Energy Source Game

Ages: 9+

Time: 30 minutes

Purpose:
To learn about the pros and cons of different sources of energy and heat.

Youth work outcomes:

Outcome 3: Young people create, describe and apply their learning and skills
Outcome 4: Young people participate safely and effectively in groups
Outcome 7: Young people broaden their perspectives through new experiences and thinking

Sustainable development goals:

Materials:
Top trump cards (below) printed out

Context:
Over 73% of global greenhouse gas emissions are caused by energy use in some form. This includes transport, heating buildings, electricity use, and energy use in industry. However, some forms of energy produce more emissions than others. This game compares different ways of producing and using energy to show which forms are sustainable, and which we should be cutting out altogether.

Instructions:
Deal all the cards so that each player has an equal number. Players hold cards in a stack and only look at the top card. When it is your turn, decide which score you want to use and read it out to the other players. The higher the number, the better. If the other players have a lower score for that section, they must give you their card. If somebody else has the highest score, everyone must give them their cards instead. Losing cards should be put at the bottom of the pile, and the game continues from the new top card until somebody ends up with all the cards.

Keep Scotland Beautiful
YouthLink Scotland The national agency for youth work
Scottish Government Riaghaltas na h-Alba gov.scot

Energy Source Game

Oil

Oil is a type of hydrocarbon that is formed over millions of years from fossilized organic matter (hence it is known as a fossil fuel). It is extracted from deep underground in the form of crude oil, which is then converted into various different forms such as petroleum for fueling cars. Oil releases its energy through combustion (burning), which releases carbon dioxide into the atmosphere, adding to the greenhouse effect. Oil makes up a huge percentage of the world's energy use, with almost 50,000 Terawatt-hours of oil being burned in 2020, releasing 11 billion tons of CO_2. Oil spills from tankers and rigs also have huge environmental impacts, damaging ecosystems and wildlife as well as human health.

- Efficiency: 2
- Environmental impact: 1.5
- Emissions: 1
- Social impact: 2
- Overall sustainability: 1.5

Gas

Gas is a more efficient source of energy than oil or coal, and emits around 30% less CO_2 than oil when burned. However, methane, the most common form of natural gas, is a harmful greenhouse gas in itself and contributes to global warming. Substantial amounts of methane are leaked into the atmosphere when extracting and transporting gas. Furthermore, fracking, a method of extracting gas from underground, uses up huge amounts of water and contaminates local water supplies, causing harm to wildlife and people.

- Efficiency: 3
- Environmental impact: 1
- Emissions: 2.5
- Social impact: 1.5
- Overall sustainability: 2

Coal

Coal is a cheap but extremely dirty energy source. It currently provides 40% of the world's electricity through coal-fired power stations, but at all stages of its extraction and use it is polluting and destructive. Coal mining blasts through landscapes and destroys ecosystems through deforestation and contaminating ground water. Rock dust from underground mining can also cause health problems for people living nearby such as lung disease and COPD.

- Efficiency: 2
- Environmental impact: 0.5
- Emissions: 1
- Social impact: 1
- Overall sustainability: 0.5

Onshore wind

Wind power has been harnessed since the late 1800s, and since then the technology has become more and more efficient. As long as the wind is blowing, wind turbines will generate electricity, making wind power one of the most reliable forms of electricity. Onshore wind accounted for about 71% of Scotland's renewable energy in 2021. Onshore windfarms have to be carefully placed so that they aren't in ecologically sensitive areas, and that the visual impact isn't too much for people living nearby.

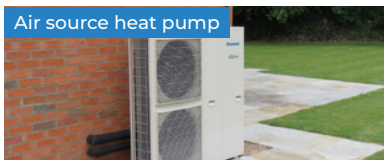
- Efficiency: 4
- Environmental impact: 4.5
- Emissions: 4
- Social impact: 4
- Overall sustainability: 4.5

Offshore wind

Offshore wind farms are expanding rapidly in Scotland as well as across Europe. Offshore turbines are much more efficient than onshore, mostly because they use much bigger turbines, resulting in over 70% efficiency. There are less concerns about the visual impact of offshore wind farms, but assessments still have to be carried out to ensure the wind farms have the least possible impact on seabirds, fish and marine mammals like seals and dolphins.

- Efficiency: 5
- Environmental impact: 3.5
- Emissions: 4
- Social impact: 5
- Overall sustainability: 5

Air source heat pump



Air source heat pumps work by moving heat from the air outside into a house and converting it to usable heat through a refrigeration cycle. They don't use fossil fuels, but the temperatures they deliver are lower than what a gas boiler would produce, so the house needs to be well insulated for it to work. Air source heat pumps are very energy efficient and are cheap to run, but installation costs are high so they aren't an accessible option for everyone.

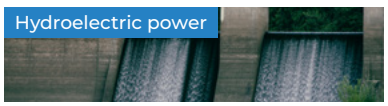
- Efficiency: 4
- Environmental impact: 4
- Emissions: 4.5
- Social impact: 3
- Overall sustainability: 4

Ground source heat pump

Ground source heat pumps work in much the same way as air source heat pumps, using a refrigerating system to convert heat from outside into usable energy. The difference is that in this case, the heat from outside comes from under the ground, via a network of underground water pipes. This is often used for underfloor heating systems. Ground source heat pumps are even more efficient than air source, however they require a large outdoor space (so you need to have a large garden ideally) and are disruptive and expensive to install, as the outside space needs to be dug up and underfloor heating may need to be installed.

- Efficiency: 5
- Environmental impact: 3.5
- Emissions: 4.5
- Social impact: 2.5
- Overall sustainability: 4.5

Hydroelectric power



Hydroelectric power is Scotland's second largest generator of renewable energy, after onshore wind farms. It works by storing water in a reservoir behind a dam and then releasing small amounts of water which turns turbines, producing electricity. Hydroelectric schemes work as huge batteries, storing potential energy as water can be released to produce electricity whenever there is demand for it, for example when the sun isn't shining and the wind isn't blowing so other forms of renewables are producing less power. You need the right type of landscape to build a hydro scheme (hilly with lots of rain), and there can be issues with flooding habitats and blocking the migration routes up rivers for fish like salmon.

- Efficiency: 4
- Environmental impact: 3
- Emissions: 3.5
- Social impact: 4
- Overall sustainability: 4

Tidal turbines

Tidal energy is extremely reliable as the tides go in and out twice a day no matter what the weather. Movement of water from the tides is converted to electricity by tidal turbines positioned in places where the tides run especially fast, such as in narrows between two islands. Tidal turbines are more efficient than wind turbines as water is denser than air, so the blades don't need to be as long. This means more turbines can fit into a smaller space. However, there hasn't been much research done on how tidal turbines affect marine animals such as seals and dolphins, which may swim into the turbines and be injured. Therefore, turbines must be placed in areas that are not important habitats or migration routes for these species.

- Efficiency: 5
- Environmental impact: 3
- Emissions: 4.5
- Social impact: 5
- Overall sustainability: 4.5

Solar power

Solar power uses photovoltaic technology to convert energy from the sun into electricity. The most efficient solar panels available are able to convert just over 20% of the energy that hits them from the sun into electricity. Depending on where you live, this is a lot of electricity. If you have solar panels on your house, you can use the electricity generated to power the house and sell the rest to the grid. Solar panels are quite expensive to install and need you to have your own roof (so blocks of flats aren't ideal). Another issue is that making solar panels requires rare minerals that are in short supply, and are often mined in a way that is polluting to the environment and exploitative of the miners.

- Efficiency: 3
- Environmental impact: 2.5
- Emissions: 4
- Social impact: 3
- Overall sustainability: 3.5

Insulation

There are many different types of insulation for houses, for example roof insulation, cavity wall insulation, floor insulation and pipe insulation. It doesn't sound that exciting, but well insulated homes are much more energy efficient and therefore don't need to use as much fuel or electricity to heat, making heating both cheaper and less carbon intensive. For example, uninsulated houses can lose up to 25% of their heat through the roof! Costs of different types of insulation can vary, and people who rent their houses usually don't have the freedom to put in their own insulation, so it's not an accessible option for everyone, but once the insulation is installed, heating costs will go down significantly.

- Efficiency: 4
- Environmental impact: 4.5
- Emissions: 3.5
- Social impact: 4
- Overall sustainability: 4.5

Biofuel

Biofuels are made from organic material such as processed plant material, by-products from industries such as wood chippings or unused animal parts, or decomposing waste. They can take liquid or gas form which are used for different purposes. Biofuels are increasingly blended with fossil fuels to power vehicles as they are a lot less polluting than pure fossil fuels, but not all vehicles are compatible with this type of fuel. 100% biofuel will only work in certain vehicles, and not at low temperatures or high altitudes. They are popular because they do not require large infrastructure changes to lower carbon emissions, however, if crops are being grown especially to create biofuel this uses up a lot of land and water which creates competition with food production, and often causes deforestation.

- Efficiency: 2
- Environmental impact: 3.5
- Emissions: 3
- Social impact: 4
- Overall sustainability: 3

Biomass

Biomass is technically the oldest form of fuel there is, as people have been burning wood and other plant material for millennia before fossil fuels were discovered to be more efficient. Nowadays, biomass is often condensed into woodchips or pellets, which are more efficient than burning logs on an open fire, but the principle is the same. Biomass is considered a form of renewable energy as the CO2 emitted by burning wood is the same as what was absorbed by the tree while it was growing, so as long as new tees continue to be planted, emissions remain neutral. Biomass can be used to heat individual houses through biomass boilers or wood burning stoves, or it can be used to produce electricity in biomass power plants.

- Efficiency: 2.5
- Environmental impact: 3
- Emissions: 3.5
- Social impact: 4.5
- Overall sustainability: 3.5

Sources:

- bettermeetsreality.com/are-fossil-fuels-efficient-coal-oil-natural-gas/
- energyeducation.ca/encyclopedia/Oil_formation
- ourworldindata.org/grapher/annual-co2-oil?tab=chart&country=USA~GBR~CHN~IND~BRA~EU-27~OWID_WRL
- fossilfuel.com/the-environmental-impact-of-natural-gas/
- www.theworldcounts.com/stories/Negative-Effects-of-Coal-Mining
- www.scottishrenewables.com/our-industry/statistics
- www.nature.scot/professional-advice/planning-and-development/planning-and-development-advice/renewable-energy/marine-renewables/offshore-wind-energy
- www.homebuilding.co.uk/advice/air-source-heat-pumps
- www.which.co.uk/reviews/ground-and-air-source-heat-pumps/article/ground-source-heat-pumps-explained/how-ground-source-heat-pumps-work-aMDCm2N7jZ6X
- www.bbc.co.uk/bitesize/topics/znrwdp3/articles/z9pwkty#zd327yc4
- www.bbc.co.uk/bitesize/topics/zxy4cmn/articles/zs83f82#znpt6g84
- www.solar.com/learn/solar-panel-efficiency/
- www.igfmining.org/minerals-green-economy-solar-panels-lithium-ion-batteries/
- energysavingtrust.org.uk/insulating-your-home-back-to-the-basics/
- scotland.permaculture.org.uk/practical-solutions/biofuels
- www.crownoil.co.uk/guides/biofuel-guide/
- energysavingtrust.org.uk/advice/biomass/