五校聯盟微課程
個體經濟學原理

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Public goods and common resources

1. Public goods 公共財

(1) Definition 定義

(2) Free-riding problem 搭便車問題

(3) Efficiency 公共財的效率性

(4) Story of lighthouse 燈塔的故事

2. Common pool resources 共有資源

(1) Tragedy of the commons 共有資源的悲劇

(2) Solutions 解方

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Market Failure

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The general idea:

- Sometimes, markets fail to function well (i.e., it does not maximize the social surplus), which is called market failure.
- Situations include externalities, public goods, and common pool resources.
- In such cases, there is a difference between the private benefits/costs and the social benefits/costs.
- Market failure gives a good reason for government to intervene the market.

有時在看不見的手操縱下，市場也無法運作良好，造成市場失靈。重要的理由包括外部性、公共財與共有資源。市場失靈是政府介入市場的重要理由之一。

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Public goods

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How to define different kinds of goods?

- Excludability 排他性

  Property of a good whereby a person can be prevented from using it
- Rivalry in consumption 敵對性

  Property of a good whereby one person's use diminishes other people's use

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Public goods

Definition

- Excludability: 排他性
  - Private goods are excludable: people can be kept from consuming them if they have not paid for them.
  - Public goods are non-excludable: it is impossible to exclude people from using them even if they don't pay.

  公共財可以由多人同時消費，也不能禁止任何人免費享用該財貨。例如陽光，空氣。

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Public goods

Definition

- Rivalry in consumption: 敵對性
  - Private goods are rival in consumption: one's consumption of the good can diminish the other people's using it
  - Public goods are non-rival in consumption: one's consumption of the good cannot diminish the other people's using it.

  公共財不能被個別消費者所獨享，某個人的消費不能減少他人對此財貨的消費，因此必須整體提供。例如燈塔、(不擁擠的)公路。

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7 ▶ Different kinds of goods

● There are four types of goods based on these two criteria:

		Excludability	
		High	**Low**
Rival in Consumption	**High**	**Ordinary Private Goods** 私有財 (clothes, food, furniture)	**Common Pool Resource Goods** 共有資源 (fish, water, natural forests, food at a picnic)
	Low	**Club Goods** 俱樂部財 (cable TV, pay-per-view TV, Wi-Fi, music downloads)	**Public Goods** 公共財 (national defense, early warning systems, earth protection programs)

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8 ▶ Public goods

● Some important public goods:

➢National defense 國防

➢Compulsory education 國民義務教育

➢Social welfare for the poor 社會福利

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slido

以下哪種財貨是公共財**?**

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10 Free-riding problem

- Free-rider problem: a person has no incentive to pay for a good because failure to pay does not prevent consumption.
  - Because of non-rival and non-excludable nature, the private market from supplying the good fails to work.
  - Government has to step in and to provide them because it can levy taxes for the provision of the public good.

  公共財因為有非排他性與非敵對性的性質，往往有「搭便車」的情況出現：因為公共財不必付錢即可享受，個體沒有動機主動付錢(或努力)。

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Free-riding problem

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- The Free-rider's dilemma:
  - ➢ You and 9 other students are given $10.
  - ➢ Students simultaneously contribute any portion of $10 back to a public account.
  - ➢ The contributions collected will be doubled and redistributed equally among all the students.
  - ➢ How much would you contribute?
  - ➢ Social optimum: to maximize the group's take-home earnings, everyone should contribute the full $10, and take-home $20. In this case, everyone's net gain is $20.

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Free-riding problem

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- What would people do in reality?
  - ➢ Experiments show that the average contributions are less than $2, and about a half of participants do not contribute at all. Why?
  - ➢ If you give $1 to the group account, then the group as a whole receives $2, but you only get 20 cents of that dollar back.
  - ➢ If everyone else contributes $10, then:
    - ■ If you contribute 0, you get: $10+$\frac{\$9\times20}{10} = 28$.
    - ■ If you also contribute $10, you get: $0+\frac{\$10\times20}{10} = 20$.
    - ■ Obviously, you have no incentive to contribute and prefer to be a free rider.
  - ➢ If everyone knows this, no one wants to contribute. This is a **free-rider dilemma**.

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Free-riding problem

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- 私人提供公共財：
  - 甲、乙兩人想蓋一個停車場，它是一個公共財。
  - 停車場的成本是30萬。停車場對每個人的價值都是20萬。
  - 他們同時決定要不要把捐錢蓋停車場。
    - 如果兩個人各捐15萬，停車場可以蓋起來。
    - 如果只有一個人捐錢，則他要獨自負擔30萬，另一人坐享其成。
    - 如果都沒人捐，停車場蓋不起來，因此每個人都得0元。
  - 停車場蓋得起來嗎?

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Free-riding problem

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- 私人提供公共財：

乙

		出錢	不出錢
甲	出錢	5, 5	-10, 20
	不出錢	20, -10	0, 0

- 甲的最佳策略是什麼?
  - 如果乙出錢，甲最好不出錢。
  - 如果乙不出錢，甲最好還是不出錢。
- 無論如何甲都不會出錢⇒free rider
- 公共財往往不能被私人提供

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15 ▶ Under-provision of public goods

Under-provision of public goods：私人提供公共財往往不足

- Citizens can **voluntarily** make contributions to the production or maintenance of a public good.
- It is usually difficult to maintain the incentives to contribute because of the free-rider problem.

實例：學生會選舉冷

由私人提供公共財往往因為搭便車的動機而難以維持。

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16 ▶ Free-riding problem

- Government can remedy the free-rider problem
  - ➢ If total benefits of a public good exceeds its costs
  - ➢ Pay for it with tax revenue
  - ➢ Make everyone better off

公共財因為搭便車問題，往往有提供不足的情況，這時往往需要政府介入，利用稅收提供公共財

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17 # Efficiency

- What is the optimal level of public good that should be provided?
  - ➤ Compute the total demand for the public good.
  - ➤ Example: to build a parking lot, the local government needs to know how much each resident wants the parking lot by asking their price or willingness to pay:

Resident	Willingness to pay（願付價格）
1	10,000
2	15,000
3	7,000

  - ➤ The total willingness to pay for this parking lot is thus 32,000.
 - ➤ This method to find the market demand is called the **vertical summation**.

公共財求取市場需求線的方法是用垂直加總，由於公共財的非敵對性，不能計算在每個價格下個別的消費量，而是計算在每個數量下，消費者的總願付價格（總價值）。

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18 # Efficiency

- Vertical summation for public goods: 垂直加總
  - ➤ There are two persons, whose demand functions are:
    You: $P = 80 - 10Q$.
    Jim: $P = 80 - 10Q$.

  - ➤ The total demand for the public good:
    Given each Q, sum these prices (willingness to pay):
    Total demand: $P = 160 - 20Q$.

  - ➤ Interpretation:
    For the first unit of the public good, the society enjoys a value of $140, and so on.
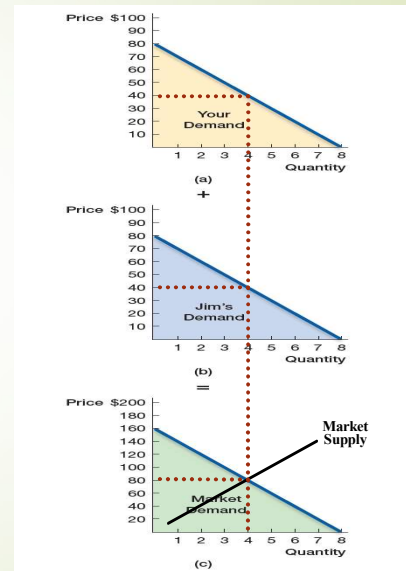

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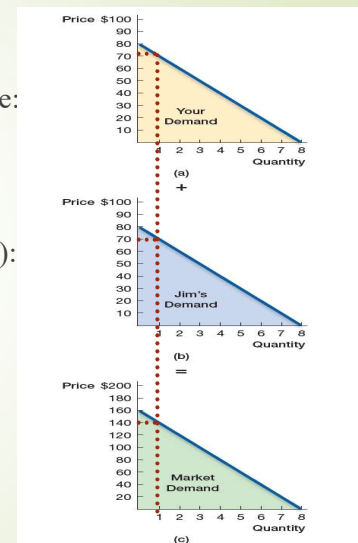
19　Efficiency

- The equilibrium output of public goods:
  - ➤ The supplier of the pubic good gives us the supply curve.
  - ➤ As typical, the equilibrium of the equilibrium output is determined by market demand = market supply ($Q_o = 4$)
  - ➤ The total price = $80. Each person pays his willingness to pay under this output level (each shares $40).

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20　Efficiency

- 停車場問題：

		乙 出錢	乙 不出錢
甲	出錢	5, 5	-10, 20
甲	不出錢	20, -10	0, 0

  - ➤ 對社會而言，甲、乙對公共財的總評價為40，大於停車場的成本
  - ➤ 停車場應該要建，但無法由私人提供⇒需要政府(管委會)介入
  - ➤ 囚犯困境(prisoners' dilemma)的例子

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Story of lighthouse

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- Some of the rare cases: the story of lighthouse 燈塔的故事
  - Mark specific locations so that passing ships can avoid treacherous waters
    - Not excludable, not rival in consumption
    - Incentive – free ride without paying
  - Most of lighthouses are operated by the government

  燈塔是典型的公共財，通常由政府興建管理

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Story of lighthouse

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- Some of the rare cases: the story of lighthouse 燈塔的故事
  - However, in England and Wales, from the 16th to the 19th century, lighthouses were privately owned and operated.
  - The owner of the lighthouse charged the owner of the nearby port, instead of the ship owners. If the port owner did not pay, the lighthouse owner turned the light off. Ships then had to avoid that port.
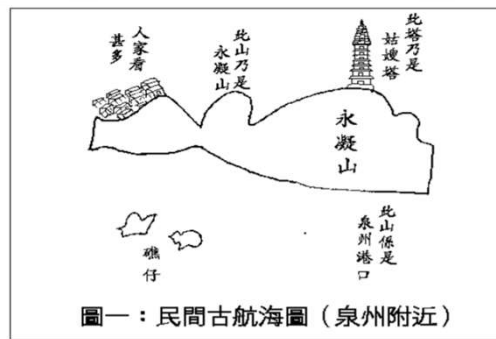
  十六到十九世紀英國海岸有些燈塔是私人擁有及營運的。燈塔擁有者對附近港口的擁有者收費(而不是對船東收費)。如果港口擁有者不付費，燈塔擁有者就會關掉燈光，船長只能避開該港口。

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23 Story of lighthouse

- 中國宋元時代重要港口都在南方，南方港口的燈塔部分由政府出資興建，部分靠民間募資興建
- 民間常於靠海之佛寺興建佛塔，以達鎮海祐民的目的，並兼具燈塔的功能

圖一：民間古航海圖（泉州附近）

來源：「公共財與私有財的區分--自宋元港市燈塔的興建談起」（黃春興）

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24 Story of lighthouse

- 錢塘江之六和塔上，自宋朝初葉以後，即裝有一永久燈號，用以在夜間指導船舶覓彼等之錨泊位置。
  - 據〈六和塔記〉稱，興建此塔共費「約用工百萬，緡錢二十萬」。此巨大工程經費…因寺僧曇和地方居士「願以身任其苦，仍不以絲毫出於官，請得募民眾，畢茲勝事」。（黃春興）
- 當佛塔加設燈光後（稱佛燈塔），捐獻者的善行功德數量於是增加，而且航行船隻愈多時，其捐贈的善行功德愈多。
- 佛燈塔因有公共財性質，故由政府出資；但部分資金來源亦為信眾捐獻興建（販賣保佑）。
- 用宗教信仰解決搭便車問題。

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Cost–benefit analysis

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- Government decide whether or not to provide the public goods by conducting the cost-benefit analysis
- Cost–benefit analysis: compare the costs and benefits to society of providing a public good
  - ➢ Doesn't have any price signals to observe
  - ➢ Rough approximations at best

評估要不要興建一個公共財，必須要做成本效益分析，確定其收益是否超過成本。但有時這些評估都沒有精確的價格可供衡量，而且往往不能只考慮短期成本利益，而必須考慮長期

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:≡ 您是否同意中油第三天然氣接收站遷離桃園大潭藻礁海岸及海域?

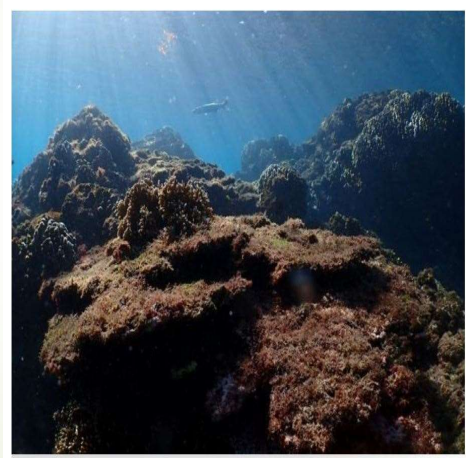蔡崇聖（五校聯盟微課程）ⓘ Staff presenting to display the poll results on this slide.

27 藻礁公投

- 公投第20案：您是否同意中油第三天然氣接收站遷離桃園大潭藻礁海岸及海域?
- 大潭藻礁保育案，是台灣第一個由民間發起成案的生態保育類公投，有其意義
- Cost–benefit analysis: 環境生態 vs 供電危機

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28 藻礁公投

- Benefit：藻礁海岸是公共財
  - 桃園海岸線的藻礁長達27公里，是台灣規模最大的藻礁，有至少20種以上的造礁藻種。
  - 藻礁生長過程緩慢，10、20年還長不到1公分，桃園地海岸線最古老的藻礁約有7600年之久。
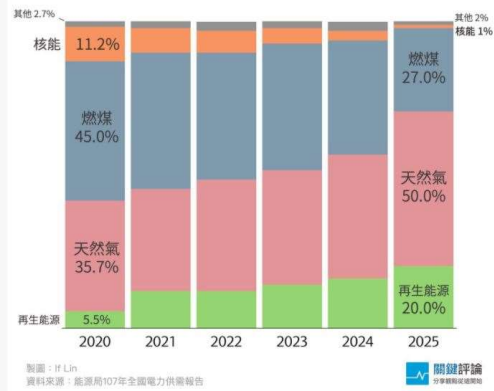 - 其利益難以衡量。

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29 藻礁公投

- Cost：台灣有供電危機
  - ➢ 台灣電力在未來預計將有50%仰賴天然氣發電，現有的2座天然氣接收站使用率已經飽和，因此政府規劃興建第三接收站。
  - ➢ 三接預定地在桃園觀塘工業區、已於1999年、2000年通過環評，直到2016年三接的投資案通過後，環保團體才注意到此處豐富的藻礁生態。
  - ➢ 如果三接無法如期完工，一年會少掉137億度的電力。

台灣未來發電比例
2025年時天然氣將佔一半的發電量

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30 藻礁公投

- 三接不蓋在觀塘，護礁團體有替代方案嗎？
  - ➢ 台北港：位於桃園大潭電廠和基隆協和電廠中間，不會影響藻礁生態系和自然海岸。
  - ➢ 但經濟部認為三接遷到台北港，需要填海造陸，整體工程評估需要11年。

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藻礁公投

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● 不破壞藻礁，政府有替代方案嗎？

➢ 經濟部提出「再外推方案」，把目前規劃離岸740公尺的工業港建設再往外推455公尺，變成離岸1.2公里，避開沿岸的藻礁。

Photo Credit: 行政院 提供

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藻礁公投

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● 這個題目拿來公投適合嗎？

➢ 公投喚起大眾的討論，嘗試了解生態與用電需求之間的取捨，為良性的政策辯論。

➢ 專家意見 or 訴諸民意？

■ 一般人民是否有專業評估成本與效益？

■ 大潭藻礁是歷經7500年才形成如今的規模，很是珍貴。但你願意花多少錢去保留它?(willingness to pay)

■ 政府一直說缺電，但對你而言缺電的成本到底有多少？

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Common pool resources

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- Common pool resource goods are not excludable but rival.
  - The externality involved with a common pool resource arises because of the combination of open access and depletion through use.
  - Individuals use too much of the resource because they do not consider how others are affected.
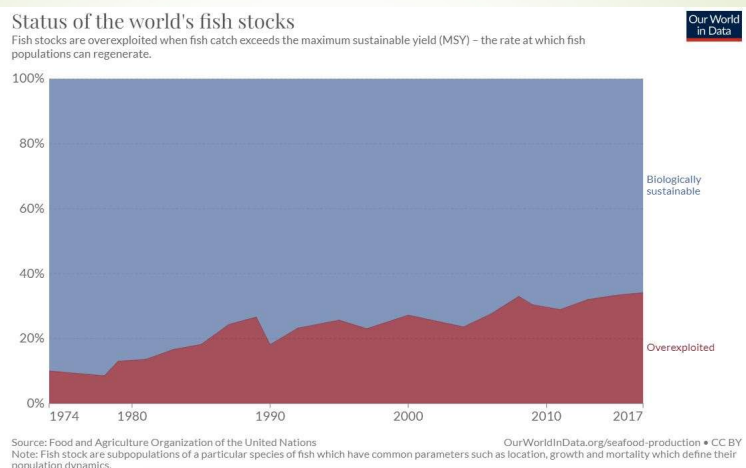 - Such overuse can result in the so-called **tragedy of the commons.**

共有資源為所有人共同擁有，不可排它但有敵對性，如森林、油田、魚產。
共有財資源數量有限，但有權使用者人數眾多，常有過度開發的現象，最
終導致資源枯竭，此即「共有資源的悲劇」。

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Tragedy of the commons

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- The share of stocks that are overfished has increased over the last half century.

Status of the world's fish stocks
Fish stocks are overexploited when fish catch exceeds the maximum sustainable yield (MSY) – the rate at which fish populations can regenerate.

Our World in Data

Biologically sustainable

Overexploited

100%   80%   60%   40%   20%   0%
1974   1980   1990   2000   2010   2017

Source: Food and Agriculture Organization of the United Nations   OurWorldInData.org/seafood-production • CC BY
Note: Fish stock are subpopulations of a particular species of fish which have common parameters such as location, growth and mortality which define their population dynamics.

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Tragedy of the commons

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- The oceans will be empty by 2048? (*Science,* by Boris Worm et al. 2006)

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Tragedy of the commons

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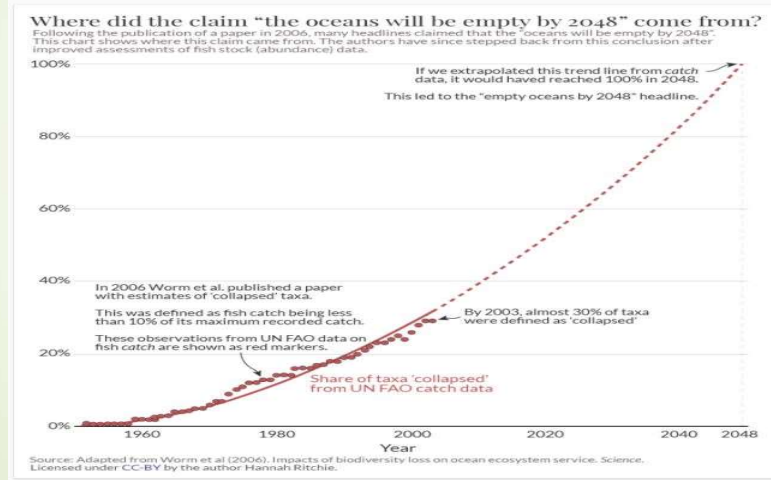
- 如果兩家廠商都汙染，每家各拿50000; 如果兩家都不汙染，每家各拿70000; 如果只有一家污染，則污染者得90000, 不污染者得5000

- (汙染, 汙染) 會是Nash均衡。但比起都不汙染，兩家都變差了。這就是「共有資源的悲劇」。這是因為 每家廠商只在乎自己的利益，不在乎社會的利益。

		Firm 2	
		Pollute	Don't pollute
Firm 1	Pollute	50,000, 50,000	90,000, 5,000
	Don't pollute	5,000, 90,000	70,000, 70,000

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Solutions to the tragedy

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- Solutions to tragedy of the commons:
  - ➤ Taxes or regulation on the users to reduce consumption of the common resource.
  - ➤ Self-regulate by users that implements a maximum usage.
  - ➤ Privatization of the resource (by assigning the property rights through auctions). This gives the owner incentives to regulate access in a way that maximizes the resource's value to the owner.

政府可以透過徵稅、管制使用量(如國家公園入園申請)、或民營化的方式，防止共有資源被過度開發。

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Solutions to the tragedy

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- <u>Evidence-based economics</u>: "congestion charge" (擁擠稅)
  - ➤ In the late 1990s, traffic become so congested in central London that travel speed dipped below the 19th-century average — before the introduction of the car!
  - ➤ A daily flat charge of 5 pounds per day called "congestion charge" is implemented in 2003.

倫敦的擁擠稅是針對進入市內汽車的收費，在星期一至五、以及連續假期上午7時至下午6時實施，以紓解交通堵塞問題。倫敦是歐洲首位對汽車進入市中心課稅的城市。
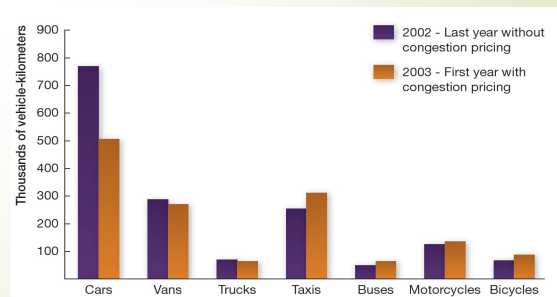
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Solutions to the tragedy

- Elinor Ostrom (2009 Nobel laureate): *Governing the commons* (1990)
  - ➤ Extends the Coase Theorem to the problem of common pool resources.
  - ➤ Proposes eight "design principles" for common pool resource (CPR) institutions.
  - ➤ These principles emphasized that common resources can be managed successfully by the people who use them rather than by governments or private companies.

Elinor Ostrom 所提「共有資源治理」八大原則：藉由共有資源使用者間的互助，有效界定邊界、讓更多的居民參與決策、透過有效的監督參與、有效的爭端解決機制等措施，可以避免共有資源的悲劇，並取代政府管制或民營化。

實例：改變環境行為

蔡崇聖（五校聯盟微課程）