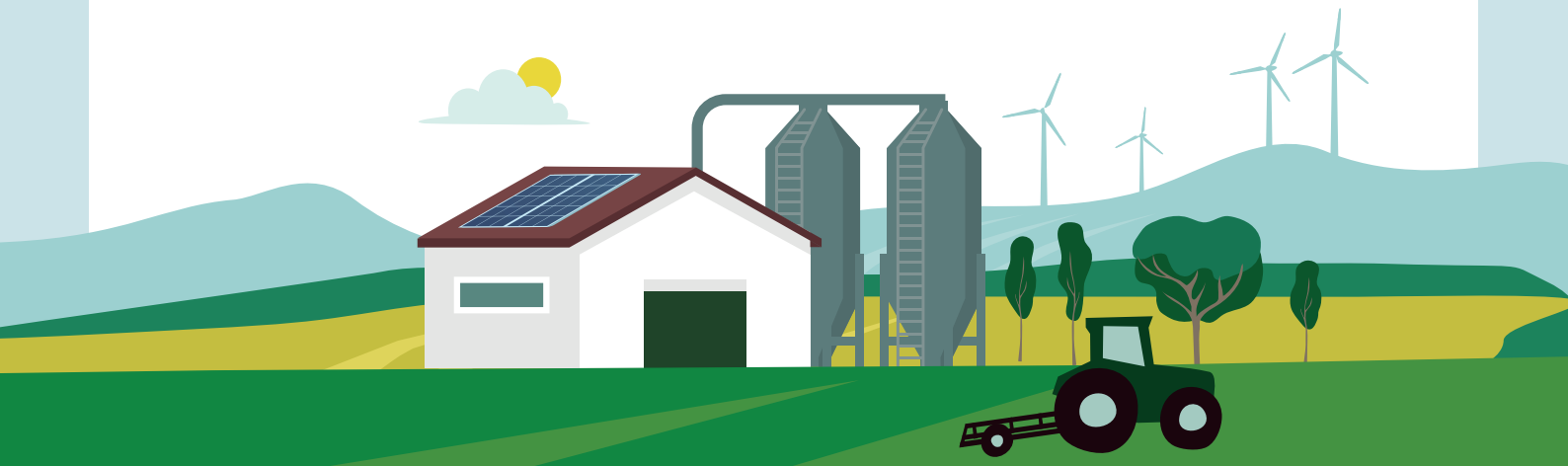
RESOURCE 5
ENERGY USE ON THE FARM

Using this resource, pupils will explore many of the ways energy is used on the farm, describe how farmers can reduce their carbon footprint and investigate the suitability of producing energy from renewable sources.

Learning Outcomes Unit 1: Soils, Crops and Habitats	**Pupils will be able to:** • give examples of how energy is used on a farm; • describe ways that farmers can reduce their carbon footprint, including: » increased woodland planting; » careful management of specific habitats; and » energy conservation; • investigate the suitability of producing energy from renewable sources, such as wind, water, sun and energy crops (biomass), considering location, cost, efficiency and environmental impact.
Cross-Curricular Skills	**Pupils will have opportunities to develop skills in:** • Communication • Using ICT
Thinking Skills and Personal Capabilities	**Pupils will have opportunities to develop skills in:** • Working with Others • Thinking, Problem-Solving and Decision-Making
Resources	• Internet access • Video 5: Energy Use on the Farm • Resource 1: Farm Map • Resource 2: Card Sort • Resource 3: Carbon Footprint • Resource 4: Greenhouse Gas Footprint Quiz • Energy Use on the Farm PowerPoint



CONTEXT

Carbon dioxide and greenhouse gases are contributing to the increased greenhouse effect and climate change.

Agriculture is a major source of greenhouse gases. There is an opportunity to reduce CO_2 emissions by decreasing energy use on the farm or generating electricity from renewable sources. Other practices such as sexed semen, improved genetics and reducing the age of calving can reduce the carbon footprint of farms.

This resource provides opportunities for pupils to enhance their understanding of the Renewable Energy and Climate Change parts of Unit 1: Soils, Crops and Habitats.
The following activities are designed to encourage pupils to consider these **key concepts**:

- the ways energy is used on the farm; and
- suitability of producing energy from renewable sources.

SUGGESTED TEACHING AND LEARNING ACTIVITIES

LAUNCH

Display the Energy use on the Farm PowerPoint slides 2, 3 and 4 explaining the learning intentions, context and definitions for this resource.

Display slide 5. Working in small groups, encourage your pupils to discuss how energy is used on the farm, for example:

» machinery
» heat
» light

- what a carbon footprint is.

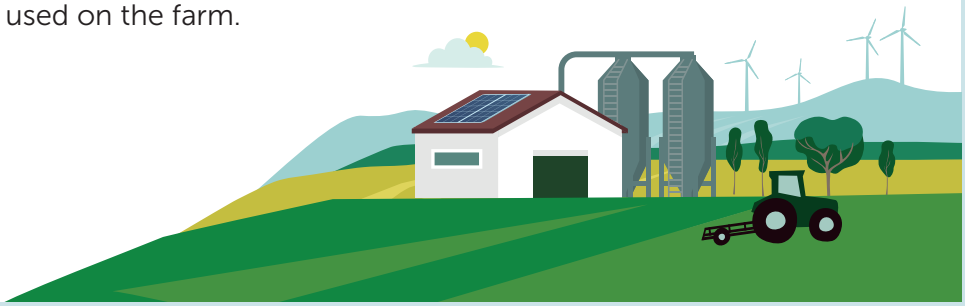
Ask your pupils to report back and establish prior knowledge.

You might also find it useful to setup an online collaborative whiteboard such as Google Jamboard or Padlet and invite the pupils to contribute what they know or understand about intensive farming.

Show slide 6. **Play Video 5: Energy use on a Farm** to introduce the examples of energy use, energy conservation and renewable energy on a farm. Ask your pupils to consider these questions:

- What examples of energy use do you see in the video?
- What examples of energy conservation do you see in the video?
- What examples of renewable energy do you see in the video?

After watching the video, ask your pupils to create a list of all the ways that energy is used on the farm.



ACTIVITY

Show slides 7 and 8. Ask your pupils to work in small groups. They will annotate **Resource 1: Farm Map**. Their **first task** is to identify where they think energy is used. Encourage pupils to make their annotations colourful and easy to understand. They should then share their group's ideas with the rest of the class.

We have also provided an alternative version of the farm map as a Google Drawings interactive document. Open the link and create a copy, saving it to your own location. Google Drawings files have tools similar to those in Word or PowerPoint. If you are familiar with Google Apps, you might find this useful for individual pupils to use or whole-class instruction on the interactive whiteboard.

Show slide 9 and discuss the definitions of **renewable** and **non-renewable energy**.
Show slide 10. Introduce the term **carbon footprint**. Encourage your pupils to discuss and describe what they already know about the term and how farmers might reduce their carbon footprint. Discuss the infographic on slide 10 showing the carbon intensity of three cities. **Resource 3: Carbon Footprint** provides further information about how carbon footprinting helps to quantify the amount of greenhouse gases produced.

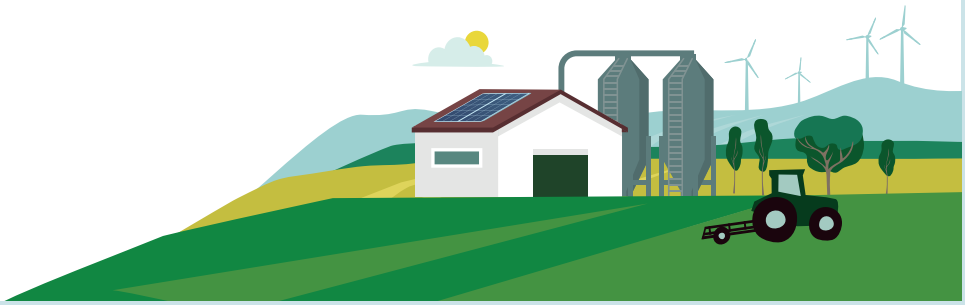
Show slide 11. Ask your pupils to return to their annotated map. Their **second task** is to identify ways that the farm could **generate renewable energy**.

Begin this part of the task with a discussion about wind energy, including:

- availability of land;
- suitability of wind;
- distance from settlements;
- distance from protected areas; and
- ease of access.

Encourage your pupils to consider:

- energy from biomass, for example growing willow or placing solar panels on the roof of a barn;
- biodigesters, for example large buildings that take up a lot of space and usually require large quantities of grass;
- hydropower;
- local environmental groups;
- wildlife areas; and
- Areas of Outstanding Natural Beauty.



DEBRIEF

Conclude by asking your pupils to write a sentence summarising the outcome of the farm map activity and sharing their ideas with the class, small groups or pairs.

If you used an online collaborative whiteboard in the launch activity, return to the whiteboard and ask your pupils to use a different coloured font and add any new ideas or information they have learned.

Review the **learning outcomes** and **key concepts** from the start of the resource with the pupils.

EXTENSION TASKS

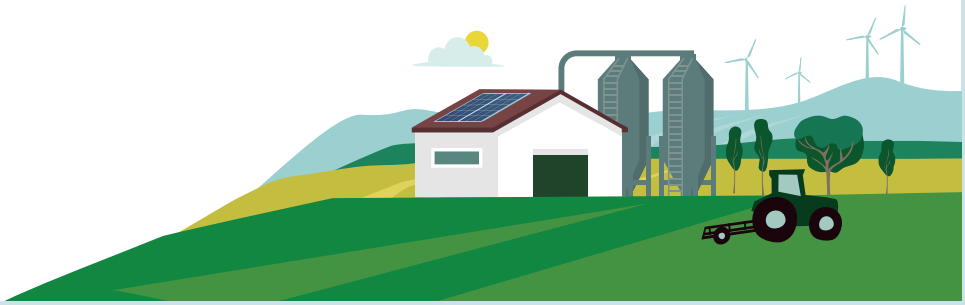
Show slide 12.

Extension: Discuss why some people might be for and others against wind turbines in their area.

Extension: Ask your pupils to complete **Resource 2: Card Sort** to extend their understanding of methods to reduce a farm's energy use and carbon footprint. Some will fit into more than one category, and this provides an opportunity for debate.

Extension: Building on the work completed in the main activity, ask your pupils to work in pairs or small groups to create their own illustration of the farm they previously annotated. This is their opportunity to make it their own. Encourage them to create a technical specification and overview of functions before working in a team to sketch their ideas. As an alternative to paper, consider asking your pupils to use an app such as Minecraft or Minecraft: Education Edition to design their farm in a three-dimensional form.

Extension: Extend the topic and discussion around greenhouse gases using **Resource 4: Greenhouse Gas Footprint Quiz**. Pupils work out the CO_2e for 10 000 kg milk in each year, and then work out the difference.

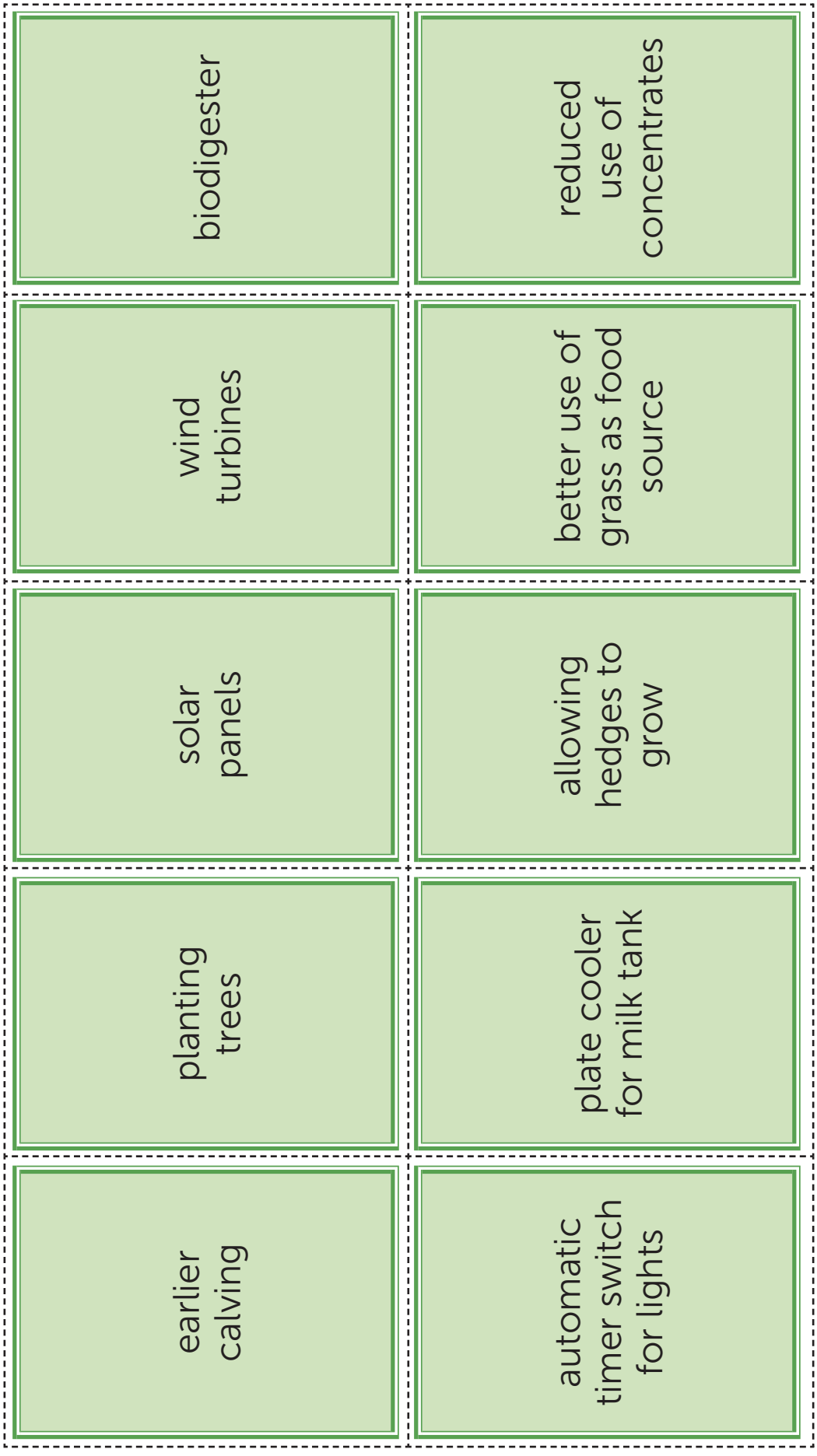


RESOURCE 1: FARM MAP

Task 1: Mark the areas of the farm that use energy.
Task 2: Mark the areas of the farm that might be suitable for producing energy from renewable sources.

RESOURCE 2: CARD SORT

Each of these methods will reduce a farm's energy use and carbon footprint:



RESOURCE 2: CARD SORT (CONTINUED)

Put them into the correct category:

RENEWABLE ENERGY	TECHNOLOGY	FARM MANAGEMENT

RESOURCE 3: CARBON FOOTPRINT

Carbon footprint generally refers to **CO_2** (carbon dioxide) which is a greenhouse gas. Dairy farms produce greenhouse gases from different activities on the farm.

WHAT IS CARBON FOOTPRINTING?

Carbon footprinting helps to quantify the amount of greenhouse gases produced. These are expressed in carbon dioxide equivalents. A CO_2 equivalent (CO_2e) is a unit of measurement that is used to standardise the climate effects of various greenhouse gases.

The Intergovernmental Panel on Climate Change (IPCC) defines carbon footprint as the amount of carbon dioxide released into the atmosphere from the activities of individuals, organisations or communities.

By reducing our carbon footprint, we can help to tackle climate change and protect the planet for future generations.

In agriculture, the main greenhouse gases are:

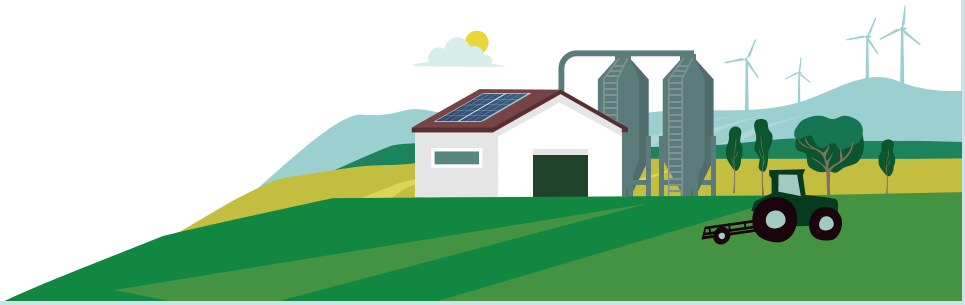
- carbon dioxide (CO_2);
- nitrous oxide (N_2O); and
- methane (CH_4).

These are converted to carbon dioxide equivalents. Different governments across the world are discussing the drive to become **carbon neutral**.

REDUCING THE AGE OF FIRST CALVING

The Agri-Food and Biosciences Institute (AFBI) Greenhouse Gas Calculator suggests that reducing the age at first calving from 27 to 24 months of age could reduce the overall dairy Greenhouse Gas (GHG) footprint by 7 percent. The footprint was reduced as fewer heifers in total were on the farm which also meant that less land, forage, fertiliser and concentrate was required.

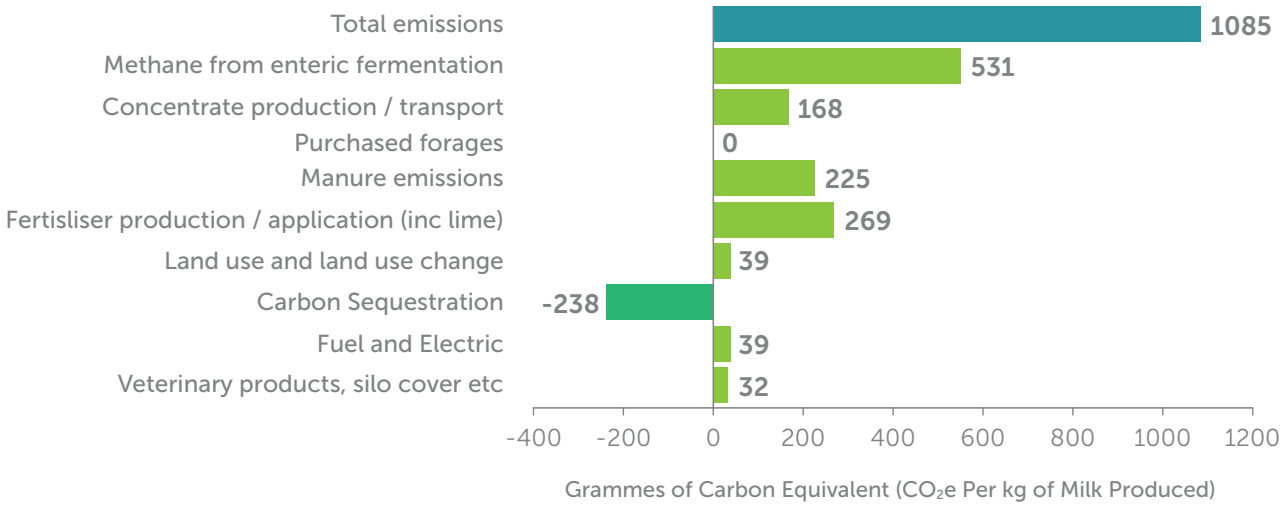
Earlier calving results in fewer of the older and therefore larger non-milk producing replacement heifers on the farm. For example, if calving heifers at 24 months instead of 36 months, a 100-cow dairy farm with a replacement rate of 35 percent will have 30 fewer heifers over 24 months of age. As a result, there will be fewer animals emitting enteric methane and less land and fewer heifer housing places will be required. This leads to reduced costs and workload.



RESOURCE 4: GREENHOUSE GAS FOOTPRINT QUIZ

The graph below shows the greenhouse gas footprint of a moderate input dairy system in Northern Ireland.

The Greenhouse gas footprint of a moderate input Northern Ireland dairy system *(AFBI 2015)*[22]



NI Carbon Intensity Indicators 2019

406 gCO_2/kWh	10.7 tCO_2e per person	139 gCO_2/km	3.38 tCO_2e
Emissions per unit of electricity generated 2017	Greenhouse gas emissions per capita 2017	Average carbon dioxide emissions of licenced cars in Northern Ireland 2018	Residential greenhouse gas emissions per household 2017

Use the information above to answer these questions:

(a) How much carbon dioxide comes from concentrate production and transport?

_____

(b) What percentage of total emissions comes from fuel and electric use on this dairy farm?

Show your working

_____ %

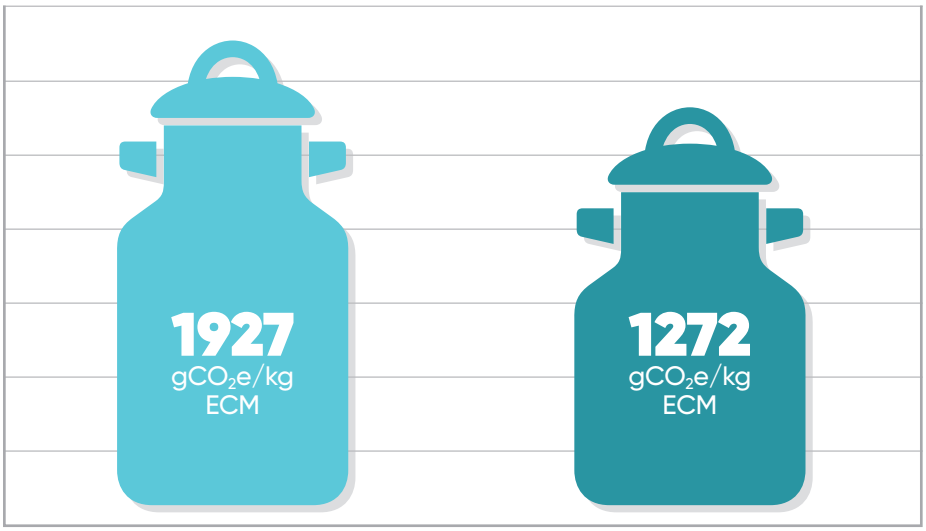
(c) The carbon sequestration on this dairy system is -238 grams of carbon equivalent. Suggest what the term **carbon sequestration** means:

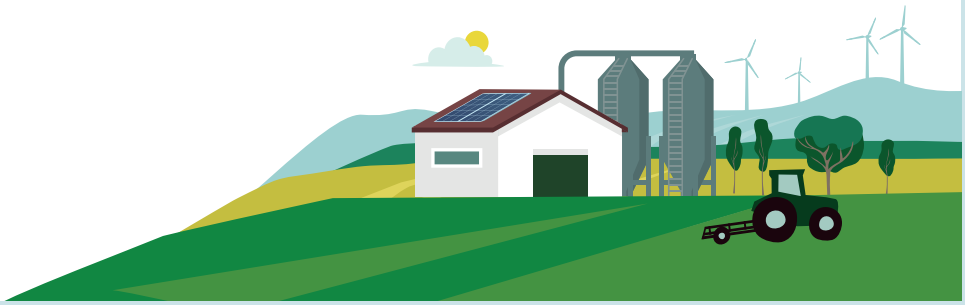
_____

RESOURCE 4: GREENHOUSE GAS FOOTPRINT QUIZ (CONTINUED)

(d) An average dairy farm produced 10 000kg milk in 1990 and 10 000kg milk in 2017. Calculate how many fewer grams of carbon dioxide equivalent were produced in 2017, compared to 1990.

Emissions intensity of milk production *(DAERA 2019)*





RESOURCE 4: GREENHOUSE GAS FOOTPRINT QUIZ ANSWERS (TEACHERS COPY)

a. 168 (grams of carbon dioxide equivalent)

b. 39/1085 x 100; 3.6%

c. The capture/storage of carbon

d. 1990: 10000 x 1927 = 19270000;

2017: 10000 x 1272 = 12720000;

19270000 – 12720000 = 6550000 grams carbon equivalent