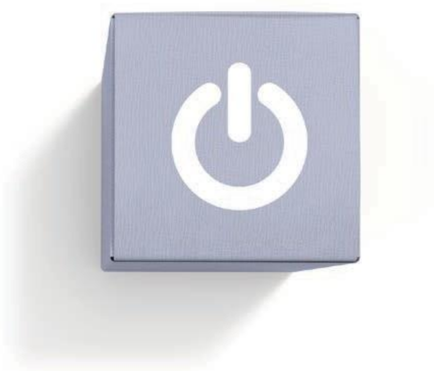
CEPA
economics matters

Greenlink Interconnector Technical Review

Phase 2: Targeted review of issues identified in Phase 1

Commission for Regulation of Utilities

March 2021



FINAL REPORT FOR PUBLICATION

Important notice

This report was prepared by Cambridge Economic Policy Associates Limited (CEPA) for the exclusive use of the client(s) named herein.

Information furnished by others, upon which all or portions of this report are based, is believed to be reliable but has not been independently verified, unless expressly indicated. Public information, industry and statistical data are from sources we deem to be reliable; however, we make no representation as to the accuracy or completeness of such information, unless expressly indicated. The findings enclosed in this report may contain predictions based on current data and historical trends. Any such predictions are subject to inherent risks and uncertainties.

The opinions expressed in this report are valid only for the purpose stated herein and as of the date of this report. No obligation is assumed to revise this report to reflect changes, events or conditions, which occur subsequent to the date hereof.

CEPA does not accept or assume any responsibility in respect of the report to any readers of the report (third parties), other than the client(s). To the fullest extent permitted by law, CEPA will accept no liability in respect of the report to any third parties. Should any third parties choose to rely on the report, then they do so at their own risk.

Contents

1. EXECUTIVE SUMMARY

1.1. Context

This report is Phase 2 of a two-stage targeted review of GIL's Final project Assessment (FPA) submission undertaken by CEPA and Atkins. It focuses on the issues identified in Phase 1 and summarised in Section 2.5; it is not a comprehensive review of all costs. The purpose of the report is to make recommendations to the CRU on the level of cost that should be used to set the cap and floor. Ofgem is separately carrying out its own review of the FPA and we recommend that the CRU and Ofgem agree cost allowances before setting the final cap and floor levels.

1.2. GIL's proposed total cost

For the purposes of the cap and floor model we build a total project cost estimate including devex, capex, risk, as well as the full operating, replacement and decommissioning costs for the 25-year period of the cap and floor regime. Each cost category forms a building block within the model. GIL's proposed cost for each of the building blocks is set out below. We use the FPA Supporting Evidence spreadsheet provided by GIL, to extend GIL's total cost estimate out to 25 operating years post construction. Based on GIL's submission, we understand the total 25-year project cost to be €835.9m. Our analysis uses these figures throughout.

Category	€ m
Devex	23.8
Construction capex	426.8
Developer Risk	24.2
Operating costs	335.5
Replacement costs	17.0
Decommissioning costs	8.8
Total cost	**835.9**

Source: CEPA analysis of b.1.1 FPA Supporting Evidence v15

1.3. Key findings by building block

Our analysis is undertaken by building block. Wherever possible we draw on benchmarks. This type of analysis has been challenging because GIL has extracted capex costs from the EPC bids which were prepared in the expectation of this being a turnkey project. There is limited granularity of cost information which makes it more difficult to ensure a fair comparison. To create more confidence in the analysis we have used a mix of bottom-up and top-down comparisons, and we have discussed our emerging findings with Ofgem which has shared its emerging views on a number of categories of expenditure that we have questioned. We have raised several queries with GIL via the SQ process, in which we sought to better understand its data, and we have had the benefit of responses that GIL has provided to Ofgem's SQ process.

By building block we find:

1.3.1. Devex

Development expenditure, or devex, is GIL's capital costs associated with items such as studies, assessments and resourcing costs that are incurred prior to the project's final investment decision (i.e. bringing the project to a construction ready state). GIL's submission is net of any grants such as the European Union's Connecting Europe Facility (CEF) grant which is available to this project.

Devex accounts for €23.8m (or 2.8% of total project costs). We find that GIL's devex submission is towards the top end of the range implied by other cap and floor interconnector projects. Taking an approach which is proportionate to the scale of these costs, we have not reviewed GIL's submitted devex costs in detail because no "red flag" issues were identified during our Phase 1 review. As GIL's costs are within our benchmark range we do not propose any disallowance and suggest that the CRU accepts GIL's submitted costs in full, unless it considers that some portion of them are the result of GIL's inefficiency in bringing the project to the FPA stage. However, we suggest that the CRU uses the consultation to indicate to GIL that it does not expect to allow for any subsequent increases to devex as a result of further delays.

1.3.2. Construction capex

GIL's submission includes €451m of construction capex, which covers all the costs incurred under the EPC contracts for the construction of the interconnector. These are turnkey contracts that include sums for the contractor's project management and risk. Construction capex also includes the developer's (GIL's) project management costs and €24.2m of developer risk.

Total capex sits within the range developed by Atkins but detailed analysis of the main EPC components shows that whilst the subsea cable costs are below the benchmark range, the cost of the converter stations is substantially above the top-end of our benchmark range. This suggests that there may be some categorisation issues that merit further investigation.

Our analysis also shows that contractor **project management (PM) costs** are towards the top-end of the benchmark range. However, a view of project management costs should be taken in the round, i.e. combining those in the EPC contract with GIL's own PM costs. This is because the relative share of PM costs may differ depending on the role that each party takes in the project. By summing contractor and developer PM costs, and excluding '*Installation Services*' and '*Installation Supervision*'[1], we arrive at a total combined PM cost of €75.2m (16.7% of total capex). The best publicly available source of PM costs that we could obtain is from Turner and Townsend, suggest PM costs for the oil and gas industry of 8-16%[2] of total costs. Atkins suggests a range of [✂]-[✂]% of total capex based on previous projects adopting a turnkey contract form. As a result, total PM costs for this project are towards the top of the range. By way of illustration, reducing the allowance to between 14% (upper quartile of the Turner and Townsend range) to [✂]% (midpoint of the Atkins range) would result in a reduction of between €3m and €12m. Taking the mid-point of these

---

[1] In discussion with GIL and Ofgem we have recategorised some of the GIL's proposed costs to better align with our benchmarks.

[2] Turner & Townsend (February 2011) "Analysing project management costs" available online

two benchmark ranges, we propose that CRU disallows €7.5m of construction capex, to account for the relatively high combined project management costs that were not well justified in GIL's submission.

Developer risk is a contingency allowance that is held in reserve by GIL for possible increases in construction costs. GIL's submission is similar in relative size to the risk allowances in other recent cap and floor interconnector projects. Therefore, we propose that CRU accepts GIL's submitted risk costs in full.

GIL's submission also includes a category of '**other'** developer costs, which covers activities undertaken by GIL ahead of the interconnector becoming operational, and the cost of construction insurances held by GIL. We have noted concerns around the benefits of DSU insurance which cover for GIL's lost revenue in the event of a delay that it may be able to control or should have allowed for in its risk analysis. We also note that GIL has the protection of force majeure provisions which will insulate it from events that it can demonstrate are beyond its control. On this basis we suggest that it would not be appropriate for consumers to fund this cost and propose that CRU disallows a further €[✂]m of construction capex in relation to DSU insurance. However, the CRU may wish to review any further evidence that GIL can provide to justify its value from a consumer perspective and reconsider this position before its Final Decision.

1.3.3. Opex

Opex costs are those incurred once the asset is operational. GIL estimates opex of €336m over 25 years. This covers centralised costs such as GIL personnel, as well as insurances and O&M costs. O&M cover outsourced or contracted operations and maintenance.

O&M costs were highlighted as unusually high in our Phase 1 work and they have been the focus of the analysis in Phase 2. O&M has been difficult to benchmark as GIL's approach differs from that on other interconnector projects. GIL proposes to outsource/contract more work than is usually the case. Atkins' analysis suggests that GIL's O&M costs are at the high end of the range, even on an adjusted benchmark basis, but we are conscious that the benchmarking is indicative only given GIL's alternative approach.

We have also carried out a simple benchmarking of total opex costs. This shows GILs costs to be lower overall than other broadly comparable projects. This is also an imperfect analysis, but it suggests that taking high O&M costs into account, GIL's opex costs overall are at the low end of a range of broadly comparable projects. As such, we propose that the CRU accepts GIL's submitted costs in full.

At this stage opex costs are indicative rather than firm. They will be revisited at a Post Construction Review (PCR). Given the uncertainty in the benchmarking, we make recommendations later in this section to manage the level of change to these costs at the PCR.

1.3.4. Repex

Replacement costs, or repex, include the cost of equipment items which will need to be replaced during the life of the interconnector. GIL's submitted replacement or repex costs total €17m and lie within a top-down benchmark range of €[✂]m – €[✂]m. GIL's estimate lies at the bottom end of our benchmark range which may be the result of a further cost allocation issue, but at this stage we propose that CRU accepts GIL's submitted costs in full. GIL may wish to provide further evidence to demonstrate that its estimate is complete. To aid this analysis Atkins has identified a list of items that GIL should confirm are unnecessary or included with the repex estimate.

As is the case for opex, we make recommendations later in this section to manage the level of change to these costs at the PCR.

1.3.5. Decommex

GIL is liable for its decommissioning obligations, and the value of the cap and floor levels are based on the CRU's assessment, at the Post Construction Review stage, of the legislative requirements relating to the decommissioning of the interconnector. Decommissioning costs, or decommex, relate to the economic and efficient costs associated with such requirements.

GIL estimates decommissioning costs of €8.8m which it has profiled evenly across the 25-year cap and floor period but would in practice be incurred at the end of the asset's useful life. We have not reviewed decommissioning costs. These costs were not previously raised as an area of concern. We recommend that CRU uses GIL's estimates to set the provisional cap and floor levels but undertakes to review these costs in more detail at the PCR.

1.4. Cost review conclusions

Table 1.1 compares an overview of GIL's costs against the CEPA–Atkins benchmarks. The sections which follow identify issues with GIL's overall submission and by cost category.

Table 1.1: Proposed cost allowances by cost category, to calculate cap and floor values (€m)

<table>
<tr><th>Cost category</th><th colspan="2">Status</th><th colspan="2">GIL FPA</th><th colspan="2">Benchmark</th></tr>
<tr><td>Devex[1]</td><td>GIL</td><td>Firm</td><td colspan="2">23.8</td><td colspan="2">[✂] – [✂]</td></tr>
<tr><td>EPC Capex[1]</td><td>Contract</td><td>Firm</td><td>[✂]</td><td rowspan="5">451.0</td><td>[✂] – [✂]</td><td rowspan="5">[✂] – [✂]</td></tr>
<tr><td>Contractor PM[1]</td><td>Contract</td><td>Firm</td><td>[✂]</td><td rowspan="2">[✂] – [✂]</td></tr>
<tr><td>Developer PM[1]</td><td>GIL</td><td>Firm</td><td>[✂]</td></tr>
<tr><td>Other developer capex[1]</td><td>GIL</td><td>Firm</td><td>[✂]</td><td>[✂]</td></tr>
<tr><td>Developer risk[1]</td><td>GIL</td><td>Firm</td><td>24.2</td><td>Accept</td></tr>
<tr><td>Opex[2]</td><td>Contract</td><td>Provisional</td><td colspan="2">335.5</td><td colspan="2">[✂] – [✂]</td></tr>
<tr><td>Repex[2]</td><td>Contract</td><td>Provisional</td><td colspan="2">17.0</td><td colspan="2">[✂] – [✂]</td></tr>
<tr><td>Decommex[2]</td><td>Contract</td><td>Provisional</td><td colspan="2">8.8</td><td colspan="2">Not considered</td></tr>
<tr><td>Total</td><td></td><td></td><td colspan="2">835.9</td><td colspan="2"></td></tr>
</table>

[1] GIL submitted Devex, Capex and Risk were submitted in nominal prices.

[2] GIL submitted Opex, Repex and Decommex in 2020 prices.

Figure 1.1: GIL's devex submission compared to other cap and floor interconnector projects (2020 prices)

Source: CEPA analysis of published information on other cap and floor interconnector projects

Figure 1.2: Top-down comparative benchmarking of capex costs (€m)

Source: Atkins analysis

Figure 1.3: Top-down comparative benchmarking of opex costs (€m, 2020 prices)

Source: Atkins analysis

Figure 1.4: GIL's submitted repex costs against our benchmark range (€m, 2020 prices)

Source: Atkins analysis

1.5. Recommendations by building block

Block	Discussion	Recommendation
Devex	• Our high-level benchmarking suggests that GIL's devex is towards the top end of our range.	• The CRU may take the view that the relatively high cost of devex is a function of the project taking a long time to reach FPA stage or it might consider a small disallowance that would bring GIL's costs in line with the mid-point of the benchmark range.
Capex	The key issues on **construction capex** are:	
	• **Converter station costs** which exceed our benchmark range on any analysis, a position for which we do not have a clear explanation.	• We suggest that GIL be asked to provide more detail on this and any interplay between the categorisation of converter station and subsea cable costs. This will allow for a more confident assessment of GIL's overall capex position.
	• **Project management costs** which are high (at the top of the range) even when considered in the round and allowing for the turnkey approach that GIL plans to use with its contractors.	• The CRU may wish to consider the merits of making a small disallowance to project management costs of around €7.5m.
	• **Other costs.** We are aware that Ofgem is considering whether covering the costs of delay in start-up (DSU) insurance is in the consumer interest.	• The CRU may wish to consider making a similar disallowance to that being considered by Ofgem.
	• **Developer Risk.** We note that some risks in the register identify uncertainties, e.g. in respect of the scope of the PCR and the regulatory approach.	• It is important to the progress of the project that issues of uncertainty are resolved, ideally in a way that does not materially increase costs and does not create a risk share that limits the appetite of lenders. • CRU and Ofgem should work together to minimise and resolve any residual uncertainty about the scope of the PCR. • CRU and Ofgem should work together to minimise any divergence in regulatory processes.
Opex	• The residual concern is that despite O&M costs being high (towards the top end of our range), overall opex is low when compared to other cap and floor benchmarks. In both cases, the benchmarks are indicative. • A particular concern is that opex costs can be reopened at the PCR stage and the incentive this creates to bid low costs now.	• Given the risk that GIL's costs could increase, given their current low position, we suggest that CRU consider limiting the scope of the PCR in relation to opex. • It might for instance opt to limit the scope of that reopener to allow only for additional costs that could not have reasonably been foreseen or mitigated at the time of the FPA.

Block	Discussion	Recommendation
Repex	• GIL's proposed costs are at the low end of the range. This suggests an allocation issue that GIL may wish to address.	• The CRU may also wish to protect consumers from increases by limiting the scope for change using a provision such as that outlined for opex above.
Decommex	• These costs were not raised as an area of concern in the Phase 1 review.	• CRU should use GIL's decommex estimates to set the provisional cap and floor levels but undertake to review these costs in more detail at the PCR.

1.6. Wider considerations

Once the CRU has taken a view on total costs, it may wish to consider how the total 25-year cost affects the overall value for money of the project. The value for money case is likely to remain strong under the "high renewables" scenarios, but the CBA analysis showed that the case was more marginal under scenarios where another interconnector came onto the Irish system, particularly under scenarios where the penetration of renewables is low. Any increase in cost since the CRU's CBA was undertaken will adversely impact the value for money assessment under these more marginal scenarios and as a consequence **the CRU may wish to mitigate the scope for any further cost increases subsequent to GIL's FPA submission.**

GIL's overall approach to the project is to contract out much of the operational work and take a high-level supervision of it, and to focus its day-to-day activities on the interconnector's commercial operations. The construction work will be undertaken on a turnkey basis, with GIL's main contractors taking most of the project risk. Thereafter, a significant part of its operational staffing will be provided on a contracted basis. This raises an issue about GIL's ability to act as an informed client which will be important if the project experiences any material difficulties. **The CRU may wish to ask GIL to provide assurance that it has sufficient technical know-how and, perhaps more importantly, access to information from its contractors to make informed decisions and overall manage the project effectively.**

The CRU may also wish to establish an annual performance review of the project against budget and schedule, which would act as an early indicator of any emerging issues and would inform any future reopening of the costs. The CRU would set out what it expects to receive from GIL to meet the expectation of keeping itself informed. If the CRU does adopt this approach, we would recommend that the requirement to provide information, and potentially the level of detail and format of that information, should be made an obligation on GIL's supply chain not just GIL. This would require GIL to include such an obligation in the EPC and SMA contracts that it is currently negotiating.

1.7. Availability Assessment

The targeted review has considered interconnector availability alongside project costs to enable the CRU to set a project specific availability target; this is used to incentivise GIL to maximise availability of the interconnector when revenues are high.

Based on Atkins' experience and benchmark values for failure modes and repair times, as well as updated reliability guarantees provided by GIL's preferred equipment providers, Atkins calculates overall system availability to be 96.7%. **We recommend that the annual target system availability level against which the cap availability incentive applies should be consistent between the CRU and Ofgem** but, subject to further engagement with Ofgem on its assessment of system availability, we recommend that CRU uses 96.7% to set the annual target availability level against which the cap availability incentive applies.

CRU should also note the interaction with the minimum availability incentive (see Section 4.4 of our Regulatory Framework Paper). We recommend the CRU implements a minimum availability incentive that requires GIL to achieve 80% annual availability to be eligible for floor payments in any given year. This is subject to two exceptions, including a limited facility for GIL to receive floor top-ups when availability is below 80%, consistent with our current expectation of how Ofgem will treat the interconnector in GB. Nonetheless, Atkins' analysis suggests that a scenario in which GIL requires several years of temporary floor top-ups when availability is below 80% is remote.

2. INTRODUCTION

The purpose of this report is to provide the CRU with a benchmark-based analysis of the costs proposed by Greenlink Interconnector Limited (GIL) for the Ireland to Wales interconnector that it seeks approval to build. When the CRU signs off the FPA it will be giving GIL the green light to proceed with financing and move to financial close.

In this section we:

- provide background information on GIL's approach to the interconnector which provides important context for the split of cost between GIL as developer and its subcontractors;
- present total project costs as set out by GIL; and
- set out our scope of work.

2.1. Summary

This report is Part 2 of the two-stage targeted review of GIL's FPA undertaken by Atkins and CEPA. It completes the review-based recommendations made in Phase 1. We focus on issues identified in Phase 1 and do not undertake a comprehensive review of all costs. Ofgem is carrying out its own review and we recommend that the CRU and Ofgem agree cost allowances before setting the final cap and floor levels.

This report also reiterates several monitoring recommendations made in Phase 1 and draws links between this technical review and the regulatory regime on which CEPA is also supporting the CRU.

2.2. Context

The CRU is in the process of reviewing GIL's Final Project Assessment (FPA) submission for an electricity interconnector between Ireland and Wales. CEPA and Atkins were appointed to undertake a targeted review of the GIL FPA on behalf of the CRU. This second phase of work aims to resolve a small number of issues identified in Phase 1 that are mainly cost related, and to reach a firm view on the overall cost of the project. These cost estimates will be used in the cap and floor model that is used to remunerate GIL once the interconnector is in operation.

We have taken a "whole life" approach considering costs over 25 years, but our review of cost is not comprehensive: we have focused on the findings of our Phase 1 technical review which was a broad but shallow review of the whole FPA submission, and which highlighted or flagged areas for further consideration in Phase 2. Ofgem is carrying out a similar review simultaneously as consumers in each jurisdiction (GB and Ireland) underwrite the project funding if the cap and floor levels are triggered. The CRU and Ofgem will need to agree on cost allowances before setting the final cap and floor levels.

When the CRU approves the FPA it will be committing to pay GIL to deliver the project through the admission of project costs into the cap and floor calculations. GIL will use the CRU's sign off as the basis for financing the project. It is adopting a project finance approach which means that sharing of risk between the developer and consumers, and the ability of the regulators to disallow costs, will be particularly important. Unlike other interconnector developers, GIL is expecting to be a special purpose vehicle (SPV), an entity created for this transaction alone. It does not have a wider balance sheet that it can use to absorb cost overruns, risk or other forms of change to the project.

Post the FPA decisions there is an opportunity to adjust certain costs in a Post Completion Review (PCR) which takes place once the asset becomes operational. We expect that the scope for change to the cap and floor levels in relation to capex to be limited to changes that could not have been anticipated or controlled by the developer and its contractors. There may be similar restrictions on opex. There is a further opportunity to review operating costs once in operation, as both GIL and the CRU can trigger an opex redetermination once during the life of the regime. But neither party can trigger that redetermination within the first ten years of the regime and once triggered it could result either in an increase or a decrease in the cap and floor levels (see Section 5.4.1 of our Regulatory Framework Report). As the scope for change in cost allowances are restricted later in the regulatory process, and because GIL requires certainty, it is necessary to fix a substantial proportion of the cost as part of the FPA approval. This is particularly important for the capital costs of the construction phase.

In respect of construction costs, GIL has confirmed that it ran an EU regulations compliant procurement process in three Lots - cable, converter stations and a combined option (Lot 3) which firms that prequalified in Lots 1 and 2 were permitted to bid for. The preferred bidder is [✂].

GIL's commercial approach is to contract its preferred bidder using a standard form Engineering, Procurement and Construction (EPC) contract (based on the FIDIC[3] Silver Book). This standard contract is for "turnkey" delivery i.e. the contractors have full responsibility for design and delivery of the assets they are to build, and is typically used where certainty of final price, and often of completion date, are of high importance to the sponsor.[4] [✂] will jointly design and construct the interconnector. They are also contracted to provide service and maintenance services for a period of up to 7 years post construction.

The EPC contract makes up [✂]% of the total "upfront" project costs, or [✂]% of the 25-year cost.[5] These upfront costs are firmer, but it is also important to consider all the other costs that consumers will cover: i.e. the full 25-year operating costs and replacement costs, as well as the developer project management, risk and other costs.

2.3. GIL's PROJECTS COSTS

GIL presents the following summary of total project costs as dated July 2020. Devex, capex and risk were submitted in nominal prices, whilst opex, repex and decommissioning costs were submitted in 2020 prices.

---

[3] International Federation of Consulting Engineers. The FIDIC acronym stands for the French version of the Federation's name (Federation Internationale des Ingenieurs-Conseil). FIDIC produce a suite of contracts that cover a wide range of projects and methods of procurement.

[4] Hosie, J. (November 2007) "Turnkey contracting under the FIDIC Silver Book: What do owners want? What do they get?" available online

[5] The costs presented in this report are in 2020 prices unless otherwise specified. They are undiscounted – i.e. we have not applied a social value discount rate to calculate the NPV as one would in a cost-benefit analysis.

Table 2.1: GIL's submitted project cost (excluding opex, repex and decommex) (€m)

Category		€ m
Devex	Incurred	[✂]
	Forecast	[✂]
	Land	[✂]
	Less CEF Grant	[✂]
EPC Costs	Converter Stations	[✂]
	Cables	[✂]
Developer Capex	Internal resources	[✂]
	External contractors	[✂]
	External advisers	[✂]
	Other costs	[✂]
	Land	[✂]
Operational Readiness	Internal resources	[✂]
	External contractors	[✂]
	External advisers	[✂]
	IT costs	[✂]
	Other costs	[✂]
Insurance		[✂]
Risk		24.2
Final FPA (ex Opex, Repex and Decommex)		**474.8**

Table 2.2: Project cost by asset category (€m)

Category	Devex	EPC Capex	Developer Capex	Total
Subsea cables	[✂]	[✂]	[✂]	[✂]
Land cables GB	[✂]	[✂]	[✂]	[✂]
Land cables IRE	[✂]	[✂]	[✂]	[✂]
Converter stations GB	[✂]	[✂]	[✂]	[✂]
Converter stations IRE	[✂]	[✂]	[✂]	[✂]
Substations GB	[✂]	[✂]	[✂]	[✂]
Substations IRE	[✂]	[✂]	[✂]	[✂]
Other	[✂]	[✂]	[✂]	[✂]
Risk	[✂]	[✂]	[✂]	24.2
Final FPA (ex Opex, Repex and Decommex)	**23.8**	**[✂]**	**[✂]**	**474.8**

Source: b.1.1 FPA Supporting Evidence v15.xlsx – 'FPA_Charts' tab

Whilst GIL states the total project cost as €474.8m (in nominal prices), this figure represents the costs of designing and constructing the asset (i.e. the devex, capex and risk costs) but it does not include any operating, replacement or decommissioning costs.

2.4. Total project costs over the 25-year cap and floor period

For the purposes of the cap and floor model we build a total project cost estimate including devex, capex and risk, as well as the full operating, replacement and decommissioning costs for the 25-year period of the cap and floor regime. For the purposes of the table below, we use the FPA Supporting Evidence spreadsheet provided by GIL, to extend GIL's total cost estimate out to 25 operating years post construction. Based on GIL's submission, we understand the total 25-year project cost to be €835.9m. Our analysis uses these figures throughout.

Table 2.3: Total project costs by category (€m)

Category	€ m	Source
Devex	23.8	'Project summary_EUR' C20
Construction capex	426.8	'Project summary_EUR' C21
Risk	24.2	'Project summary_EUR' C25
Operating costs	335.5	'Operating Costs_EUR' E9
Replacement costs	17.0	'Replacement costs_EUR' AC11
Decommissioning costs	8.8	'Decommissioning_EUR' AC9
Total cost	**835.9**	

Source: CEPA analysis of b.1.1 FPA Supporting Evidence v15

2.5. Phase 1 Technical Review

In Phase 1 CEPA and Atkins considered GIL's overall approach to the project at a high level.

2.5.1. Atkins Phase 1 Review: scope and recommendations

Atkins' Phase 1 work considered the proposed technical solution as represented in the proposed EPC contract, EPC contract costs, GIL's approach to operating the asset once built and the costs associated with operating, maintaining and renewing the asset. Atkins also reviewed GIL's system availability calculations to inform CRU's decision on the annual target availability level.

Atkins did not find any red flags in relation to the proposed technical solution though it raised an Amber concern about the system voltage rating.

On the EPC contracts they reported that:

- Specific clauses covering Latent Defects in design or workmanship were not included in the draft contract reviewed. Should a latent defect manifest itself beyond the Defect Liability period but relatively early in the design life it could leave GIL exposed financially.
- Under FIDIC Silver Book the Force Majeure clause is silent on the issue of Epidemic or Pandemic (as are many other Model Terms). It was not clear what measures GIL expected put into place but the FPA acknowledges the impact of COVID 19. This has been factored into the risk register and the contingency costs proposed.

- Atkins did not locate a provision seeking guarantees for spares availability for the design life of the equipment, i.e. protecting GIL against obsolescence of equipment. If such a provision is not available, Atkins suggested that a detailed assessment should be undertaken of the replacement costs provided, taking into account potential escalation of replacements cost due to obsolescence; and
- [✂] position in the procurement process as of some concern ([✂]).

On costs they reported:

- An amber risk for the EPC contract costs in relation to the cable costs which are below the expected average of comparable projects. An "amber flag" for the EPC costs for the HVDC converter stations which are higher than Atkins' benchmarked projects.
- Two "red flag" issues were highlighted:
    - O&M costs. GIL's proposed costs were significantly higher than Atkins' initial top down estimate and limited information was available on which to assess these.
    - Replacement costs. GIL provided some detail about expected replacement costs, but the costs proposed by GIL were higher than Atkins' own initial top down estimates.

On availability, Atkins flagged a minor risk that unavailability may be higher than estimated by [✂]. But Atkins' estimate then fell within the [✂] availability guarantee that was provided by [✂] with respect to the converter stations.

2.5.2. Phase 1 CEPA Review: scope and recommendations

CEPA considered issues including the progress of planning permissions and insurance – elements of the project that are not entirely within GIL's control. We also looked at the overall GIL risk provision and the approach to risk as set out in its risk register and its hedging strategy (the project is being undertaken in multiple currencies which creates exchange rate risk).

Our recommendations were that:

- **Insurance.** CRU should monitor insurance costs and include, within the regulatory regime, a facility to update costs early in 2021 and again immediately prior to financial close. Insurance costs are changeable but not necessarily controllable by GIL. The final project estimate should include the actual costs obtained by the broker at the time the insurances come into effect.
- **Planning.** CRU should monitor progress towards achieving the required planning permissions post FPA. GIL has made substantial progress in this area but has a significant amount of further work to do to secure all the permissions that it needs. It is pursuing the permissions in an environment affected by Covid-19 which is slowing progress and could lead to further project delays because lenders will not proceed to close unless all the required consents are in place. CRU will need to consider in its regulatory approach how to deal with any additional costs that arise from a planning delay which occurs post FPA approval.
- **Procurement.** CRU should monitor changes that impact price and/or timing and ensure that GIL uses all the commercial levers available to it (e.g. the fact that the EPC contract is not yet signed) to ensure that consumers receive value for money. This is particularly

important because the reserve bidder for converter stations is also [✂]. This is an unusual outcome of GIL's procurement approach.

- **Foreign exchange / hedging strategy.** The hedging strategy and risk share on exchange rate movements should be considered further in Phase 2. This is an area where this review links to the CRU / Ofgem's regulatory regime because it is necessary to consider who is best placed to take this risk and over what period.
- **GIL's risk.** That the updated risk register be reviewed in further detail in Phase 2 of the project.
- **Other costs.** Phase 2 should also include a review of project management costs and 'other' costs not separately considered by Atkins, to ensure that CRU has its own independent estimate of total project costs.

2.6. Scope of the Phase 2 Review

In Phase 2 our work has focused on a more extensive review of the items flagged in Phase 1. We use benchmarking to create our own assessment of project costs. In its FPA decisions Ofgem produces an analysis of the developer's costs alongside its own estimates. We produce a similar analysis in our conclusions. Our estimate will then be annualised for use in the cap and floor model.

At this stage, pending Ofgem reaching its conclusions on costs, we present our estimates of expected costs within a benchmark range and consider GILs proposals against those benchmarks.

3. TECHNICAL SOLUTION

In the Phase 1 analysis Atkins identified only a single technical issue which was flagged Amber and was related to an increase in the system voltage levels from 200 kV to 320 kV . Atkins noted that, on the basis of information previously provided by GIL, this decision may have contributed to an overall cost increase and recommended further clarification from GIL during Phase 2. This short section considers further evidence on this issue.

3.1. HVDC CABLE AND CONVERTER STATION VOLTAGE RATING

Since the Phase 1 Atkins report, GIL provided further information on its choice of cable via a Supplementary Question (SQ) response, and we have also discussed the issue with GIL directly.

In the SQ response, GIL stated that 320 kV has been a standard design line voltage for Voltage Source Converter technology since 2015 and major manufacturers have experience using this voltage level. GIL also indicated that having followed a competitive procurement process, it does not believe that there has been a material increase in cost resulting from this design decision. This was because of the maturity of available technology which would reduce the associated technology risks, and because it is now widely accepted as the industry standard voltage. In further discussions, GIL confirmed that the change to the voltage rating would not affect the overall cost, as the higher cost of converter works would be offset by cost reductions related to the DC cable system. This was confirmed in GIL's response which confirmed that none of the tenderers for the works bid a higher price for the enhanced overload capability (short-time operation at 700MW).

GIL also indicated that a change in voltage would not affect the electrical losses and related costs.

GIL explained that the project was designed to 500MW (now 504MW) to align to the maximum in-feed loss constraints on the Irish system. But having confirmed with tenderers that the overload capability was possible at no additional cost, GIL held discussions with EirGrid and National Grid who confirmed they see this functionality as beneficial to the wider transmission network (although not included as part of the existing connection agreements). GIL also told us that the overload capability was included in the cost-benefit analysis undertaken by Baringa and showed positive results for consumers. We did not review Baringa's analysis in the preparation of this report.

Overall, we are satisfied that the increase in system voltage levels from 200 kV to 320 kV, and the associated overload capability, is well justified by GIL. Atkins has confirmed that 320 kV is a technological choice which other interconnectors are adopting[6], and which GIL is better placed to make than the regulator. Having considered the additional SQ information provided by GIL, Atkins has concluded that it is no longer a significant issue that requires further analysis or discussion with GIL, but we suggest that for alignment reasons CRU should discuss the issue with Ofgem to ensure it has also resolved its position on this issue and that the two are consistent.

---

[6] Examples include COBRA (operational), IFA2 (approved), FAB link (approved) and Eleclink (in construction)

4. REVIEW OF COSTS BY BUILDING BLOCK - CAPEX

Wherever possible our cost analysis draws on benchmark analysis prepared by Atkins. This type of analysis has been challenging because GIL has extracted capex costs from the EPC bids which were prepared in the expectation of this being a turnkey project. There is limited granularity of cost information which makes it more difficult to ensure a fair comparison. To create more confidence in the analysis we have used a mix of bottom-up and top-down comparisons, and we have discussed our emerging findings with Ofgem which has shared its emerging views on a number of categories of expenditure that we have questioned. We have raised several queries with GIL via the SQ process, in which we sought to better understand its data, and we have also had the benefit of responses that GIL has provided to Ofgem's SQ process.

GIL's submission includes €451m of capex, including €24.2m of risk. We benchmarked total capex from the top-down and, for the main components of capex, from the bottom-up. We break down capex into development costs, the EPC contract (including offshore cables and converter stations), project management costs, developer risk, and 'other' developer capex costs.

We find that GIL's devex submission is at the top end of the range implied by other cap and floor interconnector projects, however we did not review devex costs in detail.

Total capex is within the range but analysis of the EPC components shows that whilst the subsea cable costs are below the benchmark range, the cost of the converter stations is substantially above the top-end of our benchmark range. This suggests that there may be some categorisation issues that merit further investigation. Our analysis also shows that contractor project management costs are towards the top-end of the benchmark range.

GIL's risk submission is similar in relative size to the risk allowances in other recent cap and floor interconnector projects. From the 'other' developer cost category, we note that Ofgem is likely to disallow €[✂]m of DSU insurance, unless GIL can justify its value from a consumer perspective.

4.1. Development costs – 'devex'

Devex is GIL's cost associated with items such as studies, assessments and resourcing costs that are incurred prior to the project's final investment decision, net of any grants such as the European Union's Connecting Europe Facility (CEF) grant which is available to this project.

Devex accounts for €23.8m (or 2.8% of total project costs). Taking an approach which is proportionate to the scale of these costs, we have not reviewed GIL's submitted devex costs in detail, because no "red flag" issues were identified during our Phase 1 review.

We have compared GIL's submitted devex relative to other cap and floor interconnector projects including IFA2, NSL, Nemo and Viking Link which create a range of £[✂]m - £[✂]m. This is shown in Figure 4.1 below. GIL's costs are towards the top of the range, which potentially creates scope to reduce the allowance. By way of illustration reducing GIL's estimate to between the mid-point of our range would create a reduction of around €4m. We note however that the high level of GIL's estimate may, in part, be explained by the length of the project's development phase – it was first granted a Cap and Floor regime in principle by Ofgem on 30 September 2015.

Figure 4.1: GIL's devex submission compared to other cap and floor interconnector projects (2020 prices)

Source: CEPA analysis of published information on other cap and floor interconnector projects

4.2. Construction capex costs

The capital construction costs of the project comprise three elements:

- EPC contract costs – these being the main component of capex;
- Developer capex, or GIL's own internal project management costs including external contractors, external advisors, overheads and operational readiness costs; and
- Developer (GIL's) risk/contingency provision.

GIL's total projected capex costs are €451.0 m, as shown in Table 3.1 below:

Table 3.1 composition of GILs projected capex costs (€m, nominal prices)

Category	Total (€m)
EPC contract (A) *Of which:*	€[✂]
Subsea cables	€[✂]
Land cables	€[✂]
Converter stations	€[✂]
Substations	€[✂]
Other	€[✂]
Developer capex (B)	€[✂]
Capex excluding risk (A+B)	**€426.8**
Developer risk (C)	€24.2
Total capex (A+B+C)	**€451.0**

Source: CEPA analysis of GIL FPA Supporting Evidence spreadsheet

4.3. Construction capex

Atkins' carried out a simple top-down capex benchmarking assessment, adjusting for capacity differences between the projects.[7] The analysis suggests a total capex benchmark range of €[✂]m –- €[✂]m.

We compare this to GIL's capex estimate both excluding developer risk (€426.8m) and including developer risk (€451m). Figure 4.2 shows that GIL's capex estimate (excl. developer risk) lies in the second quartile of the benchmark range, and the all-in total capex estimate (incl. developer risk) lies in the third quartile.

Figure 4.2: Top-down comparative benchmarking of capex costs (€m)

Source: Atkins analysis

4.3.1. EPC costs

The EPC contract is by far the largest component of capex (€[✂]m) of which the undersea cable and converter stations are key components. Given the issue Atkins identified in the Phase 1 analysis of GILs costs (relatively low cable costs and high converter station costs), we consider these EPC components costs using more detailed benchmarking by Atkins of the cable and converter stations. We use this to compare GIL's costs to other similar offshore contracts and interconnector projects.

We also consider project management costs for which separate benchmarks are publicly available.[8] CRU should note that there is no separable estimate of EPC/contractor contingency within the information provided by GIL, contractor risk is included within the EPC contract price.

Subsea Cable

HVDC subsea cable projects are bespoke in nature but the main driver of costs for cable projects is the length of cable system installed, for which a unit cost figure (€ / km) can be derived and used to form a benchmarking comparison.

Producing a benchmark range requires adjustment of the available benchmark data to ensure a broadly like-for-like comparison, so Atkins excluded projects which use the following technologies:

---

[7] To adjust for capacity differences, Atkins made an engineering judgement that approximately 20% of capex costs are 'fixed' irrespective of capacity. The remaining 80% of costs are scaled according to the capacity of the interconnector project.

[8] For PM costs we use total capex as the comparator.

- **Bipole** (2 cables) because costs are significantly higher than monopole (including with return) installations due to the additional installation, deployment, standby and risk;
- **Mass impregnated (MI) cables** because costs are higher than Cross Linked Polyethylene (XLPE) cables; and
- **Long cable projects**, as short cable sections have significantly more expensive unit costs.

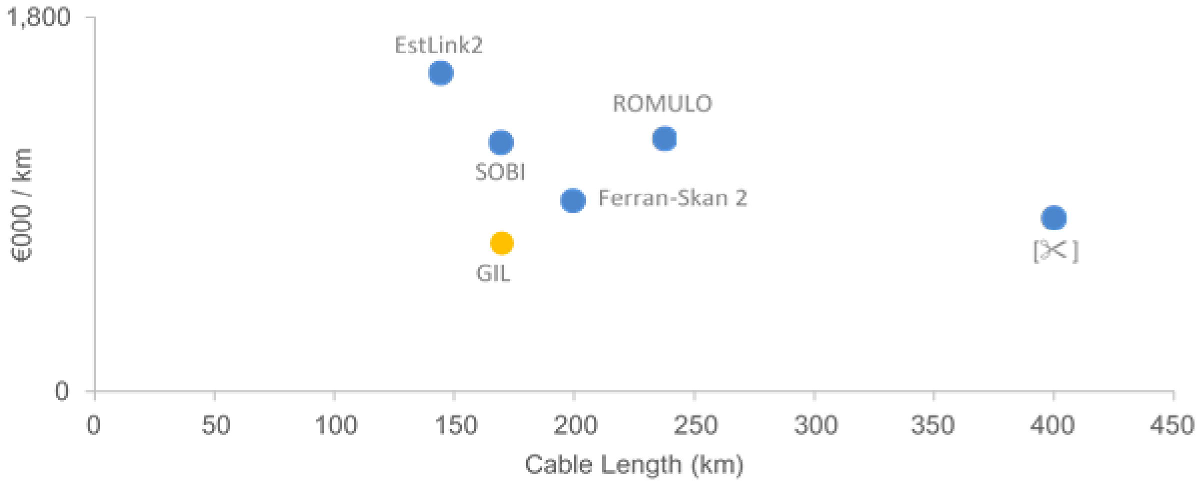
Projects such as NSL (cable length of 727km) which benefits from economies of scale were excluded, as was [✂] as it was also delivered by the [✂].

The figures in the table and chart below (adjusted to a 2020 price base) provide a comparison of contracted installed capacity to be built by the EPC contractor under similar conditions.

Table 4.1: EPC cable cost comparison (2020 prices)

Project	DC Voltage (kV)	Cable length (km)	Rating (MW)	Contract price (€k)	Unit cost (€k per km)
ROMULO	250	237	400	[✂]	[✂]
Fenno-Skan 2	500	200	800	[✂]	[✂]
SOBI	500	170	500	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
EstLink2	450	145	650	[✂]	[✂]
Greenlink	-	170	504	[✂]	[✂]

Figure 4.3: Offshore cable unit cost comparison (EPC contract only) (€k per km)



Source: Atkins analysis

The comparison shows that for the subsea cable costs, GIL is below the low end of adjusted costs, almost on par with [✂] which has the longest cable of the projects in Atkins' analysis. But this analysis should be treated as indicative. Even after adjustment and careful selection of suitable comparators, each of the projects used have bespoke elements which could be substantial. It should be noted that some of the comparator costs are outturn costs whilst GIL's are estimates. Although it is likely that the GIL EPC cable cost contract includes a risk allowance, there may be variations in construction that mean that the outturn cost may be greater than the figures used here.

Converter Stations

As is the case for the cable, HVDC converter stations are bespoke. However, the main driver of their costs is the capacity and operating voltage of the system installed. For benchmarking purposes, a unit cost figure in €k per MW has been derived. The comparison was carried out following adjustment of comparator costs to a 2020 price base and removal of HVDC convertor station developer costs. Projects with Voltage Source Converter technology were used for the comparison process as this is the technology proposed for the GIL interconnector. The figures shown therefore provide a more direct comparison of contracted installed capacity.

Table 4.2: HVDC converter station cost comparison between relevant projects (2020 prices)

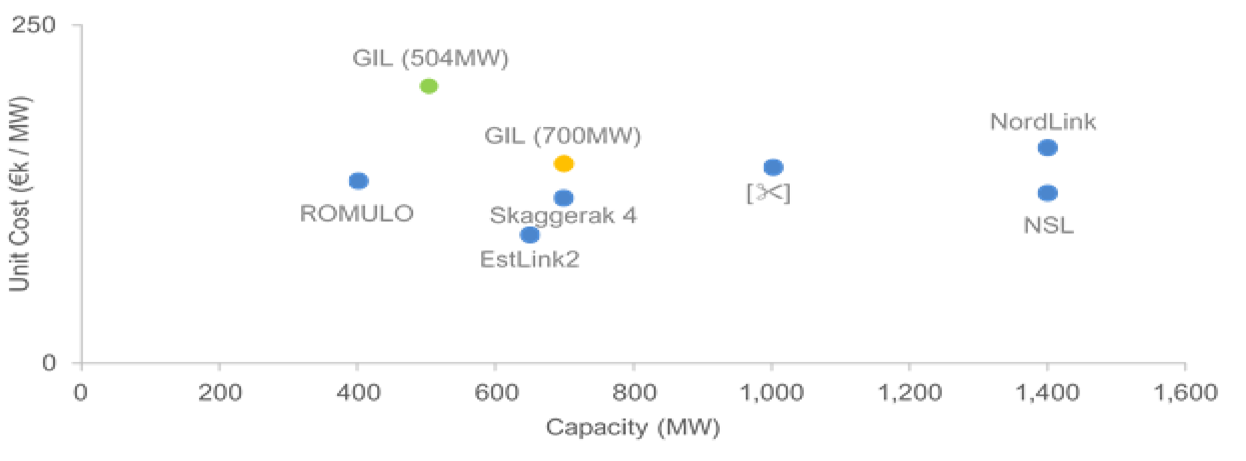
Project	DC Voltage (kV)	Rating (MW)	Contract Award	Contract price (€k)	€k per MW
Skaggerak 4	500	700	2011	[✂]	[✂]
NordLink	525	1,400	2015	[✂]	[✂]
NSL	525	1,400	2015	[✂]	[✂]
EstLink2	450	650	2011	[✂]	[✂]
ROMULO	250	400	2007	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
GIL (Baseload)	-	504	2019	[✂]	[✂]
GIL (Overload)	-	700	2019	[✂]	[✂]

Source: Atkins analysis

The analysis shows that the GIL HVDC converter EPC cost is substantially above the benchmark range for the base level of capacity (504MW) and remains above the range even if the average unit cost is scaled by the overload capacity (700MW). Of the other projects in the sample, EstLink2 project has the most similar power rating, but is substantially cheaper on a €k per MW basis.

As for the cable analysis, these comparisons should be considered indicative as there are several factors that will have a direct impact on the outturn contract costs with which we compare GIL in the analysis above. However, the cost differential here (as shown in Figures 4.3 and 4.4 below) is substantial and is unlikely to be fully explained by differences between comparators.

Figure 4.4: Top-down unit cost comparison against HVDC converter projects (€k per MW)



Source: Atkins analysis

Figure 4.5: GIL converter station costs compared to benchmark range (€m)

Source: CEPA analysis of Atkins benchmark data

Atkins benchmark range is constructed using the average €k / MW unit cost calculated from a sample of comparators and scaling it by GIL's baseload level of capacity (504MW). Since GIL's design allows for it to provide overload capacity for up to two hours in every 24 (under appropriate conditions), the top end of the range represents the average unit cost scaled by 700MW.

The interpretation of GIL's position relative to the benchmark range requires the use of judgement: for example, Atkins indicate that there is no right answer on whether it is more appropriate to use the base or overload level of capacity (504MW or 700MW) to scale the benchmark unit cost. Whilst GIL is only designed to provide overload capacity for up to two hours in every 24 (under appropriate conditions) we understand that the overload capability is inherent in the choice of cable technology and voltage rating. We also understand that removing the overload capability would not provide any cost savings but would remove some of the potential benefits to the project, and to the GB and Ireland TSOs. However, it is noteworthy that even if the most expensive unit cost comparator is scaled by the overload capacity, GIL would still be above the benchmark range for the converter stations.

The cost of the converter stations relative to the benchmark range is a concern given that they are the largest component of the EPC contract. But when we consider the offshore cable and converter station costs together, as shown in Table 4.3, GIL is in the middle of our benchmark range. As we find in Section 5 (operating costs), this could be the result of an allocation issue between cable and converter stations, but Atkins has so far been unable to ascertain whether this is the case.

Table 4.3: Benchmarking of main EPC cost categories – offshore cables and converter stations

Capex cost category	GIL FPA submission	CEPA – Atkins benchmark
Offshore cables	€[✂]m	€[✂]m – €[✂]m
Converter stations	€[✂]m	€[✂]m – €[✂]m
Combined cost (excl. onshore cables, substations & other costs)	**€[✂]m**	**€[✂]m – €[✂]m**

Source: CEPA and Atkins analysis

The benchmark ranges are wide – particularly for the offshore cables – which is driven by the range of unit costs derived from the sample of comparator projects. Combined with our concern about whether there is an allocation issue between offshore cables and converter stations, we are not confident that the benchmarks reflect an entirely like-for-like comparison. We consider that this merits further investigation because the overall capex benchmark figure provides only limited reassurance that GIL's costs are comparable to other projects.

Project management costs

The EPC contract includes contractor project management costs, given that the contractor is expected to deliver within a fixed price. Our analysis of contractor PM costs is set out below in Table 4.4 below, but should be considered together with our analysis of developer PM.

In summary, we find that contractor PM costs equate to €[✂]m but this requires some adjustment from the categorisation of PM costs used in GIL's submission, as explained in the following text.

Table 4.4: Contractor PM costs

Category	Cost (€m)	Category	Cost (€m)
Subsea cables	[✂]	Converter station Ireland	[✂]
Land GB	[✂]	Substation GB	[✂]
Land Ireland	[✂]	Substation Ireland	[✂]
Converter station GB	[✂]	Other	[✂]
GIL's Total PM contractor costs			[✂]
CEPA's adjusted project management costs			[✂]
% of total cost (excl devex, opex, repex and decommex)			[✂]

Source: GIL FPA Supporting evidence (July 2020) – Purple tabs

In its supporting evidence GIL provides PM costs by component of the project but the figures are provided for each component as a single total, i.e. with no further breakdown. Ofgem raised a SQ on the level of contractor PM costs in the bid price, noting that the composition of these costs is not transparent. GIL undertook to discuss these costs with its contractors requesting further information as its evaluation of these costs was undertaken as part of the overall evaluation of price and scope as contained in the ITT, i.e. not as a discrete item. GIL indicated that its preferred bidder was unlikely to provide more information but also suggested that its definition of PM costs may capture items that might normally be covered elsewhere.

Following GIL's responses to Ofgem's SQs, a further breakdown of GIL's submitted costs is shown in Table 4.5 for the converter stations and Table 4.6 for the cable.

Table 4.5: Disaggregated project management costs – converter stations (€)

Category	Cost (€)	Category	Cost (€)
Wales		**Ireland**	
EPC Management Services			
Project and Commercial Management	[✂]	Project and Commercial Management	[✂]
HSE and Quality Management	[✂]	HSE and Quality Management	[✂]
Contractor's Procurement - Equipment	[✂]	Contractor's Procurement - Equipment	[✂]
Contractor's Procurement - Civil Works	[✂]	Contractor's Procurement - Civil Works	[✂]
Other EPC Management Services	[✂]	Other EPC Management Services	[✂]
Construction Services			
Site Management	[✂]	Site Management	[✂]

Site Facilities	[✂]	Site Facilities	[✂]
Fuel & Services (elec, water, data)	[✂]	Fuel & Services (electricity, water, data)	[✂]
Logistics Services	[✂]	Logistics Services	[✂]
Installation Services	[✂]	Installation Services	[✂]
Installation Supervision	[✂]	Installation Supervision	[✂]
Sub-total (all costs)			**[✂]**
Sub-total (excluding logistics and installation)			**[✂]**
Sub-total (EPC Management Services only)			**[✂]**

Source: CEPA analysis of b.1.1 FPA Supporting Evidence v15 – see 'Adjust_Con_PB' column T

Table 4.6: Disaggregated project management costs – cables (€)

Category	Cost (€)	Category	Cost (€)
Wales		**Ireland**	
EPC Management Services			
Project and Commercial Management	[✂]	Project and Commercial Management	[✂]
HSE and Quality Management	[✂]	HSE and Quality Management	[✂]
Contractor's Procurement - Equipment	[✂]	Contractor's Procurement - Equipment	[✂]
Contractor's Procurement - Civil Works	[✂]	Contractor's Procurement - Civil Works	[✂]
Other EPC Management Services	[✂]	Other EPC Management Services	[✂]
Construction Services			
Site Management	[✂]	Site Management	[✂]
Site Facilities	[✂]	Site Facilities	[✂]
Fuel & Services (elec, water, data)	[✂]	Fuel & Services (elec, water, data)	[✂]
Plant	[✂]	Plant	[✂]
Interaction w/ environmental agency	[✂]	Interaction w/ environmental agency	[✂]
Offshore services			
EPC Management Services		**Construction Services**	
Project and Commercial Management	[✂]	Site Management	[✂]
HSE and Quality Management	[✂]	Site Facilities	[✂]
Contractor's Procurement - Equipment	[✂]	Fuel & Services (elec, water, data)	[✂]
Contractor's Procurement - Civil Works	[✂]	Plant	[✂]
Sub-total (all costs)			**[✂]**
Sub-total (EPC Management Services only)			**[✂]**

Source: CEPA analysis of b.1.1 FPA Supporting Evidence v15 – see 'Adjust_Cab_PB' column T

We have been unable to fully reconcile the values in Table 4.4 with those in Table 4.5 and Table 4.6, but the difference is minor.

GIL asserts that other projects may not have included *'Construction Services'* costs under the heading of project management. Ofgem is considering the issue further. We note that these are typically site overheads which are not directly related to the main work packages. We assume that there could be a degree of overlap with other cost categories, so in our benchmarking we have excluded '*Installation Services*' and '*Installation Supervision*' from our estimate, but elected to include *Site Management*', '*Facilities*' and '*Logistics*'. Pending further discussion with Ofgem on what would usually be included under project management, we calculate GIL's contractor PM costs to be €[✂]m. In our analysis we use this figure in place of the €[✂]m figure set out in Table 4.3.

GIL's project management costs

A view of project management costs should be taken in the round i.e. combining those in the EPC contract with GIL's own PM costs. This is because the relative share of PM costs may differ depending on the role that each party takes in the project. In this contract, given the allocation of risk to the contractor we would expect contractor costs to be higher than usual and developer costs to be low in comparison with other projects. GIL's PM costs are shown in Table 4.7.

Table 4.7: Developer PM costs

Category	Cost	Category	Cost
Subsea cables	[✂]	Converter station Ireland	[✂]
Land GB	[✂]	Substation GB	[✂]
Land Ireland	[✂]	Substation Ireland	[✂]
Converter station GB	[✂]		
Total PM contractor costs			**[✂]**
% of capex cost			**[✂]%**

Source: GIL FPA Supporting evidence (July 2020) – Purple tabs

In total, GIL's own PM costs are €75.2m or roundly 16.7% of capex costs. In recent exchanges with Ofgem, it indicated that it would expect developer costs to be towards the lower end of a [✂]% – [✂]% range, so we find that GIL's own PM costs are lower than we would expect perhaps reflecting the fact that they are procuring on a turnkey basis.

By summing contractor and developer PM costs, and excluding '*Installation Services*' and '*Installation Supervision*', we arrive at a total combined PM cost of €75.2m (16.7% of total capex).

Estimates of PM costs as a proportion of the overall cost of an infrastructure project vary, often depending on choice of procurement route and asset type. However, there is a common view that such costs typically range from around 10-15%. The best publicly available source of PM costs that we could obtain is from Turner and Townsend, who undertake a substantial volume of work on project costs including for organisations like Transport for London and Heathrow. They suggest PM costs for the oil and gas industry of 8-16%[9] of total costs. [✂]. Atkins suggests a range of [✂]-[✂]% of total capex based on previous projects adopting a turnkey contract form.

We therefore find that total PM costs are at the top of the range and that, by way of illustration, reducing the allowance to a figure within the following range: 14% (upper quartile of the Turner and Townsend range) to [✂]% (midpoint of the Atkins range) would result in a reduction of between €3m and €12m. CRU should note that the scope for efficiency would be significantly greater if it were to conclude that *installation services* and *installation supervision* form a part of PM costs on other projects. Taking the mid-point of these two benchmark ranges, we propose that CRU disallows €7.5m of construction capex, to account for the relatively high combined project management costs that were not well justified in GIL's submission.

4.4. OTHER CATEGORIES OF DEVELOPER CAPEX

There are two further categories of developer capex: 'developer risk' and 'other' developer costs (including insurance during construction). These sub-categories are considered further below.

4.4.1. Developer risk

The provisional cap and floor levels set out by the CRU in its Draft Decision will include a provisional value to cover project risks and uncertainties. This should reflect the CRU's view of an efficient estimate of the additional risks likely to be incurred by the developer (GIL) between its Final Decision and the PCR, to the extent that GIL has appropriate mitigations measures in place. The CRU will then need to undertake a detailed assessment of any cost changes as part of the PCR and update the cap and floor levels to reflect an economic and efficient allowance for any changes.

GIL has assessed the potential risks to the project and the resulting costs and delays: these are included in GIL's risk register.[10] It has also used Quantitative Cost Risk Analysis, a probability-based modelling tool, to estimate that it requires €24.2m in risk expenditure (or approx. 6% of total project cost excluding opex, repex and decommex).[11] This includes, for example, risks around the impact of Brexit on the cost of the EPC contract, movements in exchange rates, and the cost of managing delays due to worse than expected weather.

In Appendix B, we have assessed the risks included in GIL's FPA submission, the way that they have been estimated, and considered whether GIL's approach to risk is reasonable in the round. We note that some of the risks relating to changes in project requirements should have been resolved (or "firmed up") by the time the project reaches Financial Close, at which point the cap and floor levels could be adjusted.[12] We also noted some minor concerns around the potentially optimistic calculation of other risk events, and the potential correlation between risks relating to Brexit, COVID-19, movements in exchange rates, and possible delay to Financial Close.

---

[9] Turner & Townsend (February 2011) "Analysing project management costs" available online

[10] Greenlink Risk Register_July_Rev03.xlsx

[11] See Appendix B for further detail

[12] See Appendix B.3 for further detail

Overall, we note that €24.2m (6% of project costs) is a reasonable placeholder to cover GIL's share of the project risks. By comparison, Viking Link (8.6%)[13], NSL (9.6%)[14], IFA2 (8.6%)[15] and Nemo (5.1%)[16] have similar or slightly larger risk allowances, relative to their respective capital cost.

However, CRU should note that there is no separable estimate of EPC/contractor risk and contingency within the information provided by GIL. GIL indicates that [✂] did not provide a breakdown of risk allowances as part of the procurement process.

Alongside our findings on the size of the risk allowance, CRU should also note the recommendations on risk, as set out in Section 6. In particular in relation to currency hedging which was flagged by CEPA for further investigation in Phase 1 of the project. Although in principle GILs approach to hedging is in line with expectations, we recommend that CRU should secure greater transparency from GIL on its proposed hedging strategy and monitor its approach ahead of financial close, alongside its monitoring of the debt funding competition. As with other uncertain items of cost there is a further opportunity for hedging costs to be considered as part of the PCR. In this case, we recommend that costs arising from the hedging strategy only be reopened if GIL can evidence changes that it could not be mitigated.

4.4.2. Other costs

Ofgem has advised us that it considers 'other' costs to be those that cannot be allocated to the creation of an asset such as subsea cable. Most of GIL's up-front costs are allocated but the supporting evidence spreadsheet suggests that operational readiness costs, IT systems costs and fees and insurance are not allocated and therefore form part of other costs.

Table 4.8: Breakdown of 'other' costs by category, excluding opex (€m)

Category	€m
Internal resources	[✂]
External contractors and advisers	[✂]
'Other' costs	[✂]
Project management allocated elsewhere	[✂]
Land	[✂]
Operational readiness	[✂]
Insurance	[✂]
Total	**18.5**

Source: CEPA analysis of GIL's Supporting Evidence spreadsheet – refer to the "developer" tabs

[13] Ofgem (September 2020) "Decision on the Final Project Assessment of the Viking Link interconnector to Denmark" available online

[14] Ofgem (October 2016) "Final Project Assessment of the NSL interconnector to Norway" available online

[15] Ofgem (July 2018) "Final Project Assessment of the IFA2 interconnector to France" available online

[16] Ofgem (December 2019) "Decision on the Post Construction Review of the Nemo Link interconnector to Belgium" available online

Costs associated with **operational readiness** reflect changes to GIL's own staff in anticipation of the asset coming online. This is predominantly internal staff cost – operations director, operations manager, commercial director etc and some external support. Although it is hard to benchmark exactly the salaries appear reasonably generous[17] but not overly so allowing for overhead costs.

IT costs relate to 'commercial platform' and 'dispatch' systems and balancing market fees. We did not review these costs in detail as they are small in proportion to the total cost ([✂]%). But we note that GIL's submitted costs include the cost needed to develop its own commercial platform (€[✂]m) though it is also exploring the technical feasibility of joining the Regional Nomination Platform (developed by IFA, BritNed, Nemo) at a lower cost of €[✂]m.[18]

We reviewed **insurance costs** in Phase 1 and concluded that CRU should monitor these costs as the market is volatile and the estimates provided by GIL are early stage. We have not revisited insurance costs in this phase of work given the findings of Phase 1 and because no additional information is available.

On construction insurance, Ofgem has indicated that it may disallow the cost of the delay in start-up (DSU) insurance that GIL has included. This is on the basis that the consumer should not fund cover for GIL's lost revenue in the event of a delay that it may be able to control or should have allowed for in its risk analysis. We note that GIL has the protection of force majeure provisions which will insulate it from events that it can demonstrate are beyond its control. GIL has counter-argued that DSU insurance is a requirement of its project financing approach, and that it provides consumers with some benefit in the form of protection against additional delay-related costs in the PCR. Although Ofgem is still considering this issue at the time of writing, it seems unlikely that it will break with precedent from other projects where it has disallowed this cost.

We suggest that CRU disallows €[✂]m of DSU insurance (developer capex) unless GIL can justify its value from a consumer perspective.[19]

---

17 For example, see Payscale "Average Director, Business Operations Salary in the UK" available online

18 GIL (April 2020) "Final Project Assessment" Part 2: Cost Assessment Section 1.7.3

19 CRU should note that the €[✂]m insurance costs relate to the up-front insurance costs. The Supporting Evidence spreadsheet shows that insurance costs total €[✂]m over 25 years – see "b.1.1 FPA Supporting Evidence v15.xlsx" Operating Costs_EUR tab, cell E64. The current insurance market is very challenging. It seems possible that providers may withdraw from the offshore market, raise premiums, increase deductibles, offer more restrictive policy exclusions and/or amend their products accordingly in response to market conditions.

5. REVIEW OF COSTS BY BUILDING BLOCK – OPEX

This section focuses on operating costs including "red flag" issues identified by Atkins in Phase 1. These costs form part of the overall FPA assessment although we note that the PCR provides a means to revisit costs to an extent.[20]

This section covers, ongoing operations and maintenance, replacement costs and decommissioning costs[21] separately, as these are discrete input lines to the financial model used to calculate the cap and floor payments.

In practice, the boundaries between maintenance and renewal can be less than clear so it is important to consider the approach to asset stewardship in the round. This is relevant to GIL's submission because, some aspects of its submitted opex costs appear high, and others low, relative to Atkins benchmarks.

Opex costs are substantial: GIL estimates €336m over 25 years. They cover centralised costs such as GIL personnel, as well as insurances and O&M costs. O&M covers outsourced or contracted operations and maintenance. These costs were highlighted as unusually high in our Phase 1 work and they have been the focus of the analysis in Phase 2.

O&M has been difficult to benchmark as GIL's approach differs from that on other interconnector projects. GIL outsources/contracts more work than is usually the case. Atkins' analysis suggests that GIL's O&M costs are at the high end of the range, even on an adjusted benchmark basis, but we are conscious that the benchmarking is indicative only given GIL's alternative approach.

We have also carried out a simple benchmarking of total opex costs. This shows GILs costs to be lower overall than other broadly comparable projects. This is also an imperfect analysis, but it suggests that, taking high O&M costs into account, GIL's opex costs overall are at the low end of a range of broadly comparable projects.

5.1. Context

The total cost of the project includes €335.5m of opex costs (in 2020 prices). Opex is comprised of:

- O&M or contracted maintenance which covers both offshore and onshore operations costs and maintenance;
- GIL staff and other central admin e.g. office, IT and other professional services;
- Ongoing insurance costs post construction of the interconnector;
- Market related costs, property related costs, and other non-controllable cost elements such as the Crown Estate Lease Fees and property rates.

In the Phase 1 Review, Atkins flagged a concern about the level of O&M costs proposed by GIL based on the limited information it provided. Given the bespoke nature of offshore projects, we

[20] See Section 4.1 of CEPA's Regulatory Framework Report

[21] CRU should note that we have not assessed whether GIL's submitted decommissioning costs are economic and efficient. This is because they are only a small portion of the overall project cost over 25 years (1.1%) and, like Ofgem, CRU will undertake a full assessment of decommex at the PCR.

would ideally use a like-for-like, bottom-up comparison to benchmark GIL's costs and analyse whether they appear economic and efficient. However, as the information available was incomplete (for example, GIL provided only a 7-year estimate of service and maintenance costs) and it was uncertain what was provided under the O&M contract, Atkins conducted an independent analysis of the O&M costs using its own data and an assumed 25-year asset life consistent with the duration of the proposed cap and floor regime. Atkins concluded that GIL's costs were high and recommended further analysis in Phase 2.

In this Phase 2 Technical Assessment, Atkins has carried out bottom-up benchmarking of both onshore and offshore O&M costs based on its previous experience and relevant benchmarks. The analysis has been discussed with GIL, given several comparability issues between its approach and the benchmarks used. We have also had discussions with Ofgem about its analysis of opex.

Insurance costs were considered by CEPA in Phase 1 and we recommended that they be kept under review as GIL moves towards financial close; we do not consider insurance further in this report. Wider opex costs (such as GIL's own personnel costs) were not considered but form part of the overall benchmarking of opex that Atkins has completed in Phase 2.

We briefly consider each of the main O&M categories in the sections which follow.

5.2. Converter O&M costs (Onshore)

Benchmarking in this area has proven to be challenging. GIL's approach to contracted O&M differs from that taken on other interconnectors. It proposes to outsource or otherwise contract a lot more activity than is common elsewhere. For instance, many of its operational staff are to be provided by [✂] under the SMA contract. This explains why their costs are so high when compared to Atkins benchmarks which do not assume this degree of contracted support.

In order to create a more like for like bottom-up analysis, Atkins has adjusted its benchmarks to account for an indicative number of staff (provided by GIL) whose roles are outsourced/contracted and applied its own estimates of utilisation levels based on experience of similar projects. Atkins has assumed 12 maintenance outage support personnel are contracted at 50% utilisation (i.e. the staff work on a wider range of projects than the GIL interconnector). Where applicable, costs are doubled to cover both converter stations.

Atkins estimate of converter O&M costs is set out in Table 5.1 below.

Table 5.1: Bottom-up benchmarking assessment of converter O&M costs (€k, both converter stations)

Service	Total cost (both converter stations)
O&M Start-Up Costs	
Substation setup - safety equipment, earths, demarcation, etc	[✂]
Ongoing Maintenance Costs	
Onshore planned preventative and corrective maintenance	[✂] – [✂]
Site safety and SAP responsibilities	[✂]
Outage Maintenance	[✂]
Transport and storage of spares, plant and equipment	[✂] – [✂]
Control room costs (including Year 1 setup costs)	[✂]
Air Insulated Switchgear inspection and maintenance	[✂]
Travel & accommodation expenses	[✂]
SAPs, APs and Technical Support[22]	[✂] – [✂]
Additional Costs	
Unscheduled Services	[✂]
Total Converter Station O&M Costs	**[✂] – [✂]**

Source: Atkins analysis of benchmark prices from previous OFTO and HVDC projects

As noted above, Atkins has relied on GIL's staffing estimates because GIL only has access to a proposed contract price, without any analysis of staff costs or assumptions on the amount of time each member of staff will be used. As a result, Atkins estimates are not a fully independent assessment of GIL's proposed costs.

5.3. Cable O&M costs (Offshore)

Atkins' assessment of offshore O&M is based on the services that would usually be included based on its previous experience and other similar projects. The line items included in Atkins' bottom-up analysis have been discussed with GIL and some amendments made, but there remains a degree of uncertainty as to the extent that each Atkins line item directly aligns with those provided by GIL. However, the total cost of the offshore services procured by GIL is comparable to Atkins' benchmark range.

The bottom-up benchmarking assessment carried out by Atkins is set out in Table 5.2. Replacement costs are excluded from this analysis – those appear in Atkins' repex estimates.

[22] GIL were unable to provide a breakdown of the utilisation of staff within the O&M contract. In addition to technical support, we have assumed 12 maintenance outage support personnel at 50% utilisation and 7 FTE site personnel. These costs include additional expenditure such as training and reporting.

Table 5.2: Atkins' bottom-up benchmarking assessment of cable O&M costs (€k)

Service	Total cost (both converter stations)
O&M Start-Up Costs	
Setup monitoring and telecommand (third party)	[✂]
Setup of home base for O&M	[✂]
Substation setup - safety equipment, earths, demarcation, etc	[✂]
Storage fit-out - storage shelving/containers, security, etc	[✂]
Initial transfer of data to AIS	[✂]
Specialised technical support for compliance tests	[✂]
Ongoing Maintenance Costs	
Provision of two SAPs under TCP safety rules	[✂]
Minor repairs - fixed price in lieu of T&M	[✂]
Outage maintenance	[✂]
Callouts onshore - fixed price in lieu of T&M	[✂]
Storage of substation spares and cable accessories	[✂]
Storage of spare cables	[✂]
Monitoring and telecommand	[✂]
Water & power (onshore substation)	[✂]
Telecoms	[✂]
Travel & accommodation expenses (Y1-3)	[✂]
Travel & accommodation expenses (Y4-25)	[✂]
Environmental monitoring: fisheries surveys	[✂]
Environmental monitoring: benthic surveys	[✂]
Geophysical surveys (marine license period)	[✂]
Geophysical survey (post marine licence period)	[✂]
Midsize maintenance reserve: yr 1-3 (repair work under warranty)	[✂]
Midsize maintenance reserve: yr 4-10 (new but not under warranty)	[✂]
Midsize maintenance reserve: years 10-25 (assets now midlife)	[✂]
Total Offshore O&M Costs	**[✂]**

Source: Atkins analysis of benchmark prices from previous OFTO and HVDC projects

Offshore callouts are excluded from GIL's O&M contract costs and have been removed from Atkins benchmarks. However, GIL acknowledges that there may be a requirement to procure these services in the future. Through use of Atkins' benchmarks, we estimate a total cost of roundly €430k for offshore callouts over the 25-year operational period.

5.4. Remediation services

The Phase 2 scope included a review of GIL's assumptions on remediation services. Remediation services cover activities such as cable reburial or rock protection. These costs appeared to have been omitted from GILs estimate, so Atkins submitted an SQ asking for clarification.

GIL confirmed the cost of reburial works is not specifically included in its O&M contract costs. However, it has made provision in the risk register for remediation. This risk has been assigned a 'high' residual rating (probability 75%) and most likely case contingency of c€[✂]m. Consequently, Atkins consider that these services are accounted for within GILs estimates.

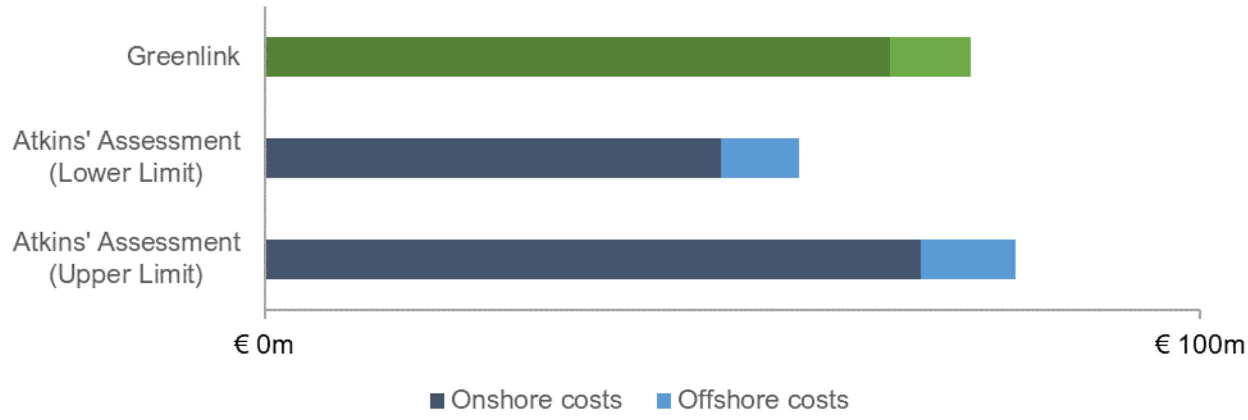
5.5. Findings with regards to O&M

An overall comparison of Atkins' bottom-up O&M assessment and GIL's current O&M costs is presented below. O&M costs are at the upper end of the calculated benchmark range even when we adjust for known differences between GIL's approach and Atkins benchmarks.

Table 5.3: Comparison of Atkins' Phase 2 benchmark assessment versus current Greenlink O&M costs (€m) over 25 year asset lifetime

	Onshore converters	Offshore cables (including surveys)	Total
Atkins estimate	[✂] – [✂]	[✂] – [✂]	[✂] – [✂]
GIL FPA submission	[✂]	[✂]	[✂]

Figure 5.1: Comparison of upper and lower limits of Atkins' benchmarking assessment (Phase 2) against current Greenlink O&M costs (€m) over 25-year operational period.



Source: Atkins analysis of GIL data (b.1.1 FPA Supporting Evidence) and Atkins own benchmark data

5.6. Overall opex

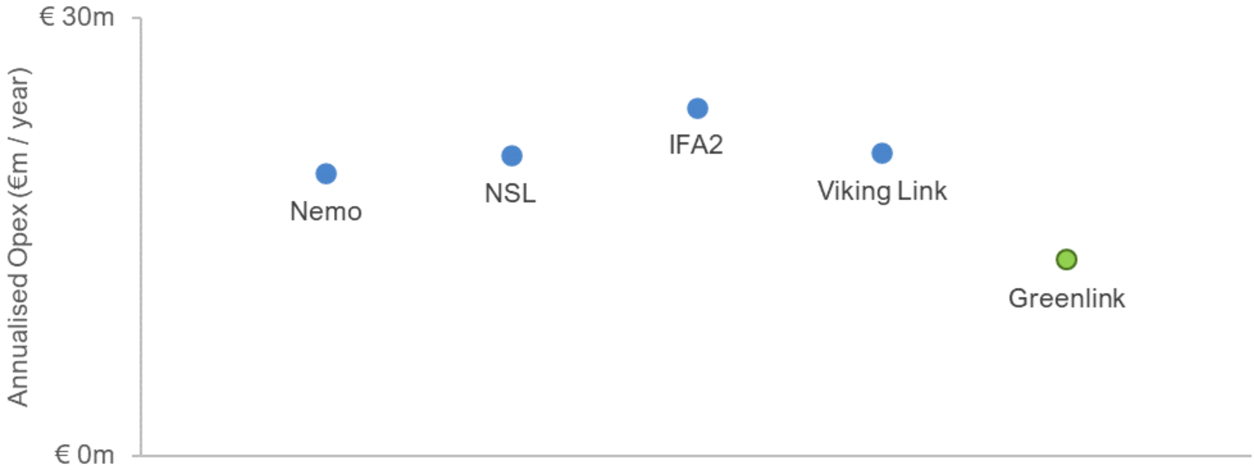
Our analysis of opex costs in Phase 2 has focused on contracted O&M, where the Phase 1 work indicated that further costs analysis was required. In Phase 1 we also considered insurance costs.

However, because GIL has taken an O&M approach that is different to most other interconnector projects, a number of services that are included in GIL's O&M contract differ from the O&M contracts which make up the bulk of Atkins' benchmarks. To address this, Atkins also took the prudent approach of comparing GIL's total opex with a group of other interconnector projects to provide a ‘top-down’ view on opex in the round. This is a simple comparison of total opex costs for each comparator against GIL’s projected total opex. A summary of Atkins’ top-down benchmarking of OPEX costs is provided in Table 5.4 and illustrated in Figure 5.2.

Table 5.4: OPEX comparative top-down benchmarking assessment (€m, 2020 prices)

Interconnector	Opex over 25 years (€m)	Average annual opex (€m/yr)
Greenlink	336	13.4
NEMO Link	[✂]	[✂]
NSL	[✂]	[✂]
IFA2	[✂]	[✂]
Viking Link	[✂]	[✂]

Figure 5.2: Annualised opex comparison



Source: Atkins analysis of Ofgem FPA decision documents

Based on this top-down comparison, GIL’s overall opex cost sits below the other cap and floor interconnector projects. Our capex benchmarks took into account issues such as scale, but this analysis does not because there is no single cost driver which is most appropriate. Whilst differences in capacity and cable length are obvious differentiators between interconnector projects, and the scale of the interconnector will have some influence on costs, Atkins’ view is that these have less impact on opex and O&M than on capex costs.

It should also be noted that this analysis does not seek to strip out “non-controllable” opex costs (e.g. Crown Estate Lease Fees) because there is insufficient information provided in Ofgem’s FPA documents to be able to do so. Such costs can vary significantly between projects but are not generally considered within the developer’s control. For example, on Nemo non-controllable opex accounts for €34.8m out of €431.6m total opex (2013/14 prices)[23] and on Viking Link it accounts for €148.5m out of €441.25m total opex (2018 prices).[24]

[23] Ofgem (December 2019) “Decision on the PCR of the Nemo Link interconnector” available online

[24] Ofgem (September 2020) “Decision on the FPA of the Viking Link interconnector” available online

5.7. Replacement costs

This section summarises Atkins' top-down benchmarking of replacement (repex) costs based on its previous experience and other HVDC project benchmarks, as well as Atkins' further investigation of replacement items which GIL does not appear to have accounted for in its submission.

Overall, we find that GIL's submitted repex costs (€17m) lie within a top-down benchmark range of €[✂]m – €[✂]m. However, CRU should note that GIL's estimate lies at the bottom end of our benchmark range. This may suggest a further cost allocation issue which GIL may wish to explain in order to provide confidence that its estimate is complete.

5.7.1. Context

For replacement expenditure, the FPA (Section 3) provided a breakdown of estimated replacement of major equipment items and other necessary replacement requirements over 25 years. The information provided was unclear on how many units GIL expected to replace through the project lifetime. As such, a granular analysis of GIL's plans could not be completed in our Phase 1 Review.

Instead, Atkins developed an independent repex estimate using the information provided in GIL's submission and other identified replacement capex requirements and compared these to GIL's submitted costs. All components of reactive routine maintenance as part of the replacement capex regime were included. Cost and other replacement information used in this analysis came from previous Atkins experience and other projects.

While Atkins did not carry out a detailed bottom-up benchmarking of repex, the high-level assessment suggested that this was an area of concern for further assessment. It was also unclear how these costs align with spares provision within the EPC contracts.

Since then, GIL has provided more information which is considered in our Phase 2 Review.

5.7.2. Analysis

GIL's submission includes €17m of repex (in 2020 prices) as shown in

Table 5.5 below.

Table 5.5: Summary of GIL's repex submission over 25 years, both converter stations

Replacement event	Asset life	In scope	Unit cost (€k)	Ops year	Total cost (€k)
Transformer coolers	25	2	250	23	[✂]
Valve coolers	25	2	250	23	[✂]
Human Machine Interface	7	2	2,000	7, 15, 23	[✂]
Comms & control system spares	16	2	2,000	16	[✂]

Source: b.1.1 FPA Supporting Evidence v15.xls

Atkins carried out an updated analysis of repex costs, which included a review of the items currently accounted for in GIL's repex costs[25] as well as several additional items which would typically be included in replacement costs . This was used to calculate a bottom-up repex

25 As provided in the replacement costs tab of the spreadsheet b1.1 FPA Supporting Evidence v15

benchmark of €[✂]m. Further top-down analysis of similar HVDC projects was also carried out to provide an additional data point for comparison.[26]

Atkins' top-down analysis based on previous HVDC projects suggests a repex benchmark range of €[✂]m – €[✂]m over the 25-year period. GIL's lies within that range, although it is at the lower end. As noted in other parts of this report, categorisation of costs for comparison has been challenging given the limited granularity of the data that GIL holds. Our experience to date suggests that costs, which currently appear to be omitted, could in fact be accounted for elsewhere. GIL may wish to provide further evidence on the allocation and quantum of its repex costs in order to reassure the CRU that its estimates are complete.

Replacement items not considered by GIL

Table 5.6 below sets out the unit and lifetime cost of items Atkins would expect to find within a repex estimate, based on industry benchmarks, and the items initially flagged by Atkins in the Phase 1 review. All costs are based on current value and the converter replacement costs are for single end only.

Table 5.6: Summary of Atkins replacement items, costs and replacement year

Replacement event	No. events	Unit cost (€k)	Ops year	Total (€k)
Industrial PCs / LAN Switches	3	[✂]	4 to 25	[✂]
Cable integrity management	3	[✂]	6, 12, 17	[✂]
Reburial (post-lay cable jetting)	3	[✂]	6, 12, 17	[✂]
Power electronic modules	8	[✂]	4 to 25	[✂]
Batteries (asset replacement due to age)	2	[✂]	12, 25	[✂]
Protection relays (age and/or failure)	2	[✂]	9 to 25	[✂]
Cable Failure (replacement after failure)	2	[✂]	12, 24	[✂]
Switchgear maintenance	2	[✂]	9, 18	[✂]
Link Box replacement (water leakage)	3	[✂]	7, 14, 21	[✂]
IGBT power modules	8	[✂]	Every 3 yrs	[✂]
Capacitor components associated w/ filters	12	[✂]	Every 2 yrs	[✂]
Control systems	1	[✂]	Every 12 yrs	[✂]
Coolant systems	6	[✂]	Every 4 yrs	[✂]
VSC AC filter	6	[✂]	Every 4 yrs	[✂]
Total				**[✂]**

Source: Atkins analysis

The repex analysis reinforces the caution with which bottom-up benchmarks should be treated, and the importance of considering GIL's costs in the round. For example, some aspects of GIL's submitted costs are at the top-end of our benchmark range (e.g. O&M), and others are at the low-end (i.e. repex). The CRU should consider to what extent this might be driven by, for example,

[26] Other HVDC projects included [✂], [✂] and [✂] (planned)

GIL’s choice of asset management strategy compared to other interconnector projects. In an offshore context, “sweating the asset” might be a more appropriate strategy than it would in other capital projects.

6. CONCLUSIONS FROM THE COST REVIEW

This section sets brings together the findings of the cost benchmarking analysis. It also raises some questions and issues that the CRU may wish to consider before taking a final view on the level of costs that GIL has submitted in its FPA.

Table 6.1 compares an overview of GIL's costs against the CEPA–Atkins benchmarks. The sections which follow identify issues with GIL's overall submission and by cost category.

Table 6.1: Proposed cost allowances by cost category, to calculate cap and floor values (€m)

<table>
<tr><th>Cost category</th><th colspan="2">Status</th><th colspan="2">GIL FPA</th><th colspan="2">Benchmark</th></tr>
<tr><td>Devex</td><td>GIL</td><td>Firm</td><td colspan="2">23.8</td><td colspan="2">[✂] – [✂]</td></tr>
<tr><td>EPC Capex</td><td>Contract</td><td>Firm</td><td>[✂]</td><td rowspan="5">451.0</td><td>[✂] – [✂]</td><td rowspan="5">[✂] – [✂]</td></tr>
<tr><td>Contractor PM</td><td>Contract</td><td>Firm</td><td>[✂]</td><td rowspan="2">[✂] – [✂]</td></tr>
<tr><td>Developer PM</td><td>GIL</td><td>Firm</td><td>[✂]</td></tr>
<tr><td>Other developer capex</td><td>GIL</td><td>Firm</td><td>[✂]</td><td>[✂]</td></tr>
<tr><td>Developer risk</td><td>GIL</td><td>Firm</td><td>24.2</td><td>Accept</td></tr>
<tr><td>Opex</td><td>Contract</td><td>Provisional</td><td colspan="2">335.5</td><td colspan="2">[✂] – [✂]</td></tr>
<tr><td>Repex</td><td>Contract</td><td>Provisional</td><td colspan="2">17.0</td><td colspan="2">[✂] – [✂]</td></tr>
<tr><td>Decommex</td><td>Contract</td><td>Provisional</td><td colspan="2">8.8</td><td colspan="2">Not considered</td></tr>
<tr><td>Total</td><td></td><td></td><td colspan="2">835.9</td><td colspan="2"></td></tr>
</table>

The charts below show the comparison between GIL's submitted costs and our benchmark ranges for devex, capex, opex and repex.

Figure 6.1: GIL's devex submission compared to other cap and floor interconnector projects (2020 prices)

Source: CEPA analysis of published information on other cap and floor interconnector projects

Figure 6.2: Top-down comparative benchmarking of capex costs (€m)

Source: Atkins analysis

Figure 6.3: Top-down comparative benchmarking of opex costs (€m, 2020 prices)

Source: Atkins analysis

Figure 6.4: GIL's submitted repex costs against our benchmark range (€m, 2020 prices)

Source: Atkins analysis

Our conclusions on each of the major areas of cost are detailed further in the sub-sections below.

6.1. TOTAL COSTS BY CATEGORY

Our analysis of development expenditure or 'devex' is limited given that no issues were identified in Phase 1. Our high-level benchmarking suggests that GIL's devex is comparatively high, towards the top end of our range. The CRU may take the view that this is a function of the project taking a long time to reach FPA stage or it might consider a small disallowance that would bring GIL's costs in line with the mid-point of our benchmark range.

When we consider capex and opex costs against our benchmarks, GIL is in the upper quartile or above the top of our capex benchmark range, depending on whether developer risk is included or excluded, but it performs well on opex. Those high-level numbers mask mixed results at a more disaggregate level. The key issues on capex are:

- **Converter station** costs which exceed our benchmark range on any analysis, a position for which we do not have a clear explanation. We suggest that GIL be asked to provide more detail on this and any interplay between the categorisation of converter station and subsea cable costs. This will allow for a more confident assessment of GIL's overall capex position.

- **Project management** costs which are high (at the top of the range) even when considered in the round and allowing for the turnkey approach that GIL plans to use with its contractors. The CRU may wish to consider the merits of making a small disallowance in this area.
- **Construction insurance.** We have not considered insurance in Phase 2 given that the estimates provided by GIL are subject to change and we reviewed them in Phase 1. But we are aware that Ofgem is considering whether covering the costs of delay in start-up (DSU) insurance is in the consumer interest. CRU may wish to do the same.
- The cost associated with **developer risk** is at a level that might be expected based on our comparison with other cap and floor projects. But we note that some risks in the register identify uncertainties, e.g. in respect of the scope of the PCR and the regulatory approach. It is important to the progress of the project that these issues are resolved, ideally in a way that does not materially increase costs and does not create a risk share that limits the appetite of lenders.

Alongside our recommendation on the size of the risk allowance, CRU should also note the following recommendations on risk:

- **GIL seeks protection against exchange rate movements between the regulators' final decisions and financial close.** We suggest that CRU sets an expectation that any adjustments for such costs will only be considered on a case by case basis, and will depend on the mitigating actions taken (i.e. not to protect GIL from delays to Financial Close that it could have managed better). We do not recommend an adjustment to the cap and floor levels for exchange rate movements at the PCR in relation to construction costs, as this risk should be reflected in GIL's risk allowance.
- **CRU and Ofgem should work together to minimise and resolve any residual uncertainty about the scope of the PCR.** CRU's Final Decision should give guidance to what types of risk events may qualify for "risk" capex allowances in the PCR. The guidance should be comparable in detail and content to that provided by Ofgem in its FPA decisions (see Section 5.3.2 of our Regulatory Framework Report).
- **CRU and Ofgem should work together to minimise any divergence in regulatory processes.** GIL's lenders may be uncomfortable with significant differences between CRU's regime and Ofgem's more established regime. If the differences are material, this could delay Financial Close and result in GIL incurring additional cost. CRU will need to consider this risk carefully as it develops its final position.

On opex the residual concern is that despite O&M costs being high (towards the top end of our range), overall opex is low when compared to other cap and floor benchmarks. In both cases, the benchmarks are indicative given the limited information that GIL has access to from its contractors and its approach to O&M overall, which differs from other projects in the degree to which is outsourced or contracted. A particular concern is that opex costs can be reopened and the incentive this creates. Given the risk that GIL's costs could increase, given their current low position, we suggest that CRU consider limiting the scope of the PCR in relation to opex. It might for instance opt to limit the scope of that reopener to allow only for additional costs that could not have reasonably been foreseen or mitigated at the time of the FPA.

Similar to opex, GIL's repex costs are also at the low end of the range and Atkins highlights areas where the provision may be insufficient. As we note earlier, separating repex from maintenance costs is not straightforward and differences in categorisation between repex and O&M for instance may contribute to a low number. Whatever the explanation, there is a risk that these costs could rise in the future and CRU may also wish to protect consumers from such increases by limiting the scope for change.

We have not reviewed decommissioning costs. These costs were not previously raised as an area of concern. However, we recommend that for now CRU uses GIL's estimates to set the provisional cap and floor levels but undertakes to review these costs in more detail at the PCR.

6.2. WIDER CONSIDERATIONS

Once the CRU has taken a view on total costs, it may wish to consider how the total 25-year cost affects the overall value for money of the project. The value for money case is likely to remain strong under the "high renewables" scenarios, but the CBA analysis showed that the case was more marginal under scenarios where another interconnector came onto the Irish system, particularly under scenarios where the penetration of renewables is low. Any increase in cost since the CRU's CBA was undertaken will adversely impact the value for money assessment under these more marginal scenarios and as a consequence, the CRU may wish to mitigate any further cost increases subsequent to GIL's FPA submission.

GIL's overall approach to the project is to contract out much of the operational work and take a high-level supervision of it, and to focus its day-to-day activities on the interconnector's commercial operations. The construction work will be undertaken on a turnkey basis, with GIL's main contractors taking most of the project risk. Thereafter, a significant part of its operational staffing will be provided on a contracted basis. This raises an issue about GIL's ability to act as an informed client which will be important if the project experiences any material difficulties. The CRU may wish to ask GIL to provide assurance that it has sufficient technical know-how and, perhaps more importantly, access to information from its contractors to make informed decisions and overall manage the project effectively.

The CRU may also wish to establish an annual performance review of the project against budget and schedule, which would act as an early indicator of any emerging issues and would inform any future reopening of the costs. The CRU would set out what it expects to receive from GIL to meet the expectation of keeping itself informed. If the CRU does adopt this approach, we would recommend that the requirement to provide information, and potentially the level of detail and format of that information, should be made an obligation on GIL's supply chain not just GIL. This would require GIL to include such an obligation in the EPC and SMA contracts that it is currently negotiating.

7. AVAILABILITY ASSESSMENT

This section summarises Atkin's calculation of overall system availability. The aim of this section is to help inform CRU's decision on where to set the project specific availability target, which is used to incentivise GIL to maximise availability of the interconnector when revenues are high. For further background on the availability incentives, see Section 4 of CEPA's Regulatory Framework Report.

Based on Atkins' experience and benchmark values for failure modes and repair times, as well as updated reliability guarantees provided by GIL's preferred equipment providers, Atkins now calculates overall system availability to be 96.7%. Subject to further engagement with Ofgem on its assessment of system availability, we recommend that CRU uses this value to set the annual target availability level against which the cap availability incentive applies.

CRU should also note the interaction with the minimum availability incentive (see Section 4.4 of our Regulatory Framework Paper). We recommend the CRU implements a minimum availability incentive that requires GIL to achieve 80% annual availability to be eligible for floor payments in any given year. This is subject to two exceptions, including a limited facility for GIL to receive floor top-ups when availability is below 80%, consistent with our expectation of how Ofgem will treat the interconnector in GB. Nonetheless, Atkins' analysis suggests that a scenario in which GIL requires several years of temporary floor top-ups when availability is below 80% is remote.

7.1. CONTEXT

Overall system availability refers to the proportion of time that the system is operational. It is calculated as 100% availability minus the sum of planned and unplanned unavailability:

- **Unplanned unavailability** relates to the loss of capacity due to unplanned events such as manufacturer defects, faults or physical damage to components of the system. Reliability refers to the proportion of time that the system is available and not subject to any unplanned outages.
- **Planned unavailability** considers loss of capacity for maintenance outages. Generally, planned outages are not considered for the O&M of subsea and underground cables. Planned availability includes the feasible alignment of maintenance of dependent systems during an outage.

Under Ofgem's cap and floor regime there is a cap availability incentive which gives a 2% upside and downside to maximum interconnector revenues at the cap based on performance against a target level of availability. If GIL outperforms against the target by up to two percentage points, then the cap level increases by the same amount. If GIL underperforms against the target by up to two percentage points, then the cap level reduces by the equivalent.

The specific availability target varies from project to project, depending on several technical factors such as project design and cable length. To calculate GIL's overall system availability, Atkins sums the availability of its individual components, taking the following factors into account for each part:

- **MW lost.** The resultant loss in system capacity due to a single or multiple fault(s) on components. The latter is dependent on the system design and system configuration.

- **Outage rate.** The outage rate factors in the number of components or the length of cabling as well as capacity of the converters and transformers. This is obtained from the mean time before failure (MTBF) of individual components.
- **Outage duration.** The system downtime due to fault on components. This is obtained from the return to service time or mean time to repair (MTTR) of individual components.
- **Component unavailability (hr/pa).** Ratio of component downtime to operational time.

The availability and reliability estimates in Atkins' Phase 1 assessment were derived based on Atkins own experience, as well as CIGRE data. The data for Mean Time Before Failure (MTBF) and Mean Time To Repair (MTTR) primarily come from information provided by CIGRE14.

Since then, GIL has provided an availability guarantee figure for the offshore cable via the SQ process. Atkins has recalculated the availability figures, as explained in Section 7.2 below.

7.2. Calculated availability and the cap availability incentive

To assess the overall availability for Greenlink, Atkins calculated:

- **Substation Unavailability.** Failure modes and repair times for substation equipment contracted by GIL. Atkins benchmark values included documented reliability guarantees provided through GIL's data room to estimate planned and unplanned availability values.
- **Cable Unavailability.** Failure modes and repair times for cable equipment. This is based on updated estimates provided by GIL:

  "MTBF assumed by Greenlink for the submarine cable is low (approximately [✂] faults / 100 ct. km yr). This is a conservative assumption and supported by industry data (Cigré 379) and the cable manufacturer ([✂]).[27]"

  This is higher than the [✂] faults / 100 ct. km yr value used in the Phase 1 Review, so the availability figure has been recalculated using the new figure provided by GIL. The MTTR assumption has not changed since the Phase 1 Technical Review and is [✂] days and [✂] days for onshore and offshore cables respectively as stated by the cable manufacturer.

Once combined, Atkins calculates overall system availability to be 96.7% as shown in Table 7.1.

Table 7.1: Calculated system availability

Asset	Phase 1 Unavailability	Phase 2 Unavailability
Cable Unplanned Unavailability	[✂]%	[✂]%
Substation Unplanned Unavailability	[✂]%	[✂]%
Planned Unavailability (system)	[✂]%	[✂]%
Total Unavailability	2.85%	3.30%
Overall System Availability	**97.15%**	**96.70%**

[27] Source: "GIL cost changes_August submission SQ Responses 11th Aug 2020 Final"

Ofgem will also calculate overall system availability separately. Ofgem maintains an extensive availability model and is similarly based on Cigre[28] and interconnector project data, though Atkins has relied on actual GIL data where available. Whilst Atkins' calculations provide CRU with its own estimate of 96.7%, we recommend that the annual target system availability level against which the cap availability incentive applies should be consistent between the regulatory authorities.

7.3. Minimum availability incentive

As explained in Section 4.4 of our Regulatory Framework Report, support from Irish consumers through a cap and floor regime is founded on the expectation that GIL will design, operate and maintain the interconnector to a high standard. GIL should have limited recourse to payments from Irish consumers should that not be the case. The purpose of cap and floor payments is primarily to manage the revenue risk of interconnectors, not to protect GIL from events (e.g. outages) that are within its reasonable control.

As such, Ofgem's regime includes a financial incentive on developers to maintain the availability of the interconnector. Ofgem has typically set the minimum availability target threshold such that developers lose automatic eligibility for floor payments for each individual year in which overall system availability is below 80%. We recommend the CRU also implements a minimum availability incentive that requires the interconnector to achieve 80 percent annual availability to be eligible for floor payments in any given year, subject to the following exceptions:

- An Exceptional Event claim process for GIL to request unavailability due to force majeure to be excluded from this incentive (see Section 4.4.1 of our Regulatory Framework Report).
- A limited facility for GIL to receive floor top-ups when availability is below 80 percent (see Section 4.4.2 of the same report).

The proposed approach set out in our Regulatory Framework Report is consistent with our expectation of how Ofgem will treat the interconnector in GB. We recommend the CRU work with Ofgem to ensure that the above points are implemented in a symmetric manner in Ireland and GB.

7.3.1. Worst case scenarios

In the supplementary documents which accompanied GIL's April FPA submission, GIL provided two "worst case" availability scenarios in which the 80% minimum availability threshold is not met in some years.[29] The scenarios were constructed to demonstrate how GIL's lenders might review the impact on cashflows were there to be a long-term reoccurring fault which threatens the long-term availability of the project. It was not an exercise to develop downside scenarios that are likely

---

[28] https://www.cigre.org/

[29] GIL (14 February 2020) "Supplementary submission regarding Variation 2 of the Interconnector Cap and Floor regime"

in any probabilistic sense, but both were developed using historical industry data based on failure events on Western Link in 2017[30], and IFA in 2016.[31]

Table 7.2: GIL's worst case unavailability scenarios to illustrate need for temporary floor payments

Scenario	Description	Impact on availability
Third party damage resulting in reduced cable reliability	This scenario involves significant third party damage to the cable such an anchor dragging and causing a significant error or weakness with the cable and recurring faults which require repair/replacement. The anchor drag in year 7 is an arbitrary assumption which is based on the cable becoming exposed through sediment movement. The scenario also assumes that the exposure is not identified in a biennial survey and therefore unprotected.	The worst case time for repair in the literature for this type of event and recurring damage is four months which would result in availability of 66%. This level of availability would be during the year that third party damage occurs and in the years when repairs from recurring faults take place. GIL estimates that in this scenario there are approx. four years when the minimum threshold will not be met.
Latent defect or design issue not earlier identified creating an unreliable asset	This scenario describes an internal cable fault from the manufacturing or design process where the asset suffers a failure in the first year and experiences an increased failure rate in the early years of the project.	Under this scenario GIL estimates that there are approximately four years when the MAT will not be met.

Atkins note that GIL has not attached any probability to either of these scenarios materialising. There is not enough historic industry data to pragmatically model the likelihood and impact of these scenarios and to support factoring these scenarios into a robust availability assessment.

In Scenario 1 (third party damage) GIL has assumed a 4-month mean time to repair (MTTR) but Atkins notes that industry benchmarks and the guarantees provided by GIL's cable manufacturer suggest that [✂] months MTTR for offshore cable faults or damage would be a more appropriate assumption.

In Scenario 2 (latent defect or design issue) the failure rate starts at around [✂], decreasing to [✂] in year 7. Although the scenario is based on the difficulties which affected Western Link, it has still been arbitrarily designed to produce a "worst case" outcome.

Atkins considers these two scenarios to be the absolute worst case, which could be mitigated by:

- Robust Factory Acceptance Tests (FAT) and Site Acceptance Tests (SAT) undertaken by the selected manufacturer. GIL are also expected to have robust systems in place to monitor these. This would be attached to liquidated damages pre-final energisation and commissioning.

---

[30] The Herald (22 September 2017) "Emergency crews race to blast near Hunterston power station" available online

[31] New Civil Engineer (18 January 2017) "Vessels deployed to repair interconnector" available online

- Unless the cable and the system pass the SAT tests and commissioning process, it should not be handed over. For significant delays passing the liquidated damages cap Atkins would also expect a price reduction clause.
- It is also expected that significant availability damages are placed on the manufacturers during the warranty period post-handover.

Overall, Atkins' analysis suggests that a scenario in which GIL requires temporary floor top-ups when availability is below 80 percent over several years during the 25-year cap and floor period is remote.

Appendix A COST INPUTS FOR THE CAP AND FLOOR MODEL

	Price base	2015	2016	2017	2018	2019	2020	2021	2022
Devex	€m nom	0.004	0.675	0.699	1.013	1.913	8.144	11.343	0.000
Capex	€m nom	0.000	0.000	0.000	0.000	0.000	0.000	81.005	141.880
Risk	€m nom	0.000	0.000	0.000	0.000	0.000	0.000	5.207	8.008
Opex	€m 2020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Repex	€m 2020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Decommex	€m 2020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	2023	2024	2025	2026	2027	2028	2029	2030	2031
Devex	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Capex	176.814	18.370	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Risk	9.976	1.052	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Opex	0.000	16.445	12.890	13.851	12.790	13.853	13.152	13.390	13.871
Repex	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.000	0.000
Decommex	0.000	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351

	2032	2033	2034	2035	2036	2037	2038	2039	2040
Devex	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Capex	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Risk	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Opex	13.048	13.048	13.048	13.871	13.048	13.048	13.198	13.871	13.048
Repex	0.000	0.000	0.000	0.000	0.000	0.000	4.000	4.000	0.000
Decommex	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351

	2041	2042	2043	2044	2045	2046	2047	2048	Total
Devex	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	23.791
Capex	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	418.070
Risk	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	24.243
Opex	13.048	13.048	13.871	13.048	13.048	13.048	13.871	13.048	335.508
Repex	0.000	0.000	0.000	0.000	0.000	5.000	0.000	0.000	17.000
Decommex	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	8.782

Note: Years represent "year ending" and costs represent both GB and Irish shares (i.e. total costs)

Note: *We have disallowed €[✂]m from capex for inefficient PM costs and €[✂]m for DSU insurance*

Appendix B DISCUSSION OF RISK EVENTS

[✂].

UK

Queens House

55-56 Lincolns Inn Fields

London WC2A 3LJ

T +44 (0)20 7269 0210

E info@cepa.co.uk

www.cepa.co.uk

cepa-ltd @cepaltd

Australia

Level 20

Tower 2 Darling Park

Sydney NSW2000

T +61 2 9006 1307

E info@cepa.net.au