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New Zealand Qualifications Authority

Scholarship 2023 Geography

RESOURCE BOOKLET

Refer to this booklet to answer the questions for Scholarship Geography.

Check that this booklet has pages 2–24 in the correct order and that none of these pages is blank.

YOU MAY KEEP THIS BOOKLET AT THE END OF THE EXAMINATION.

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CONTENTS

Section A: Production and use of energy	4
Fossil fuels vs renewable energy	4
The energy crisis	8
Alternative forms of energy to fossil fuels	9
Section B: Geopolitics – the significance of geographic location	12
Russia–Europe crisis 2022	13
Taiwan location lacking natural resources	15
The Caspian Sea region	16
Middle East	17
Section C: Achieving sustainability	18
Pledges and action	20
Canada’s broken promises	23
Saudi Arabia	23

SECTION A: PRODUCTION AND USE OF ENERGY

FOSSIL FUELS VS RENEWABLE ENERGY

There are pros and cons of both renewable energy and fossil fuels. Both have an impact on the environment, on the energy sector, on everyday life, and on the future of humanity.

Renewable energy will never run out; meanwhile, fossil fuels will. Fossil fuels are very easy to store, unlike renewable energy sources. Renewable energy storage technologies are arguably still in their infancy and the energy is unfortunately not available continuously. Renewable energy has been expensive, but with its constant spread, it is becoming more affordable. Fossil fuels are cheap, easy to store and to ship, but are detrimental for the environment.

Advantages of fossil fuels	Disadvantages of fossil fuels
<ul style="list-style-type: none"> • Ability to generate enormous amounts of electricity. • Cost-effective and in abundant supply. • Have high calorific value. • Highly stable when compared to other substances. • Can easily be transported from one location to another. • Can be stored for long periods of time. • Can power the entire globe. • Power stations for fossil fuels can be constructed in almost any location. 	<ul style="list-style-type: none"> • Air pollution (contributing to the greenhouse effect) and acid rains. • Dangerous to human health. • Use of crude oil can cause environmental hazards (oil spills etc.) and water pollution. • Coal mining may result in the destruction of vast land areas. • Power stations that use coal require a large amount of fuel. • Rising prices. • Fossil fuels like coal, oil, and gas are non-renewable.

Figure 1: Advantages and disadvantages of fossil fuels.

Figure 2: Global energy consumption 1800–2018.

US fossil fuel industry

“We have unleashed a revolution in American energy. The United States is now the number-one producer of oil and natural gas anywhere in the world.” President Trump, 2019

The health impacts of fossil fuel-generated electricity total an estimated \$886.5 billion a year in the US alone. The American Lung Association found that transitioning away from fossil fuels to clean energy could have public health benefits totalling \$1.2 trillion by 2050.



Figure 3: Electricity consumption from different sources, 2021.



Figure 4: Global surface temperature change relative to 1850–1900.



— World GDP
— Global fossil fuel consumption

Figure 5: GDP and fossil fuel consumption 1900–2015.

THE ENERGY CRISIS

China: Tug of war between green energy and security

Two months of scorching heatwaves and drought in 2022 plunged China into an energy security crisis. On top of that, the international coal market skyrocketed as geopolitical tension from Russia's invasion of Ukraine and economic recovery from the pandemic boosted global demand.



Figure 6: The Yangtze River in Chongqing, China, partially dried up due to a severe drought and heatwave.



Political challenge

Science clearly tells us that we need to remake our energy system and eliminate CO₂ emissions. However, in addition to the engineering challenges, the nature of climate change makes it politically challenging to deal with as well.



ALTERNATIVE FORMS OF ENERGY TO FOSSIL FUELS

Reliability and resilience of clean technologies

Wind and solar are less prone to large-scale failure because they are distributed and modular. Distributed systems are spread out over a large geographical area, so a severe weather event in one location will not cut off power to an entire region. Modular systems are composed of numerous individual wind turbines or solar arrays. Even if some of the equipment in the system is damaged, the rest can typically continue to operate.

For example, Hurricane Sandy damaged fossil fuel-dominated electric generation and distribution systems in New York and New Jersey and left millions of people without power. In contrast, renewable energy projects in the north-east weathered Hurricane Sandy with minimal damage or disruption.



Figure 7: Share of primary energy from renewable sources, 2021.

Environmental impacts of solar power

The sun provides a resource for generating clean and sustainable electricity without toxic pollution or global warming emissions. The potential environmental impacts associated with solar power – land use and habitat loss, water use, and the use of hazardous materials in manufacturing – can vary greatly depending on the technology, which includes two broad categories:

photovoltaic (PV) solar cells or concentrating solar thermal plants (CSPs).

Figure 8: Ivanpah Solar Power Facility – Mojave Desert.



Environmental impacts of wind power

Harnessing power from the wind is one of the cleanest and most sustainable ways to generate electricity, as it produces no toxic pollution or global warming emissions. Wind is also abundant, inexhaustible, and affordable, which makes it a viable and large-scale alternative to fossil fuels. Despite its vast potential, there are a variety of environmental impacts associated with wind power generation.



Figure 9: Wind turbines and horses.

Environmental impacts of hydroelectric power

Hydroelectric power includes both large-scale hydroelectric dams and small run-of-the-river plants. There are environmental impacts at both types of plants.



Figure 10: Hydroelectric dam spillway.

SECTION B: GEOPOLITICS

THE SIGNIFICANCE OF GEOGRAPHIC LOCATION

Geopolitics of energy

Geopolitics has three fundamental qualities: it deals with questions of territorial influence and power, uses frameworks from geography to make sense of goings-on in the world, and provides future-orientated insights. The geopolitics of energy can be viewed as resulting from the balance between supply and demand (which affects the power dynamics between energy exporters and importers), energy security, and the military strength of major powers, among other things.



Figure 11: Oil and gas producers, 2017.

Russia–Europe crisis 2022

Russia's war in Ukraine has been a major contributor to the surge in geopolitical risk. The European Union (EU) imports about 90% of the gas it consumes, with Russia responsible for about 45% of this. Access to cheap Russian gas, which feeds directly into Europe via various pipelines, was a favourable arrangement for many years.



Figure 12: Which European countries depend on Russian gas?

Russian supply of oil, coal, and natural gas to the EU



Figure 13: Imports of oil, coal, and natural gas to the EU.

Taiwan location lacking natural resources

Taiwan is an island with no physical power interconnections with neighbouring countries. Its economic prosperity is contingent on a stable geopolitical environment, and especially on stable cross-strait relations with mainland China, which is also Taiwan's largest trading partner.



Figure 14:
Taiwan's LNG
suppliers, 2015
and 2019.

The Caspian Sea region

The Caspian region is one of the oldest oil-producing areas in the world. The area has significant oil and natural gas reserves from both offshore deposits in the Caspian Sea itself and onshore fields in the Caspian basin.

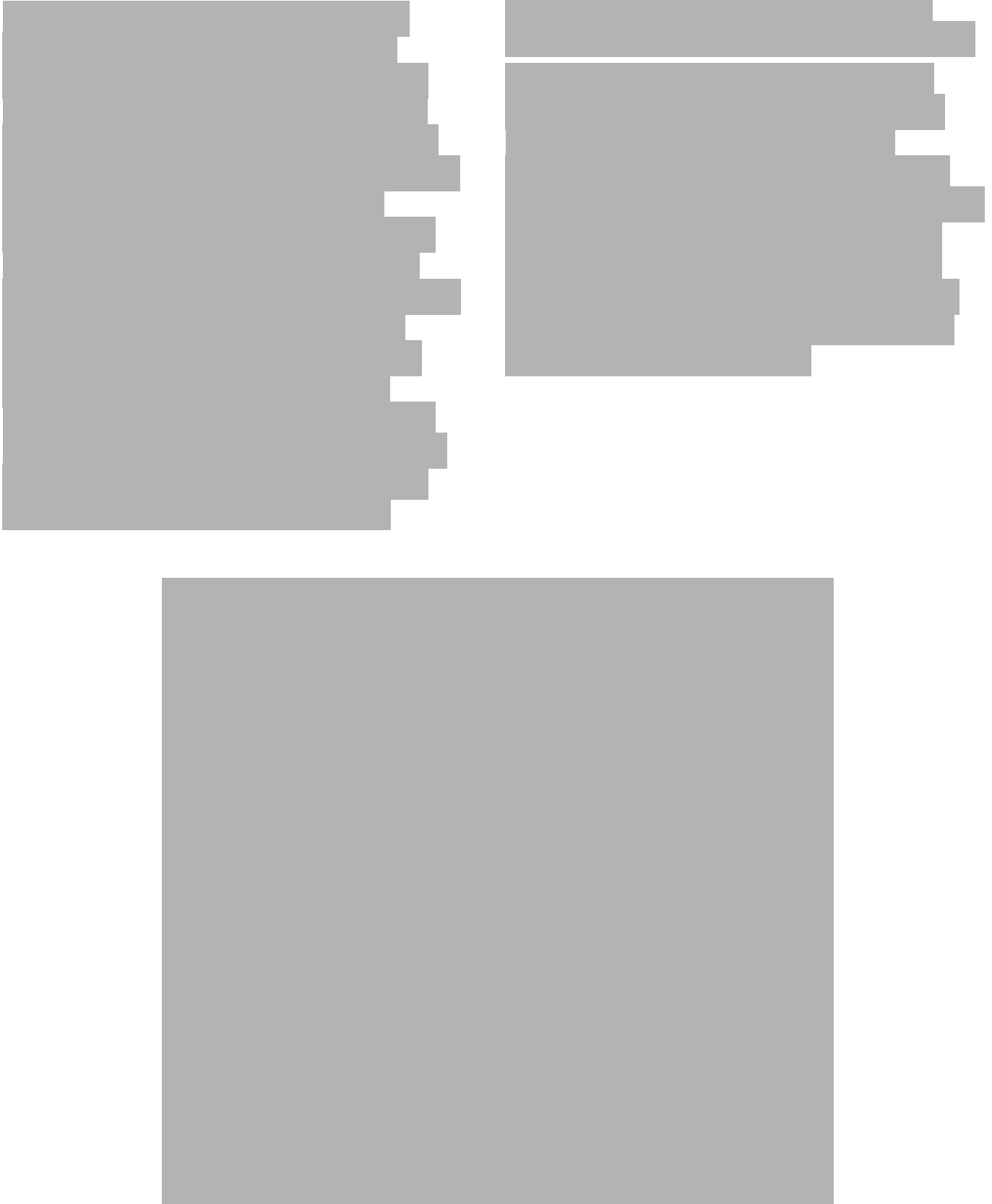


Figure 15: Caspian region oil and natural gas infrastructure.

Middle East

The Middle East remains critical for future energy supplies. Although the Middle East produces a quarter of world oil supplies, it holds between two-thirds and three-quarters of all known oil reserves. For that reason the United States and the West have continued to define the region as being vitally important.

Figure 16: Origin of oil exports to Asia.

SECTION C: ACHIEVING SUSTAINABILITY

When it comes to emission reductions, some countries aim high but miss the mark by a long shot while others reject big commitments on the international stage but still receive good marks for their greenhouse gas records.

Figure 17: Which countries are meeting their Paris agreement goals?

Figure 18: Renewable electricity sources in the EU, 2018.

Figure 19 (below): Growth in energy demand, 2017–2040.

Pledges and action



Figure 20: Are we on track to reach the Paris Agreement goal?

The US, European Union, Canada, South Korea, Japan, South Africa, and the United Kingdom have all made the pledge to cut their net climate emissions to zero by 2050. China – the world's single largest source of emissions – has said it will cut climate pollution faster than initially promised, aiming for carbon neutrality by 2060.



Such promising moves, however, have been offset by less encouraging developments over the past five years. When in office, President Donald Trump withdrew the United States from the Paris deal with few penalties. There is nothing stopping the future presidents or any other leaders from making similar decisions. Accountability in the agreement is largely external – the agreement itself doesn't have enforcement mechanisms because decisions and actions are taken domestically. Russia and Brazil, two other countries key to dealing with climate pollution, have largely thumbed their noses at the Paris Agreement.



Figure 21: Greenhouse gas emissions.

Adoption of renewable energy crucial for Paris goals

Decarbonising the power sector by ramping up the adoption of renewable energy is essential to meet the goals of the Paris Agreement.

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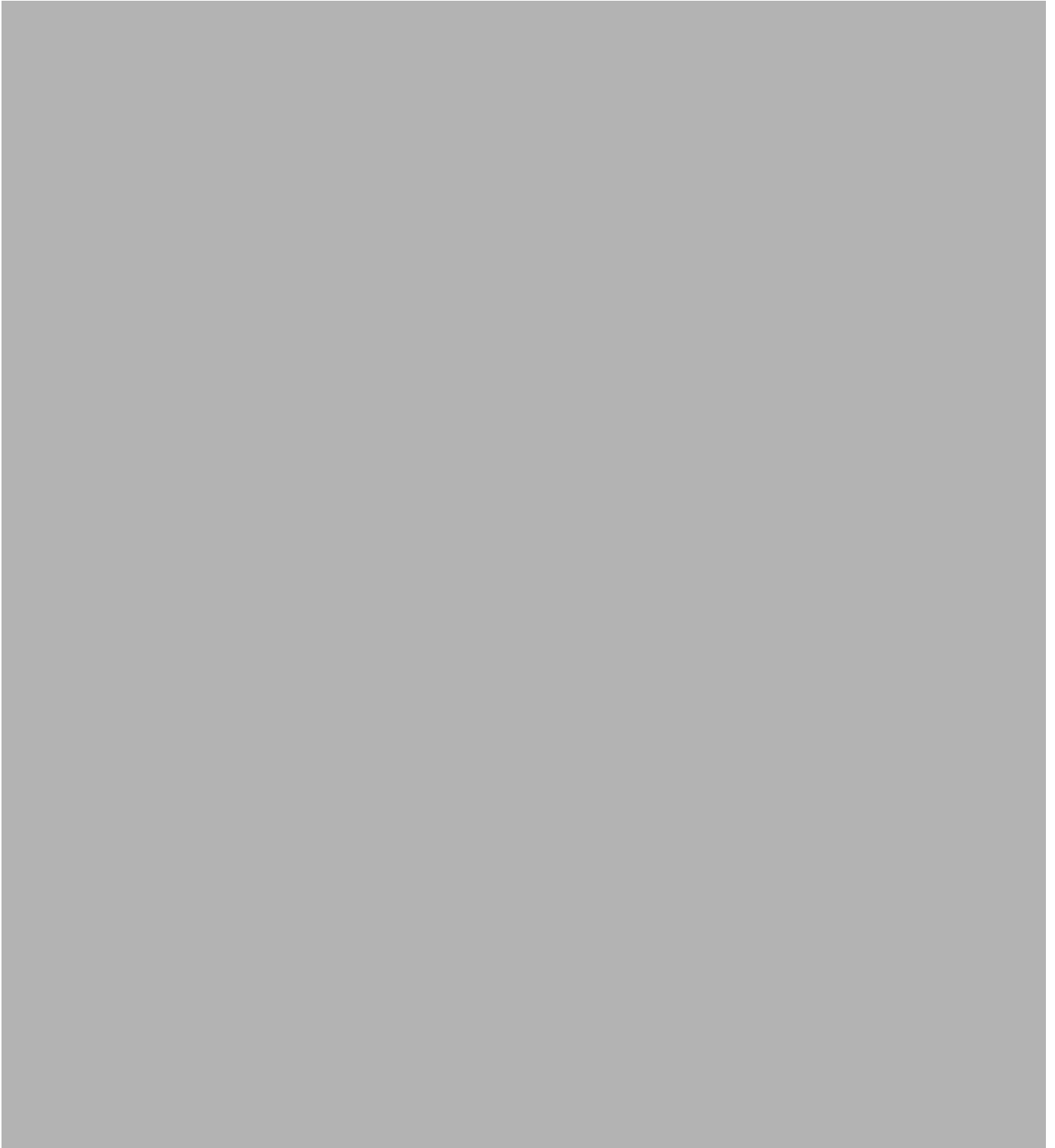


Figure 22: Top five countries by solar and wind electricity generation.

Canada's broken promises

In March 2022, the Canadian government introduced Canada's 2030 Emissions Reduction Plan (ERP), which provides a roadmap for the Canadian economy to achieve 40–45% emissions reductions below 2005 levels by 2030.



Figure 23: Canadian solar power facility.

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Saudi Arabia

It would be big news for any country to invest \$50 billion in renewable energy to generate 10 gigawatts of wind and solar power by 2023. However, when the nation concerned is Saudi Arabia – the Gulf State that possesses nearly one-fifth of the planet's proven reserves of petroleum and ranks as the largest global exporter – the story takes on another dimension.

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Acknowledgements

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