

EGT2
ENGINEERING TRIPOS PART IIA

DATE TBD TIME TBD

Module 3E11

ENVIRONMENTAL SUSTAINABILITY AND BUSINESS

*Answer not more than **two** questions.*

All questions carry the same number of marks.

*The **approximate** percentage of marks allocated to each part of a question is indicated in the right margin.*

*Write your candidate number **not** your name on the cover sheet.*

STATIONERY REQUIREMENTS

Single-sided script paper

10 minutes reading time is allowed for this paper at the start of the exam.

You may not start to read the questions printed on the subsequent pages of this question paper until instructed to do so.

1 Equinor is a major global energy company with headquarters in Norway. It remains roughly two-thirds owned by the Norwegian state, and changed its name from Statoil in 2018, in part to reflect its increasing commitment to developing and producing renewable energy. Equinor has a presence in 30 countries worldwide and develops oil, gas, wind, and solar energy to deliver to a global customer base. It is known historically for its expertise in offshore exploration and production.

Equinor reports its production numbers as follows (source: Equinor website):

Oil and gas production **per day** in 2019: 2.074 million boe (boe stands for ‘barrels of oil equivalent’ and allows us to normalise production across oil and gas reserves; one boe is the quantity of primary energy released by burning one barrel (about 159 litres) of crude oil).

Renewable electricity production (**annual**) in 2019: 1.8 TWh

1 boe is considered to be approximately equal to 1.7 MWh (1TWh= 10^6 MWh).

(a) In 2019, what fraction of Equinor’s energy production was derived from renewable sources? Explain some considerations that must be taken into account in order to put this fraction into perspective in terms of quantity and quality of environmental impact of the two types of energy sources. Specifically, when we think about systems, how does this influence the comparison of these energy sources? [35%]

(b) In early 2020 Equinor announced an ambition to achieve, by 2050, ‘near zero’ greenhouse gas emissions (GHG) from its operated offshore fields and onshore plants in Norway (source: Equinor website). This was regarded as Equinor’s most ambitious commitment on climate, but some investors did not alter their treatment of the company (e.g., a major Danish pension fund did not change its decision to exclude Equinor - and another 9 major crude oil producers - from its investments). Using the dimensions of a materiality matrix, evaluate Equinor’s ‘near zero’ ambition and explain whether you consider this announcement to be a strategically sound move. [65%]

- roughly 0.14% is renewables (a TWh is 10^6 MWh ... so 1×10^6 boe is 1.7 TWh ... so 2.074×10^6 boe per day is 2.074×1.7 TWh = 3.53 TWh; x approx. 350 days production = 1234 TWh per year ... compared to 1.8 TWh per year of renewables);

Various observations can be made about the considerations, including:

- not 'apples to apples' because oil and gas as primary energy needs to be converted if electricity as final use; reduced by about 2/3; larger question of how the energy is consumed ; could also reference broader systems (including infrastructure) around each

- the quality of the provision differs along a number of dimensions – climate impact, other environmental impact areas such as use of raw materials; toxic chemical use, water etc. renewables generally regarded as lower impact across a number of metrics but there are serious considerations as well wrt materials consumption, end of life, and associated infrastructure (e.g. storage). A sound comparison would need to consider life cycle impacts across all life stages;

- there is also a question of, strategically, how do we judge a company that is developing renewables at a currently low % of their production – what is 'enough' renewables for a fossil fuel company? Why are they doing it anyway (to appease consumers, or greenwash?). An argument can be made that companies should stick to their capabilities and allow others to develop the renewables capabilities.

Any evidence that the student is thinking more broadly about the question of % renewables, along any of the lines above or other sensible ones, should be recognized.

POST-EXAM ASSESSOR COMMENTS:

Part a) was for most a straightforward piece of math to compare the renewable energy produced to oil and gas energy produced (0.14% is renewables); a common mistake was to get a much larger number by missing that the barrels of oil equivalent number was per day, while the renewables number was annual. The students commented on why this (small) % needs to be interpreted qualitatively and quantitatively; most were able to draw attention to the distinct environmental and social impacts across the lifecycle of the respective energy production methods, the need to account for differences in actual energy delivered, and where it was delivered, and the need to account for global versus more local impacts. As with all questions, strongest responses divulged a good grasp of course material (e.g. tools like LCA, or comparison with other cases).

Part b) was generally argued with some nuance, noting the two key dimensions of a materiality matrix and the fact that multiple stakeholders might be interested in a net zero goal (for various stated reasons). While most responses also commented on the 'x' axis of sustainability, the attractiveness to the business of this goal/issue, many did not take advantage of the answer in part a) to reflect on whether this could be regarded (by Equinor and/or its stakeholders) as a credible goal. Stronger answers captured this as well as reflected on the strategic capabilities of the firm and what it might need to do in the short and long term to adapt to a carbon constrained world.

2 You are one year into a job with a medium-sized and fast-growing company that designs drones and leases them to other companies for use in deliveries to customers' homes. So far, your company has been leasing the drones to other companies for use in delivering consumer goods (e.g., books or small products for the home). However, plans are in place to partner with other organisations to support the delivery of critical medical supplies, for example, in remote parts of the UK and elsewhere in the world.

While your company does not manufacture the drones (that is done by suppliers in different countries), technological innovation in the drones' designs is regarded a key factor that differentiates you from competitors. For example, your company prides itself on the use of innovative materials that make the drones light weight yet robust, and innovative algorithms that optimize their flight routes.

You were hired in an engineering role but your manager has recently been asked by senior management to start developing a sustainability strategy and they have become aware of your interest in sustainability. They would like your help with this.

(a) Senior management is eager to develop the company's first sustainability report and set some clear sustainability goals, because potential investors and other stakeholders are asking for this. Your manager has asked for your help making recommendations for: i) *whether* to begin with a sustainability report and goals, and, ii) if you recommend beginning with those, *what* to potentially include and *why*, **or**, iii) if you recommend not beginning that way, *what else* should be done first and *why*? Draft your response. [50%]

Response should consider the tradeoffs between beginning with a report and goals as that can generate some initial data and anchor the conversation, versus 'rushing' into

this without a fuller understanding of the issues themselves and the organization's/people's readiness to act on them.

Should reflect an awareness that there are many potential environmental and social sustainability issues for the company to consider, and that a number will be outside their control (eg within the supply chain). Any effort to work systematically on this therefore must be grounded in some sort of framework (like but not limited to a materiality matrix) that enables the company to think strategically about the issues germane to their business, and well as current and emerging issues of interest to a variety of stakeholders.

Response should recognize that as the company begins to expand to work with new partners, the nature of the sustainability impacts will likely shift and therefore any sustainability efforts need to adjust to these.

(b) Now imagine a year has passed since the successful launch of the recommendations you made in part a). Senior management is concerned that different people in the business are responding differently to the company's sustainability efforts. While on balance many are enthusiastic, they have rather different ideas. For example, the designers are very keen to experiment with lower power batteries and new materials, while the legal team has become extra vigilant about some of the liabilities the company might face (e.g., in relation to electronics waste legislation that bans certain materials from landfill, or privacy laws, etc.). Senior management are now asking for your evaluation of the reasons for these differences, whether they should be concerned about them, and what further steps should be taken to communicate and enable the company's sustainability. Draft your response. [50%]

Response should recognize that it is completely normal and in fact expected for different people who fulfil different roles in the company would responds differently; can invoke ideas of cultural framing and organizations are structured to differentiate roles and expertise.

Hence arguments made should reflect the fact that, while there is no real cause for concern that people have different ideas and responses, there must be efforts made to 'sell' or 'frame' sustainability in a way that meets people where they are and leverages their specific interests and expertise while still contributing toward a common set of goals. References to specific case studies (M&S, Suncor) can be used to show how managers can frame sustainability in a way that makes it real and compelling for

different groups. Embedding project framework on culture can be used to argue that companies actually need to undertake both risk/compliance focused actions (legal liability) and innovative actions (technology development) in order to have an effective response; also balance formal and informal mechanisms for communicating and supporting sustainability efforts.

POST-EXAM ASSESSOR COMMENTS:

In part a) many argued that, while there are many virtues to setting goals, it would be premature for this company to do so, before understanding its own impacts, the concerns of its stakeholders, and the specific opportunities it may have to address these. Many suggested conducting a materiality matrix or LCA (or both) to give greater information before developing goals. Many also commented on the specific features of attractive goals (e.g. science based, credible, well communicated etc). These were all valid and effective in crafting a good response. The strongest responses also reflected on the specifics of this company and the nature of its work (e.g., a culture of innovative), so the 'generic' use of a materiality matrix, for example, could be presented with some detail and nuance. As well, stronger responses drew in lessons from other companies studied in class and/other theories or frameworks.

In part b) most responses recognized that it is normal for different members of the organization to react differently to sustainability goals and opportunities, and argued for what could be done about it. Recognising the need for effective cultural framing, or ways to connect diverse perspectives around common goals was important to a strong answer, as were some suggestions (again supported by case studies and/or theory) for how to do so.

3 Lifecycle assessment (LCA) involves four phases: i) goal and scope definition, ii) inventory analysis, iii) lifecycle impact analysis, and iv) interpretation of the results. Each of these four phases involve choices and potential trade-offs that shape the ultimate output of the LCA.

(a) You have been asked to advise a company that is considering using LCA to compare two different packaging approaches for its products. The current packaging, a recyclable plastic package, is to be compared to a biodegradable, recyclable strong paper package. The company senses that some of its consumers are keen to lower the environmental footprint of their consumption, but lacks detailed information on this. Further, the company lacks information on the LCA of its products (clothing), and consumers' practices in relation to both the clothing and the packaging. Explain how you would approach responding to this company's request to conduct a comparative LCA on the packaging. What should they do, and why, to ensure the analysis is useful? [50%]

- answers should put into perspective how well conceived this LCA is within the current state of knowledge about sustainability in the firm (eg is the goal scope and definition appropriate or should the company first evaluate whether its packaging is a significant impact relative to its product; even if it is not, arguments can be made that its important to address this, based on consumer expectations and preferences – though again, efforts should be made to understand these as otherwise the interpretation of results and actions on them may be unrealistic). Less strong responses will fail to and only lightly touch on the broader perspective and may go straight to the more mechanical aspects of the LCA (below).

- responses can focus on many potential considerations for phases ii) and iii); e.g., details re data, assumptions or simplifying choices, scope of LCA - focused (CO2) vs broad (water, energy, etc); how complete the inventory analysis is/can be; how robust the data are; what steps or components can be 'assumed away' and how complete the impact analysis is in terms of level of detail (e.g. all regions or use cases vs simplified);

- while responses need not consider choices or tradeoffs in all four phases; whatever tradeoffs they do raise they should also say something about managing these – e.g. when is it ok to assume certain components away (when there is a reasonable equivalency between them in a comparative LCA).

(b) “The promise of Circular Economy approaches and business models can only be met through the widespread adoption of LCA.” Discuss. [50%]

- can take either position on need for widespread adoption of LCA, or argue for some middle ground.

- will recognize that to assess CE approaches at some point by definition hard questions should be asked about lifecycle impact; depending on examples chosen and/or other concepts leveraged, could argue that LCA need not be used in setting up a new business model as the benefits could be evident; however, in communicating benefits some quantification would be expected (which need not solely come from LCA)

- better answers will parse what is meant by ‘the promise of’ – for whom? Customers, businesses, the environment??

POST-EXAM ASSESSOR COMMENTS:

This was a popular question and in part a) many responded through considering the main steps of LCA and pointed to key considerations within each. The stronger responses set the whole goal of doing a packaging LCA in context of the ‘system’ in the sense that they questioned whether this was the right place to start (versus looking at the clothing itself, or even more radical changes like not manufacturing as much clothing). Good answers also pointed to the importance of getting a sense from customers about the importance of the packaging impact to them, their practices (including end of life packaging recycling or disposal). Again, effective use of theories or case studies supported good responses.

The second part of the question invited nuanced responses on the opportunities and limits of LCA for circular economy approaches. Most concluded that while LCA might be necessary for getting certain types of insights, it was no sufficient given the need for many other things for circular economy to be feasible and attractive (e.g., attention to the other parties involved, government regulation, the need to build different types of relationships and trust within them, the need to get employees on board, etc). A common mistake was to implicitly equate Circular Economy with Industrial Symbiosis (one example of a type of CE, but by all means not all types). This lead to some use of the CCP case (on IS) in a way that was too sweeping to capture other aspects of CE. Finally, the best responses reflected critically on the ‘promise’ of CE – posing that CE itself is difficult to attain and might lead to actions that don’t necessarily produce sustainability.

END OF PAPER