DEWSBURY POWER STATION CONSTRUCTION PROJECT
A.A. 2020/2021 – PROJECT MANAGEMENT

GROUP 14

1ST DELIVERY – 26/10/2020

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Introduction

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 power station plant in Dewsbury (UK) where Iren SpA will be the sponsoring organization of the project.

This report 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:

- Economic and financial, which shows the financial evaluation of the project using the NPV method using the baseline data;
- Sensitivity analysis, which shows the impact of various cost drivers on the NPV;
- Risk weighted opportunity, where a high level risk analysis for the project is conducted and the NPV taking risks into account is computed;
- Qualitative alignment analysis, which shows the fit of the project with the strategy of Iren SpA;
- Alternate and value engineering, where two alternative technologies are considered, CCGT-H Class and CCGT-CHP and evaluated in terms of NPV and qualitative alignment with Iren.

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

1. Business Case

1.1 Economics and Financials

In this section an economic and financial analysis has been conducted to evaluate the profitability of the Dewsbury Power Station construction project through the NPV method.

1.1.1 Methodology for the NPV computation

Power generation

To compute the total energy that the CCGT plant will produce for sale, the following data has been considered:

POWER GENERATION		
CONTRACTED POWER	CP	50
HOURS/YEAR OF PRODUCTION	h/year	8760
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%

The yearly total energy to be produced (EP_i) in MWh has been computed as:

$$EP_n = CP * \frac{h}{year} * CF_n * APA * DR$$

where $CF_n = CF_{n-1}(1 - CD)$ is the yearly capacity factor degraded.

By considering the auxiliary requirement, the yearly total energy to be sold $(EPS_n)\ in\ MWh$ has been computed as:

$$EPS_n = EP_n(1 - AR)$$

Economics

ECONOMICS			
VARIABLE OPERATIONAL COST	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%
FIXED OPERATIONAL COST	FOC	[£/MW]	12000

The total yearly revenues have been computed as: $R_n = FT * EPS_n$

The total yearly net revenues have been computed as: $NR_n = R_n - COES_n$

where:

$COES_n = VOP\&ME_n + AGOF_n + FC_n$ is cost of the energy sold;

$VOP\&ME_n = VOC * EP_n$ is the annual variable operation and maintenance expenditure;

$AGOF_n = GOF * R_n$ is the annual grid fee;

$FC_n = \frac{GP*EP_n}{SE_n}$ is the annual fuel cost;

The yearly EBITDA have been computed as: $EBITDA_n = NR_n - FOP\&ME_n$

where $FOP\&ME_n = FOC * CP$ is the annual fixed operation and maintenance expenditure

Assets

ASSETS			
PRE-DEVELOPMENT	[£]	£	560.000
CONSTRUCTION	[£]	£	26.555.000
TOTAL CAPEX	[£]	£	27.115.000

Capital expenditure has been computed as sum of the construction and predevelopment costs and subdivided across the first three years of the project according to the profile distribution proposed in the baseline data, corresponding to [20%, 40%, 40%].

Financial

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

$$FCF_n = EBITDA_n - CAPEX_n$$

To compute the discounted yearly cash flow two cases have been considered:

- The project will be financed by only equity investors→ cash flows discounted by the cost of equity ($r_e = 15\%$)
- The project will be financed in part with debt (70%) and in part with equity (30%) → cashflows discounted by the weighted average cost of capital (r_{wacc}) computed as follows, distinguishing the pre-tax and post-tax cases:

$$r_{wacc}(pre - tax) = \frac{E}{E+D} r_e + \frac{D}{E+D} r_d$$

$$r_{wacc}(post - tax) = \frac{E}{E+D} r_e + \frac{D}{E+D} r_d (1 - T_c)$$

where

- $r_d = 8\%$ cost of debt
- $r_e = 15\%$ cost of equity
- $T_c = 19\%$ corporate tax rate

The NPV of the project has been computed using the following formula:

$$NPV = \sum_{i=1}^{n} \frac{FCF_i}{(1+r)^i} - Initial\ investment$$

where:

- initial investment has been considered to be zero;
- the discount rate r has been considered as r_e in the first case and $r_{wacc}(pre - tax)$ and $r_{wacc}(post - tax)$ in the second case.

1.1.2 Results

By using the baseline project data, the results of the NPV computation are shown below:

NPV (WITH COST OF EQUITY)	-£ 26.401.742,16
NPV (WITH rWAC PRE-TAX)	-£ 32.490.670,18
NPV (WITH rWAC POST-TAX)	-£ 34.323.214,43

If the NPV of a project or investment is positive, it means that the discounted present value of all future cash flows related to that project or investment will be positive, and therefore attractive. However, as it is possible to see in the table, in all the cases a negative NPV is obtained. This is mainly due to the fact that the yearly EBITDA is negative as well as the net revenues, so this means that the revenues generated by the plant are not able to cover the plant operational costs.

To conclude, the negative NPV computed with the baseline data suggests to avoid investing in the project.

1.2 Sensitivity to updated opportunity drivers.

Sensitivity analysis helps to determine which individual project risks or other sources of uncertainty has the most potential impact on project outcomes. It correlates variations in the project's NPV with variations in costs and revenues. One typical display of sensitivity analysis is the tornado diagram, which illustrates the magnitude of these variations.

Carrying out a sensitivity analysis is of fundamental importance to discover the areas of critical interest so that resources can be allocated more efficiently.

1.2.1 Drivers and analysis methods

The main drivers identified have been divided into two main categories, which are:

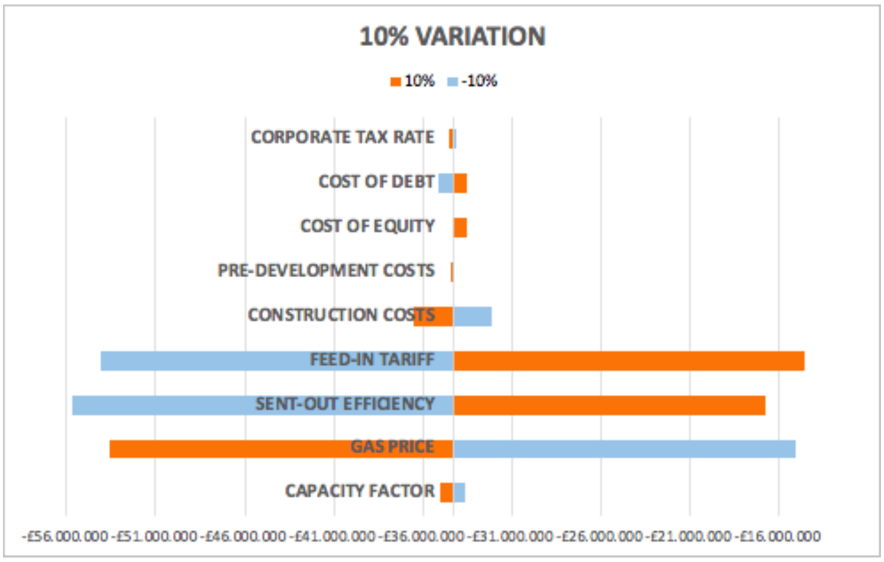
- *Construction drivers*
    - Capacity factor
    - Fuel price
    - Sent-out efficiency
    - Construction costs
    - Pre-development costs
    - Feed-in tariff
- *Financial drivers*
    - Cost of equity
    - Cost of debt
    - Corporate tax rate

The methods used to evaluate the sensitivity of the project’s outcomes to the drivers are two: one simulating a variation of a ±10% and ±20% in single cost voices (while keeping all other costs constant) and the other one evaluating the best and worst scenarios based on actual historical fluctuations.

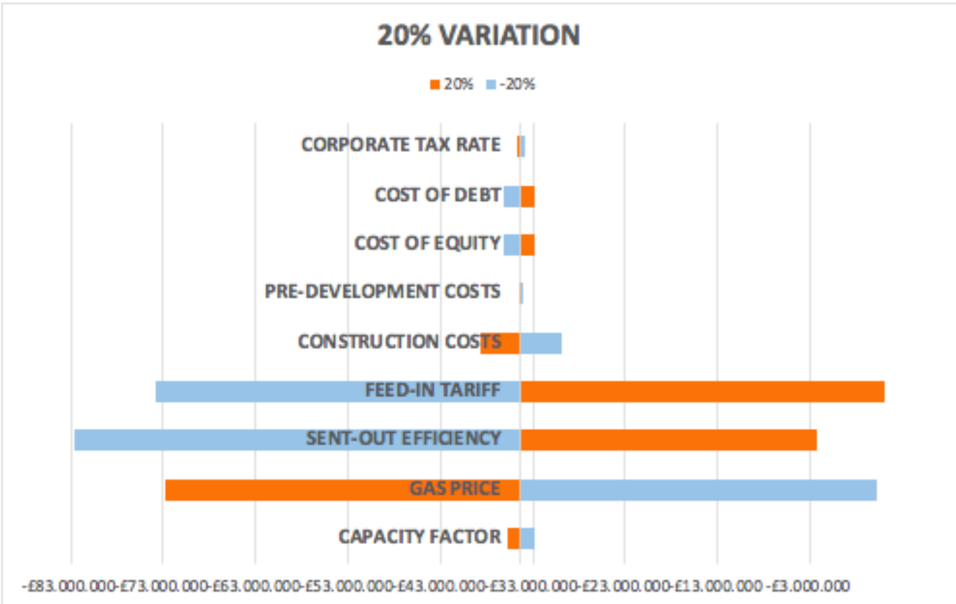
1.2.2 NPV with drivers variation for CCGT-CHP

The following tornado chart was obtained by variating the previously mentioned drivers by ±10% and illustrating how much the NPV is affected as a result. The central value represents the NPV as calculated without variations at £ -34.323.214 (discounted by r_{wacc} $(post - tax)$).

The graph below clearly shows 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 (the oscillation due to the latter especially are remarkably smaller than the rest). This highlights the importance of focussing on the drivers to whose variation the NPV is most sensible, since an increase by 10% in gas price for example would lead to the NPV falling to -£53.593.793 from -£ 34.323.214.

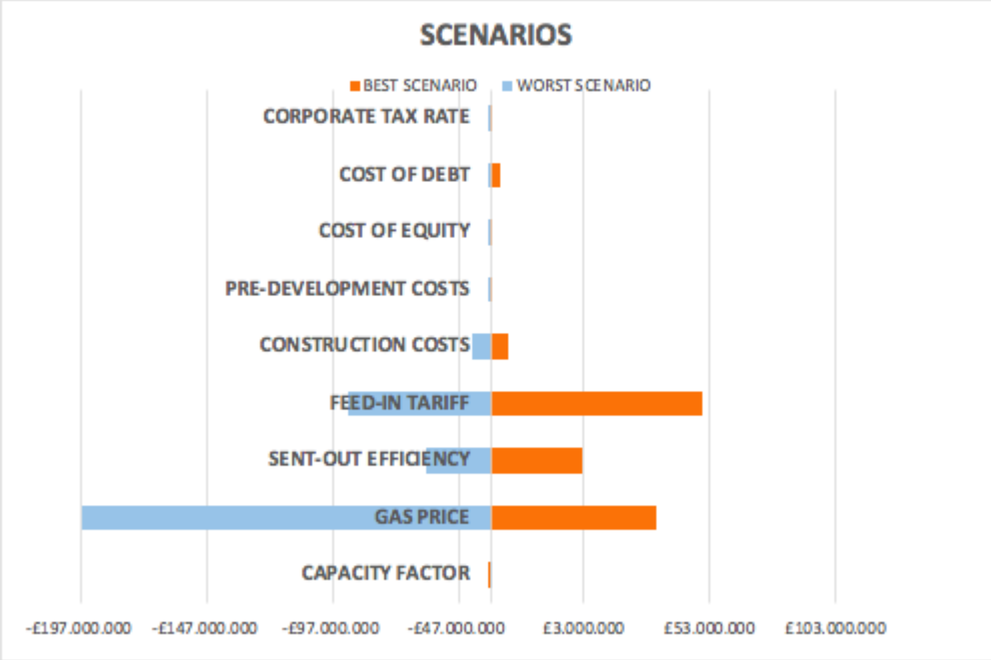


This can be done for instance by devoting effort to maintain the feed-in tariff and sent-out efficiency high, as well as using instruments like futures options to increase control over the changing gas price. The effect these variations can have on NPV is greatly emphasized in the graph below, which instead presents a ±20% variation in drivers.



1.2.3 NPV estimation in the best and worst scenarios

In order to identify the best and worst scenarios related to the specific drivers considered, recent historical data regarding the single variations was exploited to provide a realistic estimation of the impacts on the NPV. 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. This is because the possible variations in gas price and feed-in tariff exceed the considered ranges of ±10% and ±20%.



SENSITIVITY ANALYSIS RANGES VARIATIONS			
	VARIATIONS		
	WORST SCENARIO	NORMAL SCENARIO	BEST SCENARIO
CONSTRUCTION DRIVERS			
CAPACITY FACTOR	70%	80%	90%
NPV	-£ 33.407.362	-£ 34.323.214	-£ 35.239.067
GAS PRICE (GBP/kWh)	0,07	0,038	0,025
NPV	-£ 196.601.772	-£ 34.323.214	£ 31.602.450
SENT-OUT EFFICIENCY	45%	51%	63%
NPV	-£ 60.017.319	-£ 34.323.214	£ 2.382.650
FEED-IN TARIFF (GBP/MWh)	57,1	80	114,3
NPV	-£ 90.682.262	-£ 34.323.214	£ 50.215.357
CONSTRUCTION COSTS	£ 35.583.700	£ 26.555.000	£ 17.791.850
NPV	-£ 41.802.977	-£ 34.323.214	-£ 27.063.445
PRE-DEVELOPMENT COSTS	£ 750.400	£ 560.000	£ 504.000
NPV	-£ 34.480.950	-£ 34.323.214	-£ 34.276.822
FINANCIAL DRIVERS			
COST OF EQUITY	13%	15%	17%
NPV	-£ 35.471.755	-£ 34.323.214	-£ 33.260.010
COST OF DEBT	7%	8%	12%
NPV	-£ 35.406.204	-£ 34.323.214	-£ 30.682.549
CORPORATE TAX RATE	22%	19%	18%
NPV	-£ 34.635.795	-£ 34.323.214	-£ 34.220.516

1.3 Risk weighted Opportunity

1.3.1 Framework

To evaluate the risks associated with the opportunity to construct a power station plant in Dewsbury a high-level risk analysis has been conducted, starting from a more general point of view and then going into detail. The first step was writing down a PEST analysis (Appendix A) for the Electricity Market in the UK and then combining it with the results of the sensitivity analysis for the business opportunity (1.2). As highlighted in the sensitivity analysis, the drivers mostly affecting the NPV of the project are gas price, sent-out efficiency, feed-in tariff and capital expenditures. Four main risks have been identified through the PEST analysis, each one connected with one specific driver. Each risk has been catalogued by the definition of its risk source, event, consequence, impact, likelihood and estimated reserves, as shown in the table below.

	RISK	RISK SOURCE	EVENT	EFFECT	MAGNITUDE (%)	PROBABILITY	RISK (%)	RESERVE	
EXTERNAL	Cost overruns	Construction cost, custom duties and immigration policy	COVID 19, Brexit and literature evidences	Increase in capex	34%	90%	30,67%	£	8.316.000,00
	Legal risk	Regulation of feed-in-tariff	Scarcity of electricity supply in the UK	Increase in revenues	42,86%	75%	32,14%	£	64.369.470,96
	Fuel risk	Gas price	Factors (*)	Decrease fuel cost	-34,21%	50%	-17,11%	-£	32.962.832,04
INTERNAL	Technical Risk	Plant Efficiency	Underestimation of the plant efficiency	Decrease fuel cost	-19%	75%	-14,29%	-£	27.529.398,19

(*) Factors are reported below in the fuel risk section

The risk adjusted drivers and the relative NPV have been computed for a better understanding of the impact of these risks.

1.3.2 Project risks

Cost Overruns risk

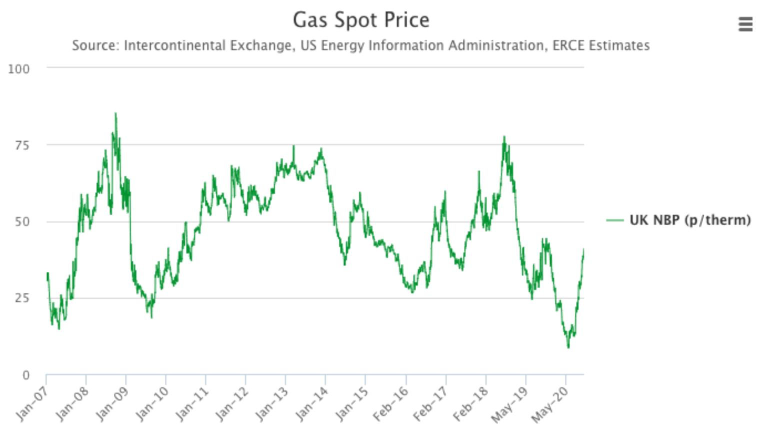
Cost overruns are one of the major problems in the cost estimation for a business opportunity. In the document ("*An international comparative assessment of construction cost overruns for electricity infrastructure*"), it has been found out that electricity infrastructure is prone to cost overrun issues almost independently from technology or location. According to the document the mean overrun per MW registered in thermal plants is 240.000 $/MW, which, by applying the current exchange rate (0,77 $/£) and considering a 50 MW thermal plant, it gives an estimated overrun of £9.240.000,00.

To assess the probability of cost overrun, it has been considered that fossil-fuelled power plants construction cost overrun was registered in the 70% of cases. By taking into account that both COVID-19 pandemic and Brexit could lead to a further increase in the construction time and costs (due to changes of the current UK's standard in terms of custom duties and immigration policy) a 20% of probability has been added. The final probability used is equal to 90%. Risk (%) has been computed as (probability) times (magnitude), whereas capex reserves have been estimated as risk percentage times capex value.

COST OVERRUNS		
Average Cost escalation		12,6%
Mean Overrun per MW		240000 $/MW
Contracted Power		50 MW
Estimated Overrunn ($)	$	12.000.000,00
Estimated Overrunn (£)	£	9.240.000,00
Baseline TOTAL CAPEX	£	27.115.000,00
Magnitude		34,08%
Probability		90,00%
Risk		30,67%
Reserve	£	8.316.000,00

Fuel risk

As shown in the sensitivity analysis, the gas price is one of the most important factors that impacts on the computation of the NPV. The price of gas is characterized by a great volatility, which reflects extraordinary characteristics of supply and/or demand. It is mainly affected by a degree of seasonality and by the level of natural gas in underground storage. In 2020, as a consequence of a decrease in demand, COVID-19 has accelerated the progressive fall in gas prices that was going on from spring 2019, as it is possible to see in the graph below.



In the business case data of 2016, the estimated gas price was 0,038 £/kWh (thermal) and no reasonable risk of having a higher gas price than this one was found. On the contrary, as reported in the article https://group.met.com/energy-insight/natural-gas-prices-forecast/3, there are different factors and events which will lower the trend of gas price. In the short term the natural gas price might decrease due to:

- COVID 19 and new possible restrictive measures, which will imply a decrease of the demand;
- Saudi Arabia-Russia price war;
- Global warming and climate changes;
- Increase in gas discoveries.

In the long run the increasing presence of renewable energy sources for energy production can be considered as a factor that will reduce the gas price. Hence, it is reasonable to assume that the average price will be lower than the one reported in the baseline data. Given the forecasts (https://www.statista.com/statistics/374970/united-kingdom-uk-gas-price-forecast/) and considering that the CCGT plant is considered to work at least until 2048, an average value of 0,025 £/kWh (thermal) can be assumed. To compute the magnitude of the risk related to gas price fluctuations, the NPV of the project has been computed both in the baseline and in the best scenario cases. The probability has been considered to be 50% due to the volatility of the gas price. Risk (%) has been computed as (probability)×(magnitude) and it is negative because the fuel cost in the best scenario is lower than the baseline one, so in this case the negative risk represents an opportunity.

GAS		
Baseline gas price	0,038	£/KWh
Best scenario gas price	0,025	£/KWh
Baseline NPV fuel cost	£ 192.705.787,33	
Best scenario NPV fuel cost	£ 126.780.123,25	
Magnitude	-34,21%	
Probability	50,00%	
Risk	-17,11%	
Reserve	-£ 32.962.832,04	

Legal risk

The price of electricity is mainly affected by the demand and supply mechanism. On the demand side, considering the final user, an overall decrease of the business and domestic electricity consumption has been registered between 2000 and 2019, as a consequence of energy efficiency regulations, energy-efficient lighting and changing consumer habits (Statista article). In 2020 UK electricity demand dropped down due to COVID-19 restrictive measures, which forced companies to shut down industrial plants and shops. Concerning the wholesale electricity supply, the growth of sustainable energy sources has the potential to slow, and even eventually reverse, the rise in gas prices, but the increase in electricity fees is unlikely to stop. (Energy Price Forecast | 2018 Energy Price Rises). This is partly due to the fact that many of the UK's electricity generation plants were closed down due to the EU's Large Combustion Plant Directive, a ruling that has then been replaced by the Industrial Emissions Directive. Coal fired power stations have been requested to contribute in reducing emissions in energy generation processes. Currently, renewable energies are not reliable in terms of generated power so they can't fill the available power gap introduced by the shutdown of coal plants. Moreover, as reported in the PEST analysis, the Brexit event slowed down investments in power generation stations in the UK. The comparison of retail and wholesale prices in the UK from 2010 to 2020 shows a yearly increase of both, even though the wholesale market is affected by seasonality. All these factors led to the conclusion that the slight decrease in the electricity demand of final users will be offset by the scarcity in the wholesale electricity supply. Hence, an increase in the electricity price and, as a consequence, of the feed-in tariff is likely to occur (a probability of 75% has been assumed in this report). In the computation of the risk, the best scenario's feed-in tariff has been computed by considering that the baseline value of 80 £/MWh was set in 2016, when the wholesale price was 35 £/MWh (UK Wholesale Electricity Prices). In 2019 the wholesale price was around 50 £/MWh, so by considering the proportion, the best scenario's tariff is 80*(50/35) £/MWh. To compute the magnitude of the risk, the NPVs of the revenues with baseline and best scenario feed-in-tariff have been considered. Risk (%) has been computed as probability times magnitude and it is negative because the revenues in the best scenario are higher than the baseline one. In this case the computed risk is positive because it concerns a revenue increase, it represents an opportunity and the related reserves a surplus.

FEED -IN-TARIFF		
Baseline tariff		80 £/MWh
Best scenario tariff		114 £/MWh
Baseline NPV revenu	£	200.260.576,31
Best scenario NPV re	£	286.086.537,58
Magnitude		42,86%
Probability		75,00%
Risk		32,14%
Reserve	£	64.369.470,96

Technical risks

In the business case data, the CCGT has been defined as a mature technology (N-of a kind) so no technological risk has been considered in this report. In the baseline data of 2016 the plant efficiency is 51% for a CCGT. Technical improvements of the gas turbine efficiency have been registered over time (Ltd. | Comparative Performance) and today, considering the J series as a reference, efficiency is around 63%. Hence, to compute the risk, the best scenario NPV of fuel cost has been identified by considering the initial sent-out efficiency of the plant as equal to 63%. Risk (%) has been computed as probability times magnitude and it is negative because the fuel cost in the best scenario is lower than the baseline one, so in this case the negative risk represents the opportunity.

SEND-OUT EFFICIENCY		
Baseline efficiecy		51%
Best scenario efficiency		63%
Baseline NPV fuel cost	£	192.705.787,33
Best scenario NPV fuel cost	£	155.999.923,08
Magnitude		-19,05%
Probability		75,00%
Risk		-14,29%
Reserve	-£	27.529.398,19

1.3.3 NPV Risk Adjusted

To better understand the impact of the risks on the project, the risk adjusted value of each driver has been computed through the following formula:

$$Risk\ adjusted\ driver = baseline\ value + (baseline\ value - possible\ value) * probability$$

This is equivalent to:

$$Risk\ adjusted\ driver = baseline\ value * \ (1 + risk)$$

The only exception is the send-out efficiency, for which the last formula does not work. For this reason, the first formula has been used.

				RISK		
		BASELINE	POSSIBLE VALUE	VARIATION	PROBABILITY	RISK ADJUSTED DRIVER
FEED IN TARIFF	[£/MWh]	80	114	34,286	75%	105,71
GAS PRICE	[£/kWh]	0,038	0,025	-0,013	50,00%	0,0315
SENT OUT EFFICIENCY		51%	63%	12%	75%	60%
TOTAL CAPEX	[£]	£ 27.115.000	£ 36.355.000	£ 9.240.000,00	90%	£ 35.431.000,00

The computed NPV value of the project with these risk-adjusted values and $\boldsymbol{r_{wacc}\ (post - tax)}$ is £79.115.658,39. In this case the positive value of the NPV represents that the project is an attractive business opportunity.

1.4 Qualitative Alignment

This section evaluates the strategic fit between Iren and UO. Several tools have been used, such as:

- PESTLE analysis: to assess the external factors which may affect the Electrical Market in the UK;
- Porter's Diamond Model: to assess the UK fit with Iren;
- Swot Analysis: to assess the strengths, weaknesses, threats and opportunities coming from the acquisition of UO and their Dewsbury Power Station Construction Project.

At the end of the qualitative analysis, a scorecard provides a quantification, based on the baseline data, of the qualitative alignment between Iren strategic objectives and the Dewsbury Power Station Construction Project.

1.4.1 PESTLE analysis

See appendix A.

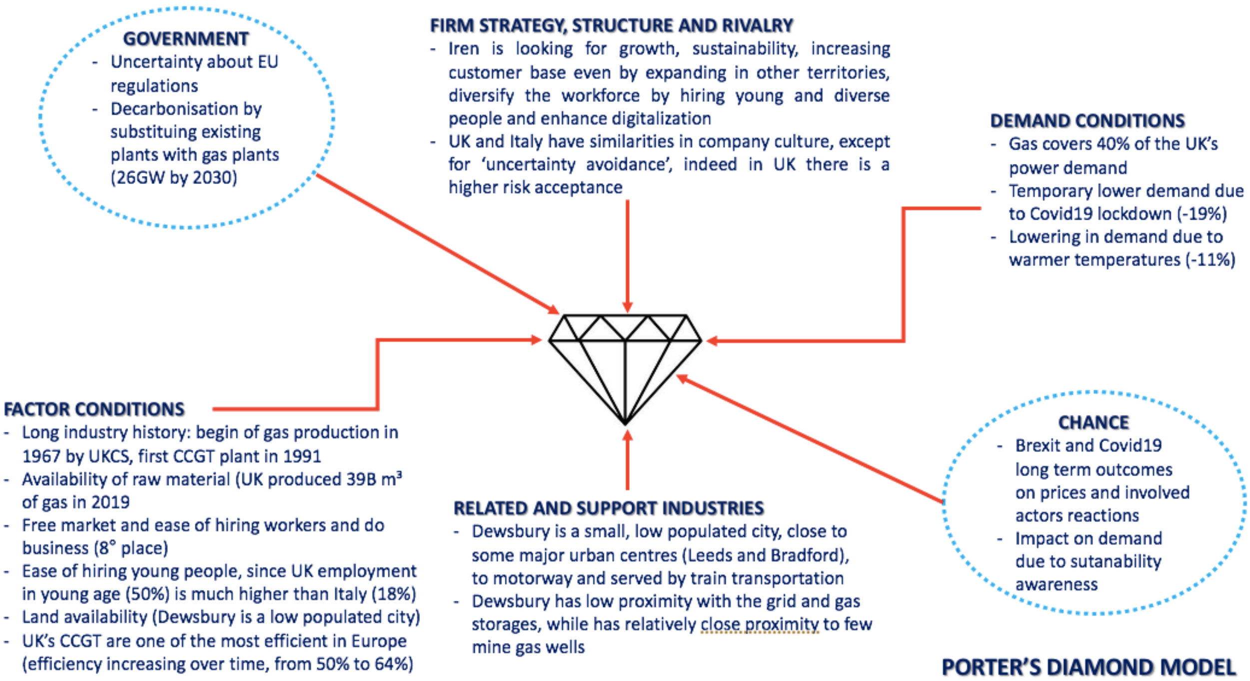
1.4.2 Porter's Diamond Model

The model allows to evaluate the country conditions related to the project addressed. The country-related factors which could influence the choice are:

- **Firm's strategy and structure:** it allows to include firm's long-term objectives and culture in the analysis, as Iren's strategic pillars and Iren's Italian company culture are included in the analysis as related to the UK's company culture. A contrasting culture could bring to conflicts and misunderstandings and non-effective integration of UO. In our particular case, the cultures can be considered aligned.
  https://www.hofstede-insights.com/country-comparison/italy,the-uk/
- **Demand conditions**: customers' and country's needs are relevant: from market demand, it is possible to deduct future trends for electricity and gas plants (*https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/920602/Gas_September_2020.pdf*).
- **Factor conditions:** The UK has several intrinsic characteristics which makes it an attractive country in which to invest (like the ease of doing business *http://documents1.worldbank.org/curated/en/688761571934946384/pdf/Doing-Business-2020-Comparing-Business-Regulation-in-190-Economies.pdf*). Furthermore, there are some enhancing factors related to Iren's objectives (the ease of hiring, the higher presence of young workers, an history regarding gas power plants).

https://data.oecd.org/emp/employment-rate-by-age-group.htm (*https://www.energy-uk.org.uk/our-work/generation/gas-generation.html*)

- **Supporting industries:** in terms of proximity with industry clusters, grids and wells, *(https://ogauthority.maps.arcgis.com/apps/webappviewer/index.html?id=29c31fa4b00248418e545d222e57ddaa)*. Dewsbury's location is not very favourable. However, it has some connections for transportation and there might be less issues regarding possible complaints for the noise or the waste emissions by close inhabitants. *(https://ukogl.org.uk)*
- **Government and chance** are two additional factors to consider, government implies rules regarding sustainability and plans to meet energy demand while chance accounts for the uncertainty, which can be favourable or not. https://www2.deloitte.com/us/en/pages/energy-and-resources/articles/power-and-utilities-industry-outlook.html



1.4.3 Swot Analysis

The SWOT analysis is a framework used to assess the Strengths, Weaknesses, Opportunities and Threats of a company. The Strengths and Weaknesses are internal factors, they show in which areas the companies excel and in which areas they are currently weak. On the other hand the Opportunities and Threats are external factors that will eventually affect the company.

1.4.4 Scorecard of the project with respect to Iren strategic objective

Considering the strategy of IREN and the external factors, the degree of strategic fit between the project and IREN has been identified. Since IREN will be acquiring the totality of UO shares, there must be a high degree of fit between the two. The table below shows the scoring for the strategic fit of the F-class project.

Strategic objectives	F-class score
Clients	5
Efficiency	2
People	4
Digitalization	1
Growth	5
Flexibility	3
Sustainability	2
Score	22
Score%	63%

Iren incorporates a new technology that will lead to energy savings and higher efficiency. Iren is focusing more on increasing plant flexibility by using CHP technology, which is more efficient and environment friendly. On the contrary, the Dewsbury project has no allowance for such a technology, as it considers building a CCGT power plant fuelled by natural gas including a waste heat recovery boiler. Hence, this explains why the level of fit in the areas of efficiency, flexibility and sustainability is low for an F-class plant scenario.

Every year Iren is growing and expanding by developing larger projects, new offerings to the end consumer, more M&A and a strong commitment to organic growth. UO as well is seeking to expand power capacity in England and build a brand-new power station to serve a larger number of people. This shows that the level of fit in the segments of growth and clients is high.

Iren wants to grow fast in digitalization; hence they are investing a lot in such technologies to deploy advanced platforms and focus on developing smart grids. To do so, they are recruiting a diversity of young workers that are more engaged in technology, but they are also providing their employees with training programs to enhance their skills in this sector. The Dewsbury plant in the UK doesn't show any use of digitalization initiatives, but the employment of young aged people in the UK is higher compared to that of Italy. This explains the low fit in digitalization and the higher fit in people.

The scale used is a 1-5 scale, for which 1 represents the lower level of fit, while 5 represents the maximum level. Since the strategic objectives represent Iren's pillars in their business plant, it was assumed that their degree of importance was equally high, therefore the evaluation did not include a weighted average sum.

The end result for F-class score is 63%, which might not be optimal from the strategic point of view. Further alternatives will be evaluated in the next section (1.5 Alternate and Value Engineering).

1.5 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. The alternatives technologies considered by this report are CCGT-CHP and the CCGT-H Class. They have been compared to the baseline technology considering the relative NPV and the fit of the technology with Iren strategic objectives (evaluated through a scorecard as in the 1.4 Qualitative Alignment).

The following table shows the results of the comparison.

	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%

1.5.1 Economic

The NPV has been computed for each technology considering the baseline (do nothing in the table) and the best scenario data. In the best scenario data has been considered the best scenario for the feed-in-tariff, construction costs and pre-development costs and gas price. In the do-nothing case, both the baseline F-Class CCGT and the CCGT CHP have a negative NPV due mainly to the operational costs which exceed the revenues (as reported in the 1.1 Economic and financial section). The operational and maintenance costs (fixed and variable) of CCGT CHP are higher than the one of a simple CCGT and the revenues coming from selling heat are not able to cover this gap, so this results in the more negative NPV for the CCGT CHP mode. For the CCGT H-Class instead the NPV is positive, mainly due to the superior plant efficiency given by this technology which lowers the fuel cost. In the best scenario cases all the NPV of the different technologies are positives and follow the same rank as in the do-nothing case.

The normalization score was found by taking as a reference the best scenario of the CCGT H-Class, which corresponds to the highest NPV value out of the technologies being considered, and the CCGT CHP do nothing scenario which correspond to the lowest NPV.

1.5.2 Qualitative alignment

The scores of the objectives have instead been retrieved from the qualitative alignment study, and the normalization of the sum was computed using the same approach as mentioned above.

Regarding Iren's objectives related to flexibility, sustainability and efficiency, F and H class have a low value while the score is higher in the case of a CHP, which allows a higher efficiency and a reduction of waste.

The level of fit in the segments of growth and clients is high and is independent of the type of plant, indeed they all allow for a customer base expansion exploiting the opportunities in a different territory, UK. Also the score regarding digitalization and people does not depend on the type of plant, it is low for the digitalization since none of the plants is enhancing a switch to digital, while is higher for people due to the UK's employment conditions. The end result of the strategic fit is different depending on which type of plant we adopt.

The CHP shows the highest fit with a score of 80%, the F class on the contrary gave the lowest score of 63%, while the H class is in between with a score of 71%. Hence, for the best fit between IREN and UO, the CHP technology is better to adopt.

1.5.3 Results

Finally, the total scores were obtained by performing the weighted sum between the normalized value of the NPV and the one relative to the qualitative alignment, attributing to the first a weight of 70% and to the second a weight of 30%. This helps understanding what technology is the most feasible and fits the most with IREN's strategy and should therefore be considered. The results were then normalized and the most applicative result being the CCGT CHP plant configuration in the best scenario as the best followed by the CCGT-H Class. In the do-nothing scenario still the CCGT-H Class is the best.

2. Project Charter

Project Title: Dewsbury Power Station Construction Project

Sponsoring organization: Iren SpA

Prepared by: John Taylor and his team

2.1 Project 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.

2.2 Project Charter purpose

The Project Charter outlines the scope, schedule, budget and deliverables. The completion of the Project Charter will allow the team to finalize a detailed construction schedule. Once approved by the key stakeholders and authorities, the Charter and any amendments will provide a guideline for the project.

2.2 Project Stakeholders

In the table below the main stakeholders of the project and their description have been summarized, further information is available in the APPENDIX B STAKEHOLDERS ANALYSIS.

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

2.3 Project Purpose

2.3.1 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.

2.3.2 Business Objectives

Iren Pillars	*Strategic Plan Element of Iren*	*UO Project Business Objectives*
Efficiency and Sustainability	Develop a circular economy paradigm by building 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 regulatory requirements.
Growth and Clients	Increase the customer base outside the core territories	Revenues from delivering electricity to the UK national grid and from heat distribution in the surroundings areas of the plant, with a 50MW CCGT CHP plant.
Digitalization and People	Enhancing competencies and reskilling existing employees	Training of the actual UO personnel to work in the new plant and hire new people increasing the diversity generation (mostly young people, which are engaged in technology).

2.4 Project Overview

2.4.1 Project Description

Dewsbury Power Station Construction Project entails the construction of a CCGT CHP plant in Dewsbury, UK. The project will be managed by the project manager and his team on the behalf and supervision of the commissioner of the project, UO, and the project sponsor Iren. The project manager will plan and organize the activities to be accomplished to ensure the success of the project and the achievement of the business objectives. These activities will produce over time the project deliverables (reported in section 2.5). The construction project should be approved by the regulatory authorities and it should comply with policies concerning CO_2 emissions and waste treatment. After the approval the project, the deliverables concerning the on-site landscaping, approval of the construction project by the authority, civil and building works, a gas and steam turbine generator set, a waste heat recovery boiler, electrical equipment, interconnection with a district heating infrastructure and services will be accomplished by the external organizations contracted by UO within 3 years, from 2021 to 2023.

2.4.2 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

2.4.3 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

2.5 Project Deliverables

The scope of work or deliverables required by the project are:

- 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

The project management plan should be delivered by the project manager in December 2020.

2.6 Budget

The initial project funding for a CCGT-CHP plant has been reported below. 70% of the CCGT (combined cycle gas turbine) plant of the project will be funded by equity investors (Iren) and 30% with a 10 years debt at 8% of interest rate. For the first year of production the project will have a 90% of capital allowance and 5 years of tax holidays starting from the first year of production.

Purpose	*Amount*
CapEx – Pre-Licensing (£)	1.080.000
CapEx – Regulatory (£)	40.000
CapEx – Construction and Equipment (£)	44.118.000
CapEx – Infrastructure (£)	1.291.050

2.7 Project Risks

The main risk for the project under the assumptions in section 2.4.2 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 labour due to Brexit. However, this will not be a capital risk and should not kill the project.

2.8 Project evaluation

Holding the assumptions in section 2.4.2 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% (see the excel file CCGT-CHP FINAL CONFIGURATION). The positive outcome of this financial tool suggests that the investment is attractive and should therefore be pursued.

APPENDIX

APPENDIX A PESTLE ANALYSIS

In this document a brief PESTLE analysis regarding the "Electrical Market in the United Kingdom (UK)" has been conducted in order to better understand the macro environmental factors that may impact on the Dewsbury Power Station Construction Project. Two major events affect the following PESTLE analysis:

- Brexit, the complex and controversial exit process of the UK from the European Union (EU), happened on 31 January 2020. The UK continues to participate in the European Union Customs Union and European Single Market during a transition period that ends on 31 December 2020.
- COVID-19 pandemic, which at first was declared as a Public Health Emergency of International Concern in January 2020 and as a pandemic in March 2020.

Political Factors

From the announcement of a possible exit from the EU the country has been characterized by a climate of uncertainty which affected its political and economic situation. The future of the UK Electricity Market will depend on the political choice of the UK between remaining or not in the EU Single Electricity Market. If the government will favor a smooth approach, by continuing the integration in the energy sector, the UK will benefit from greater competition, less need for new production capacity, lower prices and greater energy security, otherwise it will entail an increase in prices and have less reliability of supplies. Also, the uncertainty may result in a general fall down of business investments, with respect to previous years or in delaying the realization of existing projects.

Regarding the climate change issue, there are a number of national legislations, international agreements and the EU directives. The Climate Change Act 2008 makes it the obligation of the Secretary of State to ensure that the net UK carbon account for all six Kyoto greenhouse gases for the year 2050 is at least 80% lower than the 1990 baseline.

(https://en.wikipedia.org/wiki/Climate_Change_Act_2008#:~:text=The%20Climate%20Change%20Act%202008,Parliament%20of%20the%20United%20Kingdom.&text=The%20Act%20aims%20to%20enable,of%20greenhouse%20gas%20reduction%20targets.)

The Climate Change Act 2008 has introduced several schemes providing financial support for renewable energy (including CHP), by encouraging their technological development and wider adoption, which potentially could lead to economies of scale and lower costs.

Economic Factors

UK GDP growth was modest and volatile in 2019, mostly due to doubts associated with Brexit. Overall, UK GDP grew by 1.4% and 1.3% accordingly in 2019 and 2018. In 2020, as a consequence of the COVID-19 pandemic, private consumption and investment fell sharply in the second quarter of 2020. Public consumption is expected to contribute significantly to GDP growth in 2020, while net exports are expected to grow. Nevertheless, UK GDP is expected to shrink by 8¼ % in 2020.

(https://ec.europa.eu/economy_finance/forecasts/2020/spring/ecfin_forecast_spring_2020_uk_en.pdf)

In Pre-Covid period, the unemployment rate in the UK reached the lowest figure (3.8% in 2019) in the last 25 years, however, the numbers are increasing as a consequence of the pandemic. The inflation shows an upward trend beginning from 2016 till reaching the 3% in 2017, after which a slight decrease occurred between 2018 and 2019, respectively matching the government target of 2%. In 2020, as a consequence of the pandemic, a steady fall is highly expected. *(https://tradingeconomics.com/united-kingdom/interest-rate)*.

The interest rate outlook after the 2008 economic crisis shifted from around 5% in 2007 to 0.5% in 2009, and the trend was stable till 2020, where it dramatically dropped to 0.1% in March.

The exchange rate GBP/USD after the 2008 crisis was around 1.60 till 2015 when it began to decrease as a consequence of uncertainty around Brexit. In 2019, the average annual value was 1.28. The COVID-19 worsened the exchange rate position of GBP in comparison to USD, while reaching the lowest value (1.165 in March 2020) since 1985. A comparatively similar trend has been registered for GBP/€ exchange rate.

(https://www.macrotrends.net/2549/pound-dollar-exchange-rate-historical-chart)

(https://www.xe.com/it/currencycharts/?from=GBP&to=EUR&view=10Y)

To conclude, in 2020 the trends of the UK macroeconomic figures are as much affected by the pandemic as the rest of the world. Overall, these economic data are clear signs of recession, in which the UK probably will be until a much clearer image from Brexit occurs.

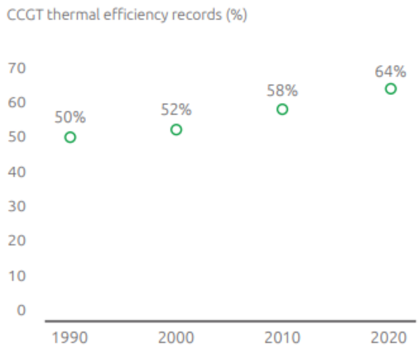
Social Factors

COVID-19 pandemic has influenced all the market segments and the life of ordinary people all around the world. In the early 2020, the lockdown measures forced most companies to diminish or even close the production, promoting smart working with a consequent drop of energy demand at the industry level. In addition to the drop of the electricity demand, the price of the raw materials, as well as gas price, dropped significantly.

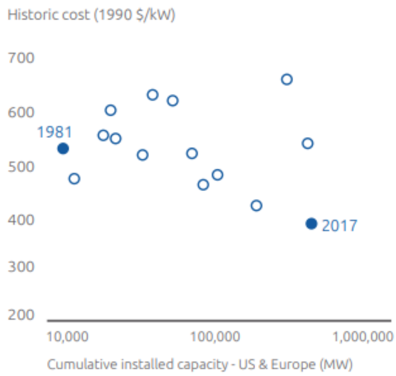
Another important factor to be considered here is the effect of Brexit on the UK labor market. The new policies could limit the immigration, causing the shortage of supply of labour which may lead to a drastic increase in the average wage of blue collars in the country.

Technological Factors

In power generation, gas technologies have become more flexible and cost efficient over time, enabling greater deployment and integration of intermittent renewable energy sources. Since CCGTs have emerged, the average thermal efficiency of similar plants has consistently improved, increasing from 50% in 1990 to 64% nowadays, as it is possible to see from the graph below.

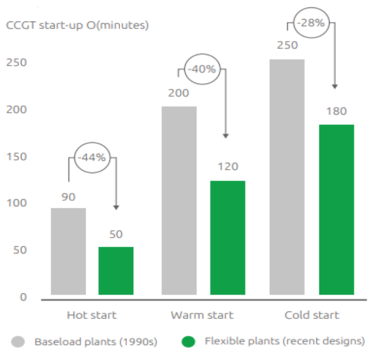


Thermal efficiency



Capital cost structure

While the capital costs of CCGTs have largely remained stable and predictable in the last 30 years, some recent studies have identified scale benefits with newer turbines that can reduce unit capex costs by up to 25% while doubling plant size. Additionally, there are other two potential improvements that can boost this technology to prosper in the future: thermal efficiency, which can increase by up to 10% and a flexibility factor that can fasten starting times in the range of 1.5-2x. As a result of these trends, the average levelized cost of gas-powered CCGTs has declined over time, reaching lower than $1,000 per KW of capacity in some instances. Modern CCGT plants are able to ramp up (start time) between 28% and 44% faster than their predecessor plants were able to do in the 1990s. This will help to integrate CCGTs with intermittent renewables.



Ramp times

Additionally, a number of emerging technologies are set to further strengthen the flexibility of CCGTs. For example, the integration of batteries with existing gas plants (gas-battery hybrid) is another potential way of improving system flexibility, whereby batteries are used to further reduce or eliminate ramp times to provide a nearly instant grid response.

Legal Factors

The tariff entered into law by the Energy Act in 2008 and took effect from April 2010. On 10 June 2019, Ofgem announced BEIS had introduced the Smart Export Guarantee (SEG). The SEG will be in force from 1 January 2020. However, this is not a direct replacement of the feed-in tariff scheme, but rather a new initiative that will reward solar generators for electricity exported to the grid. Energy suppliers with more than 150,000 domestic customers will be obligated to provide at least one export tariff, which must be greater than zero. Export will be measured by smart meters which the energy supplier will install for a free of charge.

Environmental factors

Carbon emissions tax is a tax levied on the carbon content of fuels. The idea behind it is the intention to reduce carbon dioxide emissions by increasing the price of fossil fuels and decreasing the demand for them. Carbon taxes are a form of carbon pricing, i.e. a cost applied to carbon pollution to encourage polluters to reduce the amount of greenhouse gases they emit into the atmosphere. While the UK is still part of the European Union, it has to follow the European Union Emission Trading Scheme (EU ETS), which imposes a carbon tax for all countries. The UK has additionally set the Carbon Price Support - a domestic top-up tax levied in addition to the EU's carbon price - fixed at GBP18/mt. Recent developments in the process of Brexit have seen the English government take the decision to hold steady the Carbon Price Support after the exit from the European Union, without further increases.

APPENDIX B STAKEHOLDERS ANALYSIS

The Stakeholder Analysis is an important technique for stakeholder identification, it includes the parties having a stake or an interest in Dewsbury Power Station Construction Project. In the table below, the most important stakeholders of the project have been reported.

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
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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
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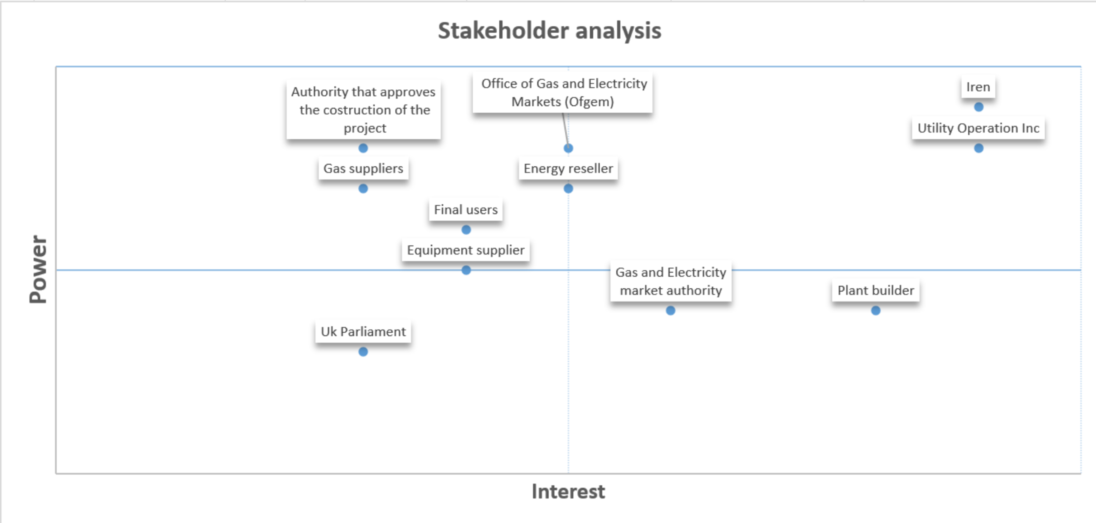
Project Manager and his team	Internal	Person choosen by UO and Iren	Manage the project	Organize, plan and control the project	Succes of the project	High	Key

The group of *direct stakeholders* contains all the companies that are in direct contact with UO like Iren, energy retailers, plant builders, equipment suppliers and gas suppliers. Energy retailers act as intermediaries between the production plants and the final users dealing with the storage and distribution of energy.

The group of *indirect stakeholders* includes all the parties that are not in direct contact with UO but that are in some way affected by the project, such as final users and public authorities.

- Final users, households or other companies, receive the electricity from the energy retailers paying a cash amount that varies between the different retailers.
- Public authorities have the role of regulating the market in order to protect the interest of the consumers. There are different public authorities that focus on different aspects of the economy but the main player worth underlining for this project is the Office of Gas and Electricity Market (OFGEM) that supports the Gas and Electricity Market Authority (GEMA). The latter ‘s main objective is to protect current and future consumers' interests in relation to gas conveyed through pipes and electricity conveyed by distribution or transmission systems.

To better understand the classification of the stakeholders, they all have been allocated to different areas in the table below. The areas represent: the key stakeholders (top right), the consultants (bottom right), context (top left) and marginal stakeholders (bottom left), where each one is being assigned with respect to their power and interest in the Dewsbury Power Station Construction Project.



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