Draft Methodology for Calculation of Relevant Costs

First Call for proposals under the Innovation Fund

Discussion Paper in support of Technical Workshop 6 February 2020

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Contents

Executive Summary

Article 5 of the Innovation Fund Delegated Regulation defines the relevant costs of projects, which can be supported by the Innovation Fund: relevant costs are those additional costs borne by the project proponent to build and operate (for a ten-year period) an innovative technology aiming at reduction or avoidance of the GHG emissions, compared to a reference scenario. The relevant costs are needed to operationalise the cost-efficiency selection criterion outlined in Article 11 of the Delegated Regulation and to determine the maximum amount of the Innovation Fund award, which is set at 60% of the relevant costs.

The challenge is to choose a methodology which is appropriate for the diverse array of projects which may apply to the first call of the Innovation Fund, due to be launched in mid-2020. In practice, such a methodology should allow quantifying and calculating the relevant costs of projects, taking into consideration the trade-off between accuracy and ease, and respecting the broad variety of projects and technologies.

A decision tree has been developed to assist project proponents in understanding which reference scenario is best suited to their own project situation. This decision tree guides the project proponents through a set of structured questions which will lead them to choose one of four different calculation methodologies:

1. No reference scenario needed (i.e. where the project is small-scale, defined as less than EUR 7.5m total capital expenditure and the relevant costs are equal to the total capital expenditure costs);
2. The reference scenario can be ignored (where there is no conventional production to compare against, such as in the case of a post-combustion CCS project);
3. Reference unit costs / product methodology – where a reference plant is not clearly defined, nor is specific reference project data available, the end-product can be used as a reference for a comparative cost calculation and to derive the relevant costs;
4. Reference plant methodology – where a well-established formula (used previously in the NER 300 programme) is used to generate a relevant cost based on an agreed reference plant.

This discussion paper provides a summary of the different relevant costs calculation methodologies so stakeholders can understand their rationale, approach and likely results. It has been written specifically to help experts attending a technical workshop on relevant costs (to be held on 6th February in Brussels) to understand and challenge the practical application, workability and utility of these methodologies. Questions are raised at various points in the paper to initiate the discussions which will be continued at the workshop.

Feedback and recommendations on how to refine these draft methodologies (and associated calculation tools) will also inform the drafting of the first call guidance document.

1 Introduction

1.1 Relevant costs under the Innovation Fund and the purpose of this paper

The Innovation Fund (IF) follows the principle of additionality and only supports the additional costs that are borne by the project proponent as a result of the application of the innovative technology related to the reduction or avoidance of the GHG emissions.

In order to calculate a project's relevant costs, in most cases, a comparison must be made with a 'reference scenario'. The calculation of a reference cost is fundamental to calculating the maximum cost for which a project can apply to receive IF support. There are special cases such as small-scale projects and novel projects where a reference scenario simply does not exist or is not reasonable.

The relevant cost is not to be confused with the maximum intervention rate of the IF, which is equivalent to a maximum 60% of the relevant cost: this is the maximum grant award that is allowed under the IF.

Across all relevant cost calculation methodologies, since the IF ultimately requires a competitive application, it is in the interests of project proponents to provide as much own fund contribution as possible to ensure the financial viability of their project.

This discussion paper sets out the various reference scenarios, as described in the IF Delegated Regulation, that can be used by project proponents. It provides a summary of the draft methodologies and has been written to underpin a technical workshop with industry experts on 6th February.

The objective of the relevant costs workshop is to elicit comprehensive feedback and recommendations from stakeholders on how to refine these emerging methodologies and associated calculation tools. It is also to seek expert judgements on how to limit the choice of parameters for project proponents in order to ensure: (a) ease and simplicity of application; (b) fair comparability across applications; and (c) robustness and simplicity of evaluations which will be required by a number of independent evaluators[1].

This feedback will also inform the drafting of the respective guidance document and identify the key practical aspects which project proponents will need to consider in developing their application and to ensure clarity on key factors (such that, for example, specific investment aid provided by Member States to the project is not considered as an operating revenue).

Key questions for stakeholders to consider whilst reviewing this discussion paper:

1. Can the outlined methodologies be applied across multiple project types and industries and generate comparable results while not prejudicing one against the other?
2. Are the calculations generating a realistic estimate of the additional investment and ten-year operational costs and revenues associated with the application of innovative low carbon technologies?
3. Are the methodologies relatively easy to use by project proponents while being difficult to 'game'?

[1] For example, if data needs to be provided by the project proponent, which is either different from the guidance or is not supplied in the guidance, then third-party validation would be required, adding time and cost to the process

4. Can the methodologies be simplified in any way and what are the critical parameters where a choice can be left to project proponents?

The paper continues with an introduction to the relevant costs decision tree. It then follows with three sections setting out the different relevant costs calculation methodologies.

2 Relevant costs decision tree for project proponents

The relevant costs decision tree presented in Figure 2.1 seeks to guide project proponents in selecting the most appropriate reference scenario for the calculation of their relevant costs during their IF application. The decision tree follows the requirement of the IF Delegated Regulation and is based on the key characteristics of the project proponents that will define which reference scenario is most appropriate for different types of project. It results in four different options:

1. No reference scenario needed (i.e. where the project is small-scale);
2. The reference scenario can be ignored;
3. Select the reference unit costs / product methodology;
4. Select the reference plant methodology.

By working down the left side of the diagram, and helped by the supporting first call guidance, project proponents will end up with the particular relevant costs methodology to be followed based on the characteristics of their projects. The prevailing market situation which they are seeking to improve upon (for example, a lower carbon product or more efficient power production) will also impact the result. Obviously, for the purposes of ensuring a fair and transparent competitive bidding process, any project proponent who wishes to deviate from the guidance on specific parameters will have to provide justification that is defensible and based on considerations such as accuracy and availability of data, and comparability of the final product, or process. It will also have to be transparent and traceable such that a set of independent project evaluators can reach similar conclusions on relevant costs.

The key parameters identified as impacting the selection of reference scenarios include:

- The **size of the project** – to understand whether the project fits into the small-scale project category which applies to total capital expenditure of less than EUR 7.5 million;
- The **existence of a comparative conventional production** – as when this does not exist, the reference scenario can be ignored (for example, in the case of a post-combustion CCS plant[2]);
- The **existence of a reference unit cost / product** – here it is recognised that in the vast majority of cases there will be some form of reference product[3]. Indeed, the IF will not be able to support projects which come up with entirely new products or services that are not substituting existing ones in the EU ETS. However, there may well be cases where an innovative project is focused on a product (e.g. liquid steel) which is part of a process of producing a comparable end product (i.e. rolled steel);

[2] The main reason is that post-combustion CCS is an add-on, which does not result in any usable products but only in reduction of emissions, so the cost and benefits of the electricity or product of the plants on to which CCS is added can be ignored. However, with other technologies for CO_2 capture, one cannot dissociate the costs of capture and the total plant costs will need to be considered and then a comparison with the costs of conventional production would be necessary.

[3] Note, this does not refer to ETS product benchmarks which are sometimes wrongly termed 'Reference products' (see https://ec.europa.eu/clima/policies/ets/allowances/industrial_en for more details)

- The **existence of a reference plant**[4];
- The **availability of reliable reference product price information** – this is required to inform the relevant costs calculation;
- The **availability of reliable reference plant cost data** – to inform the relevant costs calculation; and,
- Whether the project is a **discreet ring-fenced project or an embedded process** – in order to establish the boundaries of the project to be financed, since this will not only impact on the nature of the funding that could be available (i.e. debt, equity, corporate finance), but also on the ease of obtaining a market price for the innovative product (for example, it could be challenging where an embedded process is producing an intermediate product, as in the steel example given above).

Key questions for stakeholders to consider whilst reviewing the decision tree:

1. Is the sequencing logical? Are there any elements which are confusing?
2. What exactly is meant by "conventional" production" (as quoted in the IF Delegated Regulation)? Is it always considered to be fossil-fuel-based or can it be low-carbon-based?
3. Are the example projects realistic and accurate? What additional projects could be added to each project category to give a more complete picture for different IF sectors?

[4] While there may not be a reference plant, there is always a reference scenario. However, sometimes this can be ignored since it does not change the calculation, such as in post-combustion CCS or in smart grids.

Figure 2.1 Draft decision tree for the selection of the reference scenario for project proponents

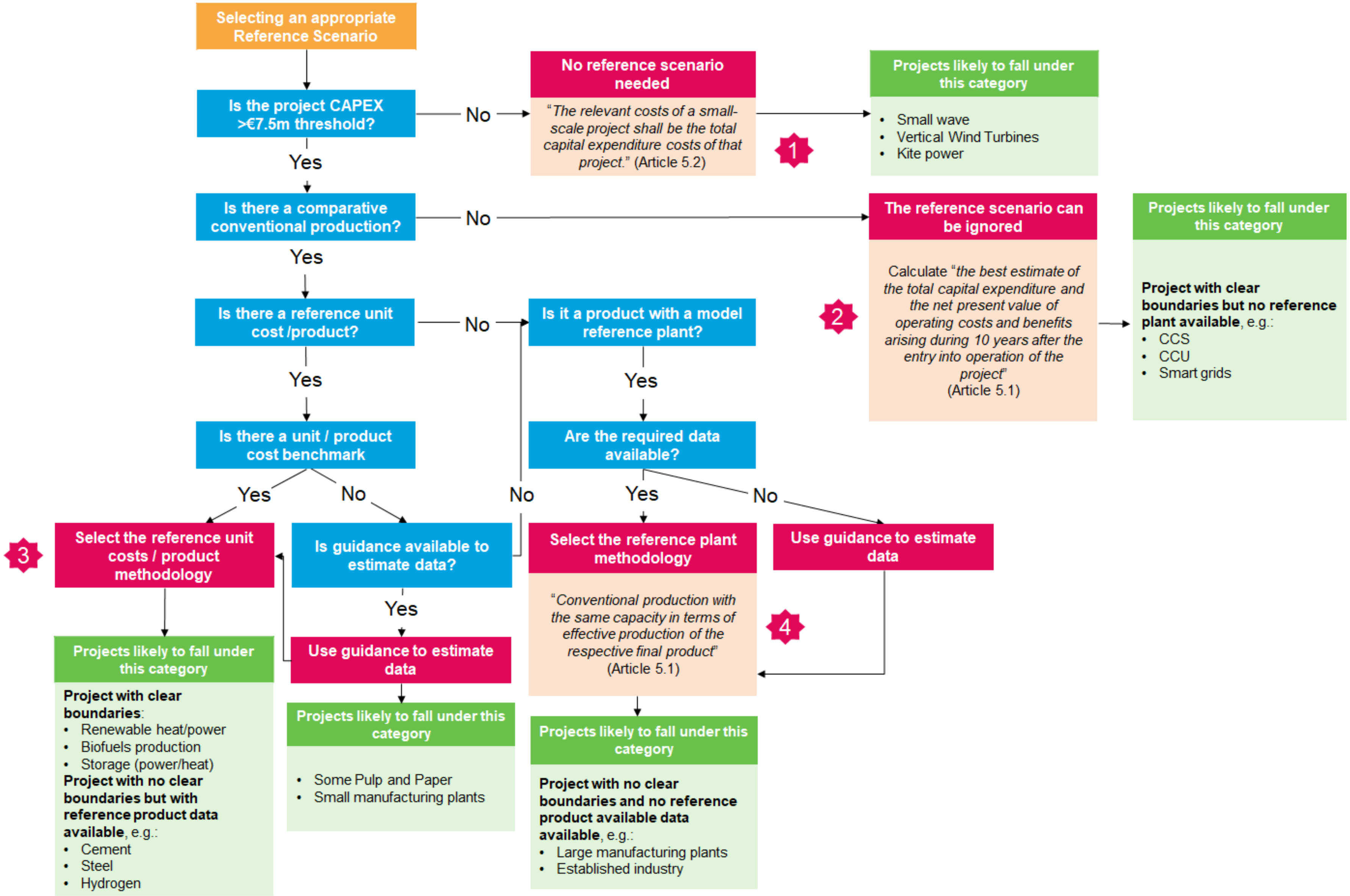


Table 2.1 below sets out an assessment of the different reference scenarios which could apply to a sample of project examples based on the above decision tree. The examples are projects where the project proponent has provided details of known reference plants/technologies and/or products to the consultant as a follow-up to the sectoral workshops in the Innovation Fund Tour 2019. Gaps in coverage across the IF eligible sectors show where further project insights would be helpful.

Based on this initial scoping of projects and testing/validation of the decision tree, it is clear that, in the vast majority of cases, the price comparison methodology is the preferable scenario, in terms of available market evidence, documentation and comparability. Indeed, it soon becomes evident that the reference-plant approach – designed to be used when a reference unit cost/product is not available – does not apply in many cases and it is therefore considered to represent a fall-back option when the price approach simply does not work.

These emerging insights – and more feedback to be obtained at the workshop - will serve as a basis for the development of the guidance accompanying the decision tree in the final guidance for project proponents to be developed ahead of the first call of the IF. They will also inform the guidance for the selection of an appropriate reference plant for the projects opting to use the reference plant methodology – more details are provided on this point under section 4.

Some of the key questions that proponents need to consider in working through the decision tree and thinking about a suitable reference scenario include the following:

- Is there more than one product as an output? This could make the calculation of relevant costs around product price much more complex (although the viability of this approach is being examined currently).
- Is there a departure from the quality of the product? This could make it challenging to directly compare the product to a conventional product.
- Is there a reference plant in the EU which can be used? This is because the reference plant should ideally be operating under the same conditions, e.g. in terms of environmental permitting regulations, health & safety considerations, etc.
    - ➔ (Potential) **Reference Plant Rule 1:** A reference plant should be ideally from within the EU, unless there is strong justification for a non-EU plant to be used.
    - ➔ (Potential) **Reference Plant Rule 2:** if a project proponent chooses to use a reference plant for the first time then there is an obligation on the proponent to have this plant checked by a third-party auditor prior to the application being made to validate the claim.
- Is there a low carbon “conventional" reference plant which can be defined?
    - ➔ (Potential) **Reference Plant Rule 3:** By default, the reference plant should be a low carbon plant when it exists and if, in the case of some renewable technologies (such as wind or solar PV), these low carbon plants may already be at or near grid parity in certain countries.

As illustrated, these questions (and additional questions which the study team will develop following the Workshop) will form the basis of the rules guiding proponent’s choices on suitable methodologies.

Key questions for stakeholders to consider whilst reviewing the illustrated examples:

1. Do the reference scenarios quoted make sense?
2. Are there any sectors where particular insights into innovations in the sector need to be flagged, since they could impact on the guidance?
3. Are there obvious reference plants or products which can be identified?
4. What rules make sense for Reference Products?
5. Do the potential rules for Reference Plants make sense? What other rules can be considered?

Table 2.1 Reference scenarios as applied to shortlisted project examples based on working through the draft decision tree

Project characteristics			**Reference scenarios**				
Eligible sectors	**Final product categories**	**Project examples**	**Is the project CAPEX> €7.5 million?**	**Is there a comparable conventional production?**	**What is the reference product?**	**Availability of product cost / price benchmark?**	**Potential reference plant (technology)**
RES - Wind	electricity	1. Floating offshore wind	Yes	Yes	Electricity	Yes - LCOE	Fixed offshore wind. (The proponent of the sole floating offshore wind project suggests *onshore* wind as the reference.)
RES - Bioenergy	electricity	1. High-pressure gasification of biomass for biogas firing	Yes	Yes	Electricity	Yes - LCOE	Conventional gasification of biomass. (The proponent suggests a "traditional steam cycle biomass-fired plant".)
RES - Bioenergy	carbon based fuels	1. Bioethanol production from sawdust	Yes	Yes	Bioethanol	Yes - cost of bioethanol	1st generation biofuels plant. (The second proponent suggest that there is no comparative conventional technology.)
RES - Ocean/Wave/Hydro	electricity	1. Wavepower pilot array	Yes	Yes	Electricity	Yes - LCOE	Existing, albeit very small-scale, demonstration arrays (examples in EU - Gibraltar; Australia)
RES - bio-energy, geothermal	heat	Two examples of geothermal projects: 1. aquifer-less geothermal; 2. low-temperature geothermal	Yes	Yes	Heat	Yes - LCOH	Conventional "hydrothermal" geothermal. (The proponent suggest that there is no comparative conventional technology.)
energy storage	energy storage	No examples received so far with sufficient information					
energy storage, ALL renewables	production facilities	1. Production of *ultra-pure* electrolytic salt LiPF6 for batteries	Yes	Yes: the production of non-ultra-pure LiPF6	LiPF6 (non-ultra-pure)	Yes - cost of LiPF6	Production of non-ultra-pure LiPF6
energy storage, ALL renewables	production facilities	2. Production of high-efficiency PV cells	Yes	Yes: the production of conventional PV cells	Conventional PV cells	Yes - comparable cost on an energy output basis from conventional PV cells	Production of conventional PV cells
refineries (including biorefineries)	carbon based fuels	1. production from timber residues of bio-oil *suitable for processing in an oil refinery*	Yes	Yes	Crude oil	Yes - cost of crude oil(s)	1st generation biofuels plant, but if that cannot be confirmed, crude oil production facilities.
	carbon based fuels	2. multi-feedstock biorefinery utilizing solid biomass and sustainable oils to produce advanced biofuels	Yes	Yes	Crude oil	Yes - cost of crude oil(s)	1st generation biofuels plant, but if that cannot be confirmed, crude oil production facilities.
	carbon based fuels	3. Production of renewable jet fuel from carbon from direct air capture and solar energy	Yes	Yes	Crude oil	Yes - cost of crude oil(s)	1st generation biofuels plant
iron & steel	metal ore	No examples received so far					
	pig iron, steel	1. Fossil-fuel-free steel production (involving hydrogen production, storage and use)	Yes	Yes	Steel	Yes - cost of steel (i.e. based on unit cost measure and process, for example Blast Furnace process per	Yes: Steel production involving use of green hydrogen produced through electrolysis. (Proponent suggests conventional steel production at conventional steelworks.)
	ferrous metals	No examples received so far					
non-ferrous metals	aluminium	No examples received so far					

Project characteristics			Reference scenarios				
Eligible sectors	**Final product categories**	**Project examples**	**Is the project CAPEX> €7.5 million?**	**Is there a comparable conventional production?**	**What is the reference product?**	**Availability of product cost / price benchmark?**	**Potential reference plant (technology)**
non-ferrous metals	other non-ferrous metals	1. Recovery of non-ferrous metals (and other valuable materials) through recycling of PV cells	Yes	Yes - but there is not one conventional method for producing all materials recovered whereas recycling allows them to be recovered all within the same operation	Silicon (in the form of powders) is the main one; others include silver and indium	Yes - cost of silicon	Yes: production of silicon
Cement & lime	cement clinker	1. Cement production involving calcined clay as a substitute for a portion of the clinker	Yes	Yes	Portland cement	Yes - cost of cement	Yes: production of cement in annular shaft kilns
	cement clinker	2. Cement production with CCS (also hydrogen production with electrolysis from wind power, production of fuels and gases from hydrogen and CO2 from cement production, use of waste heat in nearby industrial park.)	Yes	Yes	Portland cement	Yes - cost of cement	Yes: production of cement in annular shaft kilns
	lime, dolomite, calcinate	No examples received so far					
Glass & ceramics	glass and glass fibers	No examples received so far					
	ceramic products from firing		No	Yes	Porcelain ceramic	Yes - cost of porcelain ceramic	(Gas-fired) production of porcelain ceramic
Mineral wool, Gypsum	other mineral product	No examples received so far					
Pulp & paper	pulp (also lignin & hemicellulose for conversion into organic chemicals)	1. "Mild" pulping process based on Natural Deep Eutectic Solvents	Yes	Yes	Pulp	Yes - cost of pulp	Yes: ChemiMechanical Pulping. (The proponent suggest Kraft pulping.)
	paper/cardboard	No examples received so far					
Chemicals	carbon black, nitric acid, adipic acid, glyoxal, glyoxalic acid, ammonia, organic chemicals	No examples received so far					
	soda ash, sodium bicarbonate	1. Capturing CO2 from the dry flue gas scrubbers of an industrial facility, and using it as raw material for producing sodium bicarbonate	Yes	Yes: the conventional production of NaHCO3	Sodium bicarbonate	Yes - cost of sodium bicarbonate	Production of sodium bicarbonate
	inorganic chemicals	No examples received so far					
Hydrogen	hydrogen	1. Hydrogen transported by means of liquid organic hydrogen carrier	Yes	Yes	Compressed hydrogen transported / hydrogen formed through steam reformation at particular customer's	Yes - with respect to hydrogen formed through steam reformation	Production of hydrogen through steam reformation
	hydrogen	2. Hydrogen from electrolysis	Yes	Yes	Hydrogen	Yes - with respect to hydrogen formed through steam reformation	Production of hydrogen through steam reformation
CCS	CO2 sequestered	Project to capture CO2 from industrial capture sources, liquify it, and transport it by pipeline to subsea storage	Yes	No	CO2 sequestered	No	None: there is no comparative conventional production
CCU	CO2	No examples received so far - except for the project involving CCU for sodium biocarbonate production above					

3 Reference unit cost / product methodology - the main proposed option for proponents

Summary of methodology

Applies a Levelised Cost of Energy (LCOE) approach in reverse to generate a per unit production cost that can be compared to reference product costs and thereby establish the relevant costs. This approach is appropriate for power and heat projects.

The approach can also use the market price of the innovative product, compared with the market price of its reference product, to establish the relevant costs. This approach is therefore also appropriate for industrial projects.

The vast majority of projects (with capital costs over €7.5m) should end up being able to follow this methodology.

3.1 Key principles underpinning the approach

Where a reference plant is not clearly defined, nor is specific project data available, the end-product can be used as a reference for a comparative cost calculation. The product price methodology is simply a reverse method of calculating the relevant cost (or 'additional' actual cost of construction) of a new facility. The IF is a grant fund for a portion of direct construction and direct operational costs of a specified technology. It does not attempt to reward benefits that have not actually been incurred as a net cost.

In many industries there are accepted **long-term forward pricing forecasts** used for project funding (for example, the Levelised Cost of Energy (LCOE) in electricity production) OR there is a **standardised per product cost benchmark** (as for example in blast furnace steel production). We cover both aspects in this section.

3.1.1 Advantages of applying a product view of the world using the Levelised Cost of Energy (LCOE) approach

There exists within the electricity generation market, a common calculation method for the final achieved tariff – in this case the per unit cost. This is the product cost (associated with the cost of Capex, Opex and Revenues) across different technologies.

The LCOE calculation is the same as the calculation of the relevant cost for a reference plant and a new plant. It is a measurement used to assess and compare alternative methods of energy production. The LCOE of an energy-generating asset can be thought of as the average total cost of building and operating the asset, per unit of total electricity generated over an assumed lifetime. Importantly, however, it includes the cost of financing the plant based on the expected cost of capital for a particular technology.

The simplified formula[5] to calculate the LCOE is:

*(Net Present Value (NPV) of Total Cost Over the Lifetime – i.e. Capex plus Opex cash flows)/(Present Value of All Electricity Generated Over the Lifetime – i.e. the NPV of revenues)**

[5] The full LCOE formula includes a Weighted Average Cost of Capital (WACC) requirement - not shown by this written representation - but thus illustrating the linkage with WACC calculations

*Note: *it is important to state that this LCOE formula does not include any subsidies or State Aid. For example, feed-in tariffs and/or construction subsidies will reduce the final relevant cost. Therefore, to ensure comparability between a method for a reference plant and this LCOE method for the Innovation Fund, the way that subsidies are to be treated will need to be consistent. Further adjustments may be necessary therefore.*

The LCOE can be thought of as the average minimum price in which the electricity generated by the asset is required to be sold at (i.e. the per unit, per 'product' price), in order to offset the total costs of production over its lifetime, and provide an acceptable market return to the debt and equity investors in that project. Calculating the LCOE is related to the concept of assessing a project's NPV.

Similarly to using NPV, the LCOE can be used to determine whether a project will be a worthwhile venture. It can be used to both determine whether to move forward with a project or to compare different energy producing projects. If the LCOE is above the achievable tariff (the price achieved by the project specific Power Purchase Agreement (PPA) (usually a percentage of the wholesale price plus the applicable subsidy if any or in the case of the Feed in Tariff that fixed price), then a project will have to secure concessional or grant funding in order for it to proceed.

Where a project has defined boundaries, an LCOE calculation is relatively easy except for the calculation of the discount rate. The discount rate applied in the LCOE calculation is its Cost of Capital. Cost of Capital is a general term which refers to the risk-adjusted cost rate that investors ask as a return for their investment. The Weighted Average Cost of Capital (WACC) is a calculation of a project of company average costs of capital by determining a blended return expectation based on the financial structure (the ratio of debt and equity funding and the respective rates of return expected from those two sources of capital pro rata).

WACC can be applied to determine either the correct LCOE or the unit cost price, by discounting future income and cost streams to make them comparable.

Firms can either use the calculation guidelines presented below or their own documented WACC where relevant (e.g. in a published annual report).

3.1.2 Applying the LCOE in reverse to determine relevant costs

Corporate finance decision-making is usually (in the absence of other strategic reasons to pursue a project) considered to be made based on financial attractiveness of the project. That is to say, does the project have a positive NPV based on its cost of capital?

Here, the company would calculate the cost of the project based on a similar calculation to that of an energy project, but the revenue line would be related to the final product price:

If there exists:

- a product price that can be benchmarked in the market; AND,
- a product price to be established by the financial model of the project or business,

Then there is a basis to determine a calculation which corresponds to the IF Delegated Regulation, in the same sense that an LCOE calculation results in a 'per product'. The product in a standard LCOE calculation is a kWh of energy (or MWh)[6].

The calculation might be in the nature of:

[6] i.e. the unit product of electricity production is kWh of electricity

The NPV of the difference in the product price per unit multiplied by the number of units per year for a period of ten years[7] *minus the NPV of any additional benefits (sale of EUA's/ general subsidies available to all companies in a sector etc.) The project specific subsidies are not taken into consideration in the calculation.*

The calculation in the project proponent's financial model is key and must conform to common standards in order to be comparable and acceptable[8]. The financial model for the purposes of application under the IF might therefore be different to their normal internal model. In order to get to end product pricing the models for price determination have to contain common elements, many of which are covered by the IF Delegated Regulation. These will be set out in the Guidance document for the first call and are considered in section 3.3.1 under Next Steps.

3.1.3 Method to define the discount rates to be used in the unit cost / product price methodology

In order to reverse engineer a calculation of final product price, you need to have robust assumptions for the discount rate. For internal purposes, NPVs are determined using a calculation of the appropriate WACC:

$$WACC = E/V * Re + D/V*Rd * (1-Td)$$

- Re = total cost of equity
- Rd = total cost of debt
- E/V = equity portion of total financing (Equity over total Value)
- D/V = debt portion of total financing (Debt over total Value)
- Td = Tax rate[9]

Ring-fenced project WACC

<u>Cost of debt</u>

Project proponents can assume a margin for risk above the base rate[10] as they would be quoted for project finance by a commercial lender (project finance bank). If a benchmark is not available for the particular technology a premium over an established technology debt margin can be used.

<u>Cost of equity</u>

For a project where a comparable technology project construction equity return (IRR) is known, project proponents can use that construction equity return. If that is not available, project proponents can use a premium to another benchmark that is available across the market for construction equity. For example, if looking at construction equity return for an offshore wind investment, project proponents can make realistic assumptions regarding the premium to a known benchmark. The all-in equity return expectations would typically be in the range of 8 to 16% based on observed transactions, but these might be different in exceptional circumstances.

[7] Note that an actual LCOE would be usually calculated over 20 years, not 10 years (required due to IF limits).

[8] Work to develop the product-based relevant costs methodology has sought from project proponents the latest financial model appropriate to the innovative project

[9] Note that the inherent tax shield reduces the debt cost

[10] Base rate will be the risk free rate: from the ten-year government bond yield of the country of the project

Non ring-fenced (industrial) project [11] WACC

Where the investment is part of an industrial process the project proponent can also use the company assumed discount rate (WACC) for new projects, as an alternative.

The final product price should be determined in the financial model based on calculations assuming a specific WACC, whether calculated or provided by the company's internal treasury.

3.2 Key findings & suggested methodologies

Set out below are two indicative (and non-attributable) examples of how the product-based relevant cost methodology has been applied so far: one based on product price (power); the other on production costs for a solid material derived from carbon dioxide capture.

3.2.1 Worked example #1: Wave Power – product price

This project comprises a grid-connected wave energy converter array demonstrator. The key inputs provided by the project proponent were used as indicative financial indicators to test the calculation of the relevant cost. These include:

- Capacity of the project
- Project life
- Capex cost
- Variable annual opex
- Fixed annual opex
- Non-annual periodic costs
- Decommissioning costs
- Timing inputs

Key Project Inputs		
Date of financial close	31-Dec-20	
Construction		
capacity	1,500	kW
construction cost	8,000	EUR/kW
construction duration	8	quarters
Production and revenues		
project life	10	years
capacity factor	30.0%	
market price	50.0	EUR/MWh
percentage of PPA price realised	100%	
Indexation	2.00%	%
Operating costs - variable		
O&M	800	EUR/kW/year
feedstock	-	EUR/kW/year
total	800	EUR/kW/year
Operating costs - fixed		
fixed opex	600	EURk/year

The model then calculates the simple cashflows of the project over the defined operational timeframe, which can then be used to calculate the relevant cost for the project by using the following steps:

1. Calculate relevant WACC;
2. Future increased electricity prices (due to higher ETS costs) are not taken into account;
3. Discount the OPEX using the WACC;
4. Discount the actual energy produced using the same WACC or discount rate. This is done in order to reflect a flat nominal price of energy for the term of the operation of the plant as per LCOE calculation norms – as

Weighted average cost of capital	
Cost of equity	11.00%
Cost of debt	3.60%
Equity percentage	65.00%
Debt percentage	35.00%
Income tax	28.00%
WACC	8.06%

[11] Typically those not financed on a project basis, but rather on a corporate basis

you are working back to a single 2020 Euro price to calculate relevant cost (i.e. in real terms, taking inflation into account, a 2020 Euro is worth more than 2021 Euro and so on). This results in a comparable flat nominal rate / tariff throughout the lifetime which we would discount if it were revenue;

5. Use these totals to calculate the LCOE;
6. Calculate the NPV of the average received tariff as evidenced from the Power Purchase Agreement (PPA);
7. Use this to calculate the LCOE to Realised Tariff Difference' (i.e. based on difference between the all in cost (including funding cost) of a technology, and what it can earn by selling that output, expressed as a tariff difference (per unit);

Relevant Cost Calculation							
LCOE			31 Dec 20	31 Dec 21	31 Dec 22	31 Dec 23	31 Dec 24
NPV of costs			n/a	(6,000)	(6,000)	(1,948)	(1,987)
Discount rate	8.06%	*per year*					
Discount factor		1	1.000	0.925	0.856	0.793	0.733
Discounted costs	23,451		-	(5,553)	(5,139)	(1,544)	(1,458)
Energy produced discounted	22,595		-	-	-	3,124	2,891
LCOE	1.04	EUR/kWh					
NPV of realised tariff	1,130		-	-	-	156	145
Benefit	0.05	EUR/kWh					
Tariff gap	0.99	EUR/kWh					
first 10 years of production	31 Dec 32		-	-	-	3,942	3,942
total energy produced		MWh	39,420				
Relevant Cost		EUR	38,941,475				
Maximum Innovation Fund Grant Award		EUR	23,364,885				

8. Multiply the above by the energy produced in the first 10 years to calculate Relevant Cost = EUR 38.94m; and,
9. Apply IF's 60% maximum intervention rate to the Relevant Cost to derive the project's maximum grant award level = EUR 23.36m.

3.2.2 Worked example #2: Industry – product substitution

This project comprises an industrial facility producing a substitute product from carbon dioxide capture in order to replace an alternative in the market.

The key inputs are the same as for renewable energy projects. However, for ETS facilities, ETS allowance revenues from avoided emissions have to be added as part of Operational Benefits, under product cash flows.

A similar process to Example 1 is used to calculate the relevant cost, with the following differences:

Key Project Inputs		
Date of financial close	31-Dec-20	
Construction		
capacity	100,000	tpa
construction cost - 2019 prices	350	EUR/ton
construction duration	4	quarters
indexation rate	2.00%	%
Production and revenues		
project life	20	years
Operating costs - general		
O&M - percentage of capex	3.00%	%
operating costs indexation rate	2.00%	%
Operating costs - variable		
total	3	EUR/ton/year
Operating costs - fixed		
labour	500	EURk/year
electricity & heat	1,500	EURk/year
admin/other fixed costs	50	EURk/year
total	2,050	EURk/year

1. Instead of calculating an LCOE, it calculates a discounted cost per unit of production (which is based on a similar approach as the LCOE method, as explained above);
2. Project proponents also provide the cost per unit of production for a comparable product;
3. Calculate the difference between the reference product cost of production (35 EUR/ton) and the cost calculated by the model (77.87 EUR/ton) = 43 EUR/ton;

4. Multiply the above by the number of units produced in the first 10 years to calculate Relevant Cost = EUR 42.87m; and, finally,
5. Apply IF's 60% maximum intervention rate to Relevant Cost to derive project's maximum grant award level = EUR 25.72m

Relevant Cost Calculation							
				30 Sep 20	31 Dec 20	31 Mar 21	30 Jun 21
Total costs				n/a	n/a	(9,104)	(9,104)
Discount rate	7.73%	*per year*	1.88%	*per period*			
Discount factor			1	1.000	1.000	0.982	0.963
Discounted costs		74,465		-	-	(8,936)	(8,771)
Production discounted		956,332		-	-	-	-
Discounted cost per unit		77.87	EUR/ton				
Comparable unit cost		35	EUR/ton				
Additional costs		43	EUR/ton				
First 10 years of production	10	31 Dec 31		-	-	-	-
Total product produced			tons	1,000,000			
Relevant Cost			EURk	42,866			
Maximum grant	60.0%		EURk	25,719			

3.3 Next steps

3.3.1 Key principles to finalise the methodology and develop Guidance

- **Areas of guidance for project proponents:** Based on the work to date, the following elements will require clear first call guidance to enable a robust calculation of relevant costs by proponents:
  - Product price assumptions;
  - Product cost assumptions;
  - WACC assumptions (Discount rate assumptions[12]);
  - Indexation/inflation assumptions;
  - Lifetime assumptions;
  - Terminal value assumptions;
  - Decommissioning assumptions; and,
  - Carbon price assumptions.

  Each is briefly described in the following section with a current opinion expressed about how each should be dealt with:

- **Comparable product prices:** A key issue is the decision over which product price is to be used (i.e. an average, a forward curve, today's price etc.). It is important that this is agreed upon as this will determine the revenue line. It is also important that calculations correctly reflect a nominal price over the life of the project so that there is not double counting of inflation.
- **Comparable product costs:** Project proponents should be required to state the costs for producing the comparable product/component (or provide an industry acceptable standard benchmark). Since each project will be assessed on cost efficiency this approach should not be open to exploitation. This will avoid the need to provide reference costs for all products. However, guidance will be given to evaluators as to how they should check this.
- **WACC assumptions:** While the simplest approach would be to provide EU-wide, but sectorally-based figures in the call guidance, the suggestion is that the company should provide their own WACC (unless the project proponent is an SME or a Special Purpose Vehicle and then the sector WACC is applied). This is also the approach taken when

[12] We are using WACC as the discount rate for LCOE type calculations.

assessing State aid to companies. To achieve this, project proponents would need to justify their WACC calculation using appropriate reference sources (for example, as noted in a published annual report). However, the guidance will include key reference sources to enable project proponents to calculate their WACC.

- **Indexation** (i.e. adjusting CAPEX / OPEX by inflation over the project period): Project proponents should be allowed to provide their own inflation rate, although there will be guidance which refers to country-specific inflation rates.
- **Lifetime of project**: As lifetime affects the discounted Net Asset Value/NPV, this must be the same for all the projects in a sector (generally associated with the depreciation period of the assets financed[13] which is typically 20 years for renewables but in some cases may extend to 25 or 30 years or longer). While the relevant costs definition under the IF allows for 10 years, the lifecycle differs in LCOE and other methodologies. This is important as it affects high Capex, low Opex vs high Opex, Low capex technologies. Project lifetime would be set in the guidance.
- **Terminal value assumptions:** While these have a bearing on per unit cost or NPV, and a common assumption would need to be made, terminal value is actually not taken into account for LCOE or in project finance models. An initial suggestion therefore would be that no terminal value beyond the asset lifetime is the standard.
- **Decommissioning assumptions:** cost estimates vary by project and need to be included in the project models. Work is ongoing to assess this aspect through shortlisting and could be supplemented with further market research to determine the appropriate decommissioning assumptions.
- **Carbon prices:** The value of the income stream or cost saving will need to be taken into account if this is a key operational benefit of the project[14]. To be more conservative and offer a risk cushion, the current suggestion is that the first call guidance should provide a carbon price averaged over the last two years as the one to be used by project proponents.
- **Possible differences in regulatory regimes and public support:** There could be differences in electricity prices, indirect cost compensation or other operating costs/benefits due to differences in regulatory regimes. This aspect will need to be reflected in the guidance and key points will need to be given by project proponents to enable evaluators to understand some of the underlying factors.

Key questions for stakeholders to consider:

1. Do you agree with the approach being taken to finalise the methodology?
2. Are there any aspects which are not clear and need further clarification?
3. Are any elements missing from the current product-based methodology?
4. Do you have a particular view on the approach for determining product prices? What product price should be used (i.e. an average, a forward curve, today's price etc.). What factors do we need to consider in setting guidance on this issue?
5. What are is the project lifetime used in your financial models and what is the expected pay-back time for capital investments?

[13] Note that under the Innovation Fund, there is no depreciation allowed in the calculation of relevant costs.

[14] One example CCU demonstration project scrutinised requires more concentrated CO_2 to be brought on site, thereby creating an operational cost and no CO_2 avoidance benefit at the site itself.

6. Should proponents be allowed to specify their inflation rate?
7. Do you agree with the proposed approach for carbon prices? What alternatives could be used?
8. Are there good examples of EU and/or Member State support programmes where some of these aspects have been investigated in detail and which can be reviewed?

3.3.2 Brief summary of future work

Work continues on refining the methodologies so that the first call guidance will be robust:

- **Applicability:** the product-based methodology to different project types – i.e. power, power & heat (e.g. CHP) and industrial products (including CCU) – will continue to be applied in order to validate its application to the widest possible set of projects. Financial information continues to be sourced from proponents offering real project examples at TRL 7-8[15].
- **Product price and cost benchmarks:** research on a few sectoral examples will be conducted as illustrations in the Guidance document (e.g. steel, ceramic products), coupled with the guidance to proponents to inform their selection of an appropriate reference product. This will enable project proponents to provide their suggested product examples with key source information so that evaluators can check.
- **Simplifying the calculation methodology:** ensuring that the application process is robust yet appropriate for all types of proponents (including SMEs) is important in achieving the widest possible set of innovative project applications in the first call. The following minimum elements are required:
  - Capex cost and timing;
  - Capacity of plant;
  - Fixed annual opex (irrespective of plant size);
  - Variable annual opex (per unit of production);
  - Weighted Average Cost of Capital (WACC);
  - Non-annual costs (e.g. Lifecycle costs);
  - Project life (if less than 10 years); and,
  - Unit cost of comparable product.
- **Calculation tool for applicants:** Considerations have started on the format of the calculation tool/sheet which will form part of the application process. This will have sub-headings such as fixed and variable costs. Note that if a project is unable to break down these costs, it will be a strong indication of the project's lack of maturity. However, the calculation tool will still allow proponents to calculate the relevant costs, since this is required at the Expression of Interest (EoI) phase of the IF.

Key questions for stakeholders to consider:

1. Are you aware of any benchmark product cost/price data for your sector which is published?
2. Could you provide any product cost/price data for your project/sector to help inform the guidance?

[15] ICF and its partners have engaged with various organisations and its partners since the IFEG on 18 Dec 2019 and are continuing to investigate potential financial data from innovative projects to help validate methodologies

4 Reference plant methodology – fall-back option for proponents

Summary of methodology

Uses an agreed reference plant and an established and well-used formula (from NER 300 programme) to generate the additional costs arising from the innovative project.

Creates challenges in establishing precisely what the reference plant should be and this in turn requires guidance.

It is envisaged that this methodology is a fall-back option for a small number of projects. However, so far in the analysis of potential project examples we have not identified a project type which would choose this as its primary method.

4.1 Key principles underpinning the approach

As set out under Article 5 of the Delegated Regulation on the Innovation Fund, the Reference Plant scenario and methodology to derive relevant costs relies on the presence of a counterfactual (i.e. the Reference Plant), whereby funding costs are reduced by the costs of the counterfactual. This leaves the additional 'innovative' costs of the project in scope of the Innovation Fund grant award which can cover up to 60% of the total Relevant costs.

Under the NER 300 programme (the predecessor to the IF which applied solely to renewable energy and CCS projects), a typical Reference Plant used for renewable energy projects was a Combined Cycle Gas Turbine (CCGT). This choice was left to Member States (since under NER 300 they had control over many more aspects of the application process than will occur under the IF). As part of the NER 300 Review, ICF examined the effects on funding of different methodologies to calculate relevant costs. An important finding from that work is that the reference plant rules and practical guidance for the first call of the IF should be as realistic as possible for applicants, drawing on real world examples as much as possible, in order to avoid them being too theoretical. An obvious additional difference between the NER 300 and IF are that other approaches are needed to cover the new areas now included in the IF, such as energy intensive industry and energy storage. Annex 1 comprises a set of useful stakeholder insights and learnings from the NER 300 programme on the use and application of reference plants in the relevant cost calculation.

Derivation of this approach is based on a formula that examines the difference in CAPEX, OPEX and Operational Benefits over a 10-year period for both the IF project and the Reference plant:

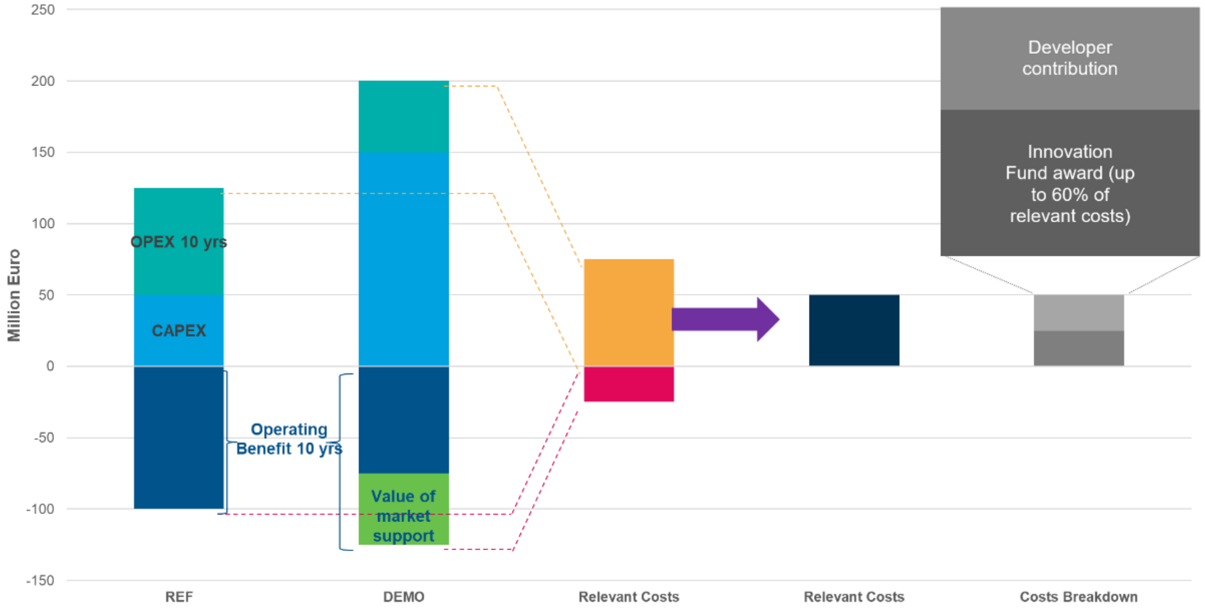
$$\begin{aligned} &\mathit{Relevant\ costs} \\ &= (\mathit{Innovation\ Fund\ project\ investment\ cost} - \mathit{Reference\ plant\ investment\ cost}) \\ &+ (\mathit{NPV\ of\ Innovation\ Fund\ project\ operational\ costs} - \mathit{NPV\ of\ Reference\ plant\ operational\ costs}) \\ &\quad - (\mathit{NPV\ of\ Innovation\ Fund\ operational\ benefits} - \mathit{NVP\ Reference\ plant\ operational\ benefits} \end{aligned}$$

Put more simply:

$$\begin{aligned} &\mathit{Relevant\ costs} = \\ &\mathit{Difference\ in\ CAPEX}\ (\mathit{between\ the\ IF\ demonstration\ plant\ and\ Reference\ plant}) + \\ &\mathit{Difference\ in\ NPV\ of\ OPEX} - \mathit{Difference\ in\ NPV\ of\ Operational\ Benefits} \end{aligned}$$

Figure 4.1 shows a conceptual outcome of this formula as applied to a hypothetical IF project against an agreed Reference plant. The Operating period is now ten years (compared to five under NER 300) and the allowable grant now covers up to 60% of Relevant Costs (compared to 50% under NER 300).

Figure 4.1 Illustration of the total relevant costs (dark blue bar) derived using a Reference Plant methodology (where a market subsidy is offered) and showing the maximum IF grant award (dark grey)



Source: Adapted from an original schematic explaining NER 300 process featured on NER300.com

For the reference cost formula, as set out in the IF Delegated Regulation, to be robust the following elements must be the basis for calculation:

- **Capex reference plant;**
- **NPV Opex reference plant**, which requires robust information on:
  - The associated expense cash flows relating to that capital expenditure,
    - The project boundary, i.e. which cash flows are associated with that Capex and only those cash flows;
    - Where the cash flows relate to a market price of a product, a basis for the estimate of the forward curve of those prices;
  - The appropriate discount rate.
- **NPV revenues**, which requires robust information on:
  - The associated revenue cash flows relating to that capital expenditure, i.e.
    - The project boundary – which cash flows are associated with that Capex and only those cash flows;
    - Where the cash flows relate to a market price of a product, a basis for the estimate of the forward curve of those prices;
    - The calculation of any subsidies relating to the production of the product (i.e. which would relate to both general market subsidies that might be available to the project as well as project-specific subsidies[16]); and,
    - The appropriate discount rate.

[16] For example, additional benefits from support schemes, even if they do not constitute State aid within the meaning of Article 107(1) of the Treaty, avoided costs and existing tax incentive measures

Key questions for stakeholders to consider:

1. Can you provide examples of reference plants which would fit well into this scenario?
2. Can you share ideas of where there are likely to be real, practical challenges in using a reference plant?
3. Should a single reference plant be defined per sector?
4. Should an independent verification be required for any 'individual' reference plant prior to the IF application[17]?
5. Do you have experience of working with a reference plants to calculate relevant costs in another public funding programme? Are there lessons or insights to share about workability?

4.2 Key findings & suggested methodology

4.2.1 Worked example #1: Compressed Air Energy Storage (CAES)

We took a potential CAES project, to be developed in the EU. The main objective is to provide system services to support integration of variable energy input from renewables to the grid and mitigate wind/solar forecast errors. At the moment the biggest difficulty for the full deployment of RES projects is the lack of storage capacity that could compensate the irregularity of the generation due to the nature of the sources of energy. On that basis, this project falls within the criteria of the IF as it provides highly innovative technology with significant potential to contribute to the GHG emission reduction.

In terms of the overall financial data, the following table summarises the capital investment costs (CAPEX), total Operational costs (OPEX) over a 10 year period and the total Operational Benefits (Revenues), also over 10 years, for both the CAES demonstration project and a reference plant (a first generation CAES project[18]). The NPV is derived for both OPEX and Benefits.

	CAPEX (€ m)		OPEX (€ m, NPV)		Benefits (€ m, NPV)		
Demonstration Plant	240		35		40		
Reference Plant	180		20		32		
Difference	*60*		*15*		*8*		
Relevant Costs	**60**	**+**	**15**	**-**	**8**	**=**	**67**

As per the formula, shown below, the relevant costs are calculated as € 67m and therefore the maximum IF grant support is 60% of relevant costs, or € 40.2m.

$$\text{Difference in CAPEX (between the demonstration plant and reference plant)} \\ + \text{Difference in NPV of OPEX} - \text{Difference in NPV of Operational Benefits}$$

[17] Note that more complicated approaches increase the risk that the IF evaluators may not understand the project and will reject the project.

[18] Note that the numbers are illustrative for the Reference plant.

4.3 Next steps

4.3.1 Key principles to finalise the methodology and develop Guidance

Based on the work to date, the following elements require further consideration and research:

- Development of a realistic list of Reference plants across eligible IF sectors;
- Research into plant benchmark data, where available;
- How to develop appropriate rules and practical guidance for project proponents which addresses key needs and allows for robust decisions to be taken on the appropriate relevant cost methodology.

4.3.2 Brief summary of future work

The remaining work on reference plants is focused on the following areas:

- **Applicability:** continue to seek actual examples of projects where the product price approach has challenges and therefore the proponent must look for an alternative methodology including the use of a Reference plant. One potential example is for biorefineries where there are multiple potential revenue streams and hence difficulties in the forecasting of the market prices for them.
- **Reference plant benchmarks:** continue to research the examples that can be used for each sector (building on what has been identified under the Decision Tree section).
- **Finalise the decision tree:** feedback from the Technical Workshop on 6 February will inform this process as well as the associated guidance note which will be presented to the IFEG in the Spring for a last round of feedback before its finalisation.
- **Draw up a set of rules for use of Reference plants:** this work is just starting and is falling out of the project examples which have been examined.
- **Simplifying the Reference plant calculation methodology:** as with the product-based relevant cost methodology, we will seek to ensure the methodology is robust yet appropriate for all types of project proponent (including SMEs).
- **Methodology to illustrate how differences in risk perception between conventional and innovative technologies can be captured in the assessment:** develop a methodology to allow project proponents to account for additional risks. This is likely to be achieved by directly incorporating the risks into the inputs they provide (for example, assuming higher operating costs or lower availability) in order to reduce the quantity of inputs they need to provide. Project proponents will have instructions to account for these risks in this way and can therefore choose how much risk they wish to take with their assumptions. We need to consider whether all risks can be accounted for in this way or if there is anything likely to fall outside of these possibilities.

Key questions for stakeholders to consider:

1. What sources provide reference plant benchmark data for your sector?
2. What data is available to share which could be used to inform the first call guidance?
3. What are the key additional risks which proponents will need to factor into their calculations to account for potential production losses? Where might these be best applied, e.g. incorporated into the expected revenues, costs, production volumes?

5 The reference scenario can be ignored - Options 1 & 2 in the decision tree

Article 5 of the IF Delegated Regulation creates two exceptions to the use of a reference scenario:

- Where conventional production […] does not exist, the relevant costs shall be the best estimate of the total capital expenditure and the net present value of operating costs and benefits arising during 10 years after the entry into operation of the project; and
- The relevant costs of a small-scale project [i.e. with a total CAPEX not exceeding EUR 7.5 million] shall be the total capital expenditure costs of that project.

The projects falling under these two categories can therefore use a much simpler relevant cost calculation methodology. The specific formulas for each option are summarised below.

Option 1: Relevant cost = CAPEX

Option 2: Relevant cost = CAPEX + NPV of OPEX – NPV of Operational Benefits

For Option 2, the only element requiring guidance is how to define the discount rate to be used for the calculation of the NPV. It is assumed that this will be the same guidance as for other methodologies.

Annex 1 Insights and learnings from the NER 300 programme on the use of reference plants in relevant cost calculations

The NER 300 covered RES and CCS projects and the following procedures (rules) were used under the programme to guide proponents in determining relevant costs:

- *Scaling-up rule:* 'Conventional' production reference plants (for RES) had to be scaled to the appropriate demonstration project plant size. The Reference Plant input parameters (i.e. CAPEX, OPEX, Operational Benefits) also had to be scaled to the size of the RES project in terms of the (eligible) renewable energy output capacity and the load factor.
- *Economic lifetime of plant:* this was set at 15 years for all plants.

The following challenges and observations were raised in consultations with project proponents around the use of reference plants. They are useful in considering how to operationalise guidance for the IF:

- Comparing the capital and operational costs of the NER 300 project to a reference plant was not straightforward, not least because of a lack of clear, practical guidance on which reference plant to choose.
- The NER 300 approach to relevant costs did not adequately capture the extra costs incurred by projects. Comparisons should be based on future realistic alternatives; not on technologies in the existing market.
- Comparisons were more challenging for some technology categories than for others. Bio-energy projects, for example, proved challenging as some of these projects are integrated in existing facilities, making it harder to distinguish between additional costs and modernisation costs and also because the impact of the market conditions on the operational costs (i.e. feedstock costs) and benefits. Conversely, it seemed to be less challenging for wind or solar projects, where a CCGT (at the time of the calls for proposals) was deemed an appropriate choice of reference plant.
- Stakeholders considered such comparisons between projects and reference plants to be an even more challenging prospect if industry projects were introduced under the Innovation Fund.
- Overall, stakeholders understood it is difficult to achieve the perfect solution, with some seeking harmonisation across EU Member States, while others would prefer local conditions to be reflected in the selection of the reference plant.