Section B - Analysis of Market Failures

a) Explain why the following represent market failure.

(i) positive externalities, (ii) existence of public (collectively consumed) goods

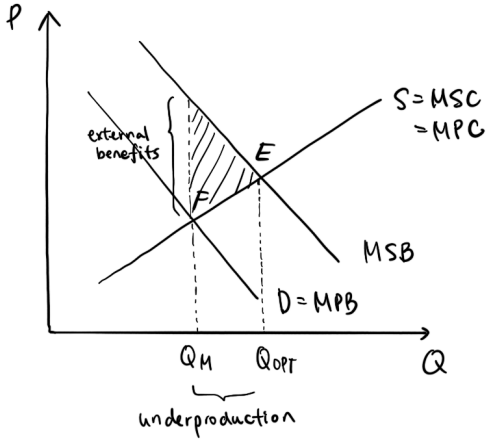
Definitions:

- **Marginal Social Benefit(MSB)**: The benefit to society from consuming one more unit of a good
- **Marginal Social Cost(MSC)**: The costs to society of producing one more unit of a good
- **Marginal Private Benefit(MPB)**: The benefit to the consumer from consuming one more unit of a good. Consumers consume according to the MPB curve, and therefore we can assume, in the scope of this essay, MPB = D.
- **Marginal Private Cost(MPC)**: The costs to the producer of producing one more unit of a good. Firms produce along the MC curve, and therefore we can assume, in the scope of this essay, MPC = S.

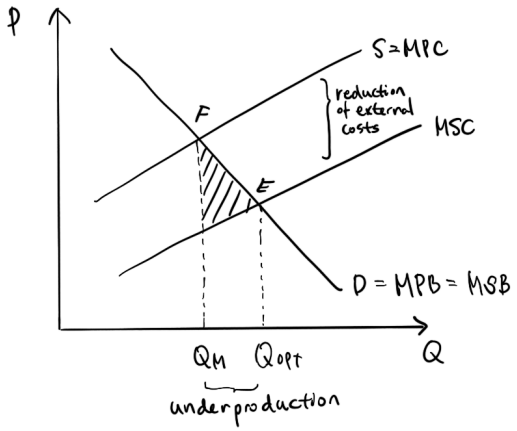
- **Market Failure**: A situation where the free market fails to reach the allocatively efficient point, and prediction quantity is at the point where Marginal Social Cost(MSC) does not equal Marginal Social Benefit(MSB).
- **Externality**: A benefit or cost to a 3rd party due to a transaction, which can incur during the production or consumption of a good
- **Public good**: A good that is non-excludable, and non-rivalrous. e.g. a tsunami siren.

(i)

Positive externalities can incur market failure, as it differentiates MSC and MPC curves, or MSB and MPB curves, depending on if the externality incurs during consumption or production. This can be explained simply with the following diagrams:



< Diagram A-1 >



< Diagram A-2 >

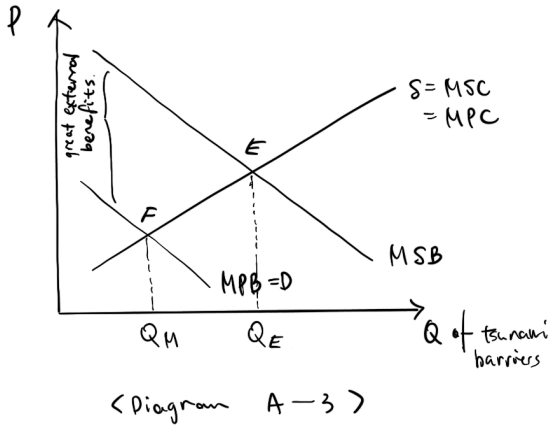
Diagram A-1 illustrates a positive externality of consumption. As society gains benefit when people consume the good, MSB is higher up than MPB, by the amount of external benefit to society. The allocatively efficient point is point E, where MSB = MSC. However, the free market moves to the equilibrium point F, where D(=MPB) = S(MPC), and **the market is underproducing the good.** The market it not at the allocatively efficient point, and therefore, **the market has failed.** In this case, the welfare loss is the area shaded in black.

Diagram A-2 shows a positive externality of production. As there is a reduction to the cost to society when producers produce the good, MSC is lower down than MPC, by the quantity of the reduction of external cost on the society. The allocatively efficient point is, again, point E, where MSB = MSC. However, the free market moves to point F, where D(=MPB) = S(MPC), and **the market is under-allocating resources, underproducing the good.** Therefore, the market it not at the allocatively efficient point, and therefore, **this market has, also, failed.** The welfare loss is the shaded area in the diagram.

(ii)

A public good can also cause a market failure, due to the problem known as the **free-rider problem**. For example, when installing tsunami barriers, an example of a public good, the market does not take into account the social benefits, that it can potentially protect assets, or even save lives. Because it is non-excludable and non-rivalrus, nobody stands up to produce at such a high cost. Therefore, **if its production was left to the free market, nobody will produce it, simply hoping that somebody else will take on the cost and build the flood barrier, and "free-ride" its safety benefits after somebody else builds it.** The good will therefore be **underproduced**. The graphical analysis of a public good is, therefore, similar to the digram of a good with a positive externality of consumption.

Note that the marginal benefit of a tsunami barrier decreases as quantity increases, simply because the additional height of the barrier will help less and less with the protection; after a certain height, building it higher is meaningless.



<Diagram A-3>

Taking a look at diagram A-3, we can see that tsunami barriers have great external benefits such as safety and protection, so the MSB is much higher than its MPB. However, the market simply produces where D(=MPB) = S(MPC). If production is left alone to the free market, only Q_M of tsunami barriers will be produced, while the optimum quantity is Q_E at point E, where MSC=MSB, and **the market is greatly underproducing the good**. Therefore, as illustrated in this example, a public good can cause a market failure.

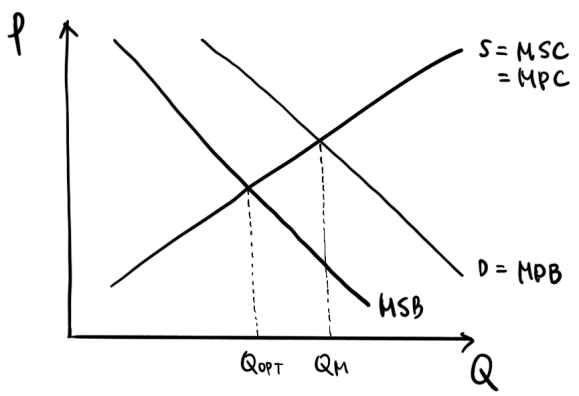
(END)

b) To what extent can government intervention correct the market failure that arises when there are environmental problems?

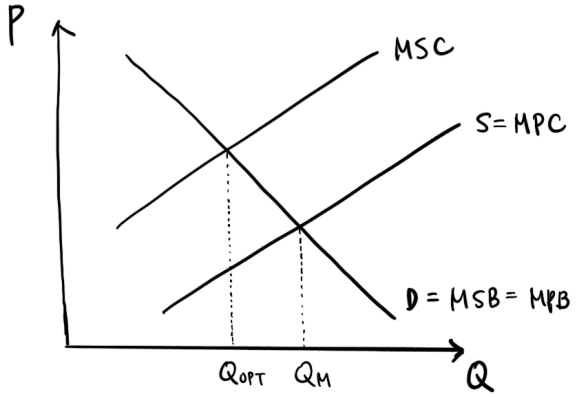
Definitions, including ones from the previous essay:

- **Indirect Tax**: A tax payed by the consumer on purchasing a good, payed indirectly through the producer to the government
- **Subsidy**: A financial aid given to the producer or the consumer in producing or purchasing a good

Governments can, and often do, intervene in the market in order to correct market failures due to externalities, and one important issue is the problem of climate change. We can consider environmental problems as **negative externalities of production or consumption.**



<Diagram 2-A>



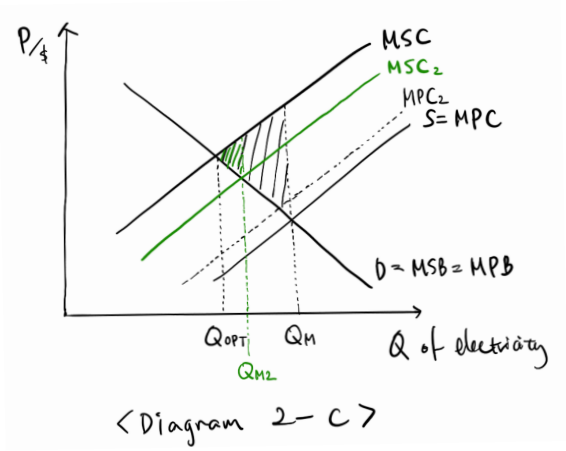
<Diagram 2-B>

The consumption of a good, such as the consumption of gasoline, which can produce greenhouse gasses, can be modeled with negative externalities of consumption, as the MSB is less than the MPB (The environmental harm is not taken account in MPB) as in Diagram 2-A

On the other hand, the production of a good, such as production of electricity using coal, which emit carbon dioxide, can be modeled with negative externalities of production, as the MSC is higher than the MPC (The environmental harm, the cost to society, is not taken account in MPC), as in Diagram 2-B

There are two main ways that governments can correct this market failure: **government regulations, and market-based solutions.** In this essay, I will detail both of these methods, provided with examples, and evaluate the pros and cons of each solutions.

Government regulations come in the form of various regulatory laws that directly limit the amount of greenhouse gases, for example, carbon dioxide, that firms can emit, or by requiring a particular technology to be installed. For example, the EPA, in 2013, has devised a regulation that mandates coal-based power plants to install Carbon Capture Technology (CCT)[1].



<Diagram 2-C>

In Diagram 2-C, we can see that the emission of carbon dioxide is modeled with the MSC deviating from MPC, and therefore the market is not producing at Q_{OPT}, but at Q_M, with the welfare loss of the area of the black shaded region, indicative of a market failure.

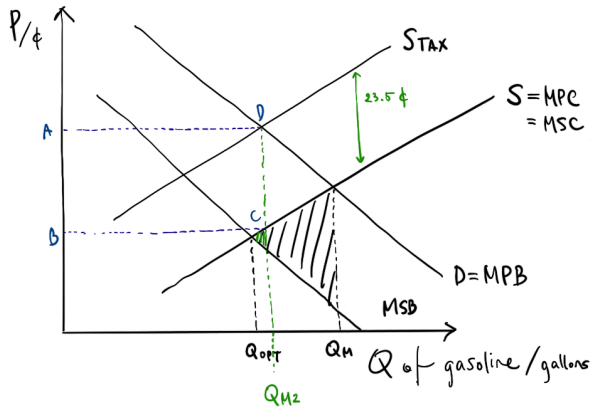
The mandate on the use of CCT can be modeled as a reduction of the social cost, as production is not hindered, but carbon emissions are reduced. The new MSC_2 due to the mandate has reduced the market equilibrium quantity of production to Q_{M2}, and had **reduced the deadweight loss to the area of the green shaded region**.

It is important to note that before the reduction of the MSC is reflected, there can be a slight increase in the MPC to MPC_2 due to the cost and maintenance of the CCT.

This method of mandating the installation of technology is quite **simple to regulate**, and requires much less economic analysis and monitoring. The government can **easily find out how much environmental benefit** this new technology gives, and therefore they are able to find out if the technology is helping the environment adequately, and adjust the strictness of the policy accordingly.

However, mandating the installation of complex and high-cost technology can **force some firms to bankruptcy**, especially small-scale firms who cannot yet take advantages of economies of scale. Also, a **government agency or monitoring organization that oversees the firms is required**, which costs the government tax revenues, as well as management issues that can arise, for example, when members of the agencies are lobbied to loosen the regulations.

Contrastingly, market-based solutions include indirect consumption tax to reduce the consumption of the good that harms the environment. For example, the U.S. government imposes a tax of roughly 23.5 cents a gallon, in order reduce car usage.



< Diagram 2-D >

In Diagram 2-D, we can see that the emission of carbon dioxide due to car usage is causing a negative external of consumption, where MSB is lower than MPB, due to the harm done to society by its consumption, and the market is overproducing gasoline, at a point of market failure. The welfare loss is shown by the region shaded in black.

The government then imposes an indirect tax of 23.5 cents[4], which shifts the supply curve to the left, due to the firm's increasing costs, to S_{TAX}. The market now meets at MPC = MPB, and produces at the equilibrium quantity of Q_{M2}. The welfare loss in this case is the area shaded in green, **much smaller than the original welfare loss.**

This method of using a market-based policy to correct market failure has various benefits, as the **government can earn a lot of tax revenue**, the area shown in the diagram with the rectangle ABCD. The government can use this revenue to subsidize alternatives, such as public transportation, or electric vehicles. Also, this solution **internalizes the externality**, where the cost is not payed by the society, but by the polluter themselves.

However, there is a problem in that it is **very hard to measure the correct amount of tax required** to correct the failure; the social cost of carbon cannot be simply calculated or limited, and therefore requires careful scientific and economic investigation. The EPA currently estimates the social cost of carbon dioxide at about $42 per ton[3], but this figure needs to be calculated with great complexity, and it, to quote the EPA, "includes changes in net agricultural productivity, human health, property damages from increased flood

risk, and changes in energy system costs,"[2] and even includes details such as "reduced costs for heating and increased costs for air conditioning."[2] This figure also needs to be constantly re-calculated as the impact of greenhouse gases continue to exponentially increase year by year.

Different policies have different benefits and drawbacks. Government regulations are good in that it is simple to give a limit of carbon dioxide emission or mandate cleaner technology, but have drawbacks in the need for monitoring and funding of oversight. Therefore, regulations are better implemented in producers, where numerous large firms can be overseen with great reduction in social costs. Market-based policies are good in that they internalize the problem, and motivates the market to an equilibrium in a natural way, but is hard to implement because of the problems of putting a price on the environmental cost. This type of policy would be better implemented in situations where consumer or producer behavior need to be altered, for example, subsidizing electric cars. Conclusively, it is crucial to analyze the individual cases where market failure needs to be corrected, and suitable policies need to be decided and developed for each instance, in order to maximize the benefit of the society.

[1] https://www.electricchoice.com/blog/existing-power-plants-exempt-from-carbon-capture-mandate-says-epa/
[2] https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html
[3] http://www.undp.org/content/sdfinance/en/home/solutions/fuel-tax.html
[4] https://www.washingtonpost.com/opinions/five-myths-about-gas-taxes/2014/12/19/cca3bc00-808a-11e4-81fd-8c4814dfa9d7_story.html