



Jane Goodall's  
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Learning Resource



# Sustainable Shipping

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# Sustainable Shipping



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Around 80% of world trade is transported by ships, but how often do you think about the environmental impact of shipping? In this resource we will think about the impact shipping has on us and our planet and come up with some ideas for creating more sustainable shipping.

## In this activity you and your students will:

- ▶ Research the impact of shipping on us and our planet.
- ▶ Design and build a model of a ship for the future.
- ▶ Test their ship on water!

## Objectives

To find out about the impact of our most common form of trade transport, and think of ways to make it more sustainable.

## What do I need to make it work?

For this activity, you'll need:

- ▶ Card, PVA glue, sticks or paper straws, anything you can find to make your ship designs.
- ▶ A large tray of water or a paddling pool.

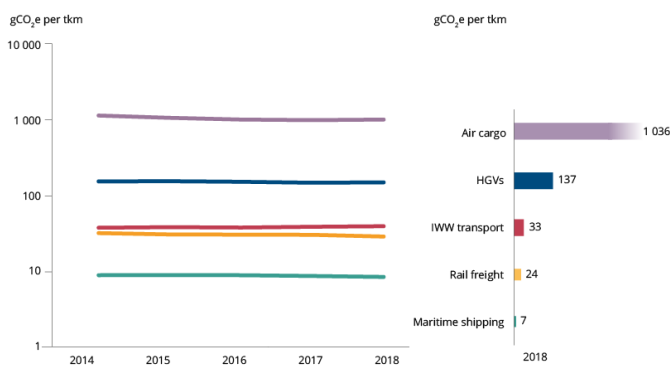
## What things will my students create?

- ▶ A concept and model of a sustainable cargo ship.

# Investigate shipping

What do you know about the world's most common form of trade transport?

Maritime shipping (transporting cargo across seas and oceans) is considered one of the least environmentally damaging forms of transportation. A study of cargo transported to and around European countries shows that maritime shipping emits very little greenhouse gas per tonne of cargo compared to other forms of transport, especially planes and trucks.



Average greenhouse gas emissions by motorised mode of freight transport, EU-27, 2014-2018. A logarithmic scale is used in the diagram on the left, the diagram on the right shows the grams of CO<sub>2</sub> produced by transporting 1 tonne of cargo one kilometer (HGV = truck, IWW = inland waterway) – Adapted from <https://www.eea.europa.eu/publications/rail-and-waterborne-transport>

However, even though the amount of CO<sub>2</sub> released per tonne of freight is low, because of the vast amount of shipping undertaken to transport all commodities we require in our lives, maritime shipping still makes a big impact on the environment – around 80% of global goods travel by sea, accounting for around 3% of total global CO<sub>2</sub> emissions.

## What do you know about ships?

In your group discuss what you already know about shipping. These questions might help you get started:

- ▶ What do ships carry? (Food, furniture, electronics, toys, everything!)

## Mini-project

Each student should choose a room in their home (their bedroom for example) and do a survey. For every item in the room that is labelled, where did it come from? Collate the class results and plot them on a map. What percentage of those goods likely travelled by sea to get to you?

- ▶ Do you know the names of any parts of a ship? And a container ship in particular? There are diagrams from simple to complex here for you to compare your knowledge with: [bit.ly/3K1FNFa](https://bit.ly/3K1FNFa)
- ▶ How much can some ships carry? You might be surprised! Here is a BBC article about the size of ships and how much they can carry: [bbc.in/32PTTZO](https://bbc.in/32PTTZO)
- ▶ How are ships powered? What makes them move?

## Take it further

It's not just the greenhouse gas emissions of ships that can be problematic for the environment. What other news stories about ships and the environment can you find? Here is an example of a ship spilling oil over a UNESCO heritage site: [cnn.it/3zLK0rN](https://cnn.it/3zLK0rN)

## Want to know more?

- ▶ Here is a fun 6 minute podcast about container ships your group could listen to: [bit.ly/3t2phyR](https://bit.ly/3t2phyR)
- ▶ Encyclopædia Britannica has a very helpful article on ships if you want to send your group off for more reading and research: [bit.ly/3G5dDGV](https://bit.ly/3G5dDGV), or check out this article on Kiddle: [bit.ly/3F2CSIH](https://bit.ly/3F2CSIH)

# What are sustainable ships?

The shipping industry has been trying to figure out how they can make shipping a carbon zero industry by powering ships with renewable energy and they have been working on some pretty cool stuff!



## What is renewable energy?

Renewable energy is energy generated from natural resources which are replenished on a human timescale, so unlike fossil fuels they will always be available. Most sources of renewable energy do not involve burning so do not create carbon dioxide and other greenhouse gases.

Can your students name some sources of renewable energy? How many can they come up with? Can they name a renewable energy that **does** create greenhouse gases? Or a non-renewable energy source that does not?<sup>1</sup>

## Wind powered ships



The E-Ship 1 is a Flettner ship: four large rotorsails that rise from its deck are rotated via a mechanical linkage to the ship's propellers. – Alan Jamieson from Aberdeen, Scotland, CC BY 2.0 <<https://creativecommons.org/licenses/by/2.0/>>, via Wikimedia Commons

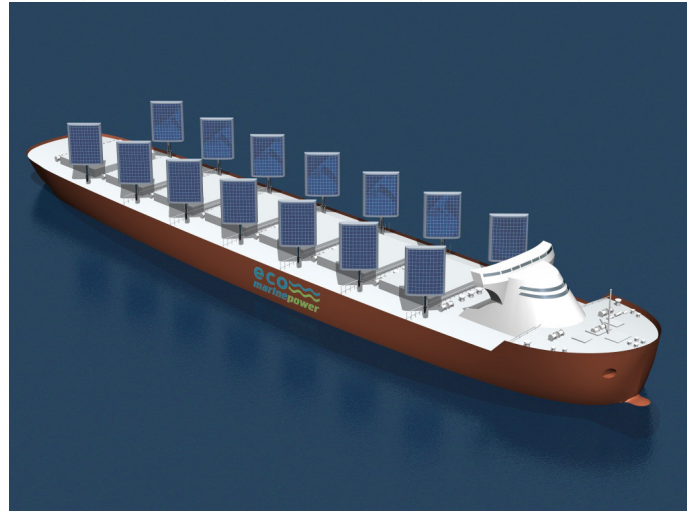
Wind powered ships aren't a new thing. It's how ships used to work before we invented engines. But to get the right thrust for a massive container ship with a sail does present a challenge! Sails don't have to look like they did in the 1700s either – the Magnus effect uses rotating masts to create thrust. There's a great explainer on YouTube, here:

[bit.ly/3HUMNBS](https://bit.ly/3HUMNBS)

Here are some other current and conceptual wind powered ships:

[bit.ly/3n6M1d7](https://bit.ly/3n6M1d7)

## Solar powered ships (with a bit of wind to help out!)



The Aquarius Eco Ship – Image: Eco Marine Power


Energy from the sun can be converted into electricity to power a motor to propel the ship through the water – which is great if it's sunny all the time. That's why this Japanese company has designed a ship that uses its solar panels as sails to capture some wind power too!

– [bit.ly/3F5Yp3p](https://bit.ly/3F5Yp3p)

## Hydrogen ships

You might have heard of hydrogen powered cars as an alternative to electric battery powered ones ([bit.ly/3K2Ypoc](https://bit.ly/3K2Ypoc)) ... well, you can power cargo ships with hydrogen as well. Here is one design that could be used up and down the River Seine in Paris soon:

[bit.ly/3t6tuBr](https://bit.ly/3t6tuBr)

Hydrogen can be used to directly power an engine, but is more commonly used to power something called a **fuel cell**, which converts the hydrogen into electricity ([bit.ly/3r9xGh5](https://bit.ly/3r9xGh5)). Both burning hydrogen in an engine, or using it in a fuel cell creates clean water as a byproduct, so hydrogen vehicles do not create harmful emissions **at point of use**. 

However, creating hydrogen in the first place requires a lot of electricity. So, for a hydrogen powered ship to be truly environmentally friendly the hydrogen needs to be created using an emissions free electricity source.



## What do you think?

What do you think would work best? What are the pros and cons of each method of powering a large ship? Can you think of any other ways to make a container ship more environmentally friendly?

Note that as container ships are really huge, it can be difficult to power them solely by emission-free means, but anything which can reduce the amount of fossil fuels used is a step forward.

1 Here's what we came up with: clean sources of renewable energy include sunlight, wind, rain, tides, waves, falling water (hydroelectricity) and geothermal heat. Biomass (burning e.g. wood) is a renewable energy source that creates greenhouse gases and nuclear power is a non-renewable energy source that does not.

# Design and make your own container ship

Now that we've thought a bit about shipping and ships, it's time to design and make your own!

## Get drawing

Start by sketching your container ship design ideas. Remember to think about:

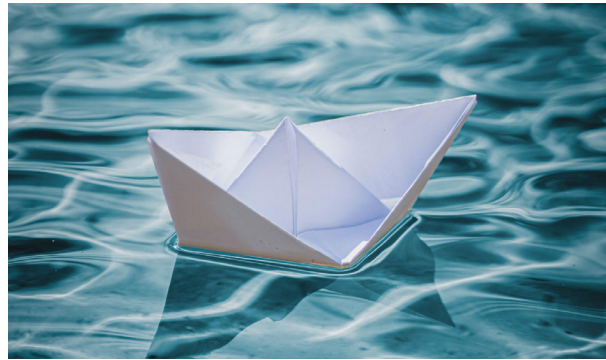
- ▶ How it will be powered or propelled through the water.
- ▶ What materials will you use to make it? And how can you make it waterproof?
- ▶ Where the cargo will go.
- ▶ How can you make it both stable in the water, but also glide through the water efficiently?

## Making your ship

With all your ideas on paper, decide which is the best one to try and make. Then plan out how you will construct the model.

Here are some basic cardboard ship tutorials:

- ▶ **Boat** with curved ends – [bit.ly/339iSXC](http://bit.ly/339iSXC)
- ▶ Flat bottomed boat – [bit.ly/3JNgSyJ](http://bit.ly/3JNgSyJ)



## Test your model

Once you have made your ship we need to test it to see if it can:

- ▶ Float
- ▶ Move forward by your chosen propulsion system (wind, windup elastic band, solar)
- ▶ Carry any cargo

It's probably best to test your ships in a large tray of water in the classroom, or paddling pool. That way you can avoid littering your school or local pond with broken boats! **Wind boats can be tested using a hair dryer**, and solar boats using a powerful torch (if your local conditions aren't sunny enough or your test 'sea' is inside).

For cargo, you could try seeing how many pieces of fruit each ship can carry, and if it makes it to the other side, the team get to eat the cargo!

**Tip!** – If you want to keep your models simple, then stick with wind power as this won't require any motors or electrics.



**Advanced Tip** – If you want to try something with a motor, here is an example of a basic solar powered boat set up: [bit.ly/337G8Fs](http://bit.ly/337G8Fs)

## Hold a competition

With older students, why not make this a competition? You could award prizes for:

- ▶ The ship which can transport the heaviest load across your 'sea' without sinking or coming to a halt.
- ▶ The ship which travels fastest under the standard conditions.

More advanced students might also be interested in developing a remotely steerable, renewable energy powered ship. You could even use a small computer like a Raspberry Pi ([www.raspberrypi.com](http://www.raspberrypi.com)) to create a ship which travels around a predetermined course.



## Want to help improve this activity?

This activity is a living document! Help us by editing this activity to make it as good as possible, just use this short link (just type it into your web browser's address bar): [bit.ly/34ow3EB](http://bit.ly/34ow3EB) – full instructions are provided. Any edits that can make this resource easier to use in the classroom are very welcome, so please follow the link and make your contribution!



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