2024 H2 Paper 1 Question 1: Suggested Mark Scheme

(a)	Compare the change in the cost of energy from fossil fuels with the change in cost of energy from solar power between 2018 to 2022. [2]

General trend: The cost of fossil fuels was increasing while the cost of solar power was decreasing. [1]

Refinement: The cost of fossil fuels changed by a larger extent of about 300% increase compared to the change in cost of solar power. [1]

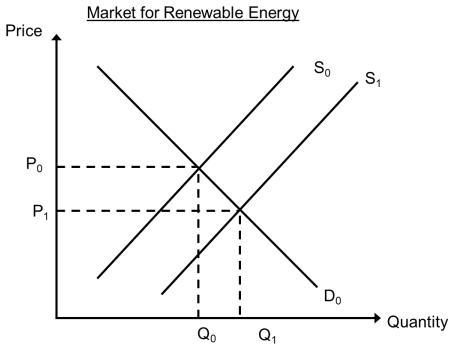
Not accepted:

- *Both decreased from 2018 to 2020 – this does not cover the entire time period of 2018 to 2022.*
- *0 marks if no explicit comparison made and student describe each change separately.*

(b)	With the aid of diagrams, explain how the developments in renewable energy may affect the markets for renewable energy and energy from fossil fuels. [4]

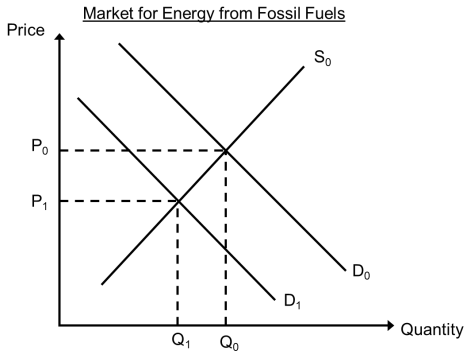
Explain the changes in the renewable energy market: [2]

- With an increase in technology and economies of scale, cost of production is falling. Firms are more willing and able to produce, resulting in an increase in supply of renewable energy.
- The increase in supply results in a surplus and downward pressure on price, decreasing the price of renewable energy.
- At the new market equilibrium, price has decreased, and quantity has increased.



Explain the changes in the fossil fuels energy market: [2]

- Renewable energy is a substitute for energy from fossil fuels. As the renewable energy becomes relatively cheaper, consumers switch away from consuming energy from fossil fuels, resulting in a decrease in demand for energy from fossil fuels.
- As demand decreases, there is a surplus and downward pressure on price.
- At the new market equilibrium, price has increased, and quantity has decreased.



Markers' notes: Award only 1 mark for each market if there are any key words (underlined) missing or if there are any errors in the diagram.

(c) (i) Explain how the development of 'Long Island' will reduce the opportunity cost of building new homes. [2]

Opportunity cost is the value of the next best alternative forgone when a choice is made. [1]

With the reclamation of land for Long Island, there is more land available for uses such as building new homes and recreation. With more land available, there is a lesser need to forgo alternative uses when the land is used to build new homes, resulting in a lower opportunity cost incurred. [1]

Markers' notes: Award one mark for the explanation of opportunity cost. Exact definition is not required as long as the meaning comes across. Award the second mark if student show's the understanding that more available land reduces opportunity cost.

(ii) Explain why coastal protection measures such as 'Long Island' must be provided by the government. [4]

Coastal protection measures are non-rival: [2]

- Coastal protection measures are non-rival because the use of the protection measure by one individual does not diminish the quality or quantity of protection enjoyed by another individual at the same time. Many households living within the proximity of Long Island can enjoy the benefits of coastal protection at the same time.
- As such, the marginal cost (MC) of providing coastal protection measures to an additional household is zero. Thus, the condition for allocative efficiency is P = MC = 0.
- Profit maximising firms will choose to price at P > MC, therefore resulting in welfare loss to society.

Coastal protection measures are non-excludable: [2]

- Coastal protection measures are non-excludable as once it is provided, it is not economically feasible to exclude a non-payer from enjoying the benefits of coastal protection.
- This results in a problem of free ridership where consumers would wait for someone else to pay for the good and enjoy the benefits for free. Thus, there would be no demand for the coastal protection measures.

- Without demand, there are no price signals, and it would not be profitable for firms to produce the good and there would be a missing market.

Since coastal protection measures are a public good, they must be provided for by the government.

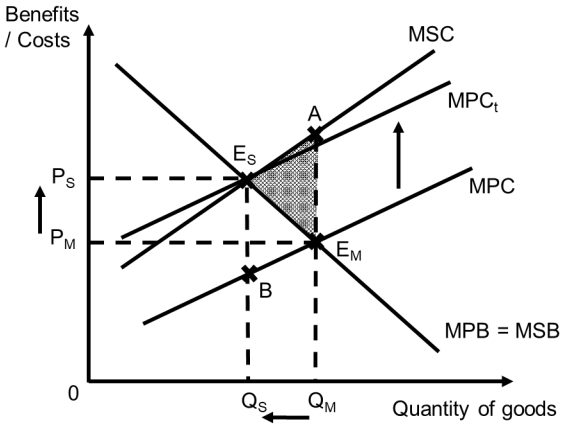
Marker's notes: Minus 1m for each characteristic if any key words are missing.

(d) Discuss whether the benefits of a carbon tax outweigh the costs to society. [8]

Introduction:
- Brief explanation of negative externalities from carbon emissions
- State policy objective: a carbon tax is used to reduce carbon emissions and maximise social welfare.

Requirement 1: Carbon tax is beneficial to society

Correction of market failure:
- Carbon tax helps to address negative externalities from carbon emissions.
- A carbon tax will increase the MPC for firms that emit carbon in their production of goods and services.
- The government should impose a per unit tax equivalent to the MEC at the socially optimal quantity.
- Such a tax would shift the MPC upwards to MPC_t



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- With the shift in MPC, the external cost is internalised by firms. Profit maximising firms will now produce at MPC_t = MPB with quantity Q_s
- Thus the socially optimal quantity is achieved. Since MSC = MSB at this quantity, the welfare loss is eliminated, and social welfare is maximised. Society benefits from the imposing of a carbon tax.

Evaluation of R1:
- The extent of this benefit to society depends on the government's ability to impose the correct amount of tax. The external cost from carbon emissions is difficult to accurately estimate. This is due to its widespread impact on society that is difficult to track.
- If the government underestimates the amount to tax, there would still be overproduction and there would still be a welfare loss incurred. If the government

overestimates the amount to tax, this would result in underproduction and there would also be a welfare loss to society.

Requirement 2: Carbon tax results in a cost to society

Impact on consumers and businesses:

- As mentioned in extract 3, consumers and businesses may feel the pinch of a carbon tax in the form of higher prices and costs.
- For firms, a carbon tax would increase the cost of production, especially for firms that have higher levels of carbon emissions. This higher cost would erode their profits and reduce producer surplus.
- As firms experience an increase in cost of production, firms are less willing and able to produce, resulting in a fall in supply of goods. A fall in supply results in a shortage and upward pressure on prices. Consumers would thus experience higher prices of goods and services such as electricity.
- If the increase in price is for necessities such as electricity, low-income households would feel a greater impact since necessities take up a larger proportion of their income. If necessities become unaffordable for some households this results in inequity in society.

Impact on the economy:

- Extract 4 also states that a carbon tax could have a negative impact on the competitiveness of trade-exposed industries.
- As mentioned above, taxes result in higher cost of production and prices of goods and services. Since firms in other countries face either no tax or a lower carbon tax rate, they would also have a lower cost of production and be able to price their goods lower.
- Thus, if countries like Singapore impose a carbon tax, exports may become less price competitive, leading to a loss of export revenue which could harm the aggregate demand and lower the economic growth in the economy. (Note: students do not need an excessively detailed AD/AS analysis for this question.)

Evaluation:

- Criteria 1: Short vs Long Term
    - A carbon tax is more costly in the short run, but leads to more benefits to society in the long run. Without the carbon tax, the problem of negative externalities may become severe in the long run, leading to high costs incurred by society if the situation is not addressed.
    - However, in the short run, it may be difficult for firms to adapt to the additional costs incurred, leading to higher cost of living and negative impacts on the economy.
- Criteria 2: Government's use of complementary policies
    - The government may use other policies to mitigate the costs in the short run. For example, they could provide subsidies to households to cope with the higher costs, or grants to firms to invest into the use of cleaner energy and green technology.
    - If these policies are implemented in the short run, the overall benefits of imposing a carbon tax are likely to outweigh the costs to society.

Level	Descriptors	Marks
L2	- Answer explains both costs and benefits well - Explanation contains economic analysis and application to the context. - Economic analysis used mostly relevant and accurate.	4 – 6
L1	- Answer may only address either the costs or benefits of a carbon tax to society. - Answer may be lacking in economic analysis and be more descriptive in nature, with excessive lifting from the extract. - Economic analysis used may be irrelevant or contain many inaccuracies.	1 – 3
E	- A summative conclusion is provided with clear criteria and reasoning for the overall stand.	1 – 2

Annotation	Level	Mark out of 8
A+C or A+A	L2	6
C+C or A	L2	5
C	L2	4

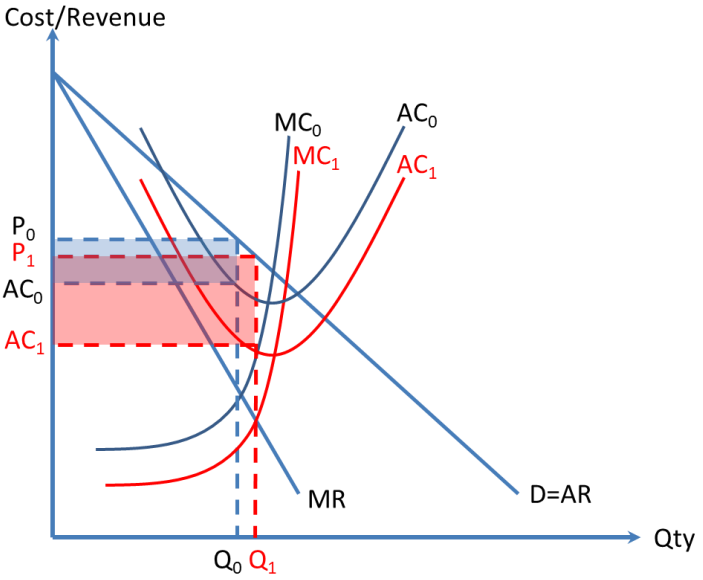
(e) Discuss whether firms should use innovation or purchase carbon credits when faced with an increase in carbon tax. [10]

Introduction:

- Firms are assumed to be profit maximising and produce at the output level where MC = MR to maximise profits.
- An increase in carbon tax increases the marginal and average cost for firms that emit carbon in production.
- This results in a lower profit margin for firms.
- Thus, a firm can adopt various strategies such as innovation or purchase of carbon credits to try to maintain their profits in light of the increase in carbon tax.

Requirement 1: Firms should use innovation when faced with an increase in carbon tax.

- Evidence: Firms like ExxonMobil has invested in innovation to reduce their emissions of carbon. (Extract 4). These include a new process of producing energy that leads to less carbon emitted.
- With such process innovation, firms will have less carbon emissions and therefore pay less carbon tax per unit of good produced.
- Since carbon tax is a cost that varies with output (variable cost), the process innovation would lead to a decrease in marginal cost and average cost of the firm, compared to without the innovation.
- In addition, process innovation could also improve the firm's efficiency such that fewer resources (e.g. fuel) are needed to produce each unit of output. This would lead to a further decrease in MC and AC.



- With the decrease in MC and AC, the profit maximising output will increase, price will fall, and profits will increase.
- Thus, innovation is an effective way for firms to respond to an increase in carbon tax.
- *Note: Student can also explain how product innovation may increase AR and MR. However, they should avoid purely theoretical answers. A possible contextualised answer would be that consumer are increasingly aware of environmental issues and have a growing taste and preference for goods that are made in sustainable ways. Thus firms that innovate to reduce their carbon footprint may experience a rise in demand for their goods and services.*

Evaluation of Requirement 1:

- However, innovation is also very costly to undertake. It could result in an increase in fixed cost. For large firms, the fixed cost can be spread over a larger output, leading to a smaller increase in AC. However, this strategy would not be feasible for smaller firms that do not have significant economies of scale. For smaller firms, the fixed cost increase would be large compared to their overall cost, and may outweigh the long term gains from lower AC and MC.

Requirement 2: Firms should purchase carbon credits when faced with an increase in carbon tax.

- Evidence: Firms can choose to buy carbon credits to reduce the carbon tax they have to pay. (Extract 5)
- Carbon credits are tradable permits, and their price is determined by demand and supply forces.
- In Singapore, firms can offset up to 5% of their taxable emissions by purchasing international carbon credits.
- **EITHER**: Doing so would reduce the amount of carbon tax the firm needs to pay by 5%. Assuming the cost of the carbon credits is lower than the cost of the tax, there will be a decrease in cost of producing each additional unit of good, decreasing AC and MC incurred by the firm, shown by a downward shift of the AC and MC curve.
- **OR**: A firm can make a one-time payment to offset up to 5% of their taxable emissions, resulting in a decrease in the AC incurred.

- The firm's profits would be increased compared to a situation of paying the full amount of carbon tax.
- Thus, buying carbon credits can be an effective way for the firms to respond to an increase in carbon tax.
- *Note: Students can also explain that the purchase of carbon credits would offset part of the carbon tax, resulting in a smaller increase in AC/MC overall, and therefore a smaller decrease in profits when the carbon tax is increased.*

Evaluation of Requirement 2:

- However, the decrease in cost might be small. Since only 5% of emission can be offset and the firm still has to incur the cost of buying the carbon credits, it would likely be a small decrease in average and marginal cost.
- Overall, firm's profits might still decrease significantly with a greater increase in the carbon tax.
- In addition, since the cost of carbon credits is determined by demand and supply forces, if many firms adopt this strategy, the cost of carbon credits might rise and end up being higher than simply paying the carbon tax.

Overall evaluation:

Criteria 1: Short vs long run

- Innovation may take a long time to take effect and will not significantly reduce carbon emissions immediately. Thus in order to avoid paying a high amount of carbon tax, firms should consider buying carbon credits to at least off set a part of the cost.
- However, in the long run, innovation has a greater potential to reduce the cost of carbon tax. This is especially since the carbon tax is likely to increase more in the long run as the government wants to address global warming effectively.

Criteria 2: Size of firm

- Smaller firms may not be able to afford the cost of innovation. R&D to come up with new processes and converting existing infrastructure to adopt new technology would be extremely costly for these firms. Thus, buying carbon credits might be a more feasible option for these firms.

Level	Descriptors	Marks
L2	- Answer explains both strategies well - Explanation contains economic analysis and application to the context. - Economic analysis used mostly relevant and accurate.	4 – 7
L1	- Answer may only address one of the strategies given or bring in irrelevant strategies. - Answer may be lacking in economic analysis and be more descriptive in nature, with excessive lifting from the extract. - Economic analysis used may be irrelevant or contain many inaccuracies.	1 – 3
E	- Answer considers the limitations of both policies	1 – 3

	- A summative conclusion is provided with clear reasoning for the strategy chosen.	

Annotation	Level	Mark out of 8
A+A	L2	7
A + C	L2	6
C+C or A	L2	5
C	L2	4