The solar panel conundrum

Everyone seems to be installing solar panels – should you follow suit?

18 February 2010

Recent twists and turns in the climate change debate have intensified the feeling of uncertainty being experienced by Australian executives. In 2009, there were among other things the leaked emails from the Climatic Research Unit at University of East Anglia, the drama of the Liberal party leadership crisis and the unmet expectations of the United Nations Conference of the Parties held in Copenhagen. Most recently, we have seen the Federal Opposition come forward with an alternative regulated approach to carbon reduction. Many executives are now justifiably unsure what action should be taken to prepare for a low carbon economy.

Despite all of these events however, the eventual imposition of a price on carbon remains a high probability. Because of the flow on effects, its implementation will create turbulence in almost every sector, providing an opportunity for businesses to gain a competitive advantage over their rivals.

In light of the above, it's surprising to see that business is continuing to move forward with climate change-related initiatives. Indeed, a recent survey by the Australian Industry Group[1] found that "only 2% of larger businesses have not taken steps or do not plan over the next three years to take steps to reduce their direct emissions, energy overheads or energy use per unit of output". People know that action is required.

What's to be done?

Of course, if we accept that something must be done, then the logical question is: exactly what should be done? While the major options for emissions reduction projects are relatively straightforward – renewable energy, biosequestration, energy efficiency, offsets – delve a level or two below the surface and one can quickly become overwhelmed by the breadth of choice. The challenge then is how to choose between these alternatives.

One obvious alternative is solar photovoltaic panels. There's little doubt that the installation of solar panels is already extremely popular. To see just how popular, consider Figure 1, which shows the growth in Renewable Energy Certificates (RECs) created by solar panels over the period 2001 to 2009. Each REC represents 1 MWh of electrical generation – enough to power a typical house for a little over two months.

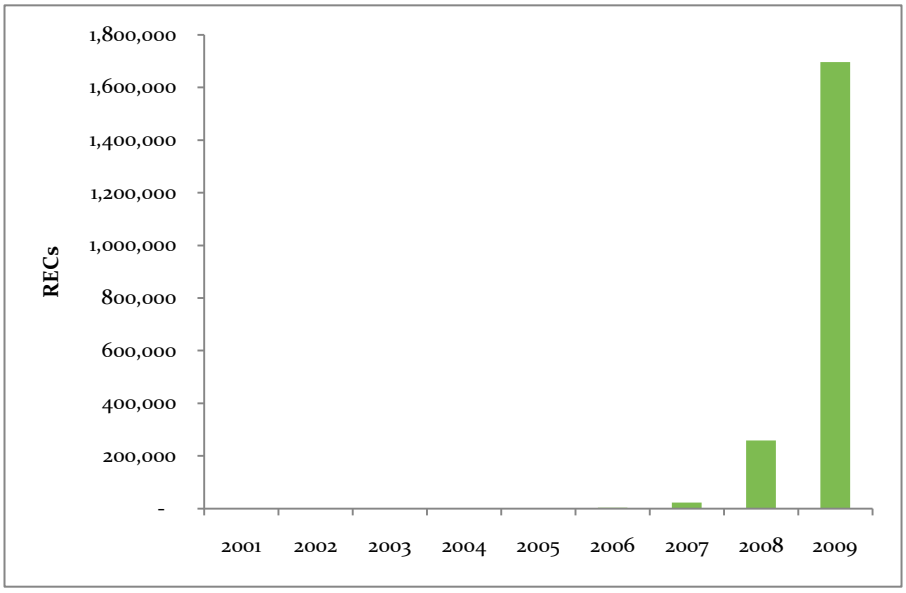

Figure 1: Annual surrender of RECs from large solar and deemed SGUs (source: ORER)

While this analysis is somewhat imprecise – for example, the introduction of a "solar multiplier" halfway through calendar year 2009 distorts the shape of the curve somewhat – there can be little doubt that solar panel sales are growing very strongly indeed.

In no small part, this popularity is due to generous rebates and incentive schemes from government. In fact, one key aspect of the current Federal Opposition's alternative to the Carbon Pollution Reduction Scheme is the allocation of a $1,000 rebate towards rooftop solar panels – a key action point of a goal to achieve "one million additional solar energy roofs by 2020"[2].

If popularity can be used as a proxy for good decision-making, it would be easy to imagine that one would be mad *not* to have a few panels on the roof. In any case, how could

[1] AiG, "Gearing Up: Business Readiness for Climate Change", 2009

[2] http://www.liberal.org.au/DirectActionPlan

anyone resist the lure of "free electricity"?

Should you "go solar"?

It's not just Mums and Dads that are installing panels. While to date the majority of solar panel sales have occurred in the residential sector – few industrial companies have been able to access government rebates – there are also many examples of major installations in the commercial and industrial sector. To name just two, Coca Cola Amatil recently opened a new distribution centre in Eastern Creek, Sydney, complete with a $1.2 million, 110 kW photovoltaic array. Pan to America and we see the giant glass company, Owens-Corning, announcing plans to install a $2m 206 kW photovoltaic array on the roof of a foam insulation manufacturing facility in Oregon. Several other examples exist.

Why are we doing this?

At issue is the motivation for these projects. Do they achieve the objective of reducing CO2 emissions, and what is the cost of that abatement?

To be sure, installing solar panels will reduce the amount of electricity that would otherwise have been imported from the electricity grid. As a consequence, this will reduce the amount of coal or gas that would otherwise have been combusted to produce that electricity. The magnitude of the carbon abatement depends primarily on the amount of electricity produced by the panel and the carbon intensity[3] of the grid. Both of these factors will vary depending on the location of the panel.

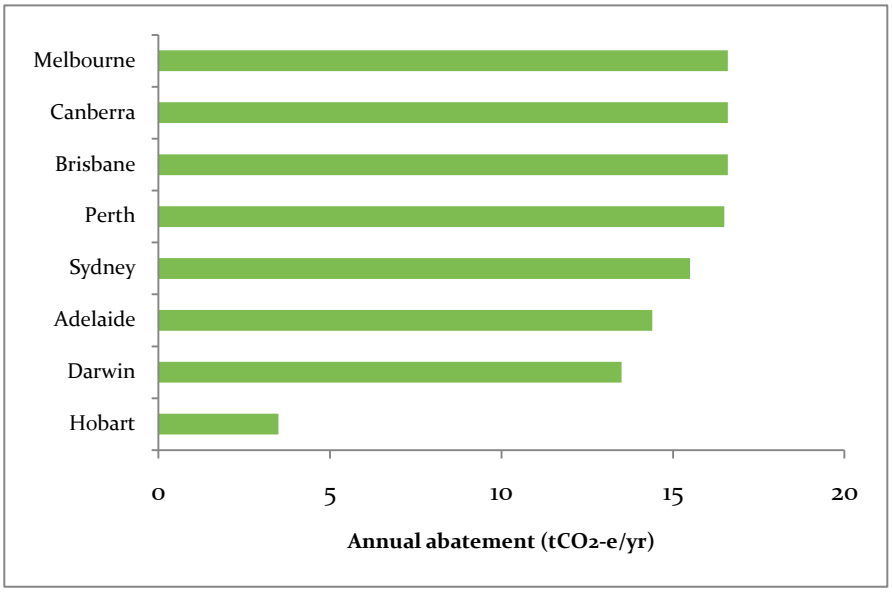

Figure 2: Abatement potential of a 10 kWp solar panel in Australian capital cities

To illustrate this point, consider Figure 2, which shows the theoretical emissions abatement that could be achieved through the installation of a 10 kWp solar panel in each of Australia's capital cities. Depending on the location, our simple analysis suggests that this investment would achieve abatement of between 3.5 tonnes of CO_2 equivalent per year (tCO_2-e/yr) and 16.6 tCO_2-e/yr. A ball-park cost for an installation of this sort would be in the region of $80,000.

This information leads us to an interesting discovery. If we divide the cost – or more correctly, the Net Present Value – of the project by the lifetime carbon abatement of the project, it is possible to calculate a metric known as *abatement cost*.

For instance, in the example above, the abatement cost of the solar panel installation in Melbourne would be approximately $127 per tCO_2-e. In other words, an investment of $127 would reduce the amount of greenhouse gas emitted from the power station supplying electricity to the factory by one tonne of carbon dioxide equivalent. Figure 3 shows comparative abatement costs for other cities.

Abatement cost as a tool

It turns out that abatement cost is in fact a very useful metric, because it provides a common basis upon which we can compare all sorts of different projects. After all, a tonne of carbon avoided is a tonne of carbon avoided, regardless of how or where it occurs. Using abatement cost, we can compare a project that reduces the gas burned by a boiler or water heater with a project that generates renewable energy. By definition, a project with a low abatement cost will cut emissions more efficiently than a project with a high abatement cost.

In simple terms, one can also make the case that a project will only be viable once the carbon price exceeds the project's abatement cost.

Pinch Analysis

Of course, as we have already stated, there are literally hundreds of ways to reduce emissions. Recently, we used a technique known as Pinch Analysis to identify waste heat recovery opportunities at a manufac-

[3] Carbon intensity refers to the quantity of greenhouse gas emitted from the generation of a unit of electrical energy. For example, an electricity grid with a large amount of brown-coal generation assets – as found in Victoria – will emit more greenhouse gas than a grid with a high proportion of hydro-electric power stations – as found in Tasmania.

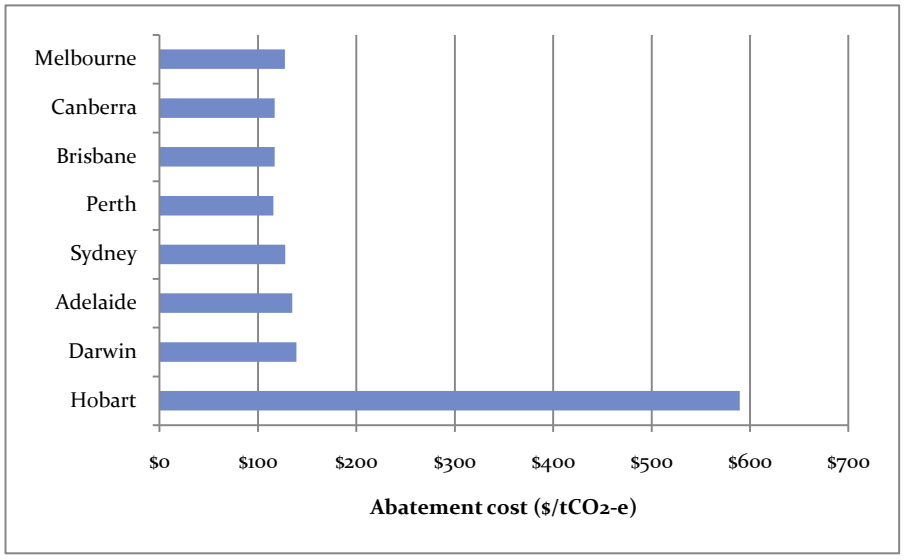

Figure 3: Abatement cost of a 10 kWp solar panel in Australian capital cities

turing plant in the food and beverage sector.

The resulting analysis showed that implementing just two of the larger waste heat recovery projects could potentially reduce total annual energy costs by more 6% per year and total greenhouse gas emissions by over 10% per year. The capital cost of the two projects was estimated to be in the region of $200,000; the estimated abatement potential was approximately 2,000 tCO_2-e/yr. Perhaps most importantly, the abatement cost was *negative* $18 per tCO_2-e. In other words, instead of spending cash to reduce emissions, the waste heat recovery project actually generated free cash flow exceeding $400,000 over its useful life – as well as emissions reductions. Of course, if properly managed, this cash can then be reinvested into other emissions reduction projects.

The comparison between the two projects is stark. Per dollar of investment, the waste heat recovery project returned greenhouse gas abatement between five and 20 times that of solar photovoltaic panels. As Figure 4 shows, the abatement cost for the solar panel project was $127 per tCO_2-e, while that of the waste heat recovery project was *negative* $18 per tCO_2-e.

A note on solar

In fairness to the solar photovoltaic industry, it should be noted that large steps are being made toward reducing panel cost to so-called "grid parity" – the point at which solar panels can generate electricity at grid prices. For example, Nanosolar has said that the next generation of thin film copper indium gallium diselenide (CIGS) solar panels will retail at less than $1 per peak Watt, compared to a current typical price of around $3-$4 per peak Watt.

Despite this, for a typical industrial or commercial facility operating under today's retail electricity tariffs, even a solar panel capital cost of $0.85 per peak Watt leads to an abatement cost of around $15-$20 per tCO_2-e – still far more expensive than the waste heat recovery project discussed earlier. In light of all of this, the support of government world-wide towards the solar PV industry over the last decade or more is confounding to say the least.

Consider your options carefully

The point is that, for a given facility – whether it is in the mining, manufacturing or commercial sectors – there is almost always an array of abatement options available to reduce greenhouse gas emissions. However, as with most things, there is an opportunity cost associated with the wrong decision.

To illustrate this point, assume the availability of an $80,000 capital budget. For this amount of investment, a waste heat recovery project similar to the one discussed earlier could return a Net Present Value (NPV) of around $200,000, whereas an $80,000 solar panel array might return an NPV of about negative $63,000.

If the option to install waste heat recovery is available but not exercised, the decision to install the solar panel array therefore carries with it an opportunity cost of around $263,000 – more than three times the entire capital budget.

None of this is to suggest that the option of installing solar panels should not be considered at all, ever. But for most commercial or industrial settings, solar panels are

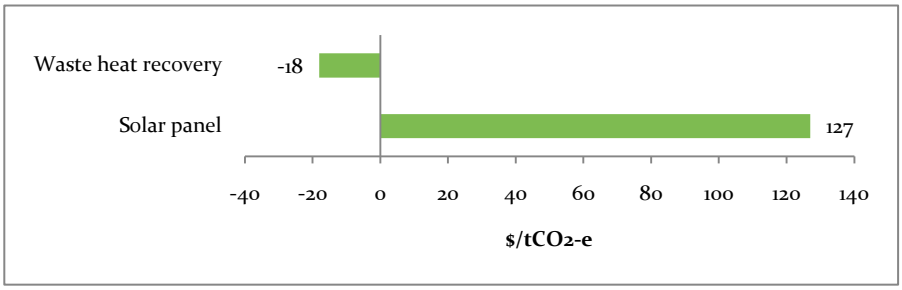

Figure 4: Abatement cost: solar photovoltaic (Melbourne) vs. waste heat recovery

unlikely to be the logical first step.

The two industry case studies briefly presented earlier are illustrative of this point. Prior to installing its solar panels, the Owens-Corning plant had already incorporated a range of energy efficiency improvements. Similarly, the CCA plant was a brand new warehouse with limited additional energy efficiency options; the availability of funding from the Australian Government's Solar Cities program, along with a corporate social responsibility-inspired desire to go beyond the "no regrets" projects was probably enough to make the business case attractive enough for management approval.

Neither is it to say that renewable energy as a class of abatement technology is fundamentally bad or expensive. Certain renewable energy technologies are available today that can generate free cash flow - particularly those that generate heat rather than electricity.

Money isn't everything. Intangible factors have a role to play in decision making. For better or worse, visual impact is often an important criterion – and solar panels have plenty of visual impact. Conversely, energy efficiency improvements provide abatement that is largely "invisible".

For most companies, there is an expectation that any activity to reduce carbon emissions must come at a cost, but this need not be the case. As shown above, there are ways to reduce emissions while simultaneously saving money – you *can* have it both ways.

At manufacturing facilities, which often have large heating and cooling loads, pinch analysis is a valuable tool that can be used to optimise waste heat recovery. Indeed, sites with large heating and cooling loads have reported average savings of to 30% of annual energy costs per year through the methodical application of pinch analysis[i].

But it doesn't end there. There is scope in almost any facility – whether it is in the manufacturing, mining or commercial space – to identify and implement a range of energy efficiency projects.

Conclusion

When allocating capital to "green" projects, consider your motivation for the investment carefully. If other options are available, investing in current solar panel technology will provide a very poor return on investment – both financially and in terms of emissions abatement. Far better options are available to maximise the benefit received.

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Northmore Gordon combines advanced engineering techniques with traditional financial analysis tools to help companies identify and implement projects to reduce greenhouse gas emissions.

For further information, please visit our website at:

http://www.northmoregordon.com

[i] Kemp, Ian C, *Pinch Analysis and Process Design*, Butterworth-Heinemann, 2nd Ed, 2007.