EPCC company
Natural Hazard; Harsh weather conditions (Heatwaves, snow and storm), flooding, wildfire.	For example if it rains for 2 months while the job is coming out of the ground, meeting the schedules can be impossible	3	3	9	Avoid Harsh seasons	UO	Site manager
Climate Change: will increase the chance and effect of natural hazard occurrence	Climate change is linked to reduced raw material availability such as water or energy shortage. It will also amplify the power of weather events (huricanes, storms...), which can disrupt operations and transportation	2	3	6	Analysis (made from internal or external expertise) of site location and scenarios on how environment conditions can affect the area	UO	Project manager
Theft and Vandalism: theft of equipment and heavy material from outsiders at night. Grafiti and chaos to the construction site	Loss of more material and equipment wich will increase expenses	2	2	4	Increase site security protection	UO	Project manager
Local protesters at site gate which claim the polluton and danger caused by the plant	Delays in construction	2	2	4	Campaign of information, highlighting benefits from the plant and low climate impact	UO	Commercial team
Exit of UK from Europe without an agreement (Hard Brexit)	Unfavourable exchange rates; difficulties for foreign workers to get permits to work in UK	4	3	12	Make workers' contracts before final Brexit agreements; use local labour	UO	Human resource manager
Covid crisis and possible government actions (lockdown, safety regulations)	Lower productivity due to limited use of resources and delays due to difficult transportation	3	3	9	Ask for special permission, respect all the safety rules rigorously	UO	Project manager
Government delay in permission and approvals	delay in project initiation	2	2	4	Schedule accounting for the possibility of the delay	UO	Project manager
Incorrect procedural information from UO	Risk of doing things many times, following the new instruction given	3	3	9	Use of suitable procedural and reporting tools	UO	Project manager
Unavailability of utilities and connections for commissioning phase	Delay in commissioning phase	2	2	4	Prepare documentation in advance	UO	Project manager

RISK REGISTER SCALE

PROBABILITY					
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5
	1	2	3	4	5

IMPACT

BUDGET COSTS

DIRECT COSTS

		VALUE
SUPPLIES		
Heat recovery steam generator and Stack	£	2.829.000
Gas treatment and compression station	£	4.300.000
Gas turbine	£	3.850.000
Generator and gear box	£	2.091.000
Steam turbine	£	2.450.000
Steam boiler	£	1.377.600
Steam condenser	£	1.476.000
Transformer yard	£	672.400
Cooling water towers	£	360.800
Water spilling pump station	£	278.800
CHP Exchanger	£	1.537.500
CHP Reservoir and Pumping skid	£	832.300
TRANSPORTATION COSTS		
Siemens Energy Global GmbH & Co. KG	£	5.832
Siemens Energy Global GmbH & Co. KG	£	32.130
Shanghai Boiler Works Co Ltd.	£	44.460
Schlee Refrigerating Equipment Manufacturing Co., Ltd	£	15.120
DFC Pressure Vessel Manufacture Co., Ltd	£	11.880
Shanghai SMEC Enterprise Co., Ltd	£	14.850
SUBCONTRACTS		
Balance of plant system, fluid piping and electrical networks	£	2.300.000
High Pressure rated Piping	£	72.750
Control room and office building	£	300.988
Excavations and foundations materials	£	188.400
Above ground structures	£	1.290.000
RENTAL		
Site installation equipment	£	4.000
MANAGEMENT, STAFF AND LABOR		
Project Manager	£	120.000
Project Engineer	£	235.200
Site Manager	£	108.000
Specialized engineer	£	795.200
Purchasing agent	£	50.400
Technicians	£	493.200
TOTAL DIRECT COSTS	£	28.137.810

INDIRECT COSTS

	BASE PRICE		VALUE
MOBILIZATION	0,5% of direct costs	£	140.689
OVERHEAD	£4.000,00 / day	£	1.905.360
TOTAL INDIRECT COSTS		£	2.046.049

CONTINGENCY

		VALUE
EPCC ACTIVITIES	£	62.598
SUB CONTRACTS	£	177.550
SUPPLIES	£	1.156.861
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TOTAL CONTINGENCY	£	2.405.752

FINANCIAL

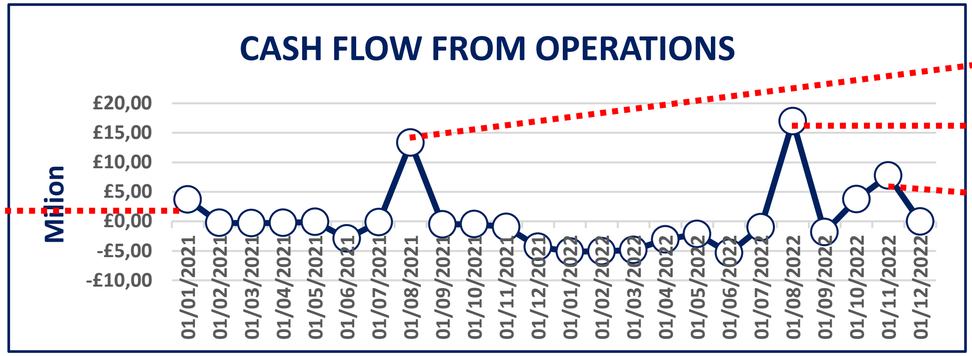
	BASE PRICE		VALUE
BONDS FEE	8%	£	312.860,26
CAR ASSURANCE	5%	£	117.240,88
BANK			
Interest due for overdraft	8%	£	79.507,25
Interest payable on deposit	1%	£	100.263,89
AVERAGE DSCR			1,56

BUDGET REVENUES

REVENUES	%	VALUE
EPCC PROFIT MARGIN		
Profit margin	20%	£ 6.517.922
PAYMENT SCHEDULE		
ADVANCED PAYMENT	10%	£ 3.910.753
MILESTONE PAYMENT		
Engineering completed	35%	£ 13.687.636
Civil works completed	45%	£ 17.598.390
Erection completed	20%	£ 7.821.506
TAKEOVER PAYMENT	10%	£ 3.910.753
TOTAL REVENUES		£ 39.107.532

- Milestone and Advance Payments have been set with the objective of having an acceptable average Debt Service Coverage Ratio for the Contractor, minimizing the financial risks of the project.

CONTRACTOR CASH FLOW

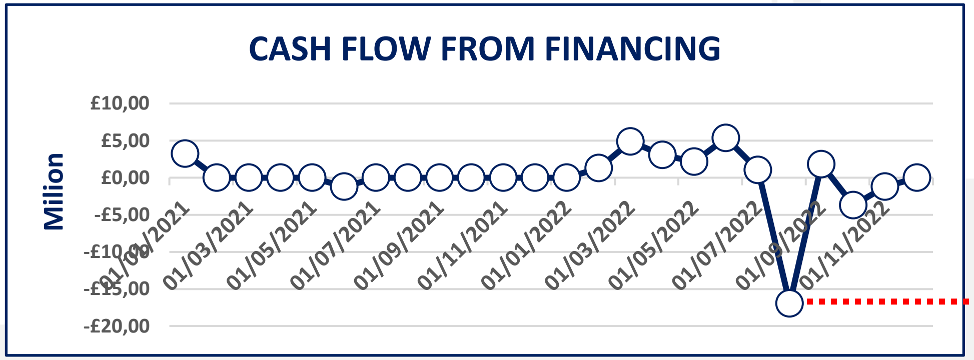


ADVANCE PAYMENT

MILESTONE 1

MILESTONE 2

MILESTONE 3



STABILIZATION EQUITY

FINAL PROPOSAL

FINAL CONTRACTOR PRICE ESTIMATION

CONTRACTOR PROFIT MARGIN + DIRECT COSTS + INDIRECT COSTS + CONTINGENCY VALUE = FINAL PRICE **£ 39.107.532**

THANK YOU