

The transport of freight is measured in tonne-miles



weight of freight (tonnes) × distance transported (miles)

1000kg = 1 tonne

Group the freight cards which have the same tonne-miles.



Cargo
Distance
Japan



Cargo
Distance
Grimsk



Cargo: 5 tonnes of cuddly toys
Distance: 10 miles from Immingham Port in Yorkshire



Cargo: 2000kg of toys.
Distance: 100 miles between factory and port.

Design another card for each freight group.

Make the distance and the weight different from the other cards in the group.

How are **distance** and **weight** related?

getting there



Cargo: 250kg of tea.

Distance: 400 miles from the Harrogate depot in Yorkshire.

Cargo: 5 Smart cars, 800kg each.

Distance: 50 miles from "Smartville" in France.

Cargo: 200kg of mobile phones.

Distance: 250 miles from the Salo factory in Finland.

Cargo: 2 tonnes of cameras.

Distance: 50 miles from Japan.



Cargo: Cargo 500kg of trampolines.

Distance: 100 miles from the Isle of Wight.

Cargo: 500kg of leather boots.

Distance: 200 miles from the factory in Bath.

Cargo: 5 tonnes of cuddly toys.

Distance: 10 miles from Immingham Port in Yorkshire.

Cargo: Cargo 250kg of sugar.

Distance: Distance 200 miles from Jamaica.



Cargo: 625kg of flowers.

Distance: 320 miles from Holland.

Cargo: 2000kg of toys.

Distance: 100 miles between factory and port.

Cargo: 1000kg of bananas.

Distance: 100 miles from Malaysia.

Cargo: 2500kg of fresh fish.

Distance: 80 miles from Grimsby docks.

getting there

The **external** costs of transporting freight affect society, but are not paid for by the transport users who cause them...



external costs = green costs + other social costs

Average External Costs in 2000

Euro/1000 tonne-kilometre (tkm)	Road*		Rail	Air	Water
	LGV	HGV			
Accidents	35.0	4.8	0.0	0.0	0.0
Noise	32.4	4.9	3.2	8.9	0.0
Air pollution	86.9	38.3	8.3	15.6	14.1
Climate change	57.4	12.8	3.2	235.7	4.3
Nature and landscape	10.9	2.0	0.3	3.8	0.8
Up/down stream	22.4	7.4	2.4	7.4	3.3
Urban effects	5.2	1.1	0.5	0.0	0.0

* LGV = Light Goods Vehicle, HGV = Heavy Goods Vehicle

This is the most recent external cost data – but it is...

- from the year 2000
- measured in tkm
- in Euros.

Adjust the cost data so it is up to date, in tonne-miles and in £s.

Which of these contribute to the **green** costs?

What is the total **green** cost of each mode of transport?

Exchange rate in 2000 1 = £0.61
Rate of inflation av 2.5%pa
Distance conversion 1 km = 0.62 m

The **external costs** of transport affect society, but are not paid for by the transport users who cause them...

Accidents – medical care, suffering and grief, work related costs.



Noise – damage to buildings and to human health.



Air pollution – crop losses and damage to human health, material and buildings.



Climate change – damages of global warming.



Nature and landscape – repairs of roads, railways and canals.



Up/down stream – the transport life cycle: construction, production and dismantling costs.



Urban effects – reduction of space in cities and towns.



New Cumnock



Greenburn Mine KA18 4QS



1,400 tonnes coal

Selby



DRAX Power Station Selby YO8 8PQ

- You have been hired as an environmental expert to advise on the **green costs** for transporting coal from Greenburn mine in Scotland to the DRAX power station in Selby, England.



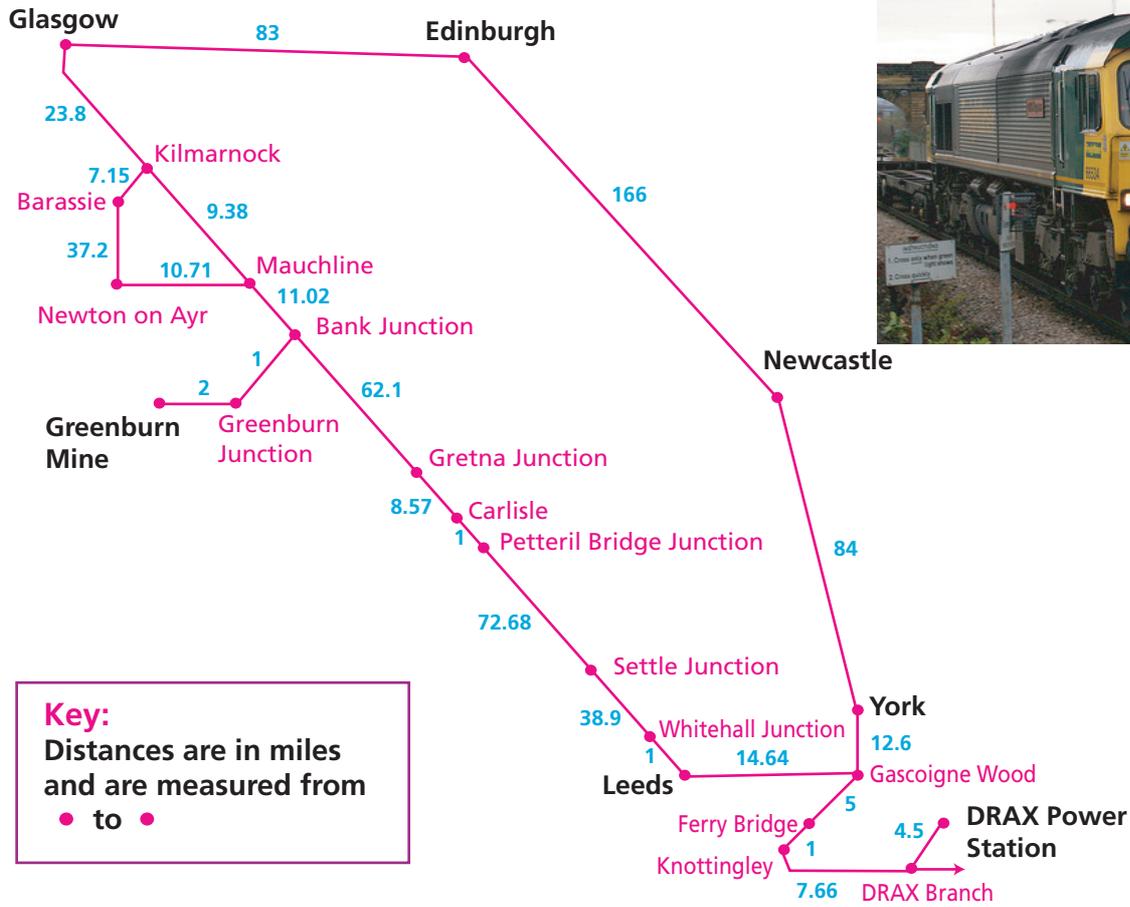
You will need to consider the distance travelled and the different modes of transport.

- Road to Borwick or Ripon then by the waterways?
- Road all the way?
- Train via Edinburgh or train via Carlisle?
- ...

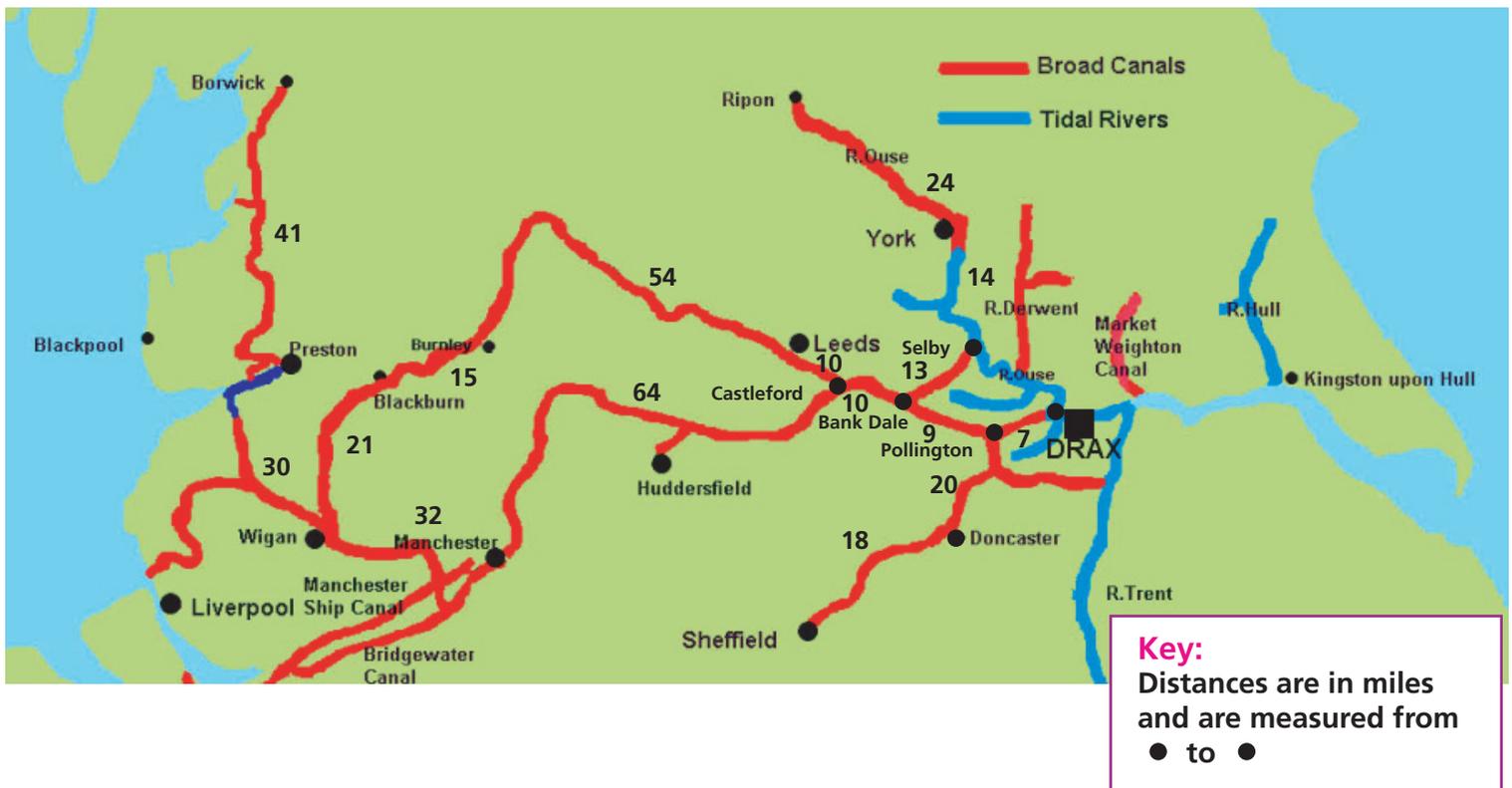


Work out the **green costs** for each route.

Rail map



Canal map



Getting there: The greenest route

Description

This topic deals with the external costs of transport which affect society but which are not paid for by the transport users who cause them. Road, rail, air and water are compared.

Activity 1: Measuring freight

Activity 2: External costs

Activity 3: Which route is best?

The idea of the *tonne-miles* as a measure of freight movement is introduced in **Measuring freight**. Each group needs a copy of the **Measuring freight** cut up sheet or a ready prepared set of laminated cards. The freight cards split into three freight groups – 50, 100 and 200 tonne-miles. Draw out in discussion with the pupils that it is an idealised measure; real transport measurement is complicated by things like time of day, type of load and so on. Creating three new freight cards will help the pupils develop their understanding of how weight and distance are inversely related in the measure.

The second activity introduces the concept of **External costs** – those costs which affect society but which are not paid for by the transport users who cause them. Some of these are green costs. Using the **External costs** information sheet, the pupils decide which costs to include to measure the *green cost of transport*. There is no right or wrong answer but air pollution, climate change, nature and landscape and up/down stream costs could be included as they all affect the climate and the environment.

In many real situations, data is available but needs modifying before it can be applied to specific problems. The external costs are presented as Euro / 1000 tonne-km in the year 2000. The pupils' task is to convert the costs into pounds per tonne-mile for the present day.

They may do this by first working out the green costs for each mode of transport from the table and then converting the five results using a calculator – this is best done in groups so they can share out the work and check each other's calculation. Alternatively, you can provide all the information in a spreadsheet for the pupils to programme the conversions. Whichever method is used, you will need to decide whether to encourage the use of a formula for compound interest or simply to develop a common sense, iterative approach.

Resources

Calculator or a spreadsheet, road atlas and distance chart or access to route planners on the internet.



Building on the first two activities, **Which route is best?** involves an investigation into the greenest method for transporting coal from Greenburn mine in Scotland to Drax power station in Selby, Yorkshire which supplies 7% of UK generated electricity. Typically, rail is used to transport the coal but there have been occasions, including rail strikes, where roads have been used. Although waterways are promoted as a green alternative the infrastructure is not in place in many areas. Some information is provided on the **Which route is best?** information sheet but the pupils will need to find out some things for themselves by using a road map or the internet.

The mathematics

The topic provides an opportunity for work on inverse proportion, conversion calculations, compound percentage change and information handling skills.