CARTER JONAS

Energy Index

Executive Summary

- This report is the first edition of the Carter Jonas Energy Index. The report ranks, via the internal rate of return (IRR) valuation method, four onshore renewable energy technologies. The principal objective of the report is to illustrate the difference in financial performance of the various technologies and to highlight the benefits and risks associated with each type.

- The performance of various scales of both wind turbines and anaerobic digestion plants are detailed within the report in order to analyse each technology type and illustrate the variance in performance returns.

- The analysis within the report demonstrates the positive returns which can be produced from the renewable energy sector along with the potential risks and benefits associated with each specific method of generation.

Methodology & General Assumptions

- The principal method of comparison is via the internal rate of return measurement (IRR). Details of project costs including consultancy charges, capital expenditure for development and construction, annual revenues and simple payback are detailed in all cases.

- No depreciation or finance has been factored into the analysis as the IRR methodology takes into account the cost of capital of a project. It has been assumed that the project developer/operator will own the freehold of the development site upon which the scheme is located.

- It has been assumed that all electricity generated from each scheme, with the exception of solar PV, will be exported to the National Grid.

- The income stream of technologies under 5MWe in terms of capacity, are based upon the fixed price for the electricity generated under the Feed-in Tariff (FiT), an additional payment for export to the grid is receivable. The 10MWe wind farm will receive income from the sale of Renewable Obligation Certificates (ROC's), sales of electricity at a wholesale price and redemptions of Levy Exemption Certificates (LEC's).

- The life of each scheme has been estimated in line with manufacturer's guidelines.

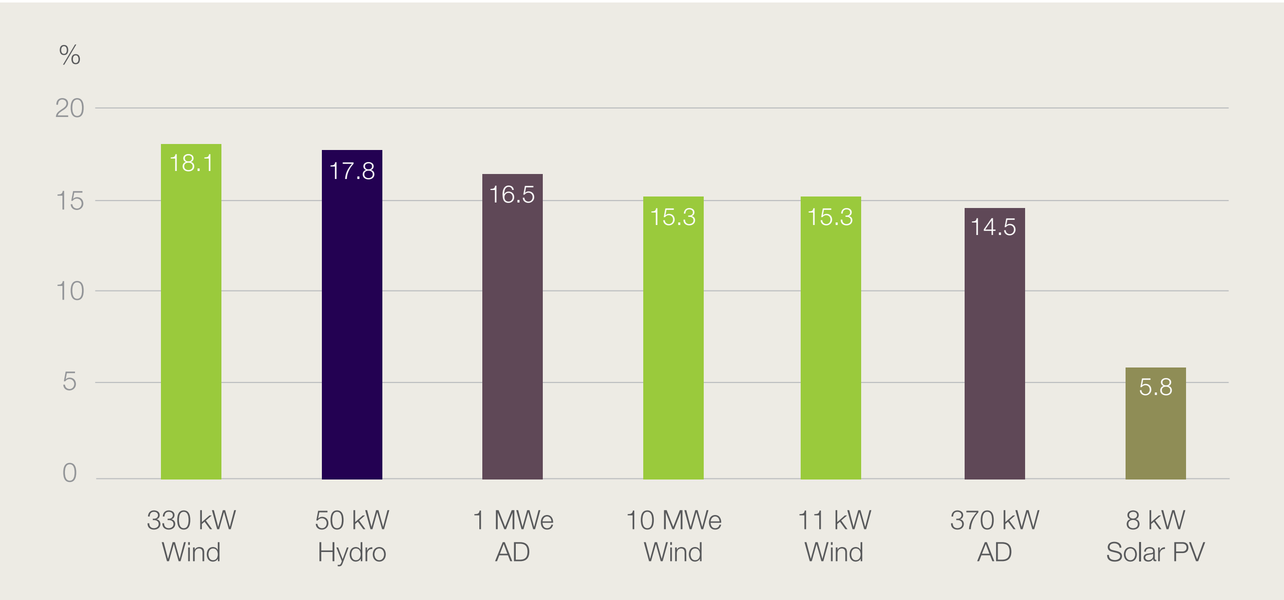
- Analysis of the payback period (the break even point) has been included within the technology studies.

- The key risks associated with each technology have been included within the report.

- The underlying assumptions for each scheme represent what we believe are typical of sites coming forward as at the date of this report (June 2010). It is difficult to generalise financial returns due to the high level of site specific variables and it is important to note that these site specifics can significantly influence the financial performance of projects.

- This analysis serves as a benchmark of average returns and is an illustration of the potential returns available.

Internal Rate of Return Analysis

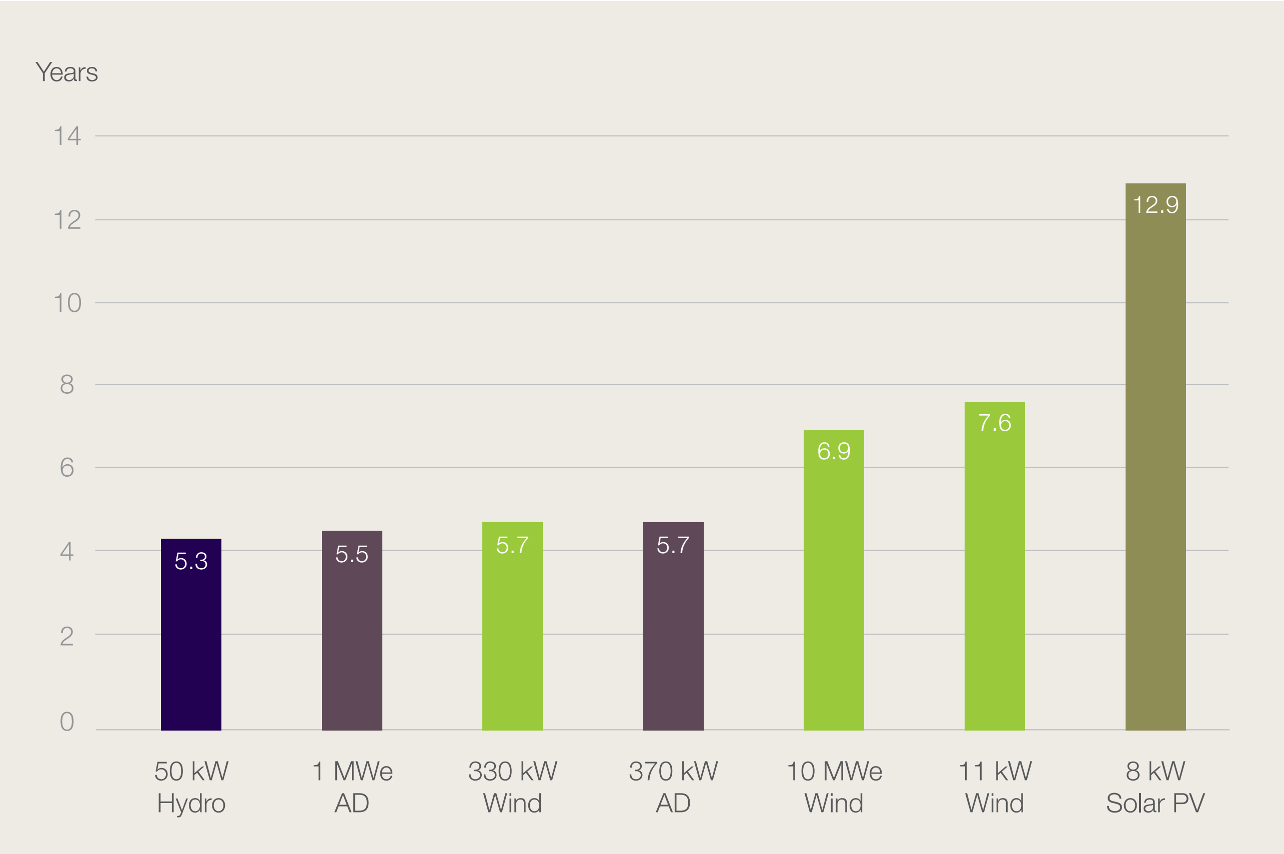


Source: Carter Jonas

Wind Energy

- We have modelled three schemes of differing capacities to demonstrate the possible variations in income stream, capital expenditure and return. These are:
  - A 10 megawatt (MWe) wind farm comprising of 5 turbines, receiving income from Renewable Obligation Certificates (ROC's)
  - A single 330 kilowatt (kW) wind turbine installed under the Feed-in Tariff (FiT)
  - A single 11 kilowatt (kW) wind turbine installed under the Feed-in Tariff (FiT)
- For this Index, the wind speed for the illustrative sites ranges between 5.5 – 6.5 metres per second (m/s) at hub height, this speed varies upon the height of the turbine. The range of wind speeds are typical for turbines located in an elevated position in the Midlands region of England.
- Annual income has been estimated based on a combination of the banding under Feed-in Tariff (FiT) and the additional and guaranteed export tariff of 3p per kWh. These are current at the time of printing.
- Renewable Obligation Certificate (ROC) and wholesale electricity values are based on a five year historic average including ROC buyout price and recycle value.

Project Pay-back Timescale Analysis



Source: Carter Jonas

330 kW Wind Turbine

- The 330 kW wind turbine produces the highest IRR, at 18.1%. The turbine has a 50m hub height and assumes a 6 metres/second (m/s) wind speed.

- Feasibility, due diligence and consenting costs totalling £80,000 are projected for this turbine size, which includes the installation of a wind monitoring mast to ensure sufficient wind resource and the 'bankability' of the project, along with a detailed environmental statement. This figure represents an estimate based on a full range of studies to support a planning application. Some of these studies may not be required and thus costs may be reduced.

- Capital expenditure totals £743,000 for the turbine fully installed, including ancillary works and grid connection, which is accounted for during the second year of the project, once the required consents have been gained. At the time of release, a six month lead in time, from order to turbine delivery is typical, although this is forecast to lengthen as demand increases.

- Operation and management (O+M) costs of circa £5,000 per annum, assuming a manufacturer's service plan, have been inputted for the first six years of the project. This rises to £9,000 per annum from year 7 onwards and is dependent upon the output of the turbine in line with industry standards.

- An annual income of £150,000 has been estimated, based on a combination of the generation and guaranteed export tariff available under the Feed-in Tariff (FiT) regime. These are fixed for 20 of the 25 year life of the project.

- The project has a payback period of 5.7 years, reflecting the positive income stream forecast.

> "The 330 kW wind turbine produces the highest IRR of all onshore technologies analysed within the report, at 18.1%"

10 MWe Wind Farm

- The 10 MWe wind farm model assumes the installation of five 2 MWe wind turbines, each with a hub height of 80m. The average wind speed has been assumed to be 6.5 metres/second (m/s) which produces an IRR of 15.3%. The wind farm would produce sufficient energy to power approximately 5,000 homes.

- The feasibility and consenting fees, including all required studies, are estimated to be in the region of £400,000 which includes an allowance for a planning appeal in year 4 of the development process. The differential between the expenditure required for this development and the smaller single turbine schemes is largely due to the requirement for a full environmental impact assessment (EIA) to support the planning application.

- It is estimated that from project inception it will take four years to achieve the required consents.

- Capital expenditure for project development and construction through to commissioning totals £12.96 million, which is evenly split between years 5 and 6.

- Annual income is estimated to total £2.2 million following the final commissioning of the wind farm via a combination

of LEC's redemptions, ROC and electricity sales. As the ROC system is guaranteed until 2027 income after that date is derived from wholesale electricity sales and LEC redemptions only.

- The estimated payback period for a 10 MWe wind farm is 6.9 years, reflecting a slower rate compared to the smaller 330kW turbine. Nevertheless this is a competitive return and the income stream is significantly higher due to the scale of the project. However, planning risks are increased due to the size of the development and increased local impact.

11 kW Wind Turbine

- The turbine is capable of providing for the electricity needs of approximately seven homes or one working farm. It has an assumed wind speed of 5.5 metres/second (m/s) at a hub height of 18m; which is lower than both of the larger turbines due to the shorter tower. This size of turbine is forecast to produce a 15.3% IRR, which is directly comparable to the 10MWe wind farm example.

- The lead in time for this smaller project is much shorter than its two larger counterparts, at one year. Feasibility and consenting costs are projected to be £4,000 and the capital cost of the fully installed turbine is estimated at £56,000.

- Annual income is projected to total £9,000 from a combination of the generation and guaranteed export tariffs available under the Feed-in Tariff (FiT) regime.

- Innovations in turbine technology at this scale are taking place at a faster rate when compared to the larger examples included within the report. Consequently these turbines may be subject to significant technological development in forthcoming years and may well improve in terms of efficiency and consequently returns over the medium-term. This model currently produces a payback period of 7.6 years.

Wind Energy - Risks

- Wind speed is critical to a successful project.

- Planning is a particular risk to wind energy developments, especially in respect of larger turbines due to visual, noise, shadow flicker and landscape impact.

- The cost of gaining planning consent is substantially increased due to the likely higher volume of environmental surveys and reports which are necessary to support a planning application, relative to other renewable technologies.

- Grid connection is often a risk with project development.

- Impact on aviation, including radar can be significant constraints.

- Telecommunications – turbines intercepting microwave links from mobile telephone masts can cause interference.

- Statutory and environmental designations also pose a risk to projects.

- Site access poses a risk in terms of transporting large rotor blades to the site.

- Public safety – turbines should be located set distances from public areas and highways.

- Net developable site area – the site must be appropriate in size to allow suitable spacing and prevent turbulence and wind shear between the machines for a commercial wind farm.

Anaerobic Digestion

- Anaerobic Digestion (AD) is a naturally occurring process in which organic compounds are broken down by micro-organisms into biogas and a form of fertiliser (digestate). The process involves feeding organic matter – slurry and/or other organic-based wastes such as forage/energy crops - into a mixing tank which is heated to 70ºc to pasteurise the contents. This substrate is then pumped into an anaerobic digester where it is maintained at a constant 37ºc.

- The result of digestion is the production of a biogas which is stored and subsequently utilised by gas engines in the production of electricity. A low grade fertiliser (digestate) is a by-product of the process and is available for spreading on farmland or may be dried and converted to a compost or soil conditioner.

- No allowance for the sale or use of the heat produced as a result of anaerobic digestion has been made in our financial models, although if the use or sale of heat could be achieved within economically acceptable parameters, this would have a positive impact on the level of return.

- The fact that forage/energy crops have to be purchased or produced at cost impacts upon the economics of a project and increases risk profile. It is this cost that significantly reduces the overall IRR produced by this method of energy production rather than any notable inefficiency of the chemical process.

- The requirement for ensuring sufficient quantities of a forage/energy crop creates a significant restriction upon the use of the technology as a whole. The opportunity cost of growing other crops, such as wheat, will need to be considered against the cultivation of an energy crop. The requirement to dispose of the digestate is also a significant issue which will need thorough investigation and planning.

- The examples given below are assumed to utilise a mixture of manures and forage crops sourced and produced on farm.

- Examples become significantly more complex if waste is taken from external sources resulting in additional ‘gate fees’ and costs.

- Plants aimed at dealing with external waste will require significantly greater capital for project funding, a ready source of uncontaminated waste (substrate) and means of spreading much higher volumes of digestate. If these can be achieved, returns will be significantly higher and grant aid may be focussed on this area in the future.

- The Coalition’s programme for government places great emphasis on “promoting a huge increase in energy from waste through anaerobic digestion”.

370 kW Anaerobic Digestion Plant

- This scale of operation requires approximately 200 hectares of land in order to manage the volume of digestate produced. The scheme is forecast to produce an IRR of 14.5%.

- Feasibility and consenting costs are estimated to total £30,000 and planning permission has been assumed to be granted in year 1. Capital expenditure for project development and construction has been calculated as £1.2 million in year 2, once the required consents have been achieved.

- Further capital expenditure in year 9, for the partial refurbishment of the system, and an entire overhaul of the gas engine and generator in year 16, has been incorporated into the model due to the intensive chemical processes involved.

- Income from the scheme is projected to be approximately £436,000/annum from a combination of the generation and guaranteed export tariffs available under the Feed-in Tariff (FiT) regime.

- Revenue expenditure is estimated at £226,000 per annum once the scheme is functional, and is significantly higher than all other renewable energy technologies examined for the reasons detailed above. It is this high revenue expenditure that impedes the economic viability of the scheme once the Feed-in Tariff (FiT) expires in year 20 of the project. We have assumed decommissioning at this stage as a result.

- The payback period of such a scheme is estimated to be 5.7 years, directly comparable to the 330 kW wind turbine.

1 MWe Anaerobic Digestion Plant

- This larger scale plant requires approximately 405 hectares of land for digestate spreading and assumes the same mix of substrates as its smaller counterpart. The model produces an IRR of 16.5%, ranking it above the 370 kW plant, although this performance is due to economies of scale rather than any other fundamental difference.

- Feasibility and consenting fees total £30,000, with planning consent forecast to be granted in year 1. Capital expenditure for project development and construction totals £2.47 million in year 2, with further tranches of £450,000 in year 9 for engine refurbishment, followed by a complete engine rebuild in year 16 at a cost of £900,000.

- Income from the scheme is projected to be approximately £981,000/annum from a combination of the generation and guaranteed export tariffs available under the Feed-in Tariff (FiT) regime.

- Revenue expenditure (predominantly operation and maintenance) is estimated to total £537,000 per annum and the same restriction regarding the long-term financial viability of the smaller scheme remains relevant for this 1 MWe scheme.

- The payback period is slightly shorter at 5.5 years, being marginally longer than the shortest payback period, demonstrated by the hydro scheme example.

Anaerobic Digestion - Risks

- Sourcing sufficient and regular inputs (substrates) to ensure maximum gas production and plant output within economic parameters poses a significant risk.

- The disposal of digestate from the system is also necessary. Significant volumes lead to a requirement for large areas of land for spreading.

- Operation and maintenance costs are significantly higher compared to other technologies as a result of the intensive chemical processes involved, and a requirement to monitor and supply the plant regularly.

- Planning is an inevitable risk although is likely to be less of an issue in a farm environment due to buildings and infrastructure being “agricultural” in nature. However objections do arise from neighbours with regard to perceived odour and noise.

- Potential future public relations issues, with land being utilised for growing energy crops rather than food crops, are possible in the light of the Government’s proposals.

Hydroelectric Power

- Hydroelectric power is based on the energy extracted from water. This depends on the volume and the difference in height between the source and the water's outflow. The height difference is called "the head" and the amount of potential energy in water is proportional to the head.

50 kW Hydroelectric Scheme

- The case study is based upon a high head run of river scheme (60m head).

- The analysis assumes this to be an entirely new build scheme with no existing infrastructure in place. The analysis also assumes a connection is made possible between an induction generator and a 3 phase grid supply at no abnormal additional expense.

- Feasibility and consenting fees total £30,000 in year 1, with capital expenditure at £210,000 included in year 2. Encouragingly, revenue expenditure in further years for the ongoing maintenance of the scheme is relatively low, at circa £900 per annum.

- Annual income is projected to total £39,000 from a combination of the generation and guaranteed export tariffs available under the Feed-in Tariff (FiT) regime.

- The model produces an IRR of 17.8%, ranking it second out of all seven renewable energy technologies analysed within the report, being very close to the top performing scheme in the Index; the 330 kW wind turbine which produces an IRR of 18.1%.

- The payback period of such a scheme is estimated to be 5.3 years, the shortest period of all technologies analysed within the Carter Jonas Energy Index.

Hydroelectric - Risks

- This technology is more site specific than other renewable energy types and therefore the analysis is highly dependent upon a set of site characteristics in terms of regional rainfall, area of catchment, sensitivity of the ecology of the river, and fish populations. The analysis relies upon assumptions based on un-gauged data. Gauged data would provide a more accurate measurement upon which to rely on.

- Gaining an Abstraction licence and other relevant permits from the Environment Agency can be complex and time consuming. Ecological studies are likely to be required which may further inflate both development costs and financial risk.

- The figures contained in this report relate the output of a software package which provides a model from the Institute of Hydrology which was run for the relevant catchment area and makes assumptions on the average rainfall.

- Parameters have been provided for quantity of flow available from 10% of the time to 95% of the time. The figures relate to such parameters for each month of the year.

- Assumptions have been made on the "hands off flow [HOF]" (the required residual flow at the intake before the scheme is permitted to abstract) which refers to the parameters that are likely to be agreed by an officer from the Environment Agency based on their assessment of the sensitivity of the river.

- The hands off flow assumptions vary from month to month based on the unique characteristics of that particular month of the year and assumes that no other hydro plants are abstracting off the same source.

Solar Photovoltaic (PV) Panels

- Solar PV is unique among renewable energy technologies in that, in addition to generating electricity from daylight, it can also be used as a building material in its own right. PV can either be roof mounted or free-standing in modular form, or integrated into the roof or facades of buildings through the use of solar shingles, solar slates, solar glass laminates and other solar building design solutions.

- PV systems exploit the direct conversion of daylight into electricity in a semi-conductor device.

- For best performance, PV modules need to be inclined at an angle of 30 – 40 degrees, depending on the latitude, and orientated facing due south.

- We have assumed a commercial sized roof top installation for the purposes of this report.

8 kW Solar PV Array

- A building size of 18m x 8m has been assumed, which gives a total roof size of 144m^2. It is also assumed the roof is dual pitched and that it is east-west aligned and located in the Midlands region. Only half of the roof will be available for use and therefore the available area for the PV array is 72 m^2.

- Due to the scale of the example, it has been assumed that the electricity will be used internally and that the majority is not exported to the National Grid.

- Capital expenditure totals £65,500. Feasibility and consenting fees have been assumed at £3,000, and are relatively modest as the cost of achieving planning consent is significantly reduced. The panels have a limited impact on the surrounding area, provided that the installation is not of an unusual design, does not involve a listed building and is not in a "designated" area.

- Minimal maintenance has been factored in at £100 per annum.

- Income of circa £5,000 per annum has been calculated, based on a combination of the generation tariff under the Feed-in Tariff (FiT) and offsetting of internal energy consumption purchased at a retail electricity price.

- An IRR of 5.8% was produced from the model along with a payback period of 12.9 years. Both figures rank lowest relative to the other technologies analysed in the Index.

Solar PV - Risks

- The technology benefits from significantly lower risks associated with planning and consenting.

- In contrast to the other technologies, the generation of electricity is predominantly for internal use and therefore a proportion of the projected income is based upon offsetting retail electricity prices. As a result, the performance of the scheme will be affected by fluctuations in electricity prices. The model has assumed an internal usage due to the relatively small generating capacity of the scheme.

- The ability of a roof to bear additional weight will need to be considered and the roof support may need to be strengthened. A typical PV panel weights 13kg per m^2 therefore the total additional weight of this example is 1,547 kg.

"...the generation of electricity is predominantly for internal use and therefore a proportion of the projected income is based upon offsetting retail electricity prices..."

Energy Index June 2010 - Conclusions

- The IRR method of analysis enables the renewable energy technologies that we have studied to be viewed on a comparable basis and clearly highlights the sound levels of return that can be expected from the sector as a whole, although it is important to consider the risk profile of each technology in tandem with this indicator.

- In terms of performance, a 330 kW wind turbine is forecast to produce the highest IRR of all the schemes examined, giving rise to an impressive 18.1%. The spread of returns of the varying technology types is relatively tight, illustrating a compelling picture for investing in the renewable energy sector.

- It should be noted that returns for the solar PV example are significantly lower due to the relative capital cost of the technology. However, this must be weighed up against a significant reduction in risk at the development stage, and can be seen as the safest investment overall.

- The levels of returns, although subject to some movement over the medium-term, are forecast to remain relatively high. This is due to the continuing and increasing emphasis placed upon the production of electricity from renewable sources, both from the domestic and european levels. Evidence of this increasing emphasis has been clearly illustrated by the new coalition government which has already confirmed its endorsement of the sector as a whole. They have also cited that measures will be put in place to promote an increase in energy specifically from waste through anaerobic digestion.

- The Renewable Obligation (RO) and Feed-in Tariff (FiT) systems will both be reviewed, with changes occurring in April 2013. The Renewable Heat Incentive (RHI) may also be introduced in 2011 which will benefit anaerobic digestion if there is an outlet for the use or sale of heat as a by product of the process.

- We conclude that on farm anaerobic digestion plants utilising energy crops, whilst having high capital requirements for project development, if well run, should be a relatively low risk operation, although the recently announced Feed-in tariff (FiT) levels are being re-examined by DECC.

- However, anaerobic digestion plants involving imported waste substrate do have significantly increased capital requirements and potential substrate contamination issues, although should produce improved returns if the business is well managed.

- Wind projects rank high in terms of risk, mainly due to the likelihood of planning issues and potential site constraints.

- In contrast, hydro is presumed to be far less contentious but by its nature is very site specific which makes analysis very subjective. Solar PV ranks the lowest in terms of risk profile of all technologies being the least contentious renewable technology reviewed in terms of planning.

- It is important to note the varying risk profiles of the technology types when reviewing the energy sector. At the end of each technology review within the report, the headline risks attributed to each technology have been outlined. It should be noted that there are potentially a wide range of site specific risks and benefits which can only be evaluated by expert due diligence and experience in the sector.

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