Assignment 2: Tour boats

Question 1: How many of the canal boats currently in use are diesel/ fossil fuel driven and how many boats are electrical driven?

By 2030, only emission free vehicles are allowed in Amsterdam. For the city center this deadline is even earlier; 2025.[1] This rule also applies for water vehicles, both commercial and private. This means that most of the boats either must leave the city, or switch to an electric drivetrain.[2]
To use the boat in the waters of Amsterdam, sailors are obligated to buy a vignette, which is around 40 euros and is usable for three years. Apart from generating revenue, this vignette system allows for information on the amount and types of private boats making use of the waters in Amsterdam.
In 2022, of the 7350 vignettes, 34% were given out to sustainable and hybrid boats.[3]
This amount is likely to rise as the infrastructure for electric boats, such as charging is increasing. Financial support, such as a discount on the vignettes, will also likely motivate new boat owners to buy an electric boat rather than a fossil fuel driven boat.
Of the commercial boats, 75% is already emission free. [4]

Question 2: Are there peak times for the canal boats?

A file on monitoring the canals, data on the variation of canal boats is published. There's a clear variation in peaks during the day, year and location. As shown in the FIGURE, the busiest moments are during the early afternoon and early evening, and locations such as Berlagebrug, Prinsengracht and Singelgracht see more boats. This can be explained since these are popular tourist locations and points of intersections with other canals. FIGURE shows that an increase in boat use is seen form the may until September. Also, there is a slight increase in number of boats during the week, with a peak in the weekend.

FIGURE shows that tourist-oriented canal boats operate during the whole day from 0700 until 2300, but see a clear peak during the late afternoon, between 1400 and 1800.

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[1] Reuters (2020) "Amsterdam's boats go electric ahead of 2025 diesel ban" https://www.reuters.com/article/us-climate-change-netherlands-idUSKBN20Q1W7

[2] Noord Holland Nieuws (2023) "2025 uitstootvrije zones" https://www.nhnieuws.nl/nieuws/320051/vanaf-2025-uitstootvrije-zones-in-de-stad-zo-zien-de-overgangsregelingen-eruit#:~:text=Vanaf%202025%20zijn%20er%20uitstootvrije,voertuigen%20zijn%20er%20overgangsregelingen%20bedacht

[3] Gemeente Amsterdam (No date) "Elektrische vaartuigen" https://www.amsterdam.nl/verkeer-vervoer/varen-amsterdam/elektrisch-varen/elektrische-vaartuigen/#h88acdf78-59ca-408e-b3e5-624293e6039b

[4] Open Research Grachtenmonitor (2022) "Commissie Mobiliteit, Openbare Ruimte en Water" https://openresearch.amsterdam/nl/page/92981/grachtenmonitor-2022

Question 3: Energy consumption canal boats vs other activities

For this exercise, we've looked at the energy consumption of narrowboats, as there's more information on their fuel consumption and as they are similar in size and form to Amsterdam canal boats.
On average, narrow boats consume around 1 liter of diesel per hour at a speed of 3 mph[5]. According to ANWB, 1 liter of diesel emits 2606 grams of CO2. [6]

We are comparing two modes of travel on similar routes, namely from and to the IJ along the Singel. On the water, this route takes around 8.8 kilometers. By car, this distance is increased to 11.3 (FIGURE). We are comparing the narrowboat with the most popular car in the Netherlands in 2022; the Peugeot 208.[7]

Type	*Narrowboat*	*Peugeot 208*
Distance [km]	8.8 [km]	11.3
Type of fuel	Diesel	Gasoline
Fuel consumption	1.76 [L]	0.66 [L]
Emitted CO2	4.69 [kg]	1.48 [kg]
Energy consumption	19.29 [kWh]	6.23 [kWh]

Question 4: Would you consider it economically feasible.

Considering the costs of fuel between the two modes, it is economically more feasible to use the Peugeot 208. The current price of gasoline and diesel are quite similar at 2,19 and 2,02 euro per liter respectively. The Peugeot consumes about a third of the amount of fuel in comparison to the narrowboat, making it the cheaper option.

Type	*Narrowboat*	*Peugeot 208*
Fuel EUR/L	2,02 (diesel)	2,19 (gasoline)
Consumption	1,76 [L]	0,66 [L]
Price [EUR]	3,55	1,45

[5] Narkive "Narrowboats 'Miles per Gallon'" (2004) https://uk.rec.waterways.narkive.com/YsNAV2OL/narrowboat-miles-per-gallon

[6] ANWB "Alles over uitstoot" (No date) https://www.anwb.nl/auto/nieuws-en-tips/alles-over-uitstoot#:~:text=CO2%20%2D%20Koolstofdioxide&text=In%20elke%20autobrandstof%20is%20een,LPG%20is%20dat%201610%20gram

[7] EAUC "Converting fuel to kWh and CO2" https://travelifestaybetter.com/wp-content/uploads/2019/02/17-Fuel-Conversion-Rates-to-kWh-and-CO2e.pdf

Question 5:How many support boats and vehicles are needed for the Paralympics event only.

We have not been able to find data or guidelines for open water swimming events on the amount of support boats or vehicles. However, we could argue how many support boats are needed for an event as such. Reviewing the highlights of the Tokyo 2020 open water swimming final, two support boats can be detected accompanied with additional man-powered kayaks. This is an indication for the amount needed. However, a paralympic swimming event might have a greater variation in the speed that participants are swimming, due to the variety of disabilities. Therefore, we have settled on an extra support boat, three in total, in combination with man-powered kayaks to support the event.

Question 6: If only clean energy can be used, how many solar panels or wind turbines are needed?

The speed of swimming for an average person is about 2 mph (bron). However, professional athletes will be participating in the event. Therefore, it is expected that the average speed will be around 3 mph, or 5 kilometers per hour. This means that the three lifeboats will be in the water for an hour each, or 3 hours in total.

Using the data from question 3, we see that the total energy used for a canal boat is 19.29 kWh. for 1.76 hours, or 10.96 kW. It is assumed that an electric version of the canal boat uses the same amount of energy. Therefore, 10.96 * 3 = 32.88 kWh is needed. [8]

The advice group for climate mitigation in The Netherlands calculated that six solar panels produce about 2100 kWh. That means that for the amount of energy needed, six panels would need 5,71 days. Or one solar panel needs 34,2 days, or little over a month of producing electricity.[9]

Is it possible to accommodate these facilities within the city?

At the moment, there are over 1 million solar panels in Amsterdam (bron). It is assumed that installing one extra solar panel and running it for a month is possible. [10]

Would there be any effect on the water quality if there are less/no canal boats using fossil fuels?

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[8] Milieu Centraal (2023) “Kosten en opbrengst zonnepanelen” https://www.milieucentraal.nl/energie-besparen/zonnepanelen/kosten-en-opbrengst-zonnepanelen/

[9] Calories Burned (2023) “Wat is the average swimming speed?” https://caloriesburnedhq.com/average-swimming-speed/

[10] Gemeente Amsterdam (2023) “Een stralende mijlpaal” https://www.amsterdam.nl/nieuws/nieuwsoverzicht/1-miljoen-zonnepanelen/

Most of the health hazards related to open water swimming in Amsterdam, reported by the health organization in The Netherlands, come from overflow of drainage systems or blue-green algea. These hazards are not affected by reducing the amount of fossil fuel powered boats. Therefore, the quality of water related to the health of the swimmers is not related to the amount of fossil fuel boats.[11]

[11] GGD Amsterdam (date unknown) “Zwemmen in open water” https://www.ggd.amsterdam.nl/gezond-wonen/zwemmen-open-water/#hbf604843-25e3-434a-8706-69f18defea3d