Personal Power Stations: The Australian Market for Micro-Combined Heat and Power to 2021

A Private Report for Strategic Research Clients

ENERGEIA

1.0 Overview

Personal power plant technology could cost effectively provide most of Australia's gas connected residential premises with all of their electricity and hot water heating needs at 23% to 39% of the carbon emissions of today. However, achieving this level of penetration will require significant product cost reductions, enhancement of the current product feature set and development of the Australian supply chain.

In this exclusive Private Report for our Strategic Research Clients, Energeia examines the emerging market for micro-scale Combined Heat and Power (mCHP), the most prospective fossil fuel based option for personal power production in Australia. The report analyses the market's key drivers, challenges, customer segments, technologies, products and players to gain insight into its medium to long-term outlook. Energeia's ten year view covers total market investment potential, final costs to the end consumer, and its total capacity, generation and CO2 abatement potential.

The history of personal power technology development has led it down a number of technological dead-ends, including products with relatively low electricity efficiencies such as Internal Combustion Engines (ICEs). The rise of ultra efficient heat pump and solar hot water technology has meant that these products could not compete at an end user level with conventionally generated electricity. More recently, fuel cells have emerged as a more likely technology platform, where their relatively high electricity generating efficiencies are better able to compete with centralised generation.

Although most of the current policy incentives and regulations do not specifically mention mCHP technologies, Energeia expects they will ultimately recognise the benefits of the technology's high overall efficiency, low carbon emissions and local electricity distribution network support. Although a major driver of some overseas markets, we do not expect to see the emergence of a mCHP feed-in tariff (FiT), except possibly in Victoria and South Australia, where the technology makes greater economic and political sense.

mCHP units produce heat and electricity in different ratios depending on the technology involved. Energeia's research and analysis shows fuel cells, with their relatively high electrical efficiency and lower heat output ratios, are likely to be the most viable mCHP products in Australia longer-term. Current products are far too expensive even with government incentives to justify investment by residential customers. Energeia expects major overseas investment programs will drive down costs within the next five years to levels competitive with retail electricity prices in most Eastern states.

Australia's relatively warm climate and, up until recently, lack of energy efficiency incentives and a carbon price, have made it a relatively unattractive market for mCHP. However, Energeia's technical and economic analysis has found a positive mCHP investment case will emerge for larger households in NSW and VIC by 2015, assuming the removal of current regulatory barriers. By 2021, we see technology make financial sense for 1.5 million households. Actual take-up will be around 175,000 households but growing rapidly, with a total annual energy generation of around 2.2 TWh.

A critical success factor for the Australian mCHP market will be the timely development of an industry value chain, including sales channels, suitably qualified and knowledgeable installers and a services and maintenance industry. While Energeia expects the mCHP market to learn the lessons of the solar PV industry, the complexity of integrating the electricity, hot water and space heating requirements within the home could significantly undermine market potential if not addressed.

Despite the formidable challenges ahead, Energeia believes mCHP could fill a key niche within the decentralised energy system of the future. As with overseas markets, Energeia expects the natural gas industry to play a major early role in market and industry development. The size of mCHP's future role in Australia is far from certain, and will be hotly contested by decentralised alternatives such as energy storage and relatively efficient centralised generation, such as combined cycle turbines.

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2.0 Introduction

The promise of mCHP generation for residential premises in Australia includes energy efficiencies approaching 90%, and 50% to 25% lower emissions than hot water and grid power alternatives. Scant government support and stubbornly high costs have to date held the technology back from reaching its potential. However, a new generation of products, backed by major overseas investment programs, appear poised to finally deliver on the promise.

Despite its false starts to date, and the emergence of strong competition from renewable energy technologies such as solar hot water, Energeia sees mCHP playing a significant role over the next decade as a transitional pathway for Australia to meet its low carbon objectives. As such, mCHP offers Australia a bridge between the low cost, low energy efficiency and high carbon emission of centralised generation and the high cost, zero carbon emissions of renewable energy.

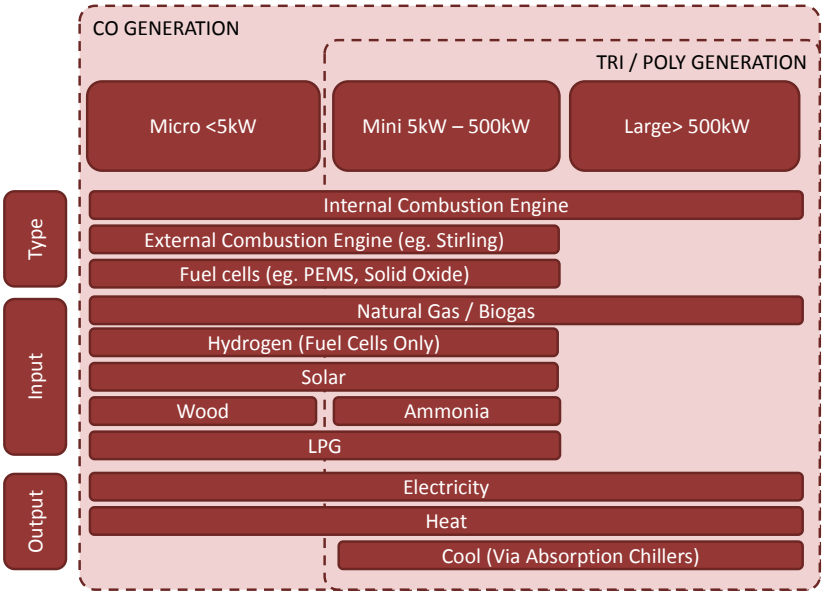
2.1 Scope

This report is part of Energeia's Strategic Intelligence Service covering Energy Technology, which focuses on the emerging energy technologies that will power the Customer of the Future. The report addresses the residential market for Combined Heat and Power (CHP) over the next ten years and the industry value chain that will import, manufacture, distribute and service it.

This report limits itself to the sub-5kW mCHP market. This is in keeping with the main focus of the Strategic Intelligence Service on residential and small business customers, which represent over one third of all energy consumption in Australia and about half its peak demand. Larger commercial systems are therefore out of scope.[1]

mCHP units are sized to meet the heating load and space constraints of residential properties. Although mCHP units are made to run on a wide range of fuels as shown in Figure 1, the units in this report are designed to run on natural gas or LPG. Most units are about the size of a washing machine and feature an external water heating cylinder and/or a heat exchanger for space heating.

Figure 1 – CHP Technology Overview



Source: Energeia

[1] Energeia's analysis of CHP technologies for commercial and industrial customers is included in our Energy Sustainability service.

The report covers mCHP products which have reached or are expected to reach commercialisation in Australia within the ten year study period. There are four main types of mCHP that have moved into or are about to move into the commercialisation stage:

- Internal Combustion Engines (ICE)
- External Combustion Engines or Stirling Engines (ECE)
- Proton Exchange Membrane Fuel Cells (PEM)
- Solid Oxide Fuel Cells or Ceramic Fuel Cells (SOFC)

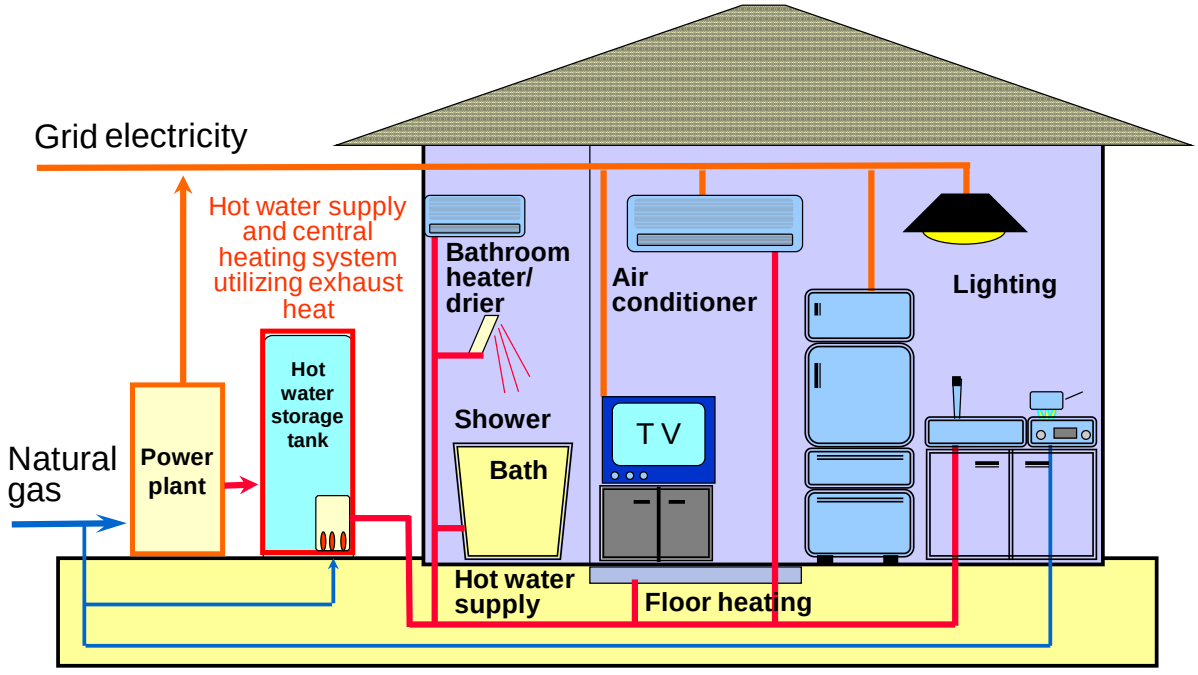
Due to their relative size, and our existing client base, the report focuses on the main Eastern markets of Queensland (QLD), New South Wales (NSW) and Victoria (VIC). National figures, and those of other key states, are also included where it is practical to do so.

Upstream issues, such as the impact of mCHP take-up on domestic gas supplies or gas prices are not covered in this report.

2.2 Definitions

CHP describes a generating system that utilises an input fuel, usually gas, to create both electricity and heat simultaneously (cogeneration). In larger configurations, heat is also converted to provide cooling using absorption chillers (i.e. tri or poly generation). Figure 1 illustrates the main components of a mCHP generating system in orange and red, and the potential residential applications.

Figure 2 – CHP System and Applications



Source: Osaka Gas Co. Ltd.

For the purpose of this report, where mCHP has been assessed against alternative water heating technologies, the costs and CO_2 savings are based on a comparison of an equivalent amount of hot water and mains electricity.

2.3 Structure

The report is structured into the following main sections:

1. **Overview** – Provides a high level summary of the report and its key findings.
2. **Introduction** – Outlines the scope and structure of the report, and provides technical definitions and assumptions.
3. **Policy and Regulation** – Reports on Australia's policy and regulatory framework at the Federal, state and local level against international best practice.
4. **Markets and Customers** – Reports on the Australian market for mCHP technology, including the estimated size, profile and potential of key market segments.
5. **Products and Services** – Reports on mCHP products and services, including an assessment of their commercial and technical performance against Australian market requirements.
6. **Supply Chain and Strategies** – Reports on the industry value chain by segment including key challenges and opportunities, the number and type of players, and player strategies.
7. **Outlook –** Reports on Energeia's proprietary models and outlook for policy and regulation, energy and product pricing, market demand, products and services and industry value chain.

Sections 3 through 6 provide the results of Energeia's research and analysis of historical and contemporary information. Section 7 is forward looking, and mostly concerned with describing the key inputs and assumptions underpinning the ten year outlook.

8.0 Glossary

This report uses the following abbreviations:

AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BASIX	Building Sustainability Index
CAPEX	Capital Expenditure
CHP	Combined Heat and Power
CO_2	Carbon Dioxide
COAG	Council of Australian Governments
CPRS	Carbon Pollution Reduction Scheme
ECE	External Combustion Engine
EEC	Energy Efficiency Certificates
EEG	Erneuerbare-Energien-Gesetz
ESCOSA	Essential Services Commission of South Australia
ESS	Energy Saving Scheme
FiT	Feed in tariff
GHG	Greenhouse Gas
GW	Gigawatts
ICE	Internal Combustion Engine
kgCO2	Kilograms of Carbon Dioxide
kVA	Kilovolt Ampere
kW	Kilowatt
kWe	Kilowatts electrical
kWth	Kilowatts thermal
kWh	Kilowatt hour
LHV	Lower Heating Value
LPG	Liquid Petroleum Gas
MCE	Ministerial Council on Energy
MEPS	Minimum Energy Performance Standards
METI	Ministry of Economy Trade and Industry
Mt	Megatonne
NEM	National Energy Market
NEPF	National Energy Policy Framework
NPV	Net present value
NSEE	National Strategy for Energy Efficiency
NSW	New South Wales
O&M	Operation and Maintenance
OPEX	Operating Expenditure
PEM	Proton Exchange Membrane
PV	Photovoltaic
QLD	Queensland
R&D	Research and Development
RET	Renewable Energy Target
ROCS	Renewable Obligation Certificate
ROI	Return on Investment
SA	South Australia
SOFC	Solid Oxide Fuel Cell
SRES	Small-scale Renewable Energy Scheme
STC	Small-scale Technology Certificates
VAT	Value Added Tax
VEET	Victorian Energy Efficiency Target
VIC	Victoria

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