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<b>Abstract</b>
<p>This interim report presents the status of the fourth and final phase of the Business Case Development work under the ELEGANCY project. It builds on the four-step business model development and selection methodology described in previous reports D3.2.1, D3.3.2 and D3.3.3. It is a companion report to D3.3.3, which comprises a methodology for H<sub>2</sub>-CCS chain business model selection and the commercial structuring required to deliver a new H<sub>2</sub>-CCS chain infrastructure. This report describes the framework, templates and tools for developing a business case, and performing a business case assessment, associated with a given business model. As with previous work, this methodology is generic and has been created for use beyond the ELEGANCY project case studies.</p>



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## 1 INTRODUCTION

This report is the last of the interim methodological reports in ELEGANCY Work Package 3 (WP3) and continues the previous work undertaken by Sustainable Decisions Limited ('SDL') in reports D3.3.2 and D3.3.3. The report concentrates on the business case assessment framework, templates and application guidelines that are complementary to the method for selecting suitable business models at both system level and business level for H<sub>2</sub>-CCS chains described in companion report D3.3.3.

This report completes the overall methodology for the development and assessment of business cases within an iterative framework repeated at various stages of a case study or project lifecycle.

The report is structured as follows.

**Chapter 2** recaps the methodological approach introduced in reports D3.2.1, D3.3.2 and D3.3.3 and extends the overview to the business case development and assessment process presented in this report.

**Chapter 3** presents the business cases development and assessment process in detail with guidance on the business case dimensions and templates contained in an ELEGANCY WP3 Excel spreadsheet tool. The templates from the spreadsheet tool are presented in Appendix A. This chapter also describes a number of public sector business case protocols and discusses methods for use in the extension of cost-benefit analysis to wider macro-economic value assessment.

**Chapter 4** summarises the ELEGANCY WP3 tool-kit and how to make effective use of the ELEGANCY Work Package 4 H<sub>2</sub>-CCS Chain Modelling tool-kit within the business case development and assessment process.

The complementary Excel spreadsheet tool for business case development and assessment has been added to the ELEGANCY WP3 tool-kit.

## 2 METHODOLOGY

### 2.1 Summary

The ELEGANCY WP3 business model development methodology has been described in reports D3.2.1, D3.3.2 and D3.3.3. WP3 follows a structured and methodological approach. Report D3.2.1 provided the method (along with guidance and tools) to define and frame the scope of a case study and facilitate the assessment of the regulatory, fiscal, macroeconomic and market background to allow the case study team to gain an early understanding of the main elements of business context which impact investment and commercial decision-making.

Report D3.3.2 extended the background characterisation to policy assessment and moved to the next stage of identification of business risks and investment barriers (i.e. key factors that make business risks excessive for private investors to bear) for each business sector of the H<sub>2</sub>-CCS chain and the review of de-risking instruments including the role of government, and other commercial and financial mechanisms. Complementary assessment spreadsheet tools were created for analysis of policy gaps, investment barriers, business risks and mitigation options. These have flexible application for use with all the business segments of the H<sub>2</sub>-CCS chain. The full suite of methods and tools comprising the methodology allows for a complete assessment of the main elements of the business context and risks for any case study.

Report D3.3.3 dealt with the business model selection process building on analysis of the business context and the structures that enable risk sharing and collaboration between public and private sector stakeholders. The report presented:

- the overall methodology to guide the selection of potential business models from the information collected and analysed on business context and risk;
- guidance on the main types of financial structures classified by their types of ownership, financing, market development and revenue streams;
- the main operability parameters and risks that impact commercial agreements;
- guidance on the main types of typical commercial agreements and terms.

A business model selection spreadsheet tool was developed to complement report D3.3.3.

In this chapter we define what a business case is, and the characteristic elements that are included. A brief recap is presented of the business model selection process contained in report D3.3.3. along with an overview of the generic business case templates and assessment process presented in this report. The business case assessment methodology also includes a complementary business case development and assessment tool. A short introduction to the application and uses of the ELEGANCY WP4 modelling tool-kit in business case assessments is included.

The overall business model and business case methodology, and the principal elements, have been tested with government, industry and NGO stakeholders in two workshops conducted jointly with the European Technology and Innovation Platform ZEP<sup>1</sup>. Ideas and recommendations from a ZEP temporary working group on ‘Collaboration across the CCS Chain’ have been included in the methodology.

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<sup>1</sup> European Technology and Innovation Platform ZEP, 2019, <http://www.zeroemissionsplatform.eu>, accessed 29<sup>th</sup> March 2019



## 2.2 What is a Business Case?

HM Treasury in the UK provides a neat and concise definition of a business case<sup>2</sup>:

*“The business case is a management tool and is developed over time as a living document as the proposal develops. The Business Case keeps together and summarises the results of all the necessary research and analysis needed to support decision making in a transparent way. In its final form it becomes the key document of record for the proposal, also summarising objectives, the key features of implementation management and arrangements for post implementation evaluation.”*

As a decision support exercise, a business case will be strongly influenced by the perspective and purpose of the entity or audience for whom it is developed. Thus, in complex infrastructure and new market investments as exemplified by the ELEGANCY case studies, public sector objectives (macroeconomic, social and environmental) and private sector business imperatives (shareholder returns commensurate with risk and opportunity cost) have to be blended together in such a way to deliver a combined business case that works for all stakeholders. To facilitate this, the ELEGANCY WP3 framework has differentiated between two contexts and scales; one for system business models and one for operational business models (see report D3.3.3). This methodology enables a targeted analysis for the system business case as well as the subordinate, but interlinked, business cases for component businesses.

For a given project, investment, or case study objective a complete business case will comprise:

1. Characterisation of the business and investment context;
2. Selection of a business model from a suite of preferences;
3. An allocation of risk and mitigation measures to stakeholders;
4. A qualitative and quantitative assessment against metrics that measure the value and delivery of the project against the objective;
5. A comparison with counterfactual alternatives if the project is not executed; and
6. Recommended ownership, financing and commercial structure.

In the ELEGANCY methodology a business case is prepared for a selected business model because of the strong relationship linking risk and liability sharing with financing and ownership. Consequently, an iterative process is used for business case definition and analysis that commences with a range of preferences of stakeholders (Section 3.1), and changes or updates the selected business model where appropriate as the process progresses. For the process to deliver an outcome satisfactory to all stakeholders there is a need for initial selection and ranking of appropriate metrics that will effectively parametrise and quantify the infrastructure proposition for comparison with counterfactuals as well as alternative business investment opportunities.

To achieve the ‘consensus’ business case described above, the ELEGANCY development and assessment process has been devised as a synthesis of best practice from standard private sector procedures and a number of public sector protocols (Section 3.4).

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<sup>2</sup> HM Treasury, 2018, Assessing Business Cases: A Short Plain English Guide, [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/190609/Green\\_Book\\_guidance\\_short\\_plain\\_English\\_guide\\_to\\_assessing\\_business\\_cases.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/190609/Green_Book_guidance_short_plain_English_guide_to_assessing_business_cases.pdf), accessed 29<sup>th</sup> March 2019

## 2.3 ELEGANCY Business Model Selection Process (Recap)

The following sub-sections briefly summarise the treatment of business models detailed in ELEGANCY report D3.3.3.

### 2.3.1 Business Model Definition

In order to create some clarity about business models the ELEGANCY WP3 methodology differentiates between system or macroeconomic business models and business segment or micro-economic business models (Figure 2-1). System business models are the combined elements, structures and mechanisms that can overcome barriers to investment by both the public and private sectors for the development and utilisation (through market creation) of a full chain H<sub>2</sub>-CCS infrastructure. Operational business models are the organisational forms and combined elements, structures and mechanisms that deliver the outputs and services for a particular business segment within the H<sub>2</sub>-CCS chain while both mitigating the risks that the business activity faces and providing a return on funds deployed.

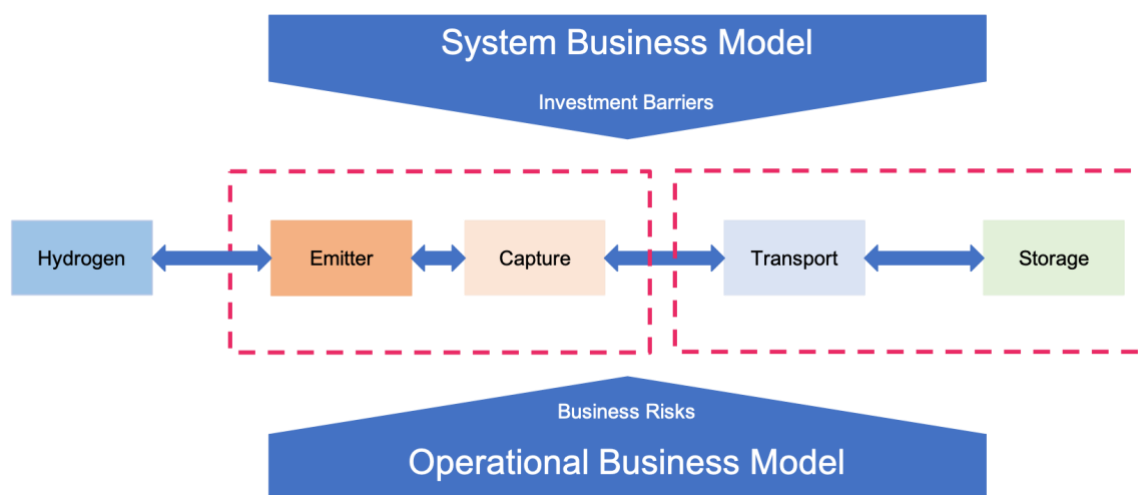


Figure 2-1 Business Model Characterisation

Section 4.5 of ELEGANCY report D3.3.2 discussed the principles of risk allocation and in particular introduced the CPI framework<sup>3</sup> of endogenous and exogenous risks as an approach to risk sharing in public-private partnerships. Building on report D3.3.2, we identify the system business model as the principal means for the mitigation of exogenous risks (including political, policy, social and outcome risks) that cannot in general be managed by the private sector alone. The operational business model is identified with mitigating endogenous business risks (market, commercial, technical and physical risks) that the private sector can manage. There is an interaction between the two when outcome, market and commercial risks must be shared between public and private sectors. How this is done, and with what preferences, is the interface between the two scales of business model. In other words, the system business model provides a macroeconomic solution that enables investment and activities to take place at the operational business segment level. What can't be resolved at the operational business level will need to be supported at the system level because the whole infrastructure chain is affected.

<sup>3</sup> Climate Policy Initiative, 2013, Risk Gaps: A Map of Risk Mitigation Instruments for Clean Investments, <https://climatepolicyinitiative.org/wp-content/uploads/2013/01/Risk-Gaps-A-Map-of-Risk-Mitigation-Instruments-for-Clean-Investments.pdf>, accessed 29<sup>th</sup> March 2019

Each scale of business model in Figure 2-1 has an associated business case, the metrics for which are tailored to the drivers and outcomes required of the case study or project. In Section 3.1 we describe the interaction between selecting business models and assessing their associated business cases within the ELEGANCY methodology.

### 2.3.2 Drivers for Business Model Selection

Different perspectives between the public and private sectors have influenced CCS dialogue and policy development with respect to business models. The public sector (Government) is looking to cost effective and “affordable” solutions for dealing with emissions targets and therefore necessarily focusses on macroeconomic and fiscal impacts of intervening or investing in infrastructure development. Private sector organisations must ensure shareholder funds are deployed in ways that provide appropriate returns either in the short term or over a longer-term strategic horizon. Hence each looks to a business model that delivers the business case which justifies their involvement. Finding alignment between these has been difficult for FOAK and early stage CCS infrastructure projects. ELEGANCY report D3.3.3 identifies and describes nine categories of business drivers that influence business model selection. These are briefly summarised in Table 2-1.

*Table 2-1 Drivers of business model selection*

Category	Description
<b>Institutional</b>	Government policies and incentives, organisational capability to implement public-private structures, adequacy of country governance and investment framework
<b>Financing (Private)</b>	Country attractiveness and sovereign risk, availability of bank finance, capital markets, cost of capital, types of infrastructure finance available
<b>Financing (Public)</b>	National debt levels, budgetary constraints, fiscal rules and constraints, public accounting rules
<b>Market Development</b>	Market maturity, market structure and regulatory environment, market demand and growth/decline, market failures
<b>Macroeconomic</b>	GDP per capita and growth, inflation, energy demand and forecast, population growth, unemployment rate (average, geographical distribution), emissions, air quality
<b>Physical &amp; Technical</b>	Existing physical assets, opportunities for re-use, geographical distribution of potential customers and assets, technology maturity, private sector capacity to manage physical activities and unforeseen outcomes
<b>Legal</b>	Adequacy of legal framework to implement different types of business structures, state aid, environmental liability, cross border waste management
<b>Societal</b>	Public perception of industries: fossil fuel, renewable, CO <sub>2</sub> storage, public perception of environmental, climate and health issues and willingness to pay for related benefits
<b>Existing Business Models</b>	Familiarity with and use of public-private business models, utility ownership, preferred government model for infrastructure service provision and delivery, commercial/contractual frameworks and regulation

### 2.3.3 Public and Private Sector Risk Sharing Structures

In the same way as risks were classified in ELEGANCY report D3.3.2 in four main categories to facilitate the risk assessment exercise, report D3.3.3 classified infrastructure investment structures according to a number of key principles linked to the business model drivers described above. The main axis to classify the structures is the degree of transfer of responsibility and risks from the public sector to the private sector. On one end of the spectrum, the public sector retains all responsibility for the ownership, financing, and all the physical activities. On the other end, all these responsibilities are transferred to the private sector without any public sector intervention. In between, there are many types of arrangements where those responsibilities are split between the public and private sector.

The structures are classified according to four main components of the transfer of responsibility (Figure 2-2).



*Figure 2-2 Main components for investment structures in the transfer of risk and responsibility from the public sector to the private sector*

The main components of the risk sharing structure are defined as:

- Assets and Rights Ownership;
- Capital Sourcing;
- Market Development (including revenue support mechanisms); and
- Physical Delivery (including facilitating commercial structures).

There is a vast range of variations based on multiple combinations of the components above to allocate the risks and responsibilities appropriately.

### 2.3.4 Business Model Selection Flow Chart

The complete process of combining all the steps in the ELEGANCY WP3 framework is described in detail in Chapter 5 of Report D3.3.3 and summarised in Figure 2-3 below.

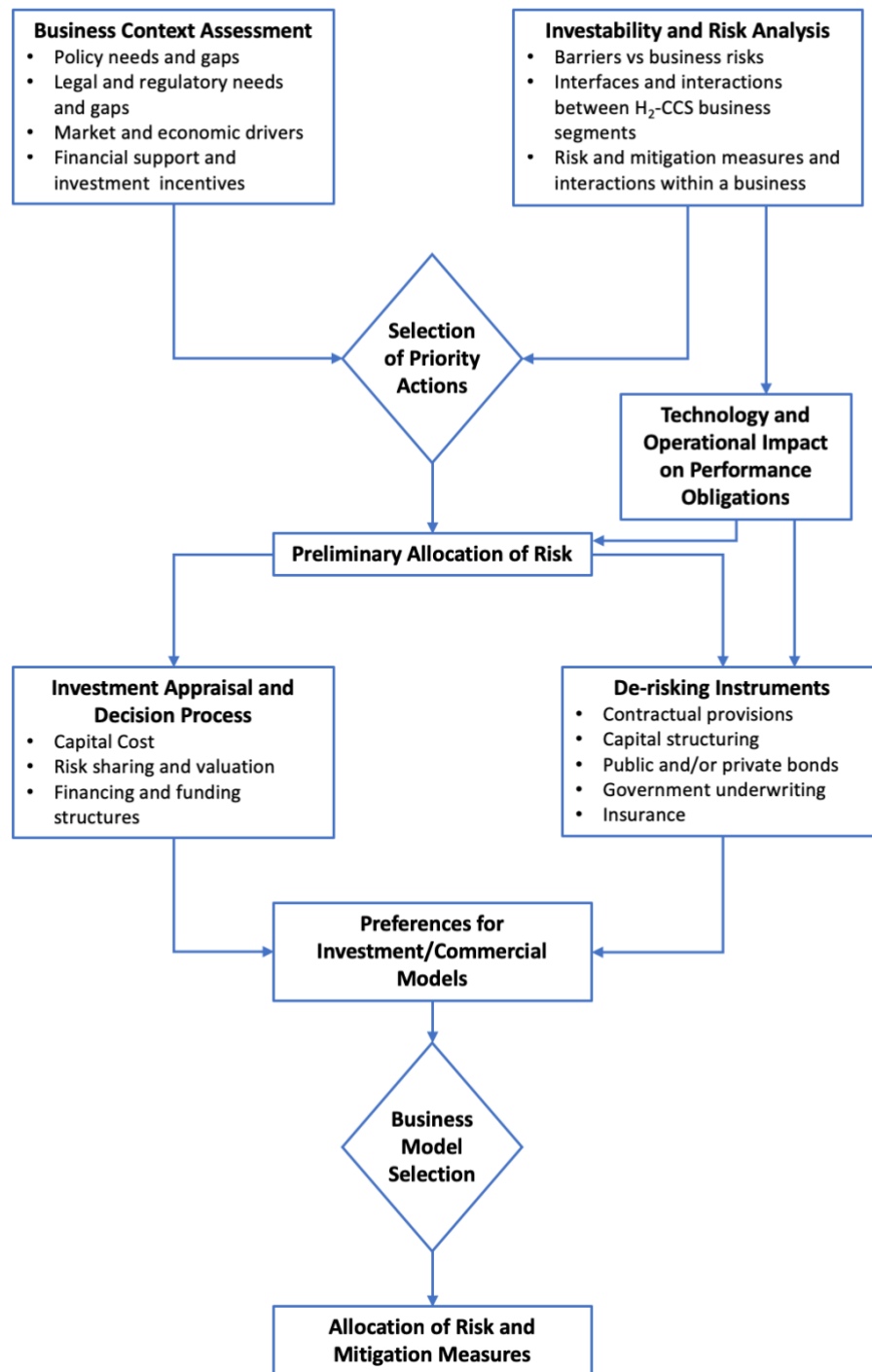


Figure 2-3 Business Model Selection Process

## 2.4 ELEGANCY Business Case Development and Assessment Process

Chapter 3 contains a detailed explanation of the ELEGANCY WP3 business case development and assessment process, with flowcharts summarising the process shown in Figure 3-2 and Figure 3-3. The framework implemented via this process comprises guidance (Section 3.3), templates (Appendix I.A.1.a)(1)A) and a spreadsheet tool that aids in the addition of content to these templates. The templates are designed to fully characterise a business case and some key foundation principles of this framework are introduced in the following sub-sections.

### 2.4.1 Business Case Dimensions

A complete business case at either H<sub>2</sub>-CCS chain system level or for an individual business segment within the chain is characterised in the ELEGANCY framework by the six dimensions illustrated in Figure 2-4, and described in more detail in Table 2-2. The data required and outputs of the assessment in each of these dimensions evolve with the iterative development of the business case through decision gates and increasing levels of expenditure. This process was discussed in ELEGANCY report D3.3.3 and is presented again in summary form in Section 3.1 below.



Figure 2-4 ELEGANCY Business Case Dimensions

Table 2-2 Overview of ELEGANCY business case dimensions

Business Case Dimension	Description
<b>Strategic Drivers and Rationale</b>	<ul style="list-style-type: none"> <li>• Business case definition</li> <li>• Objectives of project, investment and/or intervention</li> <li>• Key strategic issues to be addressed</li> <li>• Business Model Preference</li> <li>• Key performance indicators and metrics</li> </ul>
<b>Financial Cost and Benefits</b>	<ul style="list-style-type: none"> <li>• Standard evaluation of cost and revenues</li> <li>• Standard metrics of Return on Investment (RoI), IRR, NPV</li> <li>• Assessment of additional sources of value created by the project</li> </ul>
<b>Economic and Value Benefits</b>	<ul style="list-style-type: none"> <li>• Quantification of direct economic impacts, economic rate of return (ERR) and economic net present value (ENPV)</li> <li>• Identification, and quantification where possible, of indirect economic, social and environmental benefits, distributional impact</li> </ul>
<b>Commercial Feasibility &amp; Delivery</b>	<ul style="list-style-type: none"> <li>• Business model selection</li> <li>• Commercial structuring and capital sourcing</li> <li>• Contracting, procurement</li> </ul>
<b>Technical Feasibility &amp; Delivery</b>	<ul style="list-style-type: none"> <li>• Assessment of technical design and construction, operating and decommissioning arrangements for physical delivery</li> <li>• Technology assessment and comparison</li> </ul>
<b>Outcome Management</b>	<ul style="list-style-type: none"> <li>• Standard risk identification, quantification and mitigation</li> <li>• Monte Carlo, scenarios, real options, optimism bias</li> <li>• Monitoring metrics for delivery and governance</li> </ul>

#### 2.4.2 Front-end Loaded Assessment

The ELEGANCY framework is based on the principle of front-end loading (or planning)<sup>4</sup> used extensively by the private sector for stage gate decision making in project development and Final Investment Decisions (FID). This approach is also core to the UK HM Treasury business case development process<sup>2</sup> and other public sector organisations. Front-end loading simply refers to the fact that a strong emphasis is placed at an early stage of the business case on strategic rationale and objectives, business context, characterisation of the opportunities and benefits, understanding threats and risks, delivery options, and indicative costs. Essentially this approach addresses the ‘what?’ and ‘why?’ of the business proposition as the first assessment stage where the potential impact of decisions is highest, but the data and information available is at its lowest. It also begins the process of answering ‘how?’ by establishing the principal key performance indicators, or metrics, and ‘who?’ by allocating and sharing risks associated with delivering the various elements of the business proposition.

In the ELEGANCY framework the processes and tools presented in previous reports D3.2.1, D3.3.2 and D3.3.3 provide the means to develop the inputs required for completing the Strategic Drivers and Rationale dimension of a business case (Figure 2-3 and Figure 3-3).

<sup>4</sup> See for example: Samset, K. and Williams, T., 2010, Issues in Front-End Decision Making on Projects. *Project Management Journal* (PMJ), 41, 38-49, accessed 29<sup>th</sup> March 2019



### 2.4.3 Economic and Financial Analysis

Confusion often occurs for non-economists between the terms ‘economic analysis’ and ‘financial analysis’. It is important to clarify the distinction here for the correct understanding of the ELEGANCY business case dimensions and use of the business case templates.

Economic analysis frames a project from a society perspective and will attempt to take into account wider costs and benefits beyond the project. Financial analysis is used to evaluate a project directly from the perspective of an entity making an investment (this could also be a commercial bank lending to a project) and ignores externalities of any kind (markets, social, environmental, third parties etc.) beyond the project<sup>5</sup>.

Economic analysis has become increasingly important to decision-making in the context of climate change mitigation efforts and the co-investment between the public and private sectors in individual projects as well as infrastructure spanning regions and national borders. Asian Development Bank (ADB) economic analysis guidelines, for example, highlight this point<sup>5</sup>:

*“... several issues that have emerged or become more important since the adoption of the 1997 edition are introduced, including economic analysis under various financing modalities, the treatment of the social cost of carbon, and economic analysis of regional economic cooperation projects.”*

## 2.5 Business Cases for ELEGANCY Case Studies

Actual investment in, and delivery of, the projects comprising the ELEGANCY case studies will be reliant on cooperation between private sector sponsors and host governments. At the level of investigation that can be undertaken in the ELEGANCY project, it will only be possible to explore a sub-set of dimensions of a full system-level business case. Furthermore, without private sector sponsors in specific business segments, the business cases for investment in these assets and operations cannot be developed.

The work programmes specified in the case studies are heavily weighted towards the dimension of technical feasibility and delivery. Some insights can be gained from this work into the other business case dimensions through use of the Work Package 4 H<sub>2</sub>-CCS chain modelling tool-kit (See Section 4.2). Models built with this tool-kit can provide some potentially useful inputs to:

- the selection of business models in the iterative process described in Section 3.1 below;
- the selection of value and delivery metrics;
- development of counterfactual scenarios and baselines;
- economic cost effectiveness analysis;
- understanding distributional impact<sup>12</sup> and optimism bias<sup>13</sup>; and
- delivery and operability risk assessment and mitigation plans.

Ultimately the system business case in each case study (and jurisdiction) will require some understanding of how collaboration between public and private sector stakeholders will influence

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<sup>5</sup> Asian Development Bank, 2017, Guidelines for the Economic Analysis of Projects, <https://www.adb.org/sites/default/files/institutional-document/32256/economic-analysis-projects.pdf>, accessed 29<sup>th</sup> March 2019



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the business model selection and the elements of the strategic dimension. This can be facilitated by the WP3 suite of tools but will require stakeholder workshops to produce a realistic set of inputs rather than a theoretical set.

### 3 BUSINESS CASE DEVELOPMENT AND ASSESSMENT

#### 3.1 Relationship to Business Models (Recap)

Report D3.3.3 introduced the principle that to make a business case for an investment proposition, or strategic macroeconomic objective, there needs to be a business model that describes how the outcome will be achieved and what mechanisms will mitigate risks and support delivery actions. The business model selection process therefore has a link to the metrics that will define its corresponding business case.

The iterative process previously discussed, and used in the ELEGANCY methodology, is summarised in Figure 3-1 below. Decision gates refer to points at which decisions are made to undertake increasingly more detailed work and increasing expenditure on project and policy design and development. For the ELEGANCY case studies there will only be one initial pass through the process so that the proposals can be advanced to a point where there is useful input to government and industry stakeholders as per the ERA-NET ACT objectives.

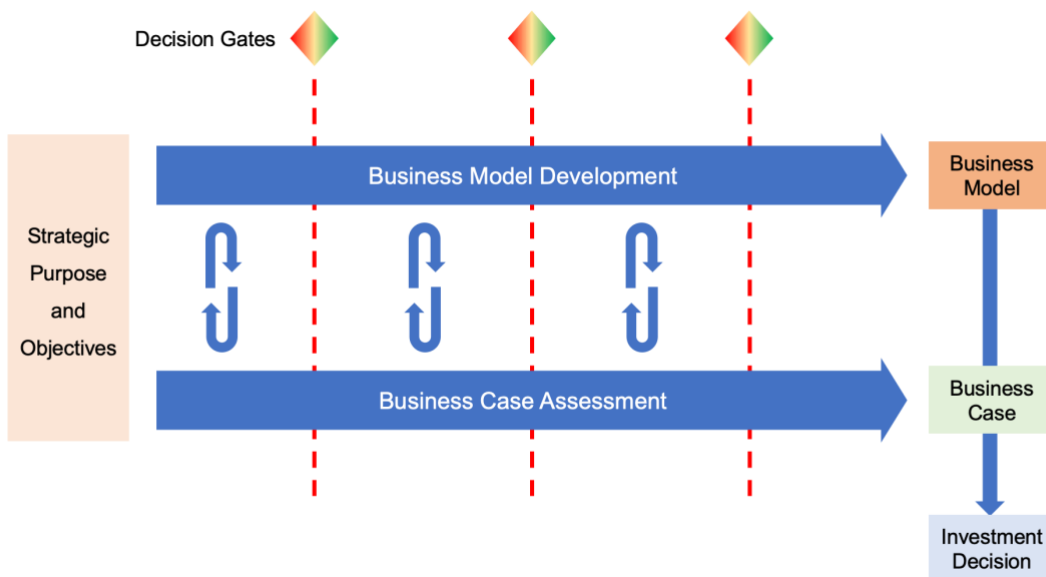


Figure 3-1 Iterative Development of Business Investment Decision

Business model development and selection is based upon the drivers that have been tailored to the strategic purpose and objectives of a case study or infrastructure project. The information on business context resulting from the detailed risk and policy assessments undertaken in previous steps of the method is used to determine stakeholder preferences for the investment and commercial models that form the basic structure of both the system business model (for removing investment barriers) and the operational business model for high priority business segments that interact with, or have an impact on, those barriers.

Once an allocation of risks and mitigation measures has been made between relevant stakeholder entities, a business case assessment can be undertaken. Depending on the outcomes of this assessment it may be necessary to review the business model and modify its structure and mechanisms. In some cases, it may also be necessary to revisit the business context analysis to

alter or vary the associated stakeholder preferences. This can lead to a different business model being selected. The business case is then again assessed. The process can repeat until stakeholders converge on an agreed outcome. Figure 3-2 below represents the main steps of the iterative process between business model selection and business case assessment.

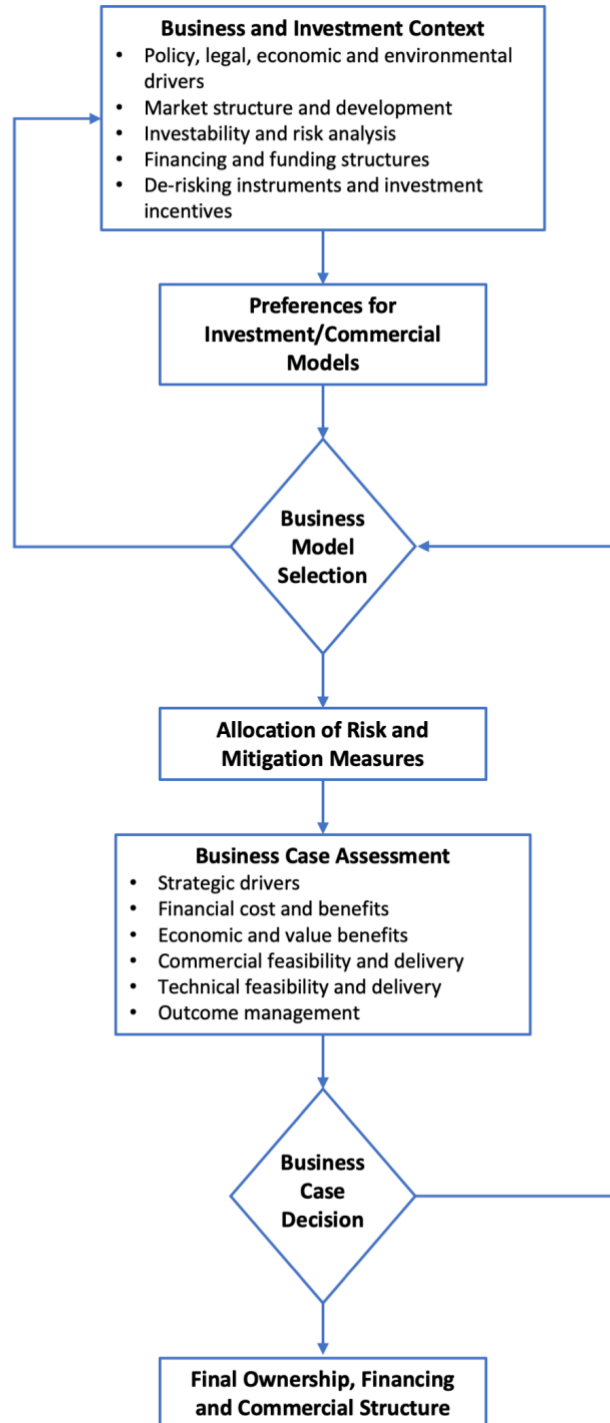


Figure 3-2 Business Case Development Process

### 3.2 ELEGANCY Business Case Assessment

A flowchart of the ELEGANCY business case assessment process is provided in Figure 3-3 below and further guidance on the assessment for each of the dimensions is provided in the subsequent sections.

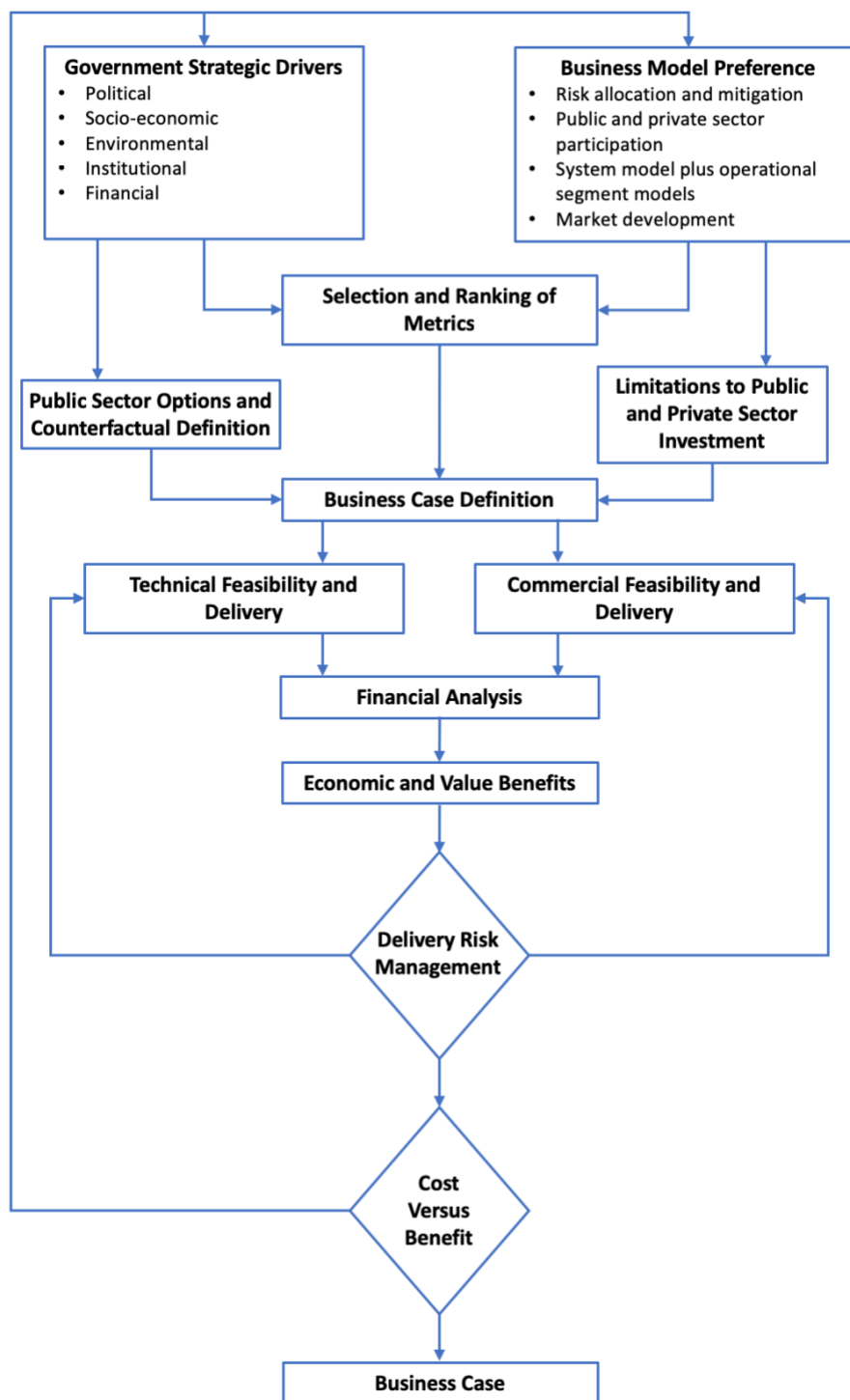


Figure 3-3 Business Case Assessment Process

### 3.3 Business Case Assessment Structure

This section presents high level guidance which has been prepared for the definition and assessment of each of the business case dimensions (Figure 2-4) and included in the Business Case Definition and Assessment Tool - in accordance with the flowchart in Figure 3-3.

The detailed spreadsheet templates which have been developed for each of these dimensions in the Business Case Definition and Assessment Tool have been included in Appendix – Business Case templates (Appendix A).

#### 3.3.1 Business Case Definition

A Business Case Definition is required to initiate the detailed assessment process in each of the business case dimensions. The first half of the flowchart in Figure 3-3 indicates the data and decisions that comprise the elements of the business case definition. This information should be developed as far as possible in a collaborative approach between public and private sector stakeholders. These elements are not prescriptive in the ELEGANCY methodology, however the following included in the Business Case Definition template would be expected as a minimum to effectively formulate a business case definition:

- Project Presentation
  - Including the relevant business sectors, project scale (financial), project scale (emissions), project type, project status, geographical extent, implementation timeline, market maturity, main public sector partners/stakeholders, main private sector partners/stakeholders;
- Business Context Summary
  - Extracted from a business context assessment exercise;
  - Supported by a review of specific business case selection drivers;
- Project Strategic Objectives
  - Summarised from both public sector and private sector perspective;
- Key Metrics
  - Measures against which outcomes and decisions will be made;
  - Both quantitative and qualitative measures should be defined;
- Business Model Preference
  - Extracted from the outcome of a business model selection exercise;
  - The four components of transfer of responsibility are used: ownership, capital sourcing, market development and physical delivery;
- Key Alternatives and Options
  - Definition of the main counterfactual scenarios (Do Nothing, Do Minimum, Do Something Else);
- Limitations to Investment
  - Summary of the principal barriers to investment for the public and private sector stakeholders based on earlier analysis.

#### 3.3.2 Guidance on Business Case Dimensions

The principal objective for each business case dimension and indicative methods that can be used to populate the templates are summarised below with an example of the differences between public and private sector focus and outcomes compiled in Table 3-1.

### 3.3.2.1 Strategic Drivers and Rationale

**Objective:** Justification for change and assessment of alignment of project with strategic objectives and major priorities of public sector and the private sector.

**Methods:** SWOT analysis, SMART objectives, ELEGANCY WP3 analysis.

### 3.3.2.2 Financial Cost and Benefits

**Objective:** Analysis and assessment of financial cost, investment return, affordability and funding over project lifetime.

**Methods:** Cash flow analysis, cost of capital, financial markets analysis, value-at-risk and portfolio analyses, sensitivity analysis, Monte Carlo analysis, real options analysis, peer review.

### 3.3.2.3 Economic and Value Benefits

**Objective:** Assessment of value delivered by the project to society (environmental, economic, social) over project lifetime.

**Methods:** Cost benefit analysis, cost effectiveness analysis, economic multiplier analysis, CGE economic modelling, distributional analysis, optimism bias, lifecycle emissions analysis, sustainability analysis, social impact analysis, value-for-money analysis, real options analysis, peer review.

### 3.3.2.4 Commercial Feasibility & Delivery

**Objective:** Assessment of effectiveness of the commercial and legal structure and arrangements for successful delivery of the project.

**Methods:** ELEGANCY WP3 analysis, regulatory and permitting review, procurement and state aid compliance, governance procedures, audit and assurance, accounting controls, peer review.

### 3.3.2.5 Technical Feasibility & Delivery

**Objective:** Assessment of feasibility and effectiveness of the technology and technical design for the delivery of the project.

**Methods:** Standards and regulatory compliance, design factors, peer review, ELEGANCY WP4 chain tool, scenario analysis, Monte Carlo analysis, real options analysis, developer capability assessment.

### 3.3.2.6 Outcome Management

**Objective:** Record the detailed plans for project delivery and realisation of benefits, risk management and post-implementation evaluation.

**Methods:** ELEGANCY WP3 Risk matrix, Bow-tie risk management, project management, GANTT chart, audit and assurance, Monte Carlo analysis, real options analysis, peer review.

Table 3-1 Example comparison of public and private business case dimensions

Business Case Dimension	Public Sector	Private Sector
<b>Strategic Drivers and Rationale</b>	<ul style="list-style-type: none"> <li>• Climate mitigation objectives</li> <li>• Lowest cost value for money energy</li> <li>• Just transition to sustainable low carbon economy</li> <li>• Maintaining options over future pathways</li> </ul>	<ul style="list-style-type: none"> <li>• Protecting and growing shareholder value</li> <li>• Securing/ensuring corporate longevity and viability</li> <li>• Environmental responsibility</li> <li>• Maintaining public and NGO trust</li> </ul>
<b>Financial Cost and Benefits</b>	<ul style="list-style-type: none"> <li>• Treasury impact including national debt levels and credit ratings</li> <li>• Affordability of interventions</li> <li>• Sources of capital</li> <li>• Taxation and other capital charges</li> <li>• Contingent liabilities to be carried by Government</li> </ul>	<ul style="list-style-type: none"> <li>• Access to cost-effective capital with appropriate tenor</li> <li>• Investability: NPV, IRR, and RoI hurdle rates</li> <li>• Cost of market hedging instruments</li> <li>• Opportunity cost, value at risk and portfolio value</li> <li>• Taxation and other imposts</li> </ul>
<b>Economic and Value Benefits</b>	<ul style="list-style-type: none"> <li>• Social cost-benefit and cost-effectiveness: ENPV, ERR, benefit cost ratio, options</li> <li>• Sector and geographical value and social distribution and productivity</li> <li>• Removal of market failures, and economic and environmental externalities</li> <li>• Long term economic multipliers and job protection/creation</li> </ul>	<ul style="list-style-type: none"> <li>• Cost effective market development</li> <li>• Cost effective access to human and natural resources</li> <li>• Supply chain effectiveness and competitiveness</li> <li>• Government policies and facilitation mechanisms for growth/investment</li> </ul>
<b>Commercial Feasibility and Delivery</b>	<ul style="list-style-type: none"> <li>• Procurement requirements and strategy</li> <li>• Ownership structure</li> <li>• Contracts – revenue support, liabilities and underwriting, organisation responsible for contract management</li> <li>• Public sector accounting and internal controls</li> </ul>	<ul style="list-style-type: none"> <li>• Ownership structure, strategic partnerships, finance structure</li> <li>• Regulatory requirements and constraints</li> <li>• Contracts – Finance, EPCM, service, sales and purchase, state agreement</li> <li>• Access to insurance, guarantees, warranties, market hedging instruments, bonds and other risk mitigation methods</li> </ul>
<b>Technical Feasibility and Delivery</b>	<ul style="list-style-type: none"> <li>• Technology choice – level playing field</li> <li>• Demand analysis</li> <li>• Environmental sustainability</li> <li>• Capability of developer/contractor</li> </ul>	<ul style="list-style-type: none"> <li>• Technology selection and performance</li> <li>• Design, permitting, construction and commissioning</li> <li>• Operations and maintenance</li> <li>• Facilities and service availability</li> <li>• Supply chain performance</li> <li>• Innovation requirements</li> </ul>
<b>Outcome Management</b>	<ul style="list-style-type: none"> <li>• Financial and outcome risks</li> <li>• Catastrophe risk</li> <li>• Public acceptance</li> <li>• Mitigation of delivery delays and cost overruns</li> <li>• Monitoring and evaluation of outcome of intervention</li> </ul>	<ul style="list-style-type: none"> <li>• Sovereign risk</li> <li>• Market risk</li> <li>• Utilisation and stranded asset risk</li> <li>• Technical risks</li> <li>• Management and delivery plan</li> <li>• Decommissioning plan</li> </ul>

### 3.4 Examples of Public Business Case Assessment Protocols

In the following sub-sections, we review some best practice public sector business case assessment protocols. These protocols provide valuable insights into how a collaborative business case can be developed between the public and private sectors. They also demonstrate just how similar the public sector decision-making is to that of the private sector. Closing the business case gaps between the two as demonstrated in Table 3-1 relies on merging the financial and economic cases (and the drivers of a cost-benefit analysis<sup>6</sup>) to find a value-for-money proposition that works for both public and private perspectives. Joint determination of the business model based on agreed risk and liability sharing is essential to achieve this outcome. Hence, the need for the iterative process within the ELEGANCY methodology described earlier in Section 3.1. Each of the public sector protocols described here is a subset of, and compatible with, the ELEGANCY business case structure and templates.

#### 3.4.1 United Kingdom HM Treasury

HM Treasury guidance, known as ‘The Green Book’<sup>7,8,9,10</sup>, on how to appraise and evaluate policies, projects and programmes is a detailed framework that has been developed over more than two decades as an adjunct to the UK’s approach to public-private partnerships using its private finance initiative (PFI) approach.

The framework recognises that business cases evolve through stages of maturity:

- strategic outline;
- business outline;
- full business case.

This conforms with the typical front-end loading (planning) and iterative approach to decision-making used by the private sector. Hence it is a particularly practical way of merging public and private collaboration for joint business case assessment. It is used as a foundation for the ELEGANCY business case development process shown in Figure 3-1.

For each business case maturity stage five elements of the HMT business case model are assessed to a greater or lesser extent depending on data and the level of detail defined at that stage<sup>7</sup>:

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<sup>6</sup> Cost benefit analysis (CBA) is a quantitative technique that assesses costs and benefits in monetary terms for a project, investment or intervention over a forecast period and discounts each to arrive at present values that can be adjusted for risk and uncertainty. The difference between the present value benefits and costs is the net present value (NPV). CBA is conducted as a comparative calculation against the case when the intervention is not performed, or against an alternative case.

<sup>7</sup> HM Treasury, 2018, The Green Book, [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/685903/The\\_Green\\_Book.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685903/The_Green_Book.pdf), accessed 29<sup>th</sup> March 2019

<sup>8</sup> HM Treasury, 2018, Guide to Developing the Project Business Case, [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/749086/Project\\_Business\\_Case\\_2018.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/749086/Project_Business_Case_2018.pdf), accessed 29<sup>th</sup> March 2019

<sup>9</sup> HM Treasury, 2018, Guide to Developing the Programme Business Case, [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/749085/Programme\\_Business\\_Case\\_2018.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/749085/Programme_Business_Case_2018.pdf), accessed 29<sup>th</sup> March 2019

<sup>10</sup> HM Treasury, 2018, Checklist for Assessing Business Cases, [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/190603/Green\\_Book\\_guidance\\_checklist\\_for\\_assessing\\_business\\_cases.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/190603/Green_Book_guidance_checklist_for_assessing_business_cases.pdf), accessed 29<sup>th</sup> March 2019



1. Strategic Case – the justification for change;
2. Economic Case – the assessment and optimisation of options providing value-for-money;
3. Commercial Case – the assessment and selection of commercially viable options;
4. Financial Case – the analysis and demonstration of affordability and funding;
5. Management Case – the plans for delivery and arrangements for management of risk, the realisation of benefits, and monitoring to evaluate outcomes.

The following additional concepts are important elements in the appraisal process, which has its basis in welfare economic analysis:

- Rationale for intervention – ensuring markets work effectively or to achieve distributional benefits;
- Long-list delivery and funding options – a full range of options for achieving government objectives should be canvassed;
- Short-list appraisal – use of social Cost Benefit Analysis (CBA) or social Cost Effectiveness Analysis<sup>11</sup> (CEA) to assess the value of intervention against the business as usual (BAU) alternative (counterfactual with no intervention). Relevant direct and indirect costs and benefits are for society as a whole and should be valued and monetised wherever possible, but unmonetisable factors should not be ignored;
- Long term perspective – e.g. 10 to 60-year time horizon (very long term includes nuclear waste storage and would include geological storage of CO<sub>2</sub>);
- Distributional analysis<sup>12</sup> – if an intervention has a re-distributional objective this should be evaluated at sub-national, regional and local levels;
- Optimism bias<sup>13</sup>, risk and sensitivity analyses should be carried out to explore the envelope of uncertainties associated with the project, investment, or intervention.

### 3.4.2 European Commission

The European Commission (EC) provides statutory guidance on appraising investment decisions for major infrastructure projects (above €50 million) to ensure consistency with EU policy objectives and positive welfare benefits. The protocol is based on undertaking a structured Cost Benefit Analysis (CBA) according to a strict set of rules that are binding on the beneficiaries and is a regulatory requirement for Commission co-financing using the European Regional Development Fund (ERDF) and the Cohesion Fund<sup>14</sup>.

*“CBA is an analytical tool to be used to appraise an investment decision in order to assess the welfare change attributable to it and, in so doing, the contribution to EU cohesion policy objectives. The purpose of CBA is to facilitate a more efficient allocation of resources, demonstrating the convenience for society of a particular intervention rather than possible alternatives.”*

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<sup>11</sup> Social cost effectiveness analysis (CEA) can be used when there is insufficient quantitative data for measuring the monetisation of output benefits to undertake a full CBA. It provides an assessment of the cost to achieve a given objective or target outcome, thus allowing comparisons amongst different options or alternatives.

<sup>12</sup> Distributional analysis attempts to understand how the impacts of an intervention/investment vary between sections of society or geographical regions, and how value may be re-distributed to prevent disadvantage or imbalance.

<sup>13</sup> Optimism bias is the “demonstrated systematic tendency for appraisers to be over-optimistic about key project parameters, including capital costs, operating costs, project duration and benefits delivery” (HMT Green Book).

<sup>14</sup> European Commission, 2014, Guide to Cost-Benefit Analysis of Investment Projects,

[https://ec.europa.eu/inea/sites/inea/files/cba\\_guide\\_cohesion\\_policy.pdf](https://ec.europa.eu/inea/sites/inea/files/cba_guide_cohesion_policy.pdf), accessed 29<sup>th</sup> March 2019

Key information required in the co-financing approval framework by the EC includes:

- The responsible entity for implementation of the project;
- The total cost and total eligible cost;
- Feasibility studies and options analysis;
- A CBA, incorporating economic and financial analyses, and risk assessment;
- An environmental impact analysis, including climate change mitigation and adaptation needs;
- Consistency with requirements of co-financing funds and socio-economic development objectives (smart, sustainable and inclusive growth);
- A financing plan and monitoring metrics including physical and financial indicators; and
- Implementation timetable and co-financing schedule.

The EC requires a standardised seven step structured CBA that incorporates the above requirements:

1. Description of the project context – socio-economic, institutional and political;
2. Definition of objectives – needs assessment and project relevance;
3. Project identification – activities and responsible entity for implementation;
4. Technical feasibility and environmental sustainability – demand and options analyses, environmental factors, and technical design, costs and implementation;
5. Financial analysis – cash flows, sources of finance, affordability, profitability, sustainability;
6. Economic analysis – evaluation of market and non-market impacts, economic profitability; and
7. Risk assessment – sensitivity analysis, qualitative and quantitative risk analyses.

Note the following concepts are important to, and included in, the assessment:

- Opportunity cost – the potential gain from the best alternative forgone;
- Long term perspective – 10 to 30-year time horizon for the investment;
- Economic performance indicators are determined in monetary terms, such as Economic NPV<sup>15</sup> (ENPV) and Economic Rate of Return<sup>16</sup> (ERR);
- Micro-economic approach – only direct impact and value are assessed, not indirect and/or wider effects or benefits of the investment;
- Incremental assessment – comparing the project/investment with a counterfactual scenario that does not include the project.

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<sup>15</sup> Economic Net Present Value (ENPV) is the difference between the discounted total social and economic benefits and total costs quantified in monetary terms for a project or investment<sup>14</sup>.

<sup>16</sup> Economic Rate of Return (ERR) is the discount rate in an economic cash flow analysis that results in a value of zero for the ENPV<sup>14</sup>. It is analogous to internal rate of return (IRR) calculated in an investment cashflow analysis but based on economic values instead of financial values and prices.

### 3.4.3 European Investment Bank

The European Investment Bank (EIB) characterises the economic appraisal of projects as follows<sup>17</sup>:

*“Private sector investors evaluate projects using standard financial appraisals that focus on private financial returns. Economic appraisal, in turn, takes a broader view to include other benefits and costs to society, accounting for all resources used by the project, whether human, technological, or natural, and gauges the value the project generates to all stakeholders, to determine whether society at large gains from the investment.”*

EIB project appraisal for investment is based on a CBA and focusses on:

- Financial Case – analysis of expenditures and revenues over the lifetime of a project, assessment of project financial sustainability and profitability rate of return, market assessment, estimates of residual value;
- Economic Case – identification and quantification (where possible) of wider costs and benefits in the economy including spillovers and externalities, economic profitability (ERR and ENPV);
- Social Case – ensure social equity via application of the EIB’s social guidelines<sup>18</sup>
- Environmental Case – assessment, quantification and incorporation of cost and benefits of externalities in the economic CBA including global and local pollutants, and ecosystem impacts. The protocol makes additional use of CEA for energy projects;
- Technical Case – The EIB is interested in the physical life of an infrastructure project and thus on engineering designs, stress tests, safety factors, and impact of operations on assets;
- Physical and Financial Monitoring – metrics and processes for monitoring performance of project delivery and operations, asset integrity, financial governance, budget accounting, outcomes, and post-project evaluation.

Important EIB assessment requirements include:

- The Counterfactual Scenario – this is defined taking account of the degree of competition in the market. A low competition market requires a greater level of assumptions to create an ad hoc counterfactual. The three counterfactual scenarios used by EIB are “do nothing”, “do minimum” or “do something else”;
- Wider Economic Impacts – these are tangible benefits or costs to the economy arising from an investment, but not included in standard economic appraisal techniques. Identification and assessment of primary and secondary markets and the avoidance of double counting are key elements. Impacts on public finances, GDP, labour markets are investigated;
- Risk Analysis and Uncertainty – use of probability distributions and Monte Carlo analysis is recommended if sufficient quality data is available, otherwise scenarios are used if there is insufficient data. Real options analysis is incorporated where appropriate.

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<sup>17</sup> European Investment Bank, 2013, The Economic Appraisal of Investment Projects at the EIB, [http://www.eib.org/attachments/thematic/economic\\_appraisal\\_of\\_investment\\_projects\\_en.pdf](http://www.eib.org/attachments/thematic/economic_appraisal_of_investment_projects_en.pdf), accessed 29<sup>th</sup> March 2019

<sup>18</sup> European Investment Bank, 2018, Environmental and Social Standards Handbook, <http://www.eib.org/about/publications/environmental-and-social-practices-handbook.htm>, accessed 29<sup>th</sup> March 2019

### 3.4.4 World Bank

The World Bank regularly publishes updated procedures for the economic analysis of projects and investment project financing.<sup>19,20,21</sup> In its current protocol the World Bank prioritises three questions for making the case to invest in, or finance, a project:

1. What is the project's development impact?
2. Is public sector provision or financing the appropriate vehicle?
3. What is the World Bank's value added?

These three questions are analogous to some of the key strategic drivers that need addressing by governments and/or public entities in business model selection and business case assessment for FOAK and early stage H<sub>2</sub>-CCS infrastructure. The bank requires that the formal project concept (the rationale) should address and incorporate these three questions.

The principal dimensions of World Bank project appraisal are:

1. Technical Analysis – design and capability of borrower and/or developer, implementation issues;
2. Economic Analysis – economic rationale, financial viability analysis, cost benefit analysis;
3. Financial Management – planning, budgeting, accounting, internal control, funds flow, financial reporting, and auditing arrangements;
4. Procurement – must be consistent with Bank policy and directives;
5. Environment and Social – requirements need to satisfy Bank policies and operating procedures and deliver sustainable outcomes;
6. Risk Assessment – risks to achieving project objectives and consideration of the risks of inaction.

As with the other protocols, cost-benefit analysis and the use of Economic Rate of Return (ERR) against a counterfactual are integral to a World Bank appraisal, however there is recognition of CBA limitations (see Section 3.5 below) and also the need to use Cost Effectiveness Analysis in situations where monetary value of benefits is difficult to quantify.

Other key principles applied in the assessment and decision-making process include:

- The project development outcome, economic benefits and key performance indicators (KPIs) should be integrated, and analyses carried out in the assessment process should highlight the interdependencies between economic rationale, quantitative results and risks;
- An iterative process should be followed for the economic analysis, starting with a preliminary assessment to guide the refinement of the objectives, economic rationale, KPIs, costs and benefits, and risks;

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<sup>19</sup> Squire, Lyn; Van Der Tak, Herman G., 1979, Economic analysis of projects (English). A World Bank research publication; Staff working paper; no. SWP 194, <http://documents.worldbank.org/curated/en/667241468020087552/Economic-analysis-of-projects>, accessed 29<sup>th</sup> March 2019

<sup>20</sup> World Bank, 2018, Bank Policy, OPS5.03-POL.110, Investment Project Financing, <https://policies.worldbank.org/sites/ppf3/PPFDocuments/796071c468754b6fb9ba5eeeb8de20a4.pdf>, accessed 29<sup>th</sup> March 2019

<sup>21</sup> World Bank Operations Policy and Quality Department, OPSPQ, 2013, Investment Project Financing Economic Analysis Guidance Note, [http://siteresources.worldbank.org/PROJECTS/Resources/40940-1365611011935/Guidance\\_Note\\_Economic\\_Analysis.pdf](http://siteresources.worldbank.org/PROJECTS/Resources/40940-1365611011935/Guidance_Note_Economic_Analysis.pdf), accessed 29<sup>th</sup> March 2019

- Financial sustainability - entities undertaking a project on a commercial or cost-recovery basis should eventually be able to self-finance;
- Fiscal sustainability - projects should not have a deleterious effect on a host government's budget;
- Any counterfactual scenario used in economic analysis should not just be a continuation of business-as-usual. Appropriate definitions of logical no-project baselines can use different plausible future trends.
- Use of prospective and retrospective impact evaluation<sup>22</sup>

### 3.5 Beyond Cost Benefit Analysis

Measurement of benefits against a counterfactual is integral to cost-benefit analysis. Addressing “benefits” versus a counterfactual is becoming increasingly more difficult and rigorous procedures to measure economic, social and environmental impact of an investment more accurately need to be integrated with CBA. The Independent Evaluation Group (IEG) of the World Bank Group has stated<sup>23</sup>:

*“In recent years, the managing for results agenda has been dominated by discussions about measuring results, using logical frameworks to frame the monitoring and evaluation efforts, and impact evaluation to measure impact in a more accurate and rigorous way. These efforts complement each other and also complement cost-benefit analysis. Yet in practice they are often treated separately, leading to unnecessary fragmentation.”*

and

*“Cost-benefit analysis is not a stand-alone activity; it is part of a larger effort to appraise and evaluate projects. The crucial issue is not simply whether a cost-benefit analysis is done but whether the reasoning motivating the project is analytically sound and supported by credible evidence.”*

The ELEGANCY business case assessment methodology does not prescribe what metrics and what analysis methods should be used to define and quantify the economic and value benefits of a project or investment proposition. The ELEGANCY templates and Excel spreadsheet tool allow for selection of any analytical methods that are fit-for-purpose in supporting a business case.

In Europe CCS projects have in the past primarily been associated with electricity generation and the cost benefit analysis of these has been relatively limited to simple comparative metrics such as levelised cost of electricity (LCOE) and emissions abatement cost (€/t CO<sub>2</sub>). A number of cost effectiveness studies at the macro-economic level have shown the system cost of abatement of European emissions to reach 2050 targets is much lower when CCS technologies are deployed as

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<sup>22</sup> World Bank (2016) Impact Evaluation in Practice, Second Edition:  
<https://openknowledge.worldbank.org/handle/10986/25030>, accessed 29<sup>th</sup> March 2019

<sup>23</sup> Independent Evaluation Group (IEG), World Bank Group, 2010,  
<https://ieg.worldbankgroup.org/evaluations/cost-benefit-analysis-world-bank-projects>, accessed 29<sup>th</sup> March 2019

an integral part of the energy system<sup>24,25</sup>. However, quantifying the full benefits to society of CCS, including H<sub>2</sub>-CCS and CO<sub>2</sub> utilisation with CCS (CCUS), is a complex task. Nevertheless, a business case assessment should attempt to include as far as possible attributable benefits and value such as avoided environmental and adaptation costs, GDP, jobs, tax revenue, and supply chain growth created by new products and services.

An increasingly popular method to investigate macro-economic benefits is the use of economic multiplier assessments. Economic multipliers quantify the total activity or output in the economy for a unit of money spent or person employed in a single sector, and thus act as a proxy for the complex relationships in the economic system between different activities and sectors. Recent studies and reports in a European setting using this method have suggested likely improvements against counterfactuals for CCS and H<sub>2</sub>-CCS activities compared with more conventional CBA analyses<sup>26,27,28</sup>. These studies, and ones like them<sup>29,30</sup>, suggest that CCS-related business cases should make use of the economic multiplier technique and/or economic multi-sector computable general equilibrium (CGE) models<sup>31</sup>. Multiplier analyses can also demonstrate value destruction such as can result from the effect of carbon leakage and migration of industrial activities to other countries.

Thinking beyond CBA to the quantification of macro-economic benefits should be included in the ELEGANCY business case development process. Both cost metrics such as cost per valued outcome (e.g. cost-per-job ‘CPJ’) and benefit metrics such as multipliers will provide a fuller assessment for the economic value benefits dimension.

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<sup>24</sup> Zero Emissions Platform, 2017, CCS and Europe's Contribution to the Paris Agreement - Modelling least-cost CO<sub>2</sub> reduction pathways, <http://www.zeroemissionsplatform.eu/extranet-library/publication/271-me5.html>, accessed 29<sup>th</sup> March 2019

<sup>25</sup> Pöyry, 2018, Fully decarbonising Europe's energy system by 2050, [http://www.poyry.com/sites/default/files/media/related\\_material/poyrypointofview\\_fullydecarbonisingeuropesenergysystemby2050.pdf](http://www.poyry.com/sites/default/files/media/related_material/poyrypointofview_fullydecarbonisingeuropesenergysystemby2050.pdf), accessed 29<sup>th</sup> March 2019

<sup>26</sup> Zero Emissions Platform, 2018, Role of CCUS in a below 2 degrees scenario, <http://www.zeroemissionsplatform.eu/extranet-library/publication/282-ccusbelow2degrees.html>, accessed 29<sup>th</sup> March 2019

<sup>27</sup> Turner, K., Race, J., Alabi, O., and Low, R., 2018, Making the macroeconomic case for near term action on CCS in the UK? The current state of economy-wide modelling evidence, University of Strathclyde, [https://pureportal.strath.ac.uk/files/85319669/Turner\\_etal\\_IPPI\\_2018\\_Making\\_the\\_macroeconomic\\_case\\_for\\_near\\_term\\_action\\_on\\_CCS\\_in\\_the\\_UK.pdf](https://pureportal.strath.ac.uk/files/85319669/Turner_etal_IPPI_2018_Making_the_macroeconomic_case_for_near_term_action_on_CCS_in_the_UK.pdf), accessed 29<sup>th</sup> March 2019

<sup>28</sup> Turner, K., Alabi, O., Smith, M., Irvine, J., and Dodds, P., 2018, Framing policy on low emissions vehicles in terms of economic gains: Might the most straightforward gain be delivered by supply chain activity to support refuelling?, Energy Policy, [online] 119, pp.528-534.

<sup>29</sup> Størset, S.O., Tangen, G., Wolfgang, O. and Sand, G., 2018, Industrial opportunities and employment prospects in large-scale CO<sub>2</sub> management in Norway, SINTEF: Report 2018:0594, ISBN 978-82-14-6865-8, [https://www.nho.no/contentassets/c7516d8d47b84af9b174c803964b6e75/industrial-opportunities-ccs\\_english-ii.pdf](https://www.nho.no/contentassets/c7516d8d47b84af9b174c803964b6e75/industrial-opportunities-ccs_english-ii.pdf), accessed 29<sup>th</sup> March 2019

<sup>30</sup> Summit Power, 2017, Clean Air – Clean Industry – Clean Growth: How carbon capture will boost the UK economy, <http://www.ccsassociation.org/news-and-events/reports-and-publications/clean-air-clean-industry-clean-growth/>, accessed 29<sup>th</sup> March 2019

<sup>31</sup> UK HM Revenue and Customs defines a computable general equilibrium (CGE) model as ‘a large-scale numerical model that simulates the core economic interactions in the economy. It uses data on the structure of the economy along with a set of equations based on economic theory to estimate the effects of fiscal policies on the economy’.

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/263652/CGE\\_model\\_doc\\_131204\\_new.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/263652/CGE_model_doc_131204_new.pdf), accessed 29<sup>th</sup> March 2019



## 4 COMPLEMENTARY TOOLS

### 4.1 ELEGANCY Work Package 3 Tools

All the supporting tools developed by Work Package 3 are listed in Table 4-1 below:

*Table 4-1 ELEGANCY Business case development tool-kit*

Supporting Tools	Source
<ul style="list-style-type: none"> <li>Market Background Assessment</li> <li>Market Failures</li> </ul>	Report D3.2.1
<ul style="list-style-type: none"> <li>Risk Assessment and Matrix</li> <li>Policy and Financial Support Analysis</li> </ul>	Report D3.3.2
<ul style="list-style-type: none"> <li>Risk Mitigation Heat Map</li> <li>Policy Needs Heat Map</li> <li>Business Model Selection Tool</li> </ul>	Report D3.3.3
<ul style="list-style-type: none"> <li>Business Case Definition and Assessment Tool</li> </ul>	Report D3.3.4

### 4.2 The ELEGANCY Work Package 4 H<sub>2</sub>-CCS Chain Modelling Tool-kit

#### 4.2.1 Overview

The ELEGANCY Work Package 4 modelling tool-kit<sup>32</sup> can be used for evaluating an integrated H<sub>2</sub>-CCS chain network on the basis of a number of factors such as technological efficiency, capital and operating costs, operability, and social and environmental impact. From a technical perspective the models created using the tool-kit will help to provide insights into the trade-offs between those different factors and how the trade-offs affect system performance. In other words, a modeller using the tool-kit can analyse various potential applications for H<sub>2</sub>-CCS chains, whilst being able to assess network performance under multiple performance criteria. The analysis technique is based on the method of multi-criteria optimisation, making use of decision variables defined in the model and an outcome objective relevant to questions a modeller wishes to explore, such as ‘what is the least cost network to achieve a given emissions target?’. These optimisation questions can be simple or very complex, and at small (e.g. an individual network component like an H<sub>2</sub> production facility) or large (e.g. regional, national or multi-national infrastructure) scales.

Although the focus of the modelling framework is on production-delivery-market systems of H<sub>2</sub>-CCS networks, inputs to models can include reference or business-as-usual (BAU) scenarios that define baselines of existing infrastructure for other energy carriers and technologies used to meet market demand. Thus, models can be built that integrate counterfactual projects, networks or

<sup>32</sup> ELEGANCY Project, 2018, H<sub>2</sub>-CCS chain tool and evaluation methodologies for integrated chains – WP4, <https://www.sintef.no/projectweb/elegancy/publications/>

scenarios and undertake simultaneous optimisation to provide insights into the extent to which a case being investigated may be preferable to a BAU or alternative case.

Models can be built in two modes: design and operational. Design mode is used to investigate the evolution of a network and system in steady state over a medium to long time-frame (e.g. 5 – 50 years) and allows for optimisation calculations that achieve defined objectives and outcomes for a given scenario. Operational mode is used to simulate the dynamic performance of a system with a fixed topology and elements, thus enabling a determination of the technical operating envelope (including intermittent and transient behaviour).

#### 4.2.2 Metrics and Key Performance Indicators (KPIs)

The modelling tool-kit multi-criteria evaluations are based on a set of quantifiable performance metrics as shown in Table 4-2 below. Some of the environmental and social metrics rely on calculations based on expert qualitative input or protocols and standards that try to approximate impacts and damage resulting from climate change, pollution, and other human activity.

Table 4-2 Quantifiable KPIs included in the ELEGANCY chain modelling tool-kit

Economics	Environmental
<ul style="list-style-type: none"> <li>Levelised cost of hydrogen (LCOH) at a desired purity level</li> <li>CAPEX and OPEX for design and operation, inclusive of network costs</li> </ul>	<ul style="list-style-type: none"> <li>Greenhouse gas emissions</li> <li>Energy efficiency</li> <li>Key pollutant emissions</li> <li>Ecosystem damages</li> </ul>
Security of Energy supply	Social
<ul style="list-style-type: none"> <li>Non-renewable primary energy demand</li> <li>Resource autonomy of energy supply chain</li> <li>Utilization of “critical” metal resources</li> </ul>	<ul style="list-style-type: none"> <li>Conflict potential</li> <li>Human health damages</li> <li>Social costs of carbon pollution (LCA)</li> </ul>
Geography related	Technical
<ul style="list-style-type: none"> <li>Demand for CO<sub>2</sub> storage capacities</li> <li>Demand for H<sub>2</sub> storage capacities</li> <li>Extent of utilization of domestic natural gas reserves</li> <li>Demand for upgraded or extended pipeline network</li> </ul>	<ul style="list-style-type: none"> <li>Hydrogen recovery</li> <li>CO<sub>2</sub> recovery</li> <li>(V)PSA specific power use per tonne of H<sub>2</sub> or CO<sub>2</sub></li> <li>CO<sub>2</sub> capture unit specific heat duty and power consumption</li> <li>Specific CO<sub>2</sub> avoided</li> <li>Specific primary energy consumption per tonne of CO<sub>2</sub> avoided</li> <li>System efficiency – first law</li> <li>System efficiency – second law</li> <li>(Load) flexibility</li> <li>Technology readiness level</li> </ul>



### 4.2.3 Using the Chain Modelling Tool-kit in Business Case Assessment

The ELEGANCY modelling tool-kit has a place in the suite of methods and tools utilised in the six dimensions of a business case assessment described in Chapter 3. The following summary provides a brief guidance on how the tool may be used in each one of the business case dimensions.

#### 4.2.3.1 *Strategic Drivers and Rationale*

The modelling tool does not have a direct role to play in the development and definition of the strategic drivers and rationale for a business case. These come from policies, investment criteria, business model preferences and strategic objectives of the various stakeholders. However, because of the iterative nature of the development of a business case some of the functionality and outputs of an ELEGANCY H<sub>2</sub>-CCS chain model can provide insights that may help to refine or modify elements of the strategic case. These can include the structure of the system business model, the primary business case metrics and their importance, geographical and social aspects of the business case definition, and the characterisation of one or more counterfactual scenarios.

#### 4.2.3.2 *Financial Cost and Benefits*

The financial metrics within an ELEGANCY model are capital and operating expenditure (CAPEX and OPEX). Cashflows in the current modelling tool-kit are therefore limited to expenditure flows and thus the primary utility of a model from a financial perspective is the timing or phasing of these expenditures. Scenarios can be run with different cost of capital rates added to model OPEX based on offline analysis of capital sources, ownership or splits between public and private sector participation. The time series for either data inputs or post processing need to be created and/or analysed outside the model. Hence, conventional models for assessment of financial sustainability and profitability rate of return either for the whole system (ERR, ENPV) or for component businesses (NPV, IRR) have to be created separately and interfaced with the ELEGANCY output datasets.

#### 4.2.3.3 *Economic and Value Benefits*

In its current version an ELEGANCY model built with the tool-kit will not directly perform economic cost-benefit analysis (CBA) but can be used to perform social cost-effectiveness analyses (CEA<sup>11</sup>) of defined objectives. Time series outputs from ELEGANCY models can be post-processed in CBA calculations, provide insights into macro and microeconomic metrics, and help with understanding environmental and social impacts as defined in the suite of metrics in Table 4-2. Because it is difficult to quantify value benefits in monetary terms beyond the immediate and direct economic and financial impact of an investment in network infrastructure or its component businesses, CEA provides the best foundation for business case assessment in the types of scenarios dealt with by the ELEGANCY modelling tool-kit. To this end the models can support value-for money comparisons and optimisation of the different options or technology solutions to achieve an objective. Other aspects of the economic dimensions of the business case such as distributional impact<sup>12</sup> and optimism bias<sup>13</sup> can also be explored through design of appropriate scenarios.

#### 4.2.3.4 *Commercial Feasibility & Delivery*

As above, the modelling tool does not have a direct role to play in business case commercial matters such as handling of risk allocation and performance obligations within business models, preferences for procurement strategies, or various contract structures to handle tariff, payment or revenue support mechanisms. Outputs from model scenarios may provide insights that influence choices within the commercial dimension and thus can be used during the iterative business case

development process. These insights are likely to be primarily associated with the operability conditions and performance envelope of different elements of the H<sub>2</sub>-CCS network which affect the business risk exposure between counterparties and thus are dealt with in commercial contracts.

#### 4.2.3.5 *Technical Feasibility & Delivery*

ELEGANCY H<sub>2</sub>-CCS chain models will be able to answer a large number of questions that can be posed in both design and operational modes related to the technical feasibility of building, operating and deploying a network over time against physical constraints (e.g. geography, scale, timing, market growth, resource availability, etc.) and target outcomes such as emissions reductions, air quality and energy efficiency. The technical KPIs listed in Table 4-2 can be used not only to understand the physical system and its performance characteristics but also to determine where risks may occur to an investment proposition for delivery or to the ability to apportion those risks between different elements (and thus businesses) within a H<sub>2</sub>-CCS chain. The relative technical feasibility of delivering alternative options of different technologies and mixes of technologies using BAU networks or other counterfactual scenarios can also be explored as part of this business case dimension.

#### 4.2.3.6 *Outcome Management*

The ELEGANCY WP4 Functional Specification document<sup>32</sup> states: “The main benefits of using a multi-scale modelling approach is that a user can combine the insights obtained from various scales to ensure that their confidence levels in decision making is improved.” The outcome management dimension of business case assessment covers many parameters related to design, finance, policy, operation and delivery, and is cross-cutting through all the other business case dimensions addressed in the WP3 ELEGANCY framework described herein. The ELEGANCY modelling tool-kit can be used directly to perform sensitivity analysis, Monte Carlo analysis, qualitative and quantitative uncertainty analyses, and identification of principal delivery and operational risks (including timing, scale and utilisation of the system). Post processing of output time series from multiple scenarios can be performed using spreadsheet models or other software to undertake decision support calculations such as real options analysis and estimation of value-at-risk, and insights can be gained for selecting key risk factors that require monitoring within delivery management plans.

## A APPENDIX – BUSINESS CASE TEMPLATES

### A.1 Business Case Definition

#### A. PROJECT PRESENTATION

H2-CCS Sectors	
Project Scale (financial)	
Project Scale (emissions)	
Project Type	
Project Status	
Geographical Extent	
Implementation timeline	
Market Maturity	
Main Public Sector partners/stakeholders	
Main Private Sector partners/stakeholders	

#### B. BUSINESS CONTEXT SUMMARY

The information for this business context summary can be obtained using the ELEGANCY business model development and selection process described in Reports D3.2.1, D3.3.2 and D3.3.3. A suite of tools for assisting with the collection and analysis of this information is contained in the **ELEGANCY Business Case Development Toolbox**: <https://www.sintef.no/projectweb/elegancy/programme/wp3/business-case-development-toolbox/>

Summary of main business drivers (see tab "a.Drivers" for additional information)

DIMENSION	SUMMARY
Institutional	(Appropriate existing organisations, governance structures, regulators)
Financial	(Fiscal pressures, market liquidity)
Environmental	(Levels of emissions by geography, by sector)
Energy Supply	
Economic	
Structural	(Existing physical infrastructure, energy market ownership and regulatory structure)
Social	

Summary of Government's key policy objectives

#### C. PROJECT STRATEGIC OBJECTIVES

Describe the objectives of the project in respect of the dimensions below from both a public and private sector perspective

DIMENSION	PUBLIC SECTOR	
	SHORT TERM	LONG TERM
Financial		
Economic		
Social (incl. reputation, licence to operate)		
Environmental		
Technology		

DIMENSION	PRIVATE SECTOR	
	SHORT TERM	LONG TERM
Financial		
Economic		
Social (incl. reputation, licence to operate)		
Environmental		
Technology		

**D. KEY METRICS**

DIMENSION	METRICS				
Financial	NPV	IRR	CAPEX		
Economic	ENPV	ERR			
Social					
Environmental	tons CO2/				
Technical					

**E. BUSINESS MODEL PREFERENCE**

Describe the preferred system business model for the H2-CCS chain and the relevant operational segment models using the 4 main components of transfer of responsibility between the public and private sector (see table below and general information in the guidance sheet "Methodology").

This preferred business model can be determined using the ELEGANCY business model development and selection process described in Report D3.3.3 and implemented in the ELEGANCY Business Model Selection Tool. See the **ELEGANCY Business Case Development Toolbox**:

<https://www.sintef.no/projectweb/elegancy/programme/wp3/business-case-development-toolbox/>

Business Model	Ownership	Capital Sourcing	Market Development		Physical Delivery	
			Responsibility	Revenue Model	Responsibility	Business Structure
H2 Production	Private		Private	Demand Based	Private	Operate
H2 Transmission						Design-Build-Operate
H2 Distribution						
H2 Storage	Private	Private	Private	Regulated Asset Base	Private	Design-Build-Operate
CO2 Capture						
CO2 Gathering						
CO2 Transmission	Private	Private	Private	Demand Based	Private	Design-Build-Operate
CO2 Storage						
Mobility						
Industry						
Decentralised Heat & Power						
Centralised Heat & Power						

**F. KEY ALTERNATIVES AND OPTIONS**

Summarise the public sector project and policy options as well as the preferred counterfactual scenarios that will be examined in the business case economic and financial analyses. The detailed definitions and specification of these will take place in the relevant dimensions of the business case assessment.

**G. LIMITATIONS TO INVESTMENT**

Summarise the principal barriers to investment for the public and private sector stakeholders based on the analysis performed using the suite of ELEGANCY Business Case Development Toolbox. Describe the principal limitations for these stakeholders to progress an investment if the barriers are removed. Some of these will be highlighted in the a.Drivers tab and some will be obtained from the ELEGANCY assessment tools.

## A.2 Strategic Rationale

### A. STRATEGIC RATIONALE - OBJECTIVE

**OBJECTIVE:** JUSTIFICATION FOR CHANGE AND ASSESSMENT OF ALIGNMENT OF PROJECT WITH STRATEGIC OBJECTIVES AND MAJOR PRIORITIES OF PUBLIC SECTOR AND THE PRIVATE SECTOR PARTICIPANTS

### B. STRATEGIC ISSUES

KEY STRATEGIC ISSUE	QUESTIONS	ALIGNMENT RATING	RESPONSE
Demonstrate how proposal fits with private sector participants' strategic objectives	Financial	Low	
	Market and Product Development	High	
	Environmental	Medium	
	Reputation/Brand		
	Other strategic objectives		
Sources of Value (Private Sector)	Does the project support other ongoing activities in the company(ies)? How?		
	What are the additional sources of value created by the project for the company(ies)?		
	Does the project support the acceleration/execution of other projects for the company? How? What are the potential synergies?		
Sources of Value (Public Sector)	How does the project support other ongoing activities in the company(ies)?		
	What are the additional sources of value created by the project for the <b>public sector</b> ?		
	Does the project support the acceleration/execution of other H2-CCS projects? How? What are the potential synergies?		
Justification for CCS	Why is CCS investment necessary in the short term?		
	Why is CCS investment necessary in the medium and long term?		
	Why is the combination of CCS with the specific sector (industry, power, heating, transport) better than alternatives for that sector?		
Societal Acceptance	Does the proposal address concerns that CCS is pushed by special interest groups? How?		
	Does the project fit with the public perception or social acceptance of the specific business opportunity along the H2-CCS chain? How? (E.g. public perception of CO2 transport and storage)		
	Does the project incorporate a planned transition away from CCS and fossil fuels? How is this structured?		
	Does the proposal incorporate clean hydrogen? How?		
Demonstrate how proposal fit with (public sector) economic objectives	Regional level		
	National level		
	International level		
Demonstrate how proposal fit with (public sector) environmental objectives	Regional level		
	National level		
	International level		
Competition & Support (public sector)	Does the project compete with other similar H2-CCS projects regionally/nationally?		
	What support does the project have from the public sector (local, regional, national)?		
	What is the rationale for government intervention?		
Competition & Support (private sector)	Does the project compete with other similar H2-CCS projects regionally/nationally?		
	What support does the project have from the private sector?		
Demonstrate how the project can be scaled up	Does the proposal offer a transition from a project approach to a system approach? How?		
	Does the project facilitate the future integration of other energy intensive business sectors? How?		
	Does the project facilitate the expansion into other regions? How?		
Low Regret & Optionality	Does the project offer optionality for decision making and minimise impact if no further projects are built or if future deployment is limited? How?		

## A.3 Financial Costs and Benefits

### A. FINANCIAL COST AND BENEFITS

OBJECTIVE: ANALYSIS AND ASSESSMENT OF FINANCIAL COST, INVESTMENT RETURN, AFFORDABILITY AND FUNDING OVER PROJECT LIFETIME

### B. FINANCIAL ANALYSIS

	DIMENSION	SUBJECT	COMPLETED (Y/N)	RESPONSE
PRIVATE SECTOR	Cost and Financing	Capital cost (Capex)		
		Operating cost (Opex)		
		Abandonment cost (Abex)		
		Gearing Ratio		
		Cost of Capital (WACC)		
		Cost of Market Hedging Instruments		
	Financial Return and other KPIs	NPV (levered, unlevered)		
		IRR (levered/unlevered)		
		Return on Investment (ROI), Return on Average Capital Employed (ROACE)		
		Return on Equity		
		Other KPIs		
		Sensitivity Analysis		
	Sources of Value	Describe and quantify additional Source of Value (1)		
		Describe and quantify additional Source of Value (2)		
		Describe and quantify additional Source of Value (3)		
	Taxation & Imposts	Key Summary		

	DIMENSION	SUBJECT	COMPLETED (Y/N)	RESPONSE
PUBLIC SECTOR	Funding Cost and Sources of Capital	Summary of financial support interventions		
		Direct Funding		
		Indirect Funding		
	Financial Impact on treasury	Impact on national debt level		
		Impact on credit rating		
		Impact on other public sector ratios		
	Taxation and other charges	Expected Revenue		
	Contingent Liabilities	Details and Quantification		

### C. ASSURANCE AND PEER REVIEW

Describe in this section the assurance process followed by the project team to review and challenge the assessment completed above:

## A.4 Economic and Value Benefits

### A. ECONOMIC AND VALUE BENEFITS

OBJECTIVE: ASSESSMENT OF VALUE DELIVERED BY THE PROJECT TO SOCIETY (ENVIRONMENTAL, ECONOMIC, SOCIAL) OVER PROJECT LIFETIME

### B. COST BENEFIT AND COST EFFECTIVENESS ANALYSIS

	DIMENSION	SUBJECT	COMPLETED (Y/N)	RESPONSE
PRIVATE SECTOR	MARKET	Market development strategy and cost effectiveness		
		Innovation and new low carbon or "green" products		
		Government growth/investment facilitation mechanisms		
	SUPPLY CHAIN DEVELOPMENT	Effectiveness and limitations		
		Requirements and impact on supply chain		
		Access to cost effective natural resources		
	LABOUR	Analysis of capabilities and limitations		
		Requirements and impact on labour market		
		Access to cost effective human resources		

	DIMENSION	SUBJECT	COMPLETED (Y/N)	RESPONSE
PUBLIC SECTOR	ECONOMIC CASE	Economic Rationale		
		Economic KPIs: ENPV, ERR		
		Impact on markets (primary/secondary, removal of market failures)		
		Geographical distribution of economic value		
		Distribution of economic value in different sections of society		
		Impact on GDP		
		Impact on regional/national/international competitiveness		
		Impact on labour markets (job protection & creation, productivity)		
	ENVIRONMENTAL CASE	Long term economic multipliers		
		Environmental KPIs (emissions targets)		
		Sustainability Analysis		
		Lifecycle Emissions Analysis (LCA)		
	SOCIAL CASE	Other Pollutant Analysis		
		Social KPIs		
		Social Impact Analysis		

### C. ASSURANCE AND PEER REVIEW

Describe in this section the assurance process followed by the project team to review and challenge the assessment completed above:

## A.5 Commercial Feasibility & Delivery

### A. COMMERCIAL FEASIBILITY AND DELIVERY - OBJECTIVE

**OBJECTIVE:** ASSESS EFFECTIVENESS OF THE COMMERCIAL AND LEGAL STRUCTURE AND ARRANGEMENTS FOR SUCCESSFUL DELIVERY OF THE PROJECT

### B. COMMERCIAL STRUCTURES

This commercial structure and feasibility assessment is directed at the preferred business model(s) determined using the ELEGANCY business model development and selection process described in Report D3.3.3 and implemented in the ELEGANCY Business Model Selection Tool. The preferences and the outputs from the process are recorded in the Business Case Definition sheet of this current tool. The **ELEGANCY Business Case Development Toolbox** is found at: <https://www.sintef.no/projectweb/elegancy/programme/wp3/business-case-development-toolbox/>

	DIMENSION	SUBJECT	COMPLETED (Y/N)	RESPONSE
PRIVATE SECTOR	Ownership structure	Key terms of ownership structure (current and future as relevant)		
		Financial Control, Operational Control		
		Financial distribution		
		Strategic partnerships, incorporated/unincorporated JV		
	Financing Structure	Summary of financing structure (balance sheet, limited recourse/non recourse project finance)		
		Gearing Ratio		
		Internal financing (bonds, new equity)		
		Debt Financing - Key terms		
		Public Sector Financing - Key terms		
		Other financing (Import/export banks, international banks)		
		Engineering, Procurement, Construction (EPC) and Management (EPCM)		
	Contracts	Financing agreements		
		Main operating contracts - Key Terms		
		Sales and Purchase or Service Agreements - Key Terms		
		Public sector agreements - Key Terms		
	Risk Mitigation Instruments	Insurance, pooled mutual funds		
		Surety Bonds, Catastrophe (CAT) bonds		
		Market Mechanisms (interest swaps, hedging instruments)		
		Public sector guarantees.		
	Main Liabilities	Guarantees, Warranties, Security, Indemnities, Liquidated Damages		
Legal and Regulatory Requirements and Constraints	Public sector counterparties			
	Statutory performance, penalties, remedies			

	DIMENSION	SUBJECT	COMPLETED (Y/N)	RESPONSE
PUBLIC SECTOR	Procurement requirements and strategy	Competitive tender - terms and conditions		
		Grant Competition - terms and conditions		
		Legal and regulatory compliance		
	Ownership structure	Public utility or public-private partnerships		
	Contracts	Public body responsible for commercial delivery and contract management		
		Private sector contractors to the state		
		Risk allocation		
		Revenue support, subsidies		
		Government underwriting of liabilities		
		Public sector counterparties		
	Public sector accounting and internal controls	Disbursement controls, assurance, audit, contingent liabilities		
		Tax concessions		

### C. ASSURANCE AND PEER REVIEW

Describe in this section the assurance process followed by the project team to review and challenge the assessment completed above:



## A.6 Technical Feasibility & Delivery

### A. TECHNICAL FEASIBILITY AND DELIVERY - OBJECTIVES

OBJECTIVE: ASSESS FEASIBILITY AND EFFECTIVENESS OF THE TECHNOLOGY AND TECHNICAL DESIGN FOR THE DELIVERY OF THE PROJECT

### B. TECHNICAL DESIGN

	DIMENSION	SUBJECT	COMPLETED (Y/N)	RESPONSE
PRIVATE SECTOR	Technology Selection and Performance	How proven? Testing, Experience, & Risks		
		Rationale for selection		
		Quantitative performance metrics (efficiency, energy consumption, emissions)		
		Assessment of utilisation rate		
		Assessment of alternative technologies		
		Impact of interfacing with other technologies in the H2-CCS chain		
	Design, permitting, construction and commissioning	Impact of future decommissioning on technology selection		
		Impact of innovation and novelty		
		Impact of location and geography		
	Operations and maintenance	Supply chain capability and performance		
		Facilities and service availability		
		Operational interface with other technologies in the H2-CCS chain		
		Ongoing innovation requirements		
	Environmental sustainability	Impact of regulatory requirements		
		Vulnerability to climate change and natural disasters		
			Co-location with economic activity based on natural resources	

	DIMENSION	SUBJECT	COMPLETED (Y/N)	RESPONSE
PUBLIC SECTOR	Technology choice – level playing field	Options analysis - public sector preferences		
		Demand forecasts and analysis		
		Ongoing viability and longevity of technology choices		
	Capability of developer/contractor	Certainty of delivery and performance		
	Environmental sustainability	Direct GHG emissions from project implementation and decommissioning		
		Indirect GHG emissions		
		Other pollutants, impact of input resources		
		Vulnerability to climate change and natural disasters		
		Impact on natural resources used in economic activity		

### C. ASSURANCE AND PEER REVIEW

Describe in this section the assurance process followed by the project team to review and challenge the assessment completed above:

## A.7 Outcome Management

### A. OUTCOME MANAGEMENT - OBJECTIVES

**OBJECTIVE:** TO RECORD THE DETAILED PLANS FOR PROJECT DELIVERY AND REALISATION OF BENEFITS, RISK MANAGEMENT AND POST-IMPLEMENTATION EVALUATION

### B. RISK ASSESSMENT AND MITIGATION

The information for risk assessment and mitigation can be obtained using the ELEGANCY business model development and selection process described in Reports D3.2.1, D3.3.2 and D3.3.3. A suite of tools for assisting with the collection and analysis of this information is contained in the **ELEGANCY Business Case Development Toolbox**:

<https://www.sintef.no/projectweb/elegancy/programme/wp3/business-case-development-toolbox/>

Risk #	Risk Category	Business Risk	Mitigation Measure	Category	Mitigating Party
1	Reputation and Social				
2					
3					
4					
5					

### C. OVERALL DELIVERY PLANNING

Key Activity	Start Date	End Date	Responsible Party	Funding Required

### D. PUBLIC/PRIVATE SECTOR ENGAGEMENT AND COLLABORATION

Define and insert engagement plan between public and private sector to progress joint business case definition

Key Activity	Start Date	End Date	Leading Party

## A.7.1 Risk

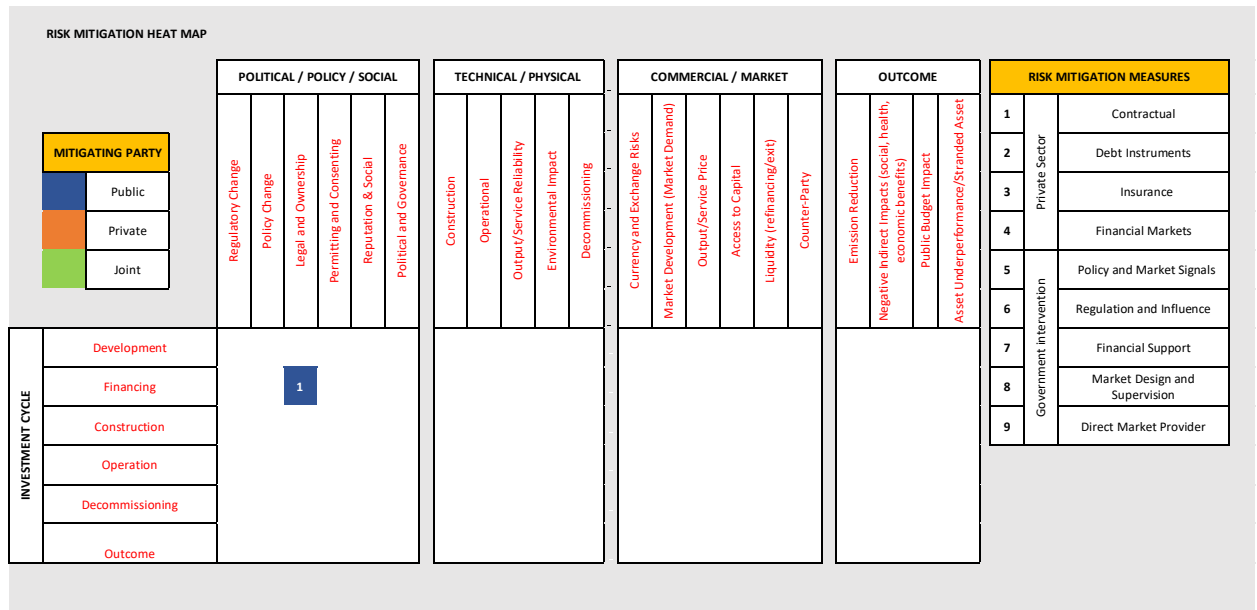
### A. RISK ASSESSMENT AND MITIGATION - OBJECTIVES

**OBJECTIVE:** DEMONSTRATE HOW THE MAJOR RISKS ARE MITIGATED THROUGH PRIVATE SECTOR MITIGATION MEASURES, TRANSFERRED OR SHARED WITH THE PUBLIC SECTOR

### B. STANDARD RISK ASSESSMENT AND MITIGATION

The information for this risk assessment and mitigation summary can be obtained using the ELEGANCY business model development and selection process described in Reports D3.2.1, D3.3.2 and D3.3.3. A suite of tools for assisting with the collection and analysis of this information is contained in the **ELEGANCY Business Case Development Toolbox**: <https://www.sintef.no/projectweb/elegancy/programme/wp3/business-case-development-toolbox/>

**Guidance:** Highlight the major business risk categories that impact the potential investment by colouring the relevant cell in the table below. Choose the colour which corresponds to the selected party responsible for the mitigation of the risk by copying and pasting the relevant cell from the mini-table to the left, and enter subsequently one or multiple numbers (separated by a coma) which correspond to the risk mitigation measure category (See table to the right).



Risk #	Risk Category	Business Risk	Mitigation Measure	Category	Mitigating Party	Current Status of Measure
1	Reputation and Social					
2						
3						
4						
5						
6						
7						
8						
9						
10						

**C. OTHER RISK ASSESSMENT METHODOLOGIES: OPTIMISM BIAS, MONTE CARLO, REAL OPTIONS**

Add comments and linkages to other business case dimensions using these techniques for analysis of scenarios

RISK ASSESSMENT METHODOLOGY	OUTCOME

**D. ASSURANCE AND PEER REVIEW**

Describe in this section the assurance process followed by the project team to review and challenge the assessment completed above:

## A.7.2 Planning

### A. PLANNING - OBJECTIVES

**OBJECTIVE:** TO DEVELOP AND MANAGE THE DELIVERY PLANS WITH MILESTONES, DECISION GATES, GOVERNANCE, QUALITY ASSURANCE AND CONTRACT OVERSIGHT

### B. COMMERCIAL DELIVERY PLAN

Insert commercial delivery plan with list of key activities, milestones

KEY ACTIVITY	START DATE	END DATE	RESPONSIBLE PARTY	FUNDING REQUIRED

KEY MILESTONES	DATE

### C. TECHNICAL DELIVERY PLAN

Insert technical delivery plan with list of key activities, milestones

KEY ACTIVITY	START DATE	END DATE	RESPONSIBLE PARTY	FUNDING REQUIRED

KEY MILESTONES	DATE