



Case Study

Gold Fields' Agnew, Granny Smith and Gruyere mines

Introduction

Gold Fields is a gold mining company operating mines in five countries. From its Perth office, it manages three mines with isolated power systems in the region around Leonora. A fourth mine, St Ives, is connected via a private network to Western Australia's South West Interconnected System.

In 2020, Gold Fields' global gold mines had an average energy intensity of 5.64 GJ/ounce, consisting of about 52 per cent diesel fuel for haulage and mining equipment and 48 per cent electricity.

Gold Fields is committed to the Paris Climate Change Agreement. In December 2021, it set Environmental, Social and Governance targets which include a 30 per cent reduction in Scope 1 and Scope 2 greenhouse gas emissions from 2016 levels by 2030 and a net zero target by 2050.



Gold Fields' global decarbonisation investment plans amount to about US \$1.2 billion (AUD \$1.8 billion) to 2030. Around a quarter is expected to be financed directly and the rest underpinned by power purchase agreements. All the investments are expected to provide a positive return on investment by displacing more expensive, fossil fuels. To date, Gold Fields has integrated renewable generation into three isolated mines in Western Australia and an overview of these mines is provided in Table 1.

Table 1: Summary of Gold Fields' isolated, gold mine operations in Western Australia¹

	Agnew	Granny Smith	Gruyere
Operation and key dates	Underground mine since 2002	Underground mine since 2005	Open cut, commencing in 2018
Acquisition by Gold Fields	2001	2013	50% in 2017 ²
Jobs ³	>250	>500	>150
Ore processing Mt pa	1.3	3	9
Gold production ounces pa	>200,000	>250,000	>300,000
Mine life ⁴ years	5	10	10

1. Mines with onsite, fossil and renewable power generation. Figures are 2020-21, unless specified otherwise.

2. The Gruyere mine is a Joint Venture with Gold Roads.

3. Ongoing, onsite employment, not including contractors.

4. Mine life figures shown are an estimate based on mineral reserves as of 2020. Typically, mine life is revised as estimated mineral resources become mineral reserves after ongoing exploratory drilling confirms ore grades.

Summary of power generation

A focus for Gold Fields is reducing reliance on imported fuels for power generation by installing renewable generation. Gold Fields is also a member of the [Electric Mine Consortium](#) (EMC), which is trialing technologies to electrify trucks, heavy mining equipment and other vehicles to reduce emissions. Gold Fields is sharing its learnings from the St Ives underground, electric loader and truck trials with EMC members.

In the last few years, Gold Fields has reduced reliance on diesel generation at its isolated mines by connecting them to the gas pipeline network. It has also installed renewable generation using a number of local suppliers. In a first for Australia, the Agnew power system combines solar, wind and batteries to meet more than half the mine's annual electricity needs. An overview of the power generation infrastructure for Gold Fields' isolated mines in Western Australia is provided in Table 2.

Table 2: Summary of Gold Fields' isolated mine power generation

	Agnew	Granny Smith	Gruyere
System capacities	Wind 18 MW, Tracking solar 4 MW _p , Battery 13 MW / 4 MWh, Gas/diesel 21 MW	Tracking solar 7.7 MW _p Battery 2 MW / 1 MWh Gas 35 MW	Tracking solar 13.6 MW _p Battery 4.4 MW / 4.4 MWh Gas/diesel 57 MW
RE supplier	EDL	Aggreko	APA
Commissioning	2020	2020	2022
Annual renewable energy fraction	55 to 60%	~10%	~10%

Gold Fields advises all its renewable energy projects met corporate commercial investment hurdles, including required rates of return. The Australian Renewable Energy Agency (ARENA) provided grant funding to contribute to the costs of the Agnew project.

Gold Fields reports on all its Australian mines under the National Greenhouse and Energy Reporting Scheme (NGER Scheme) and they are subject to the Australian Government's Safeguard Mechanism requirements. Its operations are well-positioned in the context of the West Australian Government's [Sectoral Emissions Reduction Strategies](#), currently under development.

Agnew

The Agnew gold deposit was discovered in 1897 and mined as an open pit in the 1980s. Underground mining from a portal at the pit floor commenced in 2002. Agnew currently produces more than 250,000 ounces of gold per year from several underground mine operations accessed by declines from the pit ramp.

Ore is milled before the gold separation using carbon-in-leach processing. Major power uses are mine ventilation and ore milling, which operate on a 24 hour basis. A 24 kilometre spur pipeline connects the mine to the Goldfields Gas Pipeline.

Renewable energy development

EDL constructed and owns, operates and maintains all aspects of the mine's power supply system under a 10-year power purchase agreement with Gold Fields struck in October 2018. Gold Fields assumed all fuel risk, which removed the need for bankable, long term wind monitoring. Construction commenced in December 2018 and practical completion was achieved in May 2020.

The total power project, including the new gas-fired generation and gas pipeline, cost \$111.6 million. The project created 215 jobs across its 12-month construction phase and supports six new jobs on an ongoing basis.

In support of the renewable energy project, Gold Fields secured a \$13.5 million grant from ARENA as it is the first to combine wind turbines, solar and a battery to achieve a high renewable contribution for a mine's isolated power system. The combination allows for an annual, renewable energy fraction of 55 to 60 per cent.

The power system also incorporates solar forecasting with a cloud camera and load management capabilities to reduce spinning reserve requirements.

ARENA receives reports on the financial modelling, procurement processes, renewable energy production, lessons learned and barriers to commercialisation under [knowledge sharing](#) arrangements.

Outcomes

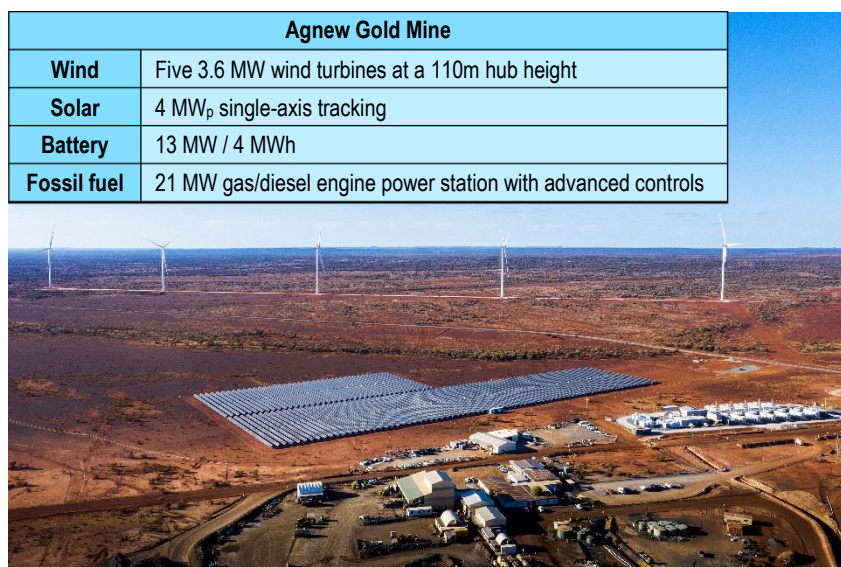
About 57 per cent of the mine's electricity was generated from renewable energy in 2020. On average, it saves more than 2,100 GJ of gas per day, resulting in greenhouse gas emissions savings of more than 40,000 tonnes per year.

The instantaneous renewable power fraction is currently limited to around 85 per cent and work is being undertaken to increase this to 95 per cent. Investigations are also underway examining options to expand the solar array and incorporate long duration energy storage. Gold Fields reports that the Agnew power project is meeting expectations and that power reliability is extremely high.

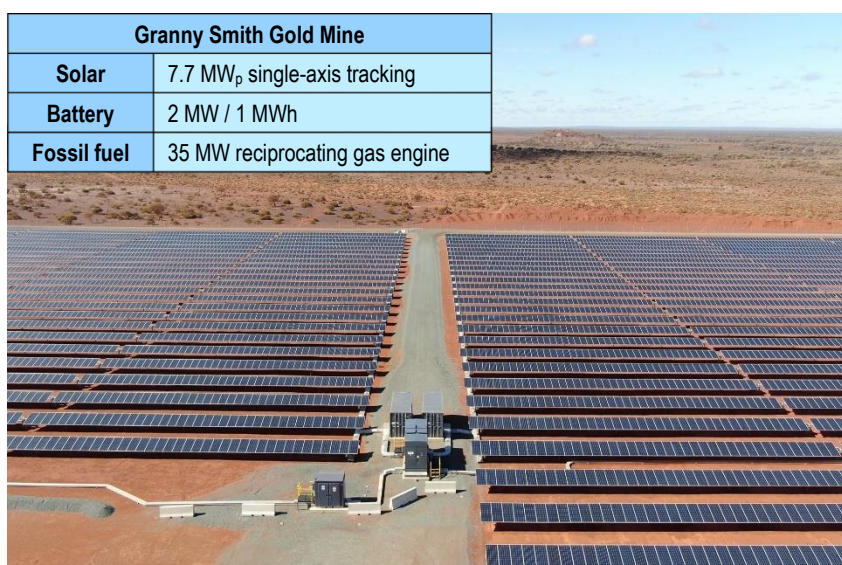
Granny Smith

Gold was discovered at Granny Smith in 1979 and mined as an open pit until 2005, when underground operations commenced. The mine has an ore processing capacity of 3 Mt per year. The plant includes grinding circuits and a leach carbon-in-pulp train.

The Granny Smith mine commenced open pit mining at the Wallaby Project in 2001 before transitioning to underground mining in 2004. In 2016, the power supply was upgraded from diesel with the addition of 24.2 MW of gas generation, with gas supplied via the Eastern Goldfields Pipeline.



Agnew mine's solar array, wind farm and power station. Source: EDL.



Granny Smith's solar array occupies 22.7 hectares. Source: Gold Fields.

Renewable energy development

In February 2019, Gold Fields announced the expansion of the existing gas power station and integration of a solar array and battery. Aggreko undertook the construction which was completed in October 2020. Aggreko's control platform is used to integrate the solar array and the battery. The total cost of the project was about \$17 million. The solar array reduces the need to run the gas generators, while the battery provides spinning reserve, solar ramp rate control and voltage and frequency support.

Outcomes

The solar array provided about 9 per cent of the mine's annual electricity in 2020. On average, it saves more than 500 GJ of gas per day, reducing greenhouse gas emissions by more than 9,500 tonnes per year. Trialing of an electric light vehicle is also underway.

The instantaneous, renewable power fraction peaks at around 30 per cent. Wind monitoring is being undertaken as part of investigations to increase the annual renewable energy fraction. Gold Fields plans to undertake studies to incorporate a wind farm, increasing the size of the solar array and battery energy storage system. Gold Fields reports that the Granny Smith power project is meeting expectations and that power reliability is extremely high.

Gruyere

Gruyere is a new open pit mine owned in a joint venture between Gold Fields and Gold Road Resources, and operated by Gold Fields. The mine has 9 Mt per year of ore processing capacity. Processing at the mine includes crushing, milling and a conventional gravity and carbon-in-leach process.

Renewable energy development

APA built the original gas-fired generation and the Yamarna spur pipeline connecting it to the Eastern Goldfields Pipeline. In December 2020, APA commenced a 4 MW expansion of the gas-fired generation, the installation of a 4 MW / 4.4 MWh battery and contracted Juwi Renewable Energy to add a solar array.

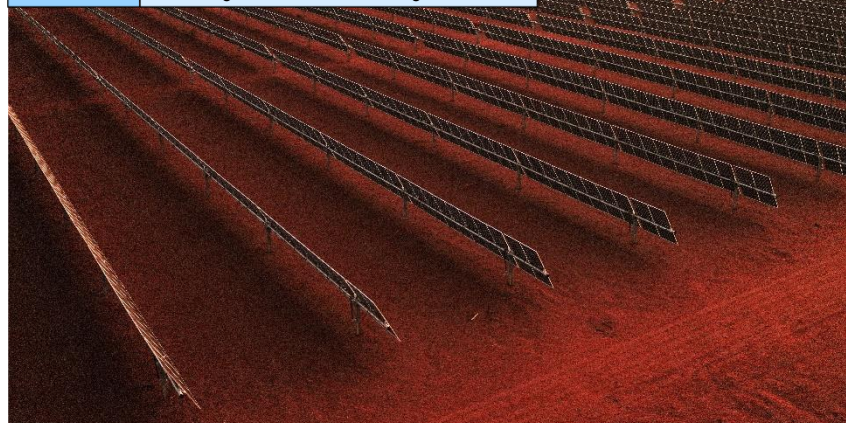
The addition of the solar array was completed in July 2022. The control system incorporates solar forecasting from a cloud camera to maximise the use of solar energy.

Outcomes

Gold Fields expect the solar array to achieve an annual, renewable energy fraction of 10 per cent and reduce greenhouse gas emissions by more than 16,000 tonnes per year.

On average, the system saves more than 850 GJ of gas per day reducing unit power supply costs by more than five per cent.

Gruyere Gold Mine	
Solar	13.6 MW _p single-axis tracking
Battery	4.4 MW / 4.4 MWh
Fossil fuel	53 MW gas and 3 MW diesel generation



Gruyere mine's solar array. Source: Gold Fields.

Gold Fields plans to undertake studies to increase renewable generation and the size of the battery energy storage system. Gold Fields reports that the Gruyere power project is meeting expectations and that power reliability is extremely high.

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Published: September 2022