3.	**In 2009 UK government supported the production of renewable energy through subsidies, to reduce the reliance on non-renewable energy.**	
	(a) Explain, with the aid of diagrams, the effects of subsidies on the different energy markets.	[10]
	(b) Discuss whether taxation is the best way to deal with the misallocation of resources in the market for non-renewable energy.	[15]

Question Approach:
This question requires students to explain the effects of subsidy on different energy markets using demand and supply analysis(with the aid of a diagram). The preamble has hinted the two possible types of energy markets to be addressed. To gain access to the full range of marks, students need to analyse the impacts on the various economic agents in the market using elasticity concepts.

Introduction:

Briefly describe the impacts of a subsidy on the renewable energy market.

A direct subsidy given to producers of renewable energy may affect the supply of renewable energy and in turn, other related energy markets. Since the interaction between demand and supply determines the equilibrium price and quantity of any market exchanges, a change in the supply is likely to have effects on the market participants via the equilibrium price and quantity exchanged. However, the final effects can be examined with the use of elasticity concepts.

Body:

Explain the effect of a direct subsidy to producers in the market for renewable energy.

- A direct subsidy reduces the unit cost of production of renewable energy.
- Producers are more willing and able to supply renewable energy at every price level → supply hence increases.
- Demand for renewable energy, like energy in general, is likely to be price inelastic (PED <1) as energy is needed in a lot of daily activities as well as industrial production processes. Furthermore, there is only one other substitute for renewable energy. This implies that a change in price will lead to a less than proportionate change in quantity demanded.

Explain the extent of change in equilibrium price and quantity using PED concepts with the aid of a diagram.

With reference to fig. 1,
- An increase in supply shifts the supply curve from SS_0 to SS_1 along a relatively steep demand curve. At the initial price P_0, the quantity supplied is greater than the quantity demanded. The surplus hence put a downward pressure on prices as producers lower prices to get rid of excess inventory while passing on the cost savings to consumers. As price adjusts downwards, quantity demanded increases according to the law of demand, while quantity supplied decreases as producers have less incentive to supply renewable energy according to the law of supply.
- The process continues until a new equilibrium is established where quantity demanded is equals to quantity supplied.
- At the new equilibrium, e_1, the increase in supply has resulted in a greater fall in equilibrium price than the increase in equilibrium quantity, ceteris paribus.

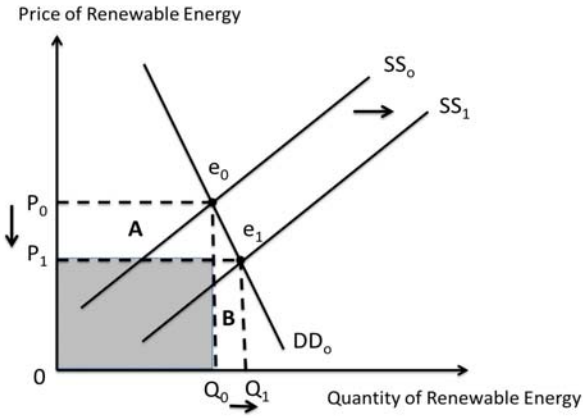

Figure 1: An increase in Supply of Renewable Energy

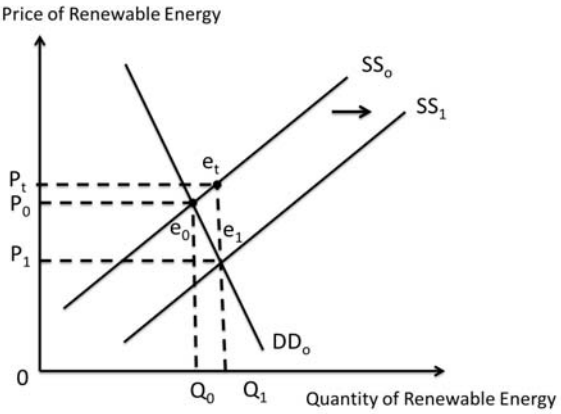

Figure 2: Effect of Subsidy on Producers

Examine the impact on producers and consumers of renewable energy.

As a result, the consumer expenditure on energy is likely to fall. In turn, the amount of revenue producers received from the market has decreased, as shown by the change in area from A to B in figure 1. The total amount of payments received by producers however has increased with the government's subsidy as shown in fig. 2 from $P_0e_0Q_00$ to $P_te_tQ_10$.

Explain the effects of the change on non-renewable energy with the aid of a diagram.

With a fall in the price of renewable energy, more consumers would be incentivise to switch from consuming non-renewable to consuming renewable energy instead. As a result, there would be a fall in the demand for non-renewable energy.

The fall in demand for non-renewable energy would result in a fall in the equilibrium price and quantity, ceteris paribus.

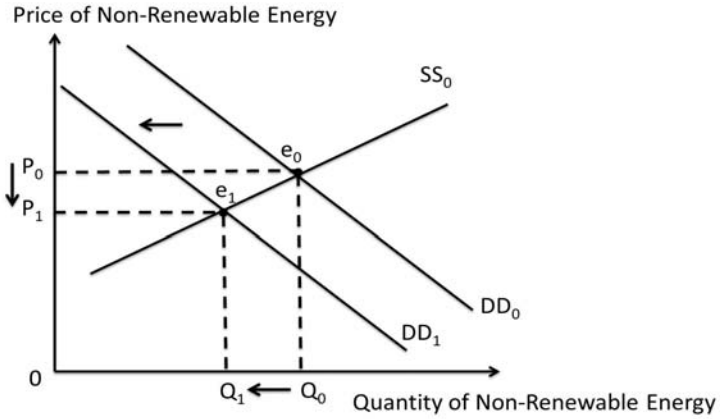

Figure 3: A Decrease in Demand for Non-Renewable Energy

Conclusion:

In the long run, producers of non-renewable may also find producing renewable energy more profitable and switch to producing renewable energy instead, reducing the production and consumption of non-renewable energy. Government's use of subsidy to reduce the reliance on non-renewable energy may hence be effective.

Level	Knowledge, Application, Understanding and Analysis	Marks
L3	For a well-developed answer examining the effects of a subsidy on producers and consumers in different energy markets using elasticity concepts. If no mention of impact on producers/consumers – Max 7m	7 - 10
L2	For an undeveloped answer explaining the effects of subsidy on producers and consumers in different energy markets. If only one market is addressed – Max 6m If no diagrams – Max 5m	5 - 6
L1	For a largely descriptive and irrelevant answer about the effects of a subsidy on the energy markets. Answer may consist of conceptual errors.	1 - 4

Examiner Comment:

(b) Discuss whether taxation is the best way to deal with the misallocation of resources in the market for non-renewable energy. [15]

Question Approach:

The second part of the question requires students to consider taxation as the best way to deal with the misallocation of resources in the market for non-renewable energy. It hence requires students to analyse the use of taxation amongst other possible policies to correct for the allocative inefficiency in the market, before evaluating on their use in allocating resources efficiently.

Introduction:

Identify and briefly explain the allocative inefficiency in the market for non-renewable energy.

The market for non-renewable energy faces **a problem of over-allocation of resources in the production of non-renewable energy**. The production of energy via non-renewable resources generates **negative externalities which are spillover negative effects** on third parties not involved in the transaction. For example, the excessive use of non-renewable energy sources to generate power causes air pollution, as harmful pollutants are released into the atmosphere. In turn, the society incurs extra costs related to healthcare treatment and restoration of damaged buildings from acid rain. As a result, the marginal private cost (MPC) of producers diverges from the marginal social cost (MSC) by the marginal external cost (MEC).

As producers are self-interested and only consider their marginal private cost and benefit (MPB), the equilibrium output level when left to the free market deviates from the socially optimum output level where MSC=MSB. The market hence fails to allocate the optimum amount of resources to the production of energy using non-renewable energy sources resulting in a deadweight loss of area e_0e_1A, as shown in figure 1.

Taxation can correct for the misallocation of resources in the market for non-renewable energy by reducing the production and consumption of non-renewable energy and hence the resultant deadweight loss to the society. However, taxation has its limitations and other measures should be explored and jointly evaluated against taxation to determine the best way to deal with the misallocation of resources.

Body:

Explain how taxation can correct for the market failure due to negative externality

The government can levy an indirect tax on utility firms generating power with the use of non-renewable sources of energy like coal and fossil fuel. An indirect tax increases the unit cost of production of these producers. Hence, for every price level, the producers are less willing and able to produce since their profit margin has fallen, ceteris paribus.

With reference to figure 1, the tax equivalent to the marginal external cost shifts the MPC to the left, reducing the equilibrium quantity of non-renewable energy to the socially optimum quantity. Less resources are channeled to the production of non-renewable energy, reducing the production and hence eliminating the deadweight loss to the society. Hence, the tax can help to achieve allocative efficiency in the market for non-renewable energy.

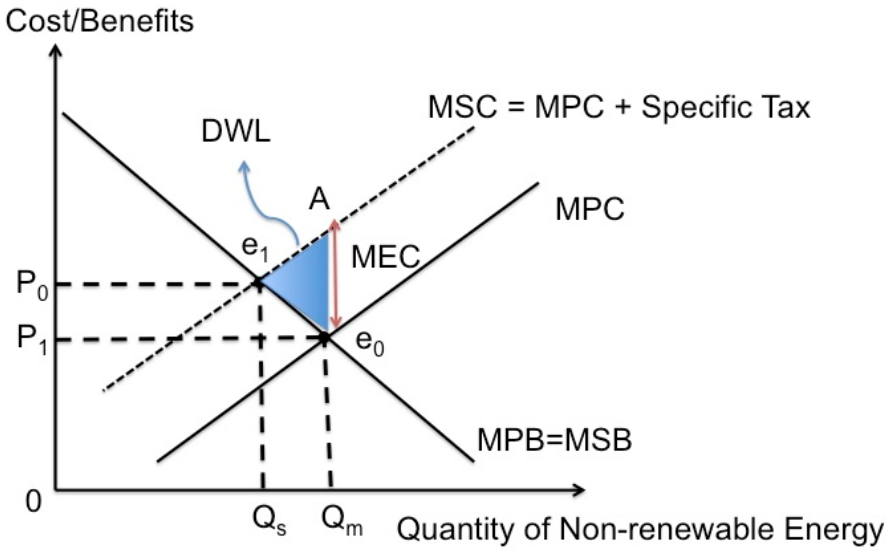

Figure 1: Indirect Tax on Non-renewable Energy

Evaluate on Taxation (Strength and limitations)

Strengths:

1) Taxation is a market-oriented measure which is easy to implement and transparent. With good enforcement, taxation can force firms to internalise the external cost and effectively reducing the reliance on non-renewable source of energy.

2) Tax revenue collected can be channeled to subsidise the production of renewable energy encouraging producers of energy to switch to using renewable energy sources, reducing the reliance for non-renewable energy. This is as explained in part (a).

Limitations:

1) It is difficult to impose the optimum amount of tax as it is difficult to calculate the actual amount of external cost on the society due to imperfect information (of MB & MC). A situation of over/under taxation will not eliminate the deadweight loss and may even worsen the problem. (Explain with reference to figure 2)

2) Frequent changes in the tax rate in order to arrive at the optimum amount of tax would create uncertainty to the producers which would affect output decisions.

3) Effectiveness of taxation is dependent on the price elasticity of demand (PED) for non-renewable energy. Energy is a necessity in many production processes → PED<1. The increase in price due to tax → less than proportionate fall in the Qd for non-renewable energy. A larger amount of tax is required for it to be effective which may not be acceptable to utility firms.

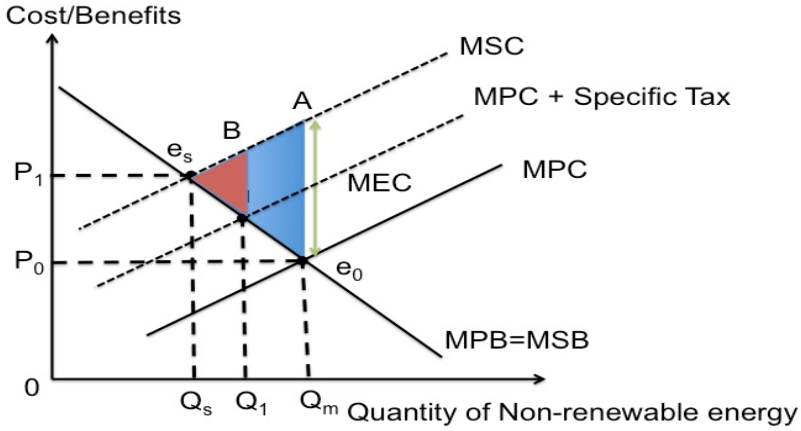

Figure 2: Under Taxation on Non-renewable energy

Explain how regulations can correct for the market failure

In the case of over-production, the government can place a legal maximum on the amount of non-renewable energy that the firm can produce so that output is restricted to the socially optimal level. In addition, government can also set guidelines for energy conservation.

Evaluate on regulations

Strength:
1) Effective as it directly controls the level of output preventing overproduction. Beyond the permissible level of non-renewable energy output level, firms will be forced to switch to alternative sources of energy.

Limitations:
1) It imposes high monitoring costs on the government as it is difficult and costly to ensure compliance.
2) There is no incentive for firms to reduce production level beyond the legally required limit which may not reduce pollution levels to the socially optimum level.

Explain how persuasion and education can correct for the market failure

Government can also raise awareness of the negative impacts of over reliance on non-renewable energy and encourage producers to switch to using alternate green energies. This is to instill social responsibility towards the community and environment. For example, firms assume Corporate Social Responsibility (CSR) by contributing to educational and social programs; reduce waste and pollution process and earning adequate returns on the employed resources. This also includes educating the public about the harmful effects of pollution on the environment so as to influence consumers' preference and their consumption of non-renewable energy. (Fall in MPB → fall in equilibrium quantity → closer to socially optimal quantity, ceteris paribus).

Strength: Successful persuasion and education effects an intrinsic motivation in firms and consumers to reduce production and consumption of non-renewable energy which is effective in the long run.

Limitations: Positive impacts of successfully educating the public to effect behavioural change takes a long time to materialise. In addition, firms may not have incentive to assume the responsibility. Besides, even with the knowledge that extraction and burning of non-renewable energy resources such as fossil fuel contribute significantly to environmental problems and external cost, there is still a rapid rise in the consumption and production of non-renewable energy.

Other acceptable answers:
- Subsidy on green technology to reduce cost of producing green energies

Overall Evaluation

Whether taxation is the best policy depends on whether the tool can **effectively** address the problem of misallocation of resources in the market for non-renewable energy while having the **minimum negative impact** on the society **when compared to other tools.**

As compared to moral suasion and public education, both taxation and regulation can result in a more immediate change in consumption and production decision by economic agents. In fact, if the UK government reckons that the problem is severe and there is a need to tackle the problem immediately, implementing a regulation will ensure that production and hence

pollution level is actually reduced, instead of a market-based incentive like tax, which has greater uncertainty.

Yet, taxation is a more efficient method of intervention as compared to regulation, as taxes are not levied on the firms per se but on per unit of emission. In reality, firms have different cost structures and a "one size fits all" method like that of a regulation does not take that into account and treats all firm equally. Hence, even if it is costly to reduce pollution by a bit, a firm will have to comply and may end up closing down.

Conclusion:

Taxation may be a plausible measure, but to solve the problem of misallocation of resources in the market for non-renewable energy requires more than just taxation. Ultimately, the rapid consumption of energy in the name of industrialisation and economic development implies that firms are more likely to rely on cheaper and more readily available sources of energy to meet production demands and while taxation and education to reduce the reliance of non-renewable energy is employed, more needs to be done to develop alternate green energies and encourage the use of green technology even if it brings about higher short term costs.

(To control emissions, today's coal-fired power plants are equipped with scrubbers, filters, collectors, electrostatic precipitators, and other devices. emissions.)

Level	Knowledge, Application, Understanding and Analysis	Marks
L3	For a well-developed and balanced answer examining the strengths and limitations of taxation as well as other possible measures to achieve efficient allocation of resources in the market for non-renewable energy. Fail to consider limitations or strengths of policy – Max 8m	9 - 11
L2	For an undeveloped answer which attempts to examine the strengths and limitations of taxation as well as other possible measures to achieve efficient allocation of resources in the market for non-renewable energy. Only considers policy of taxation (well-developed) – Max 6m	6 - 8
L1	For a largely descriptive and irrelevant answer about taxation without addressing the question. Answer may consist of conceptual errors.	1 - 5
Max 4m given to Evaluation		
E2	Value judgements supported by economic reasoning.	3 - 4
E1	Value judgements unsupported by economic reasoning	1 - 2

Examiner Comment: