Submission Template

COAG Review Discussion Paper 1 – Eligibility of new small-scale technologies and heat pumps

Overview

This submission template should be used to provide comments on:

COAG Review Discussion Paper 1 – Eligibility of new small-scale technologies and heat pumps

The purpose of this discussion paper is to provide an introduction to the key issues relating to the eligibility of new small-scale technologies and heat pumps within the RET, and to encourage input on these issues from individuals, businesses and organisations to inform the review process.

Stakeholders are asked to use the template provided to answer the questions posed in the discussion paper. The Department will also accept any other documents, further information, costing tables etc that are attached to the submission template.

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All submissions will be treated as public documents, unless the author of the submission clearly indicates the contrary by marking all or part of the submission as 'confidential'. Public submissions may be published in full on the Department of Climate Change website, including any personal information of authors and/or other third parties contained in the submission. If any part of the submission should be treated as confidential then please provide two versions of the submission, one with the confidential information removed for publication.

A request made under the *Freedom of Information Act 1982* for access to a submission marked confidential will be determined in accordance with that Act.

Do you want this submission to be treated as confidential? ☐ **Yes** ☒ **No**

Submission Instructions

Submissions should be made by **close of business 30 October 2009**. The Department reserves the right not to consider late submissions.

Where possible, submissions should be lodged electronically, preferably in Microsoft Word or other text based formats, via the email address - **RET@climatechange.gov.au**.

Submissions may alternatively be sent to the postal address below to arrive by the due date.

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Existing eligibility of small-scale technologies under the RET

Question 1: Are there any new small-scale renewable energy technologies not currently eligible under the RET which may be considered for eligibility to participate in the scheme? Details are sought on:

- a description of the technology and how it works (including how it uses renewable energy to generate or displace electricity); and
- the extent to which the technology has been or is ready to be deployed to the market, such as industry size, capacity and market penetration.

The proven efficient technology of Geothermal Heat Pumps (GHPs) is a notable absentee from the RET. We wish to make the case that it is inequitable and unjustifiable to exclude this technology from the RET whilst the technologies of Solar and Air -Source Heat Pumps (ASHPs) engender RET support. GHPs gain greater efficiency by using the ground as a heat source or sink. Since the ground is at a constant day-night, summer-winter temperature, performance is greater than comparable heating & cooling technologies and their use will displace substantial quantities of electricity. Their energy source is constant rather than intermittent, thus the Cost Recovery period (3-10 years for residential applications) is less and the Return on Investment (30-40% for commercial water heating applications) is greater. The technology is mature, can provide both hot-water heating and space heating and cooling, and there is precedent for policy support both locally and internationally.

GHPs were commercialized during the 1970's alongside other renewable technologies. There are currently over 3 million installed internationally [1]. Annually, GHP installations in Europe are 135,000 to 190,000 units and in the United States over 60,000 units. Rapid market growth of this technology is also reported in Asia. In China and South Korea in particular where there are sympathetic Government policies inclusive of GHPs (highlighted at the 2008 Beijing Olympic Games) there has been accelerated market of same. In Canada there is reported strong growth of GHPs. Australian uptake of GHP technology is hampered by lack of policy support – a RET excluding GHPs actually increases their barrier to entry. There is still a growing industry with several GHP suppliers and installers now operating and in a position to deliver and a growing research base and industry support [2].

The American Recovery and Reinvestment Act of 2009, H.R.1 (the Stimulus Bill of 2009) that was signed by the President on February 17, 2009, contains long-term tax incentives to encourage the installation of GHPs in residences. The new law, effective January 1, 2009, offers Americans a one-time tax credit of 30% of the total investment for GHP installations. Canada also increased its federal GHP incentive around this time.

The Victorian Government invested $1 million in a two-year Four Seasons Energy Pilot Program to demonstrate GHP technology (2007-9). The financial support offered by the Department of Innovation, Industry, and Regional Development (DIIRD) bridged the financial gap between installation costs of a traditional air-conditioning system versus a GHP. DIIRD has provided a further $150,000 for a GHP Centre of Excellence to coordinate training standards for the industry. Further Victorian GHP funding for demonstration projects came from the Renewable Energy Support Fund (RESF) administered by Sustainability Victoria [8].

Australian/NZ and ISO standards are being developed in conjunction with the Canadian GeoExchange Coalition. The Air-Conditioning, Heating and Refrigeration Institute (AHRI) has well-established standards for GHPs:

- AHRI Standard 330-98, 1998, Ground-Source Closed-Loop Heat Pumps
- AHNSI/AHRI Standard 870, 2001, Direct Geoexchange Heat Pumps

Furthermore, GHPs are EnergyStar rated and endorsed by the U.S. Environmental Protection Agency (EPA). GHPs should be included in the Australian Standard 2712 on a similar basis to Air-Source Heat Pumps.

Question 2: Where possible, provide examples of the amount of renewable energy produced by a system in a particular application, noting: geographic location; size; and the amount of fossil fuel based energy also used in producing the total energy output (if any).

A GHP installed in each of Australia's eight million households could displace 51,400 GWh/yr (51.5 Mtonne CO_2-e/yr), almost enough to single-handedly meet Australia's 2020 RET! In a 4000-home comprehensive GHP retrofit at the U.S. Army's Fort Polk in Louisiana annual electrical energy savings of approximately 25.6 million kWh (6,400 kWh per house) or 32.4% of the pre-retrofit electrical use were obtained, and summer peak electric demand on the base reduced by 6.7 MW, or over 40% [4].

The largest Australian GHP installation is the Geoscience Australia (formerly AGSO) Building in Symonston, a suburb of Canberra. 350 bores drilled to a depth of 100 m provide temperature control to a building with a total floor area of 40,000 m^2. Inside the building 210 water to air heat pumps can be independently controlled to deliver heating or cooling as required. The ~340MJ per m^2 per annum for the GHP system compares with an estimated ~400 MJ per m^2 per annum for a variable air volume (VAV) system and ~415MJ per m^2 per annum for a VAV system with chilled water storage [3]. Further GHP installations include the Integrated Energy Management Centre, the Antarctic Centre in Hobart, and the Hobart Aquatic Centre.

The relative savings reflect the local climate and two diverse examples illustrate this:
1. A GHP was retrofitted to the B'Rush Ski Lodge, Mt Hotham with winter temperatures down to minus 10 C. The lodge's high energy demand was previously met by a combination of electric and gas (LPG) fired boilers. A GHP cut energy consumption by 75 % and fossil fuel usage by over 80%. With a savings of over $50/day and a payback period of 6 years.

2. CSIRO is testing a GHP for cooling of processing electronics in a new radio telescope array to be built in remote Western Australian desert environment. Preliminary tests are conducted in Marsfield, NSW with very promising results. The demonstrated reliable operation of the GHP makes it ideally suitable for a remote environment. In addition, substantial savings are expected both in running and maintenance cost in comparison with conventional cooling systems [5].

There are many studies internationally which demonstrate the viability of GHPs from both an economic and emissions intensity perspective [6, 7].

Eligibility of heat pumps

Question 3: Should heat pumps continue to be eligible under the RET? How cost-effective are heat pumps compared to solar hot water systems and conventional systems such as gas and electric systems? In particular, details are sought on:

- the capital cost, including installation;
- annual running costs, including maintenance;
- the effective life of the system; and
- annual savings compared to using fossil fuel based energy such as gas or electricity.

Heat pumps should be eligible under the RET with the condition that GHPs are included on a basis which reflects their efficiencies. Heat pumps can provide greater efficiency than gas and electric systems and compete with solar hot water systems. ASHPs have reduced efficiency when the ambient temperature reaches the extremes (cooling in hot summer or heating in cold winter) – this challenge is not faced by GHPs. The concerns regarding a perverse outcome for ASHPs in extreme climates are valid and need to be factored into the incentives – these concerns do not apply to GHPs whose relative performance excels in extreme climates.

The capital cost of installation of a GHP exceeds an equivalent ASHP by the cost of drilling. This increased capital cost is offset by a reduced running cost. The primary GHP market failure is the expectation that building owners finance the GHP infrastructure (ground loops). GHP infrastructure will outlive the building and many generations of heat pumps, and is akin to utility infrastructure (poles and wires, underground natural gas piping). This begs the question ─ why do we expect building owners to finance GHP infrastructure, but not other utility infrastructure? The outside portion of the GHP system can be half or more of the overall GHP system cost, and if this cost is excluded, GHP systems have about the same price as competitive alternatives and could cost less in volume production.

GHP annual running costs are 30 – 70% below gas or electric systems – the particular savings is a function of climate and relative utility prices. GHPs have low maintenance because of the constant operating conditions which are shielded from ambient fluctuations, and are fully enclosed units that are typically located inside of the building, thus also shielded from inclement weather and thermal stresses.

Besides their intrinsic efficiency, GHPs operate reliably and quietly, provide better humidity control, and provide better zone-level temperature control than conventional equipment. GHPs are adaptable to almost any type of building, and there are worthwhile benefits for schools, office buildings, town halls, barracks, and factories.

To achieve the goals of reducing emissions and fossil fuel based electricity consumption, all cost-effective means must be utilized. These include improvements in both the supply-side and the demand side. Both ASHPs and GHPs reduce total electrical demand and emissions, but GHPs have greater efficiency and beneficial effect because of their stable, favourable heat source/sink. Thus, GHPs also drastically reduce weather-sensitive peak electrical demand.

The U.S. EPA and Department of Energy (DOE) have determined that GHPs have the lowest environmental impact of all heating systems and they reduce energy consumption and corresponding emissions up to 72% when compared to electric heat strips and standard air conditioning. The EPA verified up to 75% reduction in electrical consumption as compared with electric resistance water heating by a GHP commercial water heating system and that the concomitant reduction in emissions up to 937 kg-CO_2 per kW_{th} of capacity per year [9].

Question 4: What is the effectiveness of heat pumps in reducing greenhouse gas emissions in different circumstances?

Should solar water heaters remain in the RET because of their greenhouse benefits and their effect of lowering the overall cost of the RET then the scheme should also allow for electricity substitution from Direct Heat uses of geothermal energy, such as GHPs. The energy is renewable and is in fact solar stored in the first few metres of the earth's crust. While these technologies and processes do not directly produce electricity they displace the need for fossil fuel generation and thus should be included, especially in the absence of other mandatory measures such as requiring solar water heaters or geothermal heating and cooling systems to be mandatorily incorporated into the National Building Code. The argument for inclusion is further supported by the fact that such mandatory measures by their nature could apply only to new constructions. All retrofits still need to be encouraged and supported by inclusion in the RET.

GHPs are saving energy and emissions in diverse climates from Mt Hotham (heating) to Cairns (cooling) and circumstances from residential space and water heating and cooling to commercial water and pool heating. The EPA verified that GHPs reduce emissions by up to 937 kg-CO_2 per kW_{th} of capacity per year [9].

A GHP's performance is a function of the ground temperature which reflects the annual average ambient temperature for a given zone. The zones used for solar and ASHPs are thus still relevant for GHPs but the ground temperature is constant and thus there is a greater reduction in emissions. Australian/NZ standards are being developed for GHPs – in the interim, AHRI standards 330 and 870 can be used to determine eligibility for the inclusion of GHPs.

Cost-effectiveness, reliability and market deployment

Question 5: Information is sought on the cost-effectiveness of any new technology identified, in particular:

- the capital cost of the technology, including installation;
- annual running costs, including maintenance;
- the effective life of the system;
- annual savings compared to using fossil fuel based energy such as gas or electricity; and
- for electricity generation, the capacity factor of the system.

GHPs are the technology identified in this submission. Their cost effectiveness, reliability, and availability are discussed in the response to Question 3. Further quantification is given below.

The capital costs of a GHP consist of (i) ground loops; (ii) heat pump; and (iii) water tank, internal ductwork, hydronic pipes or radiant panels. The additional cost of a GHP comes from (i) and is between \$700 and \$1,500 per kW_{th} installed. Cost (ii) is incurred for an equivalent ASHP and with volume will be reduced to be comparable. Cost (iii) is no different from existing costs.

The running costs of a GHP are 30 – 70% below those of alternative methods and correspond to a savings of between \$50 and \$200 per kW_{th}. Maintenance costs of a GHP are minimal because of the constant operating conditions which are shielded from ambient fluctuations. With no fan motor on the GHP maintenance is analogous to that of a refrigerator.

The effective life of a GHP is many decades. GHP infrastructure will outlive the building and many generations of heat pumps, and is akin to utility infrastructure.

The EPA verified that GHPs reduce emissions by up to 937 kg-CO_2 per kW_{th} of capacity per year [9].

GHPs can play an important role within a new national energy strategy, but this is unlikely to happen without federal emphasis and leadership. The RET offers an ideal opportunity for their support.

Impact on existing eligible technologies and REC market

Question 6: Would including new small-scale technologies or amending the eligibility of heat pumps have a major impact on the deployment of existing eligible technologies?

New and more efficient technologies will continue to emerge, complement and/or replace old ones. The RET assists with upfront costs of installing eligible technologies and the amount of support is determined by the merit of the technology (number of MWh generated or displaced over its deemed lifetime). This is a virtue of the RET only if it is not exclusive to particular technologies. With a fixed set of annual targets there will be an impact on existing eligible technologies though their prior entrenchment will reduce this impact. Impact on the deployment of existing eligible technologies is not a reason to exclude other, more efficient technologies from the RET. The impact on the deployment of existing eligible technologies is not a reason to exclude GHPs from the RET.

Any other additional comments

Effective use of energy resources contributes to a nation's security, environmental sustainability, and economic well-being. Heating and cooling of buildings and water present one of the best opportunities to economically reduce energy consumption and limit greenhouse gas emissions. GHPs produce substantial reductions of energy and peak demand in buildings. However, GHPs have received little policy attention as an important component of a national strategy. This is a policy oversight which requires amendment and this submission addresses the conundrum.

Future policies should ensure that GHP systems are not excluded from renewable portfolio standards and goals and related environmental initiatives. To make rapid headway on the energy/carbon front in the buildings sector, existing buildings must be improved with single comprehensive deep-savings retrofits, because repeated incremental touches to the same buildings would result in large and wasteful transaction costs. GHPs are proven to be an excellent technology for anchoring comprehensive deep-savings retrofits.

The state-based energy-efficiency targets and schemes including the Victorian Energy Efficiency Target (VEET) and NSW Greenhouse Gas Abatement Scheme (GGAS) also encourage reductions in greenhouse gas emissions. Heat Pumps are rewarded on the basis of their Coefficients of Performance (COPs) having a threshold value of 3.5 and several brackets. COPs are readily measured for GHPs and ASHPs and thus easily included in these schemes as well as the RET.

Given the need to rein in our nation's energy consumption and carbon emissions, it is recommended that federal policymakers seriously consider aggressive nationwide deployment of GHPs, with programs commencing as soon as possible. Inclusion of GHP technology in the RET would be an obvious first step.

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