

AGE RANGE

9-13 years

REQUIREMENTS

- A computer or tablet capable of running Scratch
- Scratch 3 (either online or offline)
- Starter project: helloworld.cc/electricitystarter

OBJECTIVES

- I can organise a program using My Blocks
- I can draw stacked bar graphs with the Pen Extension blocks
- I can turn real-world data (numbers) into an animated and interactive data visualisation

ELECTRICITY GENERATION

Electricity generation is a fun, eco-conscious project that introduces learners to data analysis and visualisation using real data

Electricity generation is part of the 'Protect our Planet' path of projects from the Raspberry Pi Foundation. The series aims to show learners how they can protect the environment using the power of technology, and draws on several of the United Nations 17 Sustainable Development Goals (SDGs). Using step-by-step instructions with

personalisation choices, learners create an animated data visualisation chart in Scratch in which they compare the type and amount of natural resources used by three countries across the world to generate electricity. The project explores renewable and non-renewable energy sources using data compiled by the International Energy Agency. **(IHW)**

ACTIVITY 1: DEFINE YOUR COLOURS 15 MINUTES

In Scratch, you will first investigate electricity generation sources for New Zealand, before creating a key for all its energy resources. Open the starter project (helloworld.cc/electricitystarter) and you should see a grey background with a chart title. When you click the green flag, an animated column appears showing New Zealand's use of resources. You can investigate the column by hovering over the bands of different colours.

You will now choose the colours to represent each of the resources on your graph.

Select the 'nonrenewable' sprite and click on the Costumes tab. In the centre of the Paint editor is a square that has no fill colour. Click on the Fill colour slider tool and create a colour of your choice by altering the Color, Saturation, and Brightness sliders. Select the Fill tool and click inside the square. You'll see the first key square on the stage change to your new colour.

You now need to change the resource in the New Zealand sprite so that the column is drawn using your new colour. Click on the New

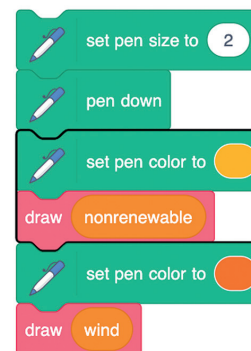


Figure 1

Zealand sprite and then the Code tab. There is some code already included in the script area; find the block that sets the pen colour for 'nonrenewable', as shown in **Figure 1**. Click on the coloured yellow circle and select the colour picker tool. Move the mouse pointer until you hover over the 'nonrenewable' sprite in the key, then click to select that colour.

Run your project; the non-renewable resource for New Zealand now draws in your chosen

ACTIVITY 1: DEFINE YOUR COLOURS 15 MINUTES (CONT.)

colour! Hover over the column, though, and you'll notice the 'non-renewable' speech bubble is missing. Select the Pointer sprite and find the **Non-renewable if touching colour** condition in the code (Figure 2). Click on the coloured circle, then select the colour picker tool. Move the mouse pointer until you hover over the non-renewable coloured square in the key, then click to select that colour.

Next, choose colours to represent the other resources. Remember to change the key square, the New Zealand sprite column colour, and the Pointer sprite speech bubble colour for each resource.

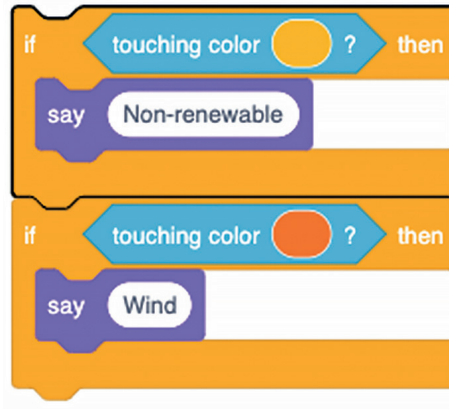


Figure 2

ACTIVITY 2: ADD A UK COLUMN 5 MINUTES

Next, you will add a UK column and populate it with data for comparison purposes. Duplicate the New Zealand sprite and rename it 'UK'. If you run the program, it looks as though nothing is happening, because the UK column is drawn underneath the New Zealand column. Go to the UK sprite Code tab and find the **go to x: -200 y: -140** block (Figure 3). Change the value of x to -20 to move the column along the horizontal axis.

Run the program to see the two side-by-side columns. Find and update the label code at the bottom of the script to move the label along the x-axis, and change the text to say 'UK'. Run your program again to check the labels and positions.

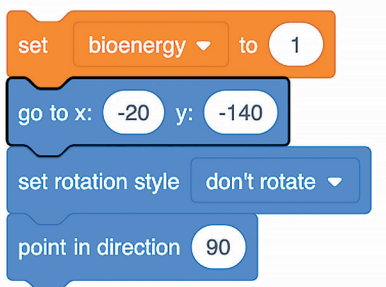


Figure 3

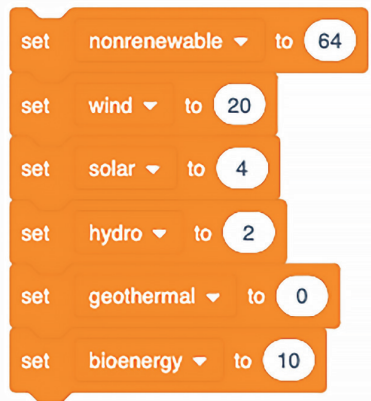


Figure 4

The columns currently look identical because the variables contain the same values for the UK and New Zealand. Find the **set variable** blocks in the UK script and change the values to match Figure 4. The values are a percentage of the country's energy generation, so the total should add up to 100.

Run the program to compare resources. You may notice that the UK uses more bioenergy but far less hydropower than New Zealand. How do the countries compare on their use of non-renewable resources?





DIFFERENTIATION

More advanced coders could add more country columns and compare energy resource usage in each. They would need to refer to the table in **Figure 5** and change both the position, label, and drawing width of the columns to fit the stage.

Less advanced coders could complete the initial steps of this project without creating the third column, then change the countries used by updating the sprite name, label, and variable values to see the impact of the changes and analyse the data further.

ACTIVITY 3: CHOOSE A THIRD COUNTRY 10 MINUTES

Resource type	Brazil	Canada	Iceland	India	Ireland	Norway	Singapore	S.Africa	US
Non-renewable	18	34	0	81	64	2	99	94	83
Wind	9	5	0	5	32	4	0	3	7
Solar	1	1	0	3	0	0	1	1	2
Hydro	63	58	70	11	4	94	0	2	7
Geothermal	0	0	30	0	0	0	0	0	0
Bioenergy	9	2	0	0	0	0	0	0	1

Figure 5

You may have noticed that the country sprites do not have costumes. This is because you only need to see the related actions of the Pen and the speech bubble, not the sprite itself. Create a new sprite by clicking on Choose a Sprite and selecting the paint editor.

The table in **Figure 5** lists a number of countries and the percentage contribution of resources they use to generate electricity. Choose one of the listed countries and rename your new sprite to match.

Click on the Code tab then the Variables blocks menu. Make a variable for each energy resource type, name each new variable, and click on the **For this sprite only** radio button so that the values are stored for this country sprite only. Remember to include all the resources even if the country doesn't use them as use changes over time.

The new variables will appear on the stage. Click on the ticks next to the variable names

in the Variables blocks menu to hide them from view.

Add code to set your new variables to the percentage of energy used by your chosen country. The code is shown in **Figure 6**, but change the values to match the use of your chosen third country.

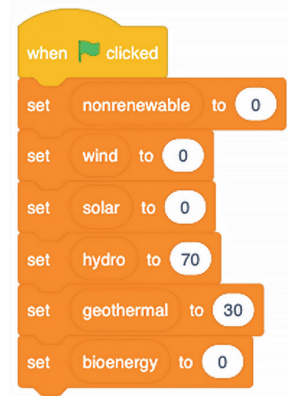


Figure 6

ACTIVITY 4: BUILD A PEN 10 MINUTES

Add Motion blocks to your code to move your third country sprite to the correct position, ready to draw the third column (**Figure 7**).

The Pen extension blocks are used to draw on the stage. Click on the Add Extension button and select Pen. This will add a set of **Pen** blocks to your blocks menu. Add **Pen** blocks to the end of your code to set the pen

size and place the pen down so that the pen can draw on the stage as the sprite moves. The Pen will change colour as it draws each resource. Add a **set pen colour** block, then click on the coloured circle. Select the colour picker tool and click on the first square in your key to set the colour for Non-renewable energy. Repeat for the next energy category in your

ACTIVITY 4: BUILD A PEN 10 MINUTES (CONT.)

key and continue until you have a pen colour block for each resource type. You will need an additional **set colour** block that sets the pen colour to the stage background colour. You can select this colour by making sure your project isn't running, then hovering anywhere on the stage.

Finally, add **Pen** blocks to the start of your code to clear the stage when your project begins and lift the pen up so that it doesn't draw as the sprite moves to the start position.

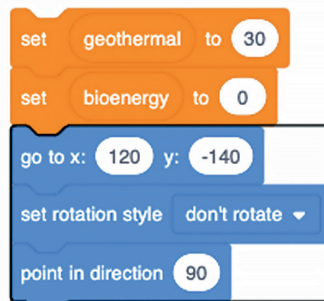


Figure 7

“ THE SERIES SHOWS LEARNERS HOW TO PROTECT THE ENVIRONMENT USING TECHNOLOGY

ACTIVITY 5: DRAW THE THIRD COLUMN 10 MINUTES

Since you have set energy variables for your third country and created a pen, now is the time to build code to draw your third column.

In Scratch, you can make your own block that starts a new script whenever it is used. You can give your new block a name and add any blocks into the script for your new block.

Go to the My Blocks blocks menu and click on the 'Make a Block' button before calling your new block **draw**. Your draw code is going to use the values stored in your resource variables as an input. To enable your block to use a number as an input, click on the 'Add an input number or text' button and type 'amount', then click OK.

You will see a new define block called **draw** has been added to the Code area for your third country sprite. Add a 'repeat' loop from the Control blocks menu and drag an **amount** block from the define block header in the Code area into the repeat block value. Add **Motion** code blocks to tell the sprite how to draw one line, then position it ready to draw the next line (Figure 8).

Insert your new **draw** blocks into your existing pen code. Add the matching

resource variable into each block so **draw** knows the amount stored in each variable. For the final background colour, type the value 1 to add a hidden line at the top of your column.

Lastly, add a label to the third country column with the name of your chosen country. Then run your project to see the animated data visualisation for all three countries!

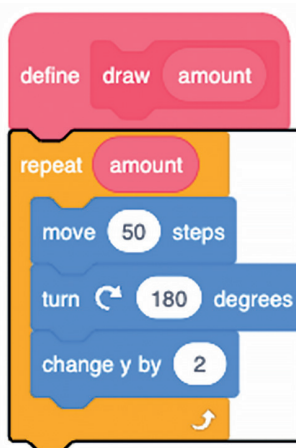


Figure 8

RELEVANT LINKS

- More about this project: helloworld.cc/electricproject



LIZ SMART

Liz is a learning coordinator in the informal learning team at the Raspberry Pi Foundation.