Suggested answer to 2023 A Level H1 Paper 1 CSQ 1

<table>
<tr><td>(a)</td><td>With reference to Figure 1, compare the net additions to offshore wind energy capacity in China to those of Germany and the UK over the period 2017 to 2021.</td><td>[3]</td></tr>
<tr><td></td><td>China’s net additions to offshore wind energy capacity from 2017 to 2021 is always higher than Germany and UK.
China’s net additions to offshore wind energy capacity from 2017 to 2021 is always increasing while Germany’s and UK’s fluctuate throughout the years.
In 2019, all three countries experienced a net addition to offshore wind energy capacity.
In 2018, 2020 and 2021, Germany and UK both experienced a decrease in net additions to offshore wind energy capacity while China experienced an increase in these years.</td><td></td></tr>
<tr><td></td><td><u>Examiners’ comments</u>
Most candidates accurately identified three broadly comparative issues in relation to China within Figure 1. Those who did not often did not make their statements comparative.</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>(b)</td><td>Explain why renewable solar energy produced in Singapore is <u>not</u> likely to be a public good.</td><td>[3]</td></tr>
<tr><td></td><td>Renewable solar energy produced in Singapore is not likely a public good because it is excludable, rivalrous, and rejectable.
It is <u>excludable</u> because it is feasible to exclude non-payers from enjoying the benefits of the good as only those who paid their utility bills or own solar panels can access renewable energy.
It is <u>rivalrous</u> because with every additional person using energy generated from renewable sources, the amount of renewable energy available is likely to be lesser for other consumers.
It is <u>rejectable</u> as consumers can refuse to consume from renewable energy sources by opting for other energy sources, such as non-renewable ones.</td><td></td></tr>
<tr><td></td><td><u>Examiners’ comments</u>
Many candidates showed good knowledge and understanding of two characteristics of a public good. Good understanding constituted a clear contextual application of these two characteristics of a public good to renewable solar energy production. Weaker responses demonstrated inaccurate understanding of the correctly-identified public goods characteristics when explaining in the context of renewable solar energy production or demonstrated inaccurate understanding of non-rejectability characteristic with that of being non-rivalrous. Other weaker responses did not provide a direct response to the question. They wasted vital time with extended explanations of the characteristics fulfilled by a public good in general and then repeating much of these explanations in the production of renewable solar energy in Singapore. Only a few candidates showed no knowledge of the characteristics of a public good.</td><td></td></tr>
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<tr><td>(c)</td><td>With reference to Extract 2, explain</td><td></td></tr>
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	(i)	**<u>one</u> positive externality that could arise from the operation of the solar panel energy farm opened in Singapore in July 2021.**	**[2]**
		Positive externalities are spill over benefits enjoyed by third parties who are not directly involved in the consumption or production of the good or service itself, without payment. Extract 2 mentions that "the solar farm will help to reduce carbon emissions by an amount equivalent to taking 7000 cars off the roads". This suggests that one positive externality that could arise from operating solar panel energy farms is that third parties such as commuters are able to enjoy the lowered carbon emissions that improves air quality, without paying for the good itself.	
		<u>Examiners' comments</u> There was a clear grasp of the information provided by the penultimate paragraph of Extract 2 by many candidates with respect to the generation of positive externalities. Weaker responses often did not make explicitly clear who the relevant third party might be in this specific case or did not include a reference to wider (third party) beneficiaries. Such wider third-party beneficiaries include those who have no link, either as producers or consumers, to the operation of the solar panel energy farm but are positively affected by it. This could be a result of the reduction in carbon emissions released on society or from the improved quality of the water in the reservoir on which the farm is located.	
	(ii)	**why solar energy produced in the Singapore farm would be under-consumed in a free market.**	**[3]**
		A consumer of solar energy will enjoy the marginal private benefit of using a renewable energy source such as reduced costs and energy savings. Private costs borne by the individual includes the utility bill or the costs of purchasing solar panels to power their homes. In a free market economy, driven by self-interest, individuals will consume at Q_f where Marginal Private Costs (MPC) equates Marginal Private Benefit (MPB) and their net private benefit is maximised. We will assume there are no external costs in the consumption of solar energy (Marginal External Costs (MEC) = 0), hence Marginal Social Costs (MSC) equals to Marginal Private Costs (MPC).	

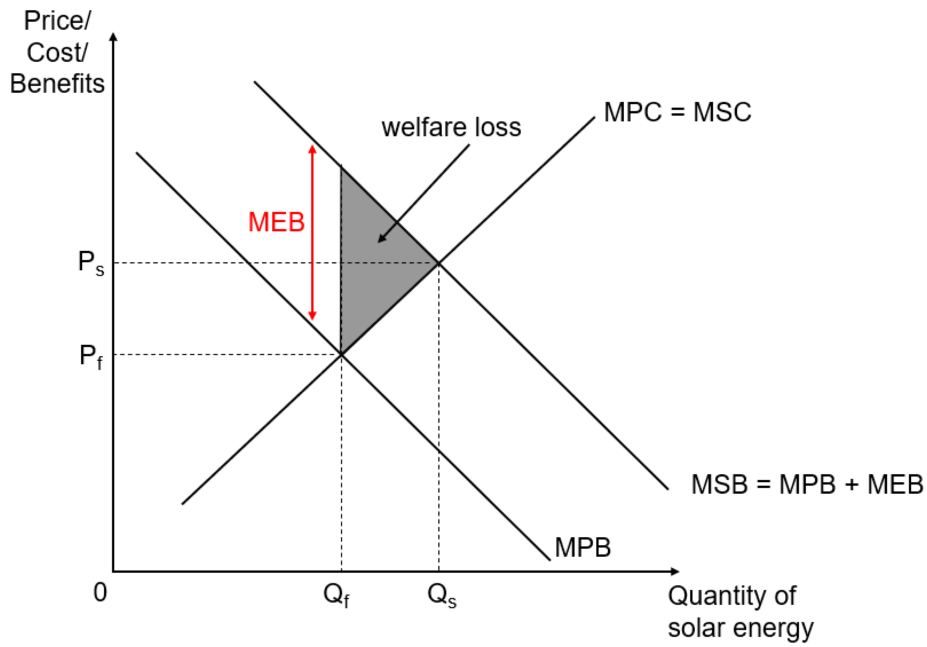

Figure 1: Positive externalities in the market for solar energy

Consumers of solar energy do not consider external benefits enjoyed by third parties when consuming the good, but only their own private marginal benefit and costs. From the extract, “the solar farm will help reduce emissions” and “be used as a tool for managing and improving the reservoir’s water quality.” By consuming solar energy, these consumers allow for potential external benefits including improved air and water quality to third parties such as traffic commuters and residents who reside near the reservoir. The marginal external benefit (MEB) generated from consumption of solar energy is shown by the divergence between MSB and MPB in Figure 1 above, where MSB (MPB + MEB) is higher than MPB of consuming solar panels at all levels of consumption.

The socially efficient equilibrium where society’s welfare is maximised is at Q_s where MSB = MSC.

Therefore, there is **under-consumption** of solar energy by amount Q_fQ_s.

With the under-consumption by amount Q_fQ_s, the total social cost incurred at output Q_fQ_s is represented by the smaller trapezium Q_fACQ_s. The total social benefit at output Q_fQ_s is represented by the bigger trapezium at Q_fBCQ_s. Thus, we can see that by underconsuming at Q_f, consumers forgo more social benefit than social cost and therefore a net welfare loss represented by triangle ABC is resulted, as shown in Figure 1.

At any output between Q_f and Q_s there is a potential net welfare gain for society should these units be consumed. The loss of this potential net welfare gain is shown by the shaded area in the diagram.

Therefore, the government’s microeconomic goal of allocative efficiency is not achieved and there is market failure.

	<u>Examiners' comments</u> Most candidates demonstrated a good understanding of the private cost and private benefit outcome/equilibrium in the market for solar energy, often with an appropriate diagram. These candidates also provided an explanation of the impact of positive externalities on the social benefit and the subsequent free market underconsumption when compared to the socially optimal outcome.	
(d)	**With reference to Extract 3, explain the likely impact on consumers' energy expenditure as a result of the price increase authorised by Ofgem in August 2021.**	**[5]**
	From the extract, Ofgem has set a "maximum energy price controls" on renewable energy to lower the prices of "greener suppliers" whose energy tend to be more expensive to generate. It was also mentioned that "A comprehensive study … concluded that it lies in the range (-)0.1 to (-)0.3." which suggests that for the market of renewable energy, the demand is likely to be price inelastic. This may be due to the lack of available substitutes for renewable energy. Therefore, the price ceiling imposed at P_c which is below the initial equilibrium price P_e will result in a less than proportionate decrease in quantity demanded to Q_d. At the new price P_c, quantity supplied is at Q_s which means that the price ceiling created a shortage as illustrated in Figure 2. The initial Total Expenditure (TE) for consumers is P_e x Q_e. After the imposition of the price ceiling, it has fallen to P_c x Q_s. This fall in TE will benefit consumers as their overall spending on the good decreases. However, as there is a shortage in the market, it may cause a black market to surface. At quantity Q_s, consumers are willing to pay the black market price of P_b, this results in an increase in consumers' TE to P_b x Q_s.	

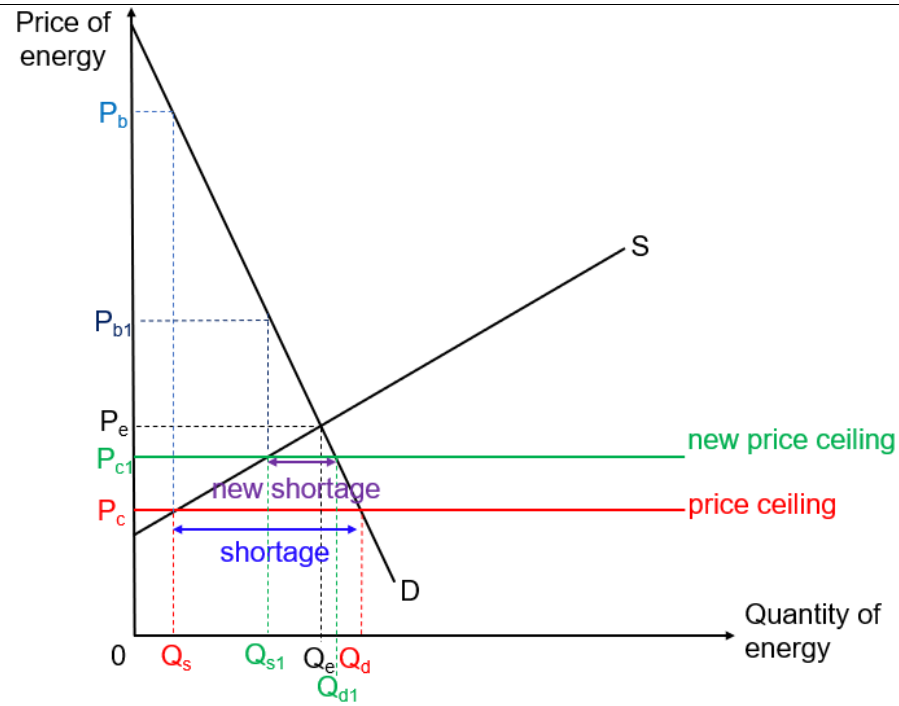

Figure 2: Market for energy

Based on the extract, "Ofgem announced an increase in the maximum price that UK energy suppliers were allowed to charge their customers", this means that there will be a rise in the price ceiling P_c set initially. This rise can be illustrated by the upward movement of P_c to new price ceiling P_{c1} in Figure 2. The increase in price will result in a less than proportionate decrease in quantity demanded from Q_d to Q_{d1} and an increase in quantity supplied from Q_s to Q_{s1}. This creates a new shortage which is lesser than the shortage before the increase in price ceiling. This means that consumers' TE has increased to P_{c1} x Q_{s1} because of Ofgem's authorised price increment. Similarly, a black market might surface but at a lower price P_{b1} as the quantity supplied is now at Q_{s1}. At the new black market price P_{b1}, there will be an increase in consumers' TE to P_{b1} x Q_{s1}.

Therefore, the increase in price ceiling from Pc to P_{c1} will increase consumers' TE. Whether the price ceiling is at initial or new levels, there might still be a rise of black markets that significantly increases consumers' TE.

Examiners' comments

Most responses assimilated the value of the price elasticity of demand in Extract 3 to explain the impact of the increased price on consumers' energy expenditure. Weaker responses did not use the information in Extract 3 as instructed or provide extraneous explanations of market operations before making the required points. When an explanation uses the price inelastic demand for energy to explain the impact of the price increase, such extraneous market operations include the operation of a price ceiling mechanism and in some cases even a price floor. For some, the extraneous market operations also included unnecessary details of the price adjustment process.

(e)	**With reference to Extract 4 and using a supply and demand diagram, explain and comment on the likely effects of the change in demand for solar energy and the change in government subsidies on the solar energy market in China.**	[6]

Command	Explain – detailed description with relevant economic analysis Comment – provide reasoned opinion on issues
Content	Demand and supply Government subsidies
Context	Market for solar energy
Approach	Increase in energy demand Fall in energy supply Extent of shifts → increase in demand > decrease in supply

From extract 4, “the growth rate in energy demand in China has averaged 5.9% per year”, which suggests that the demand for solar energy is increasing in the market of China. This may be due to rise in taste and preference for renewable energy. This increase in demand can be illustrated by the rightward shift of the demand curve from D_0 to D_1 as shown in Figure 3. As a result of the rise in demand, the equilibrium price of solar energy will increase from P_0 to P_1 and the equilibrium quantity will increase from Q_0 to Q_1.

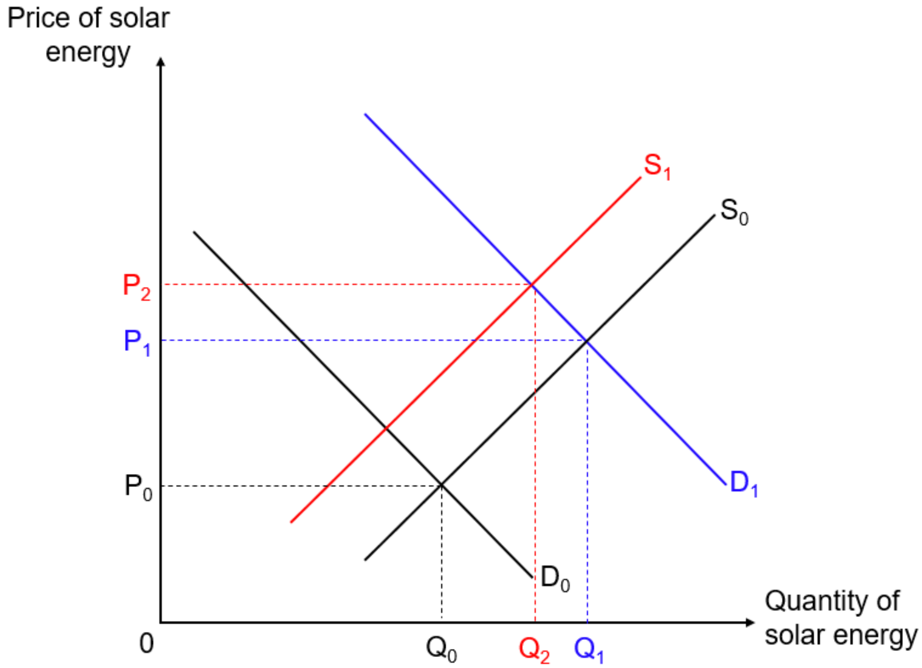

Figure 3: Market for solar energy

It was also mentioned in extract 4 that “the Chinese government announced that it will no longer grant subsidies from central government budget for new solar power stations or wind projects.” Without these subsidies, the supply for solar energy will decrease as cost of production for producers increases. This fall in supply can be illustrated by the leftward shift of the supply curve from S_0 to S_1 as shown in Figure 3. The fall in supply will lead to equilibrium price increasing further from P_1 to P_2 and equilibrium quantity to fall from Q_1 to Q_2.

Extract 4 also states that “it is estimated that (China) will account for 22% of world energy consumption by 2040.” This suggests that the demand for solar energy by China will continue rising for a period while the fall in supply might be temporal as over time, technological advancement can counter the effects of the removal of subsidies. Hence, the increase in demand for solar energy is more than the fall in supply for solar energy. This difference in the extent of shifts can be illustrated on Figure 3.

Overall, the equilibrium price for the market of solar energy increases from P_0 to P_2 while the equilibrium quantity increases from Q_0 to Q_2.

Examiners’ comments

Most responses demonstrated sound analysis of how the specified changes would affect China’s solar energy market. These responses provided a well-labelled demand and supply diagram and also used the extract material to explain the corresponding rightward shift of the demand curve. The analysis of supply was less well executed by weaker responses, leading to somewhat unjustified outcomes for the new equilibrium price in the solar energy market. Only the stronger responses included the clear evaluative point that the outcome for the

	new equilibrium quantity would be indeterminate or increase/decrease that is justified based on the relative size of the shifts in the demand and supply curves.	
(f)	**Using the information in Extract 3, discuss the likely effects on energy consumers <u>and</u> producers of the UK regulator's decision to increase the maximum price allowed in the energy markets.**	**[8]**

Command	Discuss - Two-sided answer with a well-reasoned conclusion.
Content	Price ceiling
Context	Market for energy
Approach	R1: Effects of price ceiling on consumers is negative E1: Effects of price ceiling on consumers may be positive R2: Effects of price ceiling on producers is positive E2: Limitations of price ceiling Conclusion

<u>Introduction</u>
Extract 3 mentioned that a "UK-wide maximum energy price controls (was) introduced in 2019". This suggests that there is a price ceiling set below the equilibrium price for the market of energy. A price ceiling which is a legally established maximum price set below the market equilibrium price. From Extract 3, "Ofgem announced an increase in maximum price that all UK energy suppliers were allowed to charge their customers", this means that at the initial price ceiling set by the UK regulator, there is an increase in price ceiling from P_c to P_{c1} as illustrated in Figure 4.

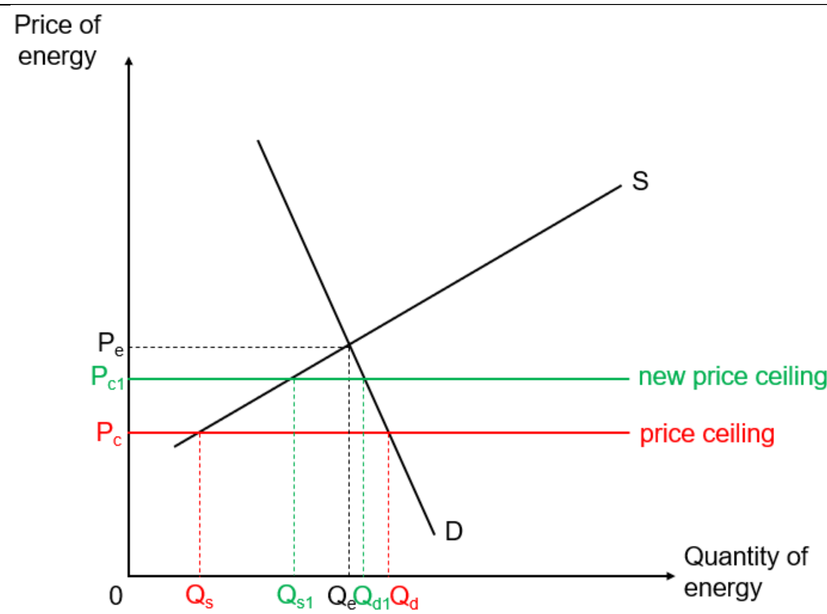

Figure 4: Market for energy

<u>R1: Effects of increase in price ceiling on consumers is negative</u>
Before the rise in maximum price, the Total Expenditure (TE) of consumers is P_c x Q_S which is lower than TE at original equilibrium P x Q. As a result of the increase in price ceiling, the quantity supplied increased from Q_s to Q_{s1} as shown in Figure 4. Since price has increased, consumers will have to pay more and therefore TE has increased to P_{c1} x Q_{s1}. Therefore, the increase in maximum price in energy market, or price ceiling, is likely to have negative effects of increasing TE for the consumers. In addition, price ceiling is implemented to keep prices low for consumers and by increasing the maximum price set on energy, it will result in increased inequity as lower-income consumers experienced higher prices.

<u>E1: Increase in price ceiling on all energy suppliers may be beneficial for consumers</u>
According to extract 3, Ofgem set price controls on all UK energy suppliers and "exempted three such suppliers ('green' suppliers) from the UK-wide maximum energy price controls". This suggests that when maximum price increased in 2021, consumers will more likely switch to cheaper substitutes like greener and renewable energy. This allows environmentally conscious consumers to consume renewable energy at a lower price level as compared to non-renewable energy. Hence, the increase in price ceiling is beneficial for consumers that are concerned about the environment.

<u>R2: Positive effects of increase in price ceiling on producers</u>
As TE for consumers increases due to the increase in maximum price allowed in the energy markets, the Total Revenue (TR) for producers increases as well. Before the rise in price ceiling, TR for producers is P_c x Q_s but after the increase in price ceiling from P_c to P_{c1}, TR for producers increased to P_{c1} x Q_{s1}. As producers benefitted from the increase in profits, the increase in maximum prices is beneficial for them.

	<u>E2: Producers are better off without price ceiling at all</u> However, without the price ceiling, producers were initially able to produce at P_e and Q_e and earn revenue at P_e x Q_e which is higher than TR at implemented price ceiling P_{c1} x Q_{s1}. In addition, with greater revenue, producers can invest in energy efficient infrastructure and production methods that can lower costs and increase profits in the long run. <u>Conclusion</u> Stand: The increase in maximum price allowed in energy markets is likely to be disadvantageous for both consumers and producers. Justification: Consumers are likely to experience negative effects as their TE increased and only environmentally conscious consumers benefit from lower renewable energy prices as the substitutability of energy are closer for them and further for other consumers. Producers benefit from the increase in TR, but the implementation of price ceiling still lowers their TR from TR in a free market. Something Special: From extract 3, it was mentioned that the increase in maximum price is due to "an increase in wholesale energy prices", this suggests that cost of producing energy has increased and therefore price controls may not be an effective policy to tackle the root cause of the problem. The UK government can instead provide subsidies to producers so that cost of production can be lowered, tacking the root cause. (Root cause + recommendation)	
	<u>Examiners' comments</u> The stronger responses provided relevant diagrammatic analysis of the impact of an increase in the price ceiling in the context of the broader energy markets. The context of the broader energy market refers to the fact that the UK regulator's decision to increase the maximum price allowed in the energy markets applied to all forms of energy. This was not just renewable/solar energy which had been the focus of earlier questions. This broader context was explicitly recognised in stronger responses to justify why separate analysis of the gas, electricity, and renewable energy market respectively was not required. Weaker responses drew a maximum price line above the initial equilibrium price and discussed a price floor effect which is incorrect. Some weaker responses assumed that the increase in the maximum price would take the market to the equilibrium price or even above it. This made the subsequent analysis of both required elements – energy consumers and producers – less justified. A reduction in equity or the issue of price elasticity of demand were used in stronger responses as a route into evaluation.	
(g)	**The use of non-renewable energy sources, such as coal, causes market failure. To achieve an efficient allocation of resources, the best government intervention would be an increase in indirect taxation on the sale of energy from non-renewable sources.** **Discuss the view that this would be the best policy.**	**[10]**

Command	Discuss - Two-sided answer with a well-reasoned conclusion.
Content	Government intervention to mitigate market failure
Context	Market for non-renewable energy sources
Approach	R1: Increase in indirect taxation is the best government intervention policy E1: Limitations of indirect taxation as a policy R2: Subsidies is the best government intervention policy E2: Limitations of subsidies Conclusion

<u>Introduction</u>
The use of non-renewable energy sources causes market failure as burning of such fuels for energy usage produces pollutants which may subsequently lead to health issues on the population. These negative externalities are spill-over costs borne by third parties who are not directly involved in the consumption or production of the good itself without compensation, such as environment pollution during the production of non-renewable sources, as well as the adverse health impacts of people who live nearby.

<u>R1: Increase in indirect taxation is the best government intervention policy</u>
Government may intervene by implementing indirect taxation to reduce the effects of market failure in non-renewable energy. The free market originally produces at Q_f where Marginal Private Cost (MPC) equals to Marginal Private Benefit (MPB) as illustrated in Figure 6. A tax equal to the marginal external cost at Q_s is imposed by the government. The tax makes the private firm internalise the negative externality in their decision making. Firms' cost of production rises because of the tax. This causes the firm's MPC to shift up to MPC* as seen in Figure 6. The market equilibrium then moves from Q_f to Q_s where the MPC* equates MPB, to maximise their net benefit. As such, the overproduction is removed, and the market produces at the socially optimal level. As a result of the tax, there will be an increase in price, reducing the quantity demanded, hence reducing the equilibrium quantity towards Q_s. This eliminates the deadweight loss and allocative efficiency is achieved in the market.

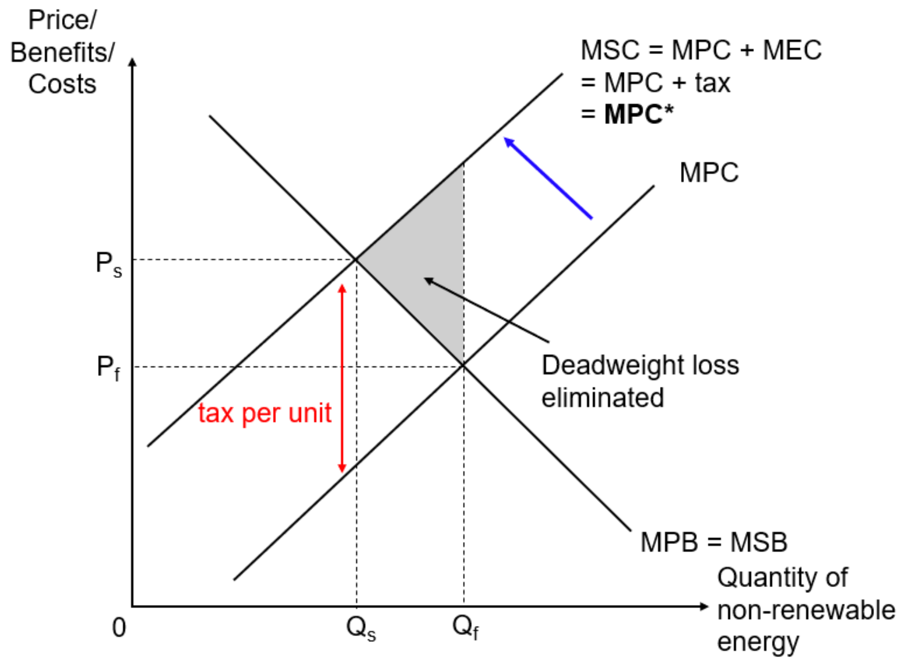

Figure 6: Effect of tax correcting negative externalities in the market of non-renewable energy

<u>E1: Limitations of indirect tax</u>

However, indirect taxation may not be the best policy resolve market failure in the market of non-renewable sources as government suffers from imperfect information. Insufficient information poses a challenge for the government in accurately assessing the negative externalities impact on third parties. Due to the intangible nature of these costs such as health effects on the population, it complicates the quantification process to monetary terms. Consequently, there is a risk of either over or under-taxation. Under-taxation fails to eliminate deadweight loss, while over-taxation creates additional deadweight loss. For instance, if the government suffering from imperfect information overestimate the external costs, they will overtax which decreases equilibrium quantity to less than Q_s, creating additional deadweight loss as illustrated in Figure 7.

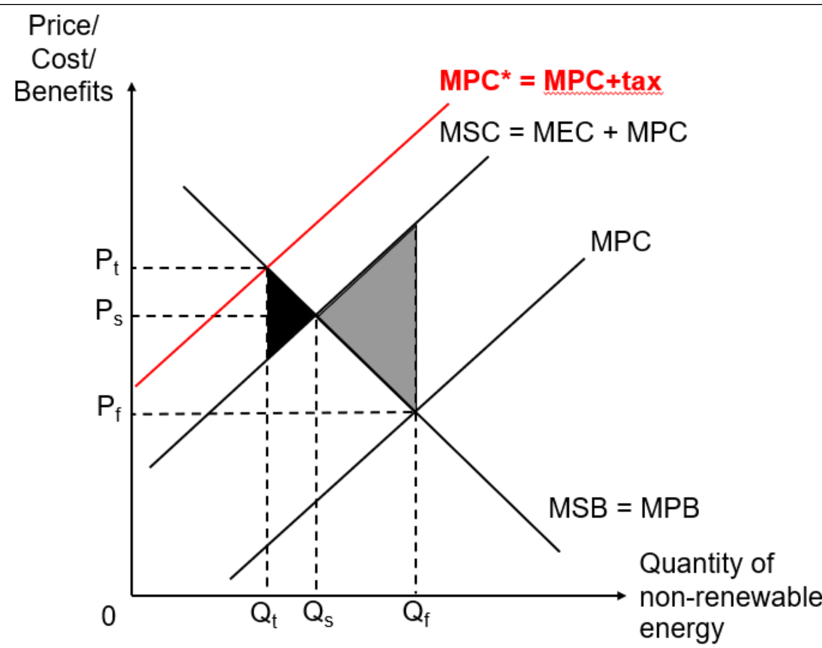

Figure 7: Over-taxation in the market for non-renewable energy

R2: Subsidising substitute markets is the best policy to tackle problem of market failure in non-renewable energy sources

The government can promote an alternative market such as renewable energy markets via subsidies to encourage the consumption of substitutes. Without government intervention, the free market quantity in the market of non-renewable energy sources is at Q_f where MPC equates MPB as shown in Figure 8. Subsidies on renewable energy sources such as solar power are given to producers and this lowers the cost of production of renewable energy sources. Producers are more willing and able to produce renewable energy and this would then lower prices and increase quantity demanded for renewable energy. As renewable energy sources and non-renewable energy sources are substitutes, the decrease in price of renewable energy would lead to a decrease in demand for non-renewable energy. The MPB curve for non-renewable energy would shift left from MPB to MPB_1 as shown in Figure 8. As a result, equilibrium output will fall from Q_f to Q_s, where zero units of the good is produced. Deadweight loss is eliminated as the consumption of non-renewable energy is reduced to the socially efficient level.

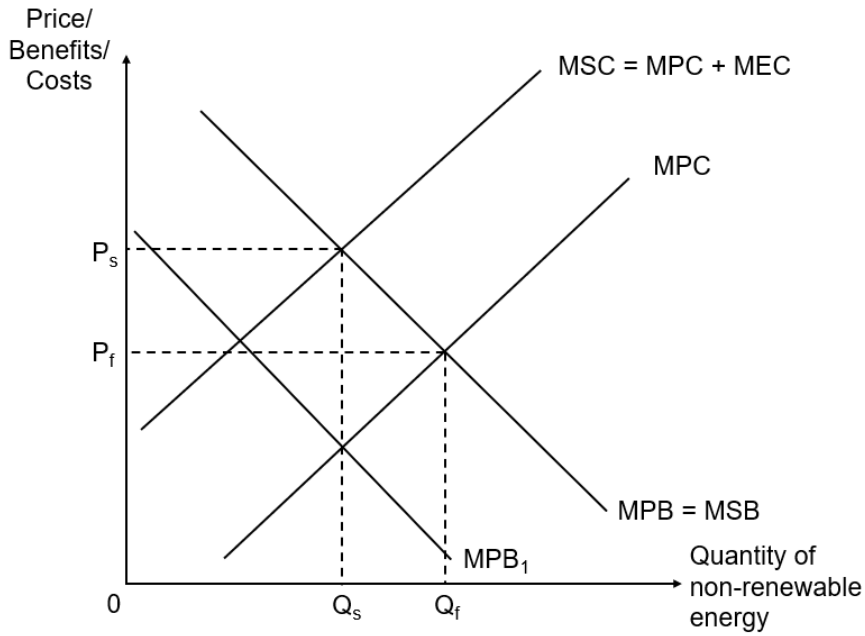

Figure 8: Effects of subsidising substitute markets on the market of non-renewable energy

<u>E2: Limitations of subsidising substitute markets</u>
However, the effectiveness of this policy is largely dependent on whether the two goods are close substitutes or not. If they are not close substitutes, then the fall in MPB in the non-renewable energy market will not be significant and the fall in consumption will not be sufficient to reach Q_s. In addition, the promotion of an alternative market may cause over-consumption of that good and therefore produces negative externalities. For example, the production of wind energy, a type of renewable energy, may generate negative externalities in the form of noise pollution on population living near the wind turbines, which can be exacerbated by the increase in production due to subsidies given to the market.

<u>Conclusion</u>
Stand: Indirect tax is the best government intervention policy to resolve market failure in the market of non-renewable energy

Justification: Although it is difficult to quantity the MEC to determine the amount of taxation to put on the market due to imperfect information, government can use tax revenue to invest in deriving actual value of MEC.

Something Special: To effectively reduce the negative externalities in the market of non-renewable energy, the government should adopt more than one policy, such as implementing taxation and subsidising substitute markets at the same time. The tax revenue earned can also be used to subsidise the substitute markets and reduce any external costs that may arise.

	Examiners' comments There were many strong responses to this question. Most responses effectively addressed the market failure issue involved in the usage of non-renewable energy sources. Indirect taxation on the sale of energy from non-renewable sources was both analysed and evaluated as a solution to the market failure presented. Many candidates then successfully introduced a second policy that is simulated by the case material or chose a relevant one from their knowledge of market failure policies in the syllabus. Only the stronger responses went on to utilise these materials fully in their development of analysis and evaluation of the second policy. In contrast, weaker responses did not compare the two policies and address the evaluative requirement of 'best' as directed by the question. Other responses, which attempt to address this aspect of the question, did so in a cursory manner, lacking clear detail as to the reason for one approach being the 'best'.	

[Total: 40]