

# ENERGY SOURCES WORKBOOK

Name: .....

Other group members: 1 .....

2 .....

3 .....

4 .....

Class: .....

Group number: .....

# Your Tasks

These are the sequence of activities you will be carrying out:

- **Activity 1: Individual task: Background Information** ..... Page 3
  - *Individually*, share your knowledge about energy sources.
- **Activity 2: Individual task: Understanding the rise of renewable energy** ..... Page 4
  - *Individually*, read through the data provided.
- **Activity 3: Group task: The model sustainable town competition** ..... Page 6
  - In *Groups*, read the details of the sustainable town competition.
- **Activity 4: Group task: Designing your model sustainable town** ..... Page 8
  - In *Groups*, begin to discuss designs for your sustainable town, i.e., running on 50% renewable energy.
- **Activity 5: Individual task: Design evaluation** ..... Page 18
  - *Individually*, evaluate your group’s design.
- **Activity 6: Group task: Our fact sheet** ..... Page 20
  - As a *Group*, send a response letter to the *Minister*, providing details of your design findings.
- **Activity 7: Group task: Critical evaluation** ..... Page 22
  - As a *Group*, critically evaluate all design calculations and decisions made by another group.
- **Activity 8: Group task: Presentation**
  - As a *Group*, present your design findings to the class.



## **INDIVIDUAL TASK: BACKGROUND INFORMATION**



**Record your own knowledge about energy sources.**

1. Name the top 3 energy sources you are familiar with.

- 1. ....
- 2. ....
- 3. ....

2. Which of these are renewable energy sources (if any)?

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3. Describe your understanding of the term “**Renewable Energy**”.

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4. What are some advantages and disadvantages of renewable energy?

a) Advantages: .....

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b) Disadvantages: .....

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## INDIVIDUAL READING: UNDERSTANDING THE RISE OF RENEWABLE ENERGY IN AUSTRALIA

There are a number of mega projects taking place in Australia. One such recent project is a \$130 million 100-Megawatt Solar Farm<sup>1,2</sup> 2 hours east of Perth in the Western Australia's Wheatbelt (see figure below).



Figure 1. Solar farm

There is another mega project being developed in Tennant Creek Northern Territory, a \$20 billion 10GW world's largest solar farm<sup>3</sup>. It will supply the electricity to Singapore, located 4,500 kilometres away. This 22 million solar panel farm covers 15,000 hectares<sup>4</sup>, and is expected to supply an estimated 22% of Singapore's electricity needs.



Figure 2. Supplying electricity from Australia to Singapore

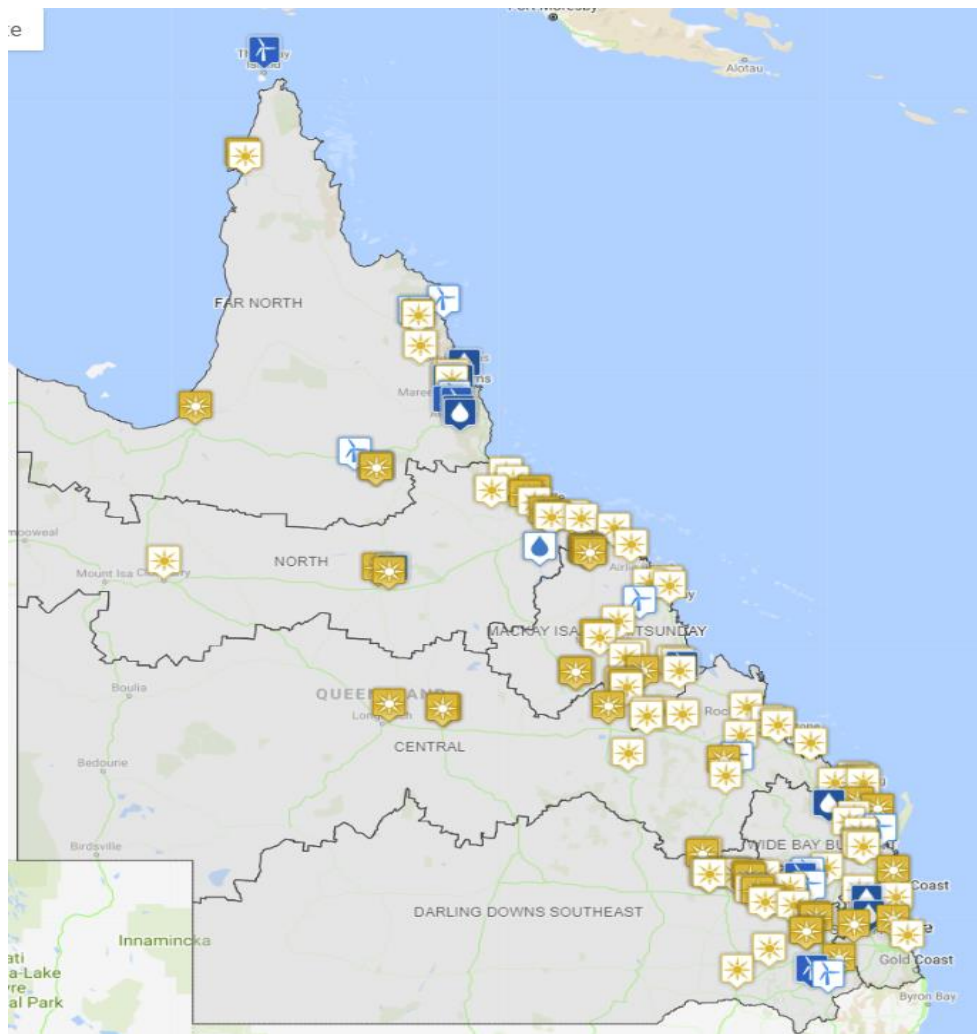
<sup>1</sup> Source: <https://www.mining.com/australias-mining-tycoon-andrew-forrest-invests-in-giant-solar-farm/>

<sup>2</sup> Source: <http://sunbrilliance.com.au/cunderdin-100-mw/>

<sup>3</sup> Source: [https://09b6cb66-c47f-4180-8cdc-7108de9fa117.filesusr.com/ugd/8113d4\\_4bde7705b87485497b2b013d75a837d.pdf](https://09b6cb66-c47f-4180-8cdc-7108de9fa117.filesusr.com/ugd/8113d4_4bde7705b87485497b2b013d75a837d.pdf)






<sup>4</sup> Source: <https://www.youtube.com/watch?v=s9XEesGuZB0>

The Queensland state government has set a target to have 50% of its energy generation coming from renewable sources by 2030<sup>5</sup>. There are currently some smaller renewable energy projects operational, with bigger renewable energy generation projects being proposed, as shown in the figure below.



**Figure 3. Queensland's current and proposed renewable energy projects**

**Table 1. Legend for Figure 3 above**

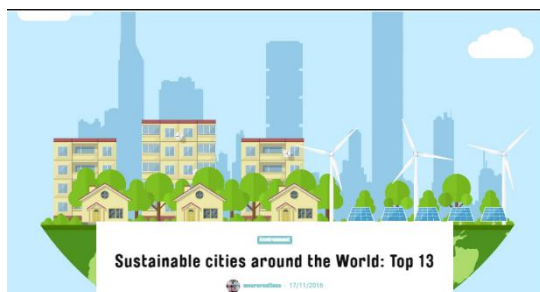
Symbol	Type	Status
	Hydro	Operational
	Solar	Operational
	Solar	Proposed
	Wind	Operational
	Wind	Proposed

<sup>5</sup> Source: [https://www.tiq.qld.gov.au/download/business-interest/invest/19007-MRE-TIQ-Renewables-brochure\\_v5.pdf](https://www.tiq.qld.gov.au/download/business-interest/invest/19007-MRE-TIQ-Renewables-brochure_v5.pdf)



## The Model Sustainable Town Competition

The Queensland Ministry for Energy, Renewables and Hydrogen is looking to move Queensland toward 50% renewable energy generation. However, rather than pouring tens of billions of dollars into mega renewable energy projects, the Queensland government would like to construct a town that is able to run on at least 50% renewable energy (i.e., a model sustainable town<sup>6</sup>).



*The Ministry would like the Year 6 students to provide design proposals for a model sustainable town within Queensland.* A panel of experts will then judge these designs and the best town will be constructed as a model town within Queensland.

*Your group has been tasked with using your knowledge of Queensland weather and geography to design a town that partially runs on renewable energy sources. It is important that the group considers various renewable energy sources to ensure that electricity is always available to the town.*



Study the design considerations presented in the following pages, and as a group, discuss your town layout and energy sources designs. *All design decisions must be written down.*

<sup>6</sup> Source: <https://wearerestless.org/2016/11/17/13-top-sustainable-cities/>;  
<https://balkangreenenergynews.com/45-mw-brezice-hydropower-plant-on-river-sava-inaugurated/>



## **THINKING SPACE**

... Drawings, diagrams, observations, notes, reflections ...



## GROUP TASK: DESIGNING YOUR MODEL SUSTAINABLE TOWN



The Queensland government has identified a tourist location in the Gold Coast Hinterland recently damaged by bushfires as a potential location for a model sustainable town running partially by renewable energy.

Studies carried out indicate that the area for the proposed model sustainable town has sufficient solar and wind sources. The nearby Hinze Dam<sup>7</sup> has also been recently fitted with a micro-hydro turbine generator, which will be able to provide renewable energy to the town in the future, but not just yet.

Discuss how you would like the town layout to be. Use this space in your workbooks to try out various ideas in developing your town. Discuss the solar and wind installations your town would require to be at least 50% renewable energy dependant. **Clearly label everything and show all your working using the criteria specified below.**

Your sustainable town design is to meet the following conditions:

- Design the town. Decide as a group the population of your town. It should be no more than 600 people, with 2 to 5 persons per household.
- Review the list of Essential services in Table 2. Decide on the number of each service and where to place it in your model sustainable town.
- In your model sustainable town designs (i.e., Proposed design in Figure 4 and final design in the A3 Cardboard sheet):
  - Indicate housing as blocks of houses rather than individual houses. Specify the number of houses in each housing block.
  - Place the solar panels and wind turbines as solar panel farms and wind turbine farms respectively. Indicate their locations clearly on the maps.
- Note: You have to keep to a budget of \$2.5 million.

**Show your calculations and design proposals on the next pages. Once your teacher has reviewed your working, you will be provided with an A3 cardboard sheet for your final design. This A3 sheet has a grid which you should use when identifying parts of your design.**

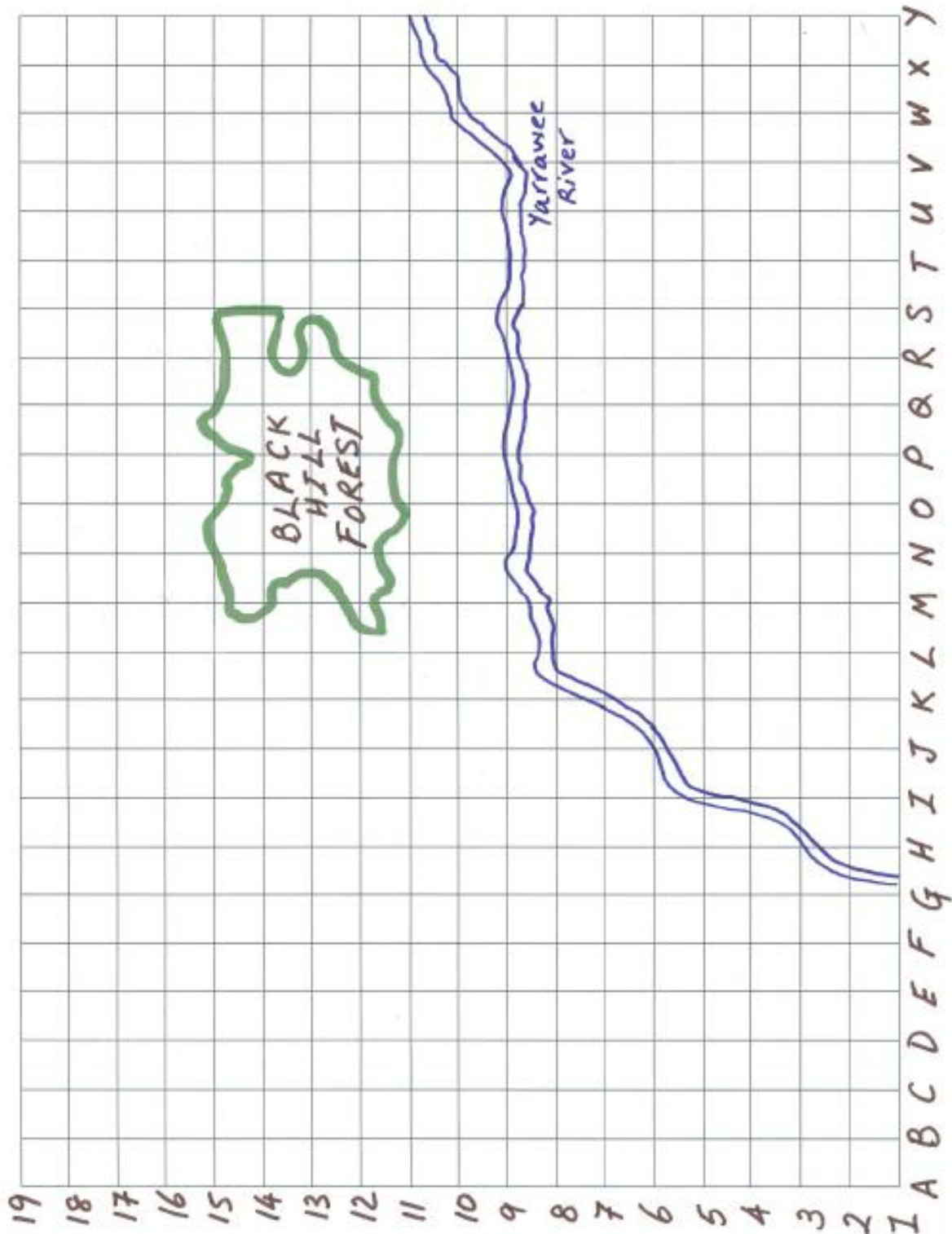


<sup>7</sup> Source: <https://www.goldcoast.qld.gov.au/council-renewable-energy-projects-4822.html>





- Study the list of services in Table 2 on page 11. Decide where you wish to place them in your proposed settlement town design (Figure 4 below). Use the symbols in the **Symbol** column in Table 2 to indicate the various services. Note: Houses should be indicated as blocks rather than individual houses (state the number of houses in each block).



**Figure 4. Proposed Settlement Town design**

5. The following refer to filling data into Table 2 below.
- i. Enter the number of each service into the “Quantity” column
  - ii. Calculate the total daily electricity consumption of each service and enter into the “Total Consumption” column, and
  - iii. Calculate the total daily consumption of each service into the “Total Consumption” column

**Table 2. List of Services**

Service	Symbol	Capacity	Daily consumption (units)	Quantity	Total Consumption (units)
Houses	Hs	2 to 5 persons			
Police station	POL	10 persons	20,000		
Hospital	H	20 beds	60,000		
Ambulance Station	AS	3 cars	3,000		
Fire Station	FS	2 trucks	4,000		
Supermarket	S	Medium size	75,000		
Church	Ch	40 person seating	23,000		
School	Sc	40 students	45,000		
Motel	M	20 person	30,000		
Shopping Centre	SC	10 stores	160,000		
Post office	PO	3 staff	10,000		
Restaurant	R	10 tables	15,000		
Town Council	TC		20,000		
Petrol Station	PS		25,000		
<b>Total consumption for your model sustainable town</b>					

6. How many units of electricity must your renewable energy sources generate to meet the minimum 50% renewable energy requirement?

7. Here are details of renewable energy sources to be considered for this town:

1. Solar Panels: Each installed solar panel<sup>8</sup> is expected to generate around *1,200 units* of electrical energy **PER DAY**, at a cost of *\$1,000 each panel*<sup>9</sup>.
2. Wind Turbines: Each installed wind turbine is expected to generate around *300,000 units* of electrical energy **PER MONTH**<sup>10</sup>, at a cost of *\$20,000 per turbine*<sup>11</sup>.

Calculate the number of Solar panels **AND** Wind Turbines you propose to install in your solar panel farms and wind turbine farms to provide at least 50% renewable energy to your model sustainable town. **Your group is to work with a budget of \$2.5 million for this project. Use the space on pages 13 and 14 to calculate. Show all your working.**

Then ENTER your results into Table 3.

**Table 3. Proposed renewable energy requirements**

	<b>Renewable Source</b>	<b>Quantity</b>	<b>Cost (\$)</b>
a.	Solar panels		
b.	Wind turbines		
<b>Total (\$)</b>			

<sup>8</sup> Source: <https://youtu.be/L8e3FGgJx3Y>;

<sup>9</sup> Source: <https://www.solarquotes.com.au/panels/cost/>

<sup>10</sup> Source: <https://www.inspirecleanenergy.com/blog/clean-energy-101/how-much-energy-does-wind-turbine-produce>

<sup>11</sup> Source: <https://www.offgridenergy.com.au/off-grid-power-systems/components/wind-turbines/>

**WORKING SPACE: USE THIS SPACE BELOW AND ON THE NEXT PAGE TO WORK OUT YOUR PROPOSED QUANTITY OF SOLAR PANELS AND WIND TURBINES. YOUR DESIGN SHOULD INCORPORATE BOTH SOLAR PANELS AND WIND TURBINES. YOUR DESIGN SHOULD INCORPORATE BOTH SOLAR PANELS AND WIND TURBINES. WHERE WILL THESE BE PLACED ON THE MAP?**



**Your group will now be provided with an A3 cardboard sheet for your final model sustainable town design. This A3 sheet has a grid which you should use when identifying parts of your design. After completing your design, answer the questions below:**

8. What changes, if any, did you make between your proposed design in Figure 4 (page 10) and your final design (A3 cardboard sheet)? List all the changes, reasons for making them and changes to the calculations.

9. List some of your group's *main ideas* in developing possible designs to meet the conditions given.

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10. What maths and science ideas did you use to design your model sustainable town?

**a. Maths ideas:**

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**b. Science ideas:**

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## INDIVIDUAL TASK: DESIGN EVALUATION

**Record** your observations below by answering each question regarding your group's **model sustainable town design**.

1. How would you rate your group's model sustainable town design? Place a mark anywhere on the line below to show your rating:

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Poor

Fair

Excellent

2. Why did you rate your group's model sustainable town design in this way?

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3. What *changes* would you make to improve your group's model sustainable town? **Give your reasons why.**

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 **GROUP TASK: OUR FACT SHEET**

Dear Minister,

*We have designed a model sustainable town that is at least 50% run by renewable energy. Here is how we designed the model sustainable town:*

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## **GROUP TASK: CRITICAL EVALUATION**

Group you are evaluating (Number): \_\_\_\_\_

Your group is to pretend that you are judges and are to critically evaluate this group's design decisions. Here are the judging criteria:

- study the groups design decisions
- review the group's written responses on pages 8 to 21

**Answer the following questions AS YOU CRITICALLY EVALUATE this group's design decisions:**

1. Identify the positive and negative aspects of the group's design.

i. Positive:

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ii. Negative:

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2. How would you rate this group's design? Please explain your decisions clearly.

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4. How would you suggest this group *improve* their design?

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