A LOCAL GOVERNMENT JOURNEY TO A CHEAPER, GREENER AIR-CONDITIONING FUTURE

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1. INTRODUCTION

Scientific evidence, collated by the Intergovernmental Panel on Climate Change confirms the findings of Svante Arrhenius as far back as 1896 [1], that human activity is serving to increase the atmospheric concentration of greenhouse gases. This rise is causing the world's climate to gradually warm (fig. 1), triggering a range of secondary climatic effects from rising sea levels and melting glaciers to changes in precipitation, storm intensity, landslides and bushfire risk. These changes will in turn lead to consequences for human health, the economy, infrastructure and the distribution of native species, pests and diseases. Reducing our emissions over the next 10-15 years is essential if we are to avoid the worst excesses of global warming.

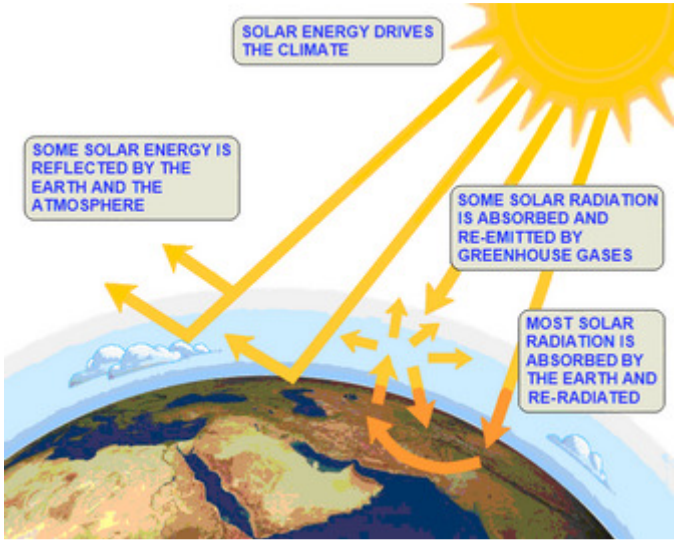

Figure 1. Energy flows and the role of greenhouse gases

While the goal is clear, the means to get there remains a source of considerable debate. Governments at all levels have a role to play in facilitating emissions reduction through research, education, demonstration, incentives and controls. Through their intimate relationship with local residents and businesses, local governments are particularly well suited to demonstration and education. However, advancing this endeavour requires municipalities to negotiate a minefield of:

- immature technologies,
- competing technologies,
- a shortage of reliable information,
- misinformation from entrenched interests,
- unreliable providers,
- a lack of industry standards,
- political partisanship,
- shifting policies and support mechanisms from State and Federal governments,
- changing trends in public perceptions and priorities, and
- the legal and cultural constraints local governments must operate under.

Improving air conditioning performance in buildings can contribute significantly to a reduction in emissions and costs for governments and industry alike, particularly as energy and refrigerant prices rise driven by network demand, the decline and eventual termination of HFC imports and the impact of the Clean Energy Act 2011. Leading the way with new air conditioning technologies and applications is therefore a valid goal for local government. However, it is often a mystery to private providers why, relative to their private clients, governments including local governments present so many barriers and take so long to implement projects, particularly where new technologies such as air conditioning are concerned.

This paper will endeavour to provide an analysis of the differences in decision-making processes and management style between public and private organisations as a foundation for exploring the Logan journey, over several years, from a solar tri-generation technology proposal, through efforts to facilitate technology development, to a tender for solar air-conditioning and finally the signing of a contract for a new ammonia-based electric chiller system.

2. PUBLIC VS PRIVATE DECISION MAKING

Organisational decision making involves gathering intelligence, setting directions, uncovering alternatives, selecting a course of action, and implementing it [4]. Private, for-profit organizations have smoother, less bumpy decision-making processes. Public organizations experience more turbulence, interrupts, recycles and conflict. These differences stem from the role that public and private sector organizations play in a society (Nutt, 2000). While the line between public and private organisations is becoming increasingly blurred as public authorities import private practices, public and private organisations still differ in a number of fundamental ways [2,3,5,6,8,9,10,11]:

- Public sector organizations are controlled predominantly by political forces with diverse agendas, rather than market forces as in the private world.
- Private firms are owned by entrepreneurs or shareholders who choose to buy or sell shares, while public agencies are owned collectively by members of whole communities who must pay taxes or rates regardless of their wishes.
- Private organizations sell products or services to make profits, while public organizations generally contract for works and services to meet public needs.
- In public organisations, cumbersome mechanisms are needed for consulting with broad stakeholders and oversight bodies, while private organisations have simpler, more direct mechanisms and far fewer stakeholders.
- Mechanisms of transparency make public organizations subject to review and interpretation by outsiders, slowing down decisions. To offset this, public organisations sometimes keep goals in public documents somewhat vague.
- Private organisations reserve the right to non-disclosure and can be clearer with goals and milestones.
- Public organisations are interrupted by scheduled elections such that decision-making processes are slowed down or sped up depending on the timing, but this is not an issue in the private world.
- Private organisations usually compete against rivals, while public organisations usually operate as a monopoly or emphasise collaborative projects with other, related public organisations.
- Private organizations disburse profits to their shareholders via dividends, but community members do not receive dividends from public organisations.
- Public organisations lack an easy metric such as profit and share prices for measuring performance, while private firms have such metrics available.
- Senior private managers often receive remuneration as shares or income linked to profits and share prices while public managers receive their remuneration more tenuously linked to performance.
- Private employees are more committed to their organisation because the corporate goals and their contribution to success are more easily identified.
- Public managers and employees are strongly motivated by ‘serving the public’ and less motivated by monetary remuneration than private employees. Performance related pay is therefore less effective in public organisations.

- Hiring and firing is more complex and rule-bound in the public arena.
- Shareholders may gain a personal benefit from monitoring corporate performance while citizens monitoring governments do not, diluting their incentive to act.
- Private organisations may access capital from or invest in any corporation, however public organisations are often limited in the places they may borrow from or invest in.
- Interestingly, public authorities may avoid the compliances which they apply to the private sector. In practice though, this rarely happens.
- Public sector organisations, such as local government are controlled in how they operate by laws such as the Local Government Act 2009, while corporations are managed under corporate law.

Integral to organisational decision-making is the process for revealing and selecting from alternatives, categorised by Nutt (2000) into four approaches:

- *The existing solution approach:*
  Pre-existing, ready-made ideas are found inside the organization
- *The benchmarking approach:*
  a good idea is sourced from elsewhere then adapted and applied
- *The integrated benchmarking approach:*
  the best ideas from several sources are amalgamated and applied
- *The cyclical search approach:*
  available ideas are revealed through an initial search followed up with subsequent searches through a 'Request For Proposals'. A final solution is then selected and applied.

Nutt (2000) reviewed a range of studies on public and private processes for seeking solutions and concluded that public organizations used all approaches while private organizations tended to favour the existing solution approach despite private firms devoting more resources to collecting data on emerging trends and being less encumbered by oversight and political interference. Satisfying multiple stakeholders guided public decision makers while internal agendas guided their private equivalent. Cyclical searches produced the best results in the public arena while single search and simple benchmarking approaches were found to be somewhat unsuccessful. However, because public organizations often lack resources, they may be prompted to take short cuts that limit innovation (Nutt 2000).

Decisions made in private organizations stress speed over enduring use, while public organisations stressed long-term use over speed. This may stem from the power of interest groups in a public organization. There is a willingness to be inefficient, to capture a 'long-term fix' that satisfies multiple constituencies. Even then, a decision can still stir opposition from a constituency long after consultation ended, rendering some public decisions still born (Nutt 2000).

3. CLIMATE CHANGE TECHNOLOGIES AND MANAGEMENT

In 1997, under the United Nations Framework Convention on Climate Change, 'the Kyoto Protocol' was adopted, aimed at stabilising greenhouse gas concentrations at levels that would prevent critical climate change. The protocol came in to effect in 2005. Australia was a signatory to the Protocol, but did not ratify it until December 2007. Meanwhile, the release of the Third IPCC Assessment Report: Climate Change 2001 (TAR) [12] articulated the significant influence of man's emissions on the world's climate and called for international action. These findings were reinforced in the Fourth IPCC Assessment Report: Climate Change 2007 (AR4) [7], with change predicted to occur at the upper level of previous estimates.

The result of these documents was to generate a range of proactive policies and funding sources to reduce emissions, particularly in the wealthier nations. In Australia, these initiatives include or have included such things as the Mandatory Renewable Energy Target (MRET, later RET), the Solar Homes and Communities Plan, the Solar Credits Program (RECs, STCs and LGCs), the Home Insulation Program, the Clean Technology Investment Program, The Community Energy Efficiency Program (for Councils) and a raft of State and local initiatives, such as feed-in tariffs and energy reduction schemes. In addition Green Loans, Low Carbon Australia Loans and Ausindustry and other assistance grants have been available.

The response of industry to these programs has been a spawning of new firms, new technologies and new business models. Unfortunately, as we saw with the ill-fated Federal Insulation Program, new funding opportunities attract a certain proportion of opportunistic investors. They include dishonest or under-skilled providers as well as purveyors of less than mature technologies, protected by a lack of awareness in the market, commercial in confidence secrecy or an absence of industry standards. These providers are also among those who cold call for sales and quote for contracts to government and industry alike.

Government policy and project officers, particularly those in local government are often required to manage a very broad range of issues, none more so than officers tasked with managing climate change. These officers are required to understand everything from climate science, legal and policy developments, funding opportunities, energy conservation and renewable energy technologies, to carbon sink plantings, vehicle and fuel technologies, waste processing and all aspects of climate change adaptation from sea level rise, insurance, biodiversity protection, water conservation, pest and disease conditions and finally Planning Scheme code development and staff and community engagement techniques. The resourcing and integration of climate change management varies greatly between Councils depending on size and political persuasion. Often only 1-3 officers are involved.

Climate change is also one of the most hotly debated areas of science and policy. Therefore, in addition to the technical aspects of climate change management, officers must deal with an ever shifting political landscape, both within their Councils and at higher levels of government. Changes

in the Federal or State position soon become reflected at a local level through vertical political alliances and upward appeasement.

Clearly, becoming an expert in all climate change technologies and developments is beyond the scope of any tasked Council officer. This creates a degree of apprehension when considering the procurement of new technologies and systems, such as low-emissions air conditioning. The existence in the market of providers with dubious products and bona fides only adds to the apprehension. When this situation is laid over the politically charged, multi-stakeholder decision making framework that public organisations operate under (see section two) the inertia to bring about change is significant and efforts to do so must be done with considerable care.

4. THE LOGAN CITY COUNCIL JOURNEY TO LOW-EMISSIONS AIR CONDITIONING

This journey demonstrates a number of the difficulties of being a public climate change mitigation practitioner in today's rapidly changing world, as outlined in the introduction and section three. Never the less, an excellent project has emerged by employing a semi-formal version of the 'cyclical search approach' of Nutt (2000).

At a university Roundtable held in 2008 by a public engagement consultancy, issues related to climate change were debated by representatives of each community sector in South East Queensland. The overwhelming conclusion of the industry sector was that they wanted government to play a leading role in demonstrating new technologies. Logan City Council staff took this message as a launch trigger for exploring and procuring new equipment to reduce Council and community emissions, with a view to industry demonstration.

At this point Council received an approach from a Logan-based businessman and an associate from a major government research organisation. He claimed he could supply the Logan Entertainment Centre (LEC) with a solar thermal driven Organic Rankine Cycle (ORC) trigeneration system which would provide cooling, hot water and base load electricity with a >90% efficiency and a payback period of seven years. The heat source would be evacuated glass tubes with the surplus energy stored in hot water tanks. Even to the uninitiated, an efficiency of >90% sounded exceptional. Never the less, the opportunity to support a developing local business and the promise of renewable base load power impressed senior staff and a significant allocation of funds was requested for the project in the budget process and later approved by Council. However, under the Local Government Act 2009, an EOI or tender process must be entered into for all projects over $150,000. We could not simply give the work to the local provider unless he was a registered ‘preferred supplier’ somewhere in the Queensland public sector. Furthermore, it soon became apparent that he had no existing plant anywhere, including a prototype. But, as he was a Logan business, his claims were impressive and he had institutional associates with excellent references, it was decided to assist with proving the technology through the development of a prototype before seeking an EOI.

Had ORC developments been more widely understood in Queensland, including at Council, staff may not have elected to take this path. Never the less, contacts were made with a north Queensland engineering consultancy and a local hot water company to assist with prototype development. Both had expressed a commercial interest in the project. Work was undertaken at a Logan premises using a generator linked to an automotive scroll compressor running in reverse on R245fa with heat supplied from a solar plate collector. It soon became apparent that efficiencies were far less than 90%, indeed only a few percent could be attained. Theoretical efficiencies of 29.6% at 150C using an evacuated tube collector were calculated. However, a similar device found to be under development for 10 years in South Australia achieved efficiencies no greater than 7% in the absence of water heating. Since this time, more ORC engines have been discovered, including several under development in Queensland. Schuster et al. 2009 reviewed a number of European and US models recording efficiencies between 9% and 21% on temperatures between 100C and 350C.

As more information came to light regarding the local businessman, his claims and his investors, alarm bells began to ring and a corporate investigation was conducted. The investigation revealed he was a registered bankrupt being pursued by a number of parties. By this point his research organisation associate had departed as had several other partners and it was decided to terminate the ORC prototype development.

Since solar air conditioning was one of the desired outcomes in the original proposal, it was decided retain the funds and continue pursuing this by other means. Our preferred supplier of energy efficiency upgrades was contacted to provide an opinion. Their opinion was to move the project to the main administration building where there was a greater need for daytime power, in line with the period of greatest insolation. The LEC is largely a night time venue. To do this required consultation with Administration Branch who manage the building. A report seeking approval to redirect the funds to a re-scoped project and site was submitted via the executive to the Environment and Sustainability Committee, followed by approval by full Council a week later. It took approximately eight weeks from contacting the energy efficiency consultant to gaining approval to seek a tender for a solar air conditioning system for the administration building.

As mentioned earlier, dedicated Council staff must simultaneously manage a broad range of projects not only to meet the technical challenges of climate change, but also to satisfy a number of stakeholders with vested and often conflicting interests. Therefore, the advancement of the solar air conditioning project had to take its place in the smorgasbord of other projects, including the development of new planning scheme codes, reviewing State and Federal proposals, preparing Council to meet the challenge of the ETS, developing a revegetation software tool to help protect biodiversity, investigating waste to energy solutions, running a smart-metering trial and a public-private partnership to supply discount solar energy to residents.

At first draft Council envisaged an arrangement with a solar thermal source feeding into an ammonia absorption chiller to reduce power costs and emissions and provide hot water from waste heat. The intention was to replace, as far as the budget would allow, two 18 year old R22 chillers (450kW each) in a roof-top plant room and two 30 year old R22 chillers (117kW) in a basement plant room with one new cooling system.

To assist with scoping and refining the tender brief, Council sought the advice of a refrigeration consultancy in Sydney. At the same time, several potential suppliers were given access to the building to make suggestions. Some suggested a solar thermal input, others a solar PV input and one suggested a configuration without solar components, but including natural refrigerants as the most cost effective. So, while the brief expressed a preference for solar-based solutions, a statement was included to ensure alternatives would be considered if they could demonstrate significantly better environmental outcomes. The Sydney consultancy provided important advice on the type of data needed from Council for companies to tender accurately and this was provided along with details and photos of the existing chiller system, and the roof. Consultation between the Administration and Environment and Sustainability Branches was required to resolve the details for the brief. The budget provided by Council was $600,000. Tenders needed to include component and configuration details as well a cost-benefit analysis, a budget, timelines, an OH&S plan, a risk management plan, a maintenance plan and all insurances.

Five tenders were received of which one, an ice ball cooling system was deemed non-compliant. The remaining four were sent to the Sydney consultants for assessment. A summary of the systems proposed is given below.

1. one ammonia absorption chiller, 192 (51.6m^2) evacuated glass tube heat collectors, 115 solar PV panels, no hot water details – cooling capacity 12kW, simple payback: 67.9 years
2. Ten lithium chloride absorption chillers, 360m^2 of evacuated glass tubes, no hot water details – cooling capacity 100kW, simple payback: 34.3 years.
3. one R134a electric chiller (COP5.0) with a cooling tower, VSD pumps, 75 solar PV panels and an R134a heat pump – cooling capacity 486 kW, simple payback: 9.64 years.
4. one ammonia electric chiller (COP 5.79) with VSDs, desuperheaters, closed circuit fluid cooler and a propane heat pump – cooling capacity 600kW, simple payback: 8.4 years

The budget did not allow for the replacement of more than one roof top chiller at best, so the consultants also provided estimates for the additional costs needed to replace all the old R22 equipment in the building (fig 2) and source all future cooling from the roof top plant room.
The consultants recommended a modified version of proposal four be installed on the basis of rapid payback and the zero global warming potential of the refrigerants. The modification involved replacing the expensive closed circuit fluid cooler with a conventional cooling tower. This reduced the simple payback period to 7.9 years.

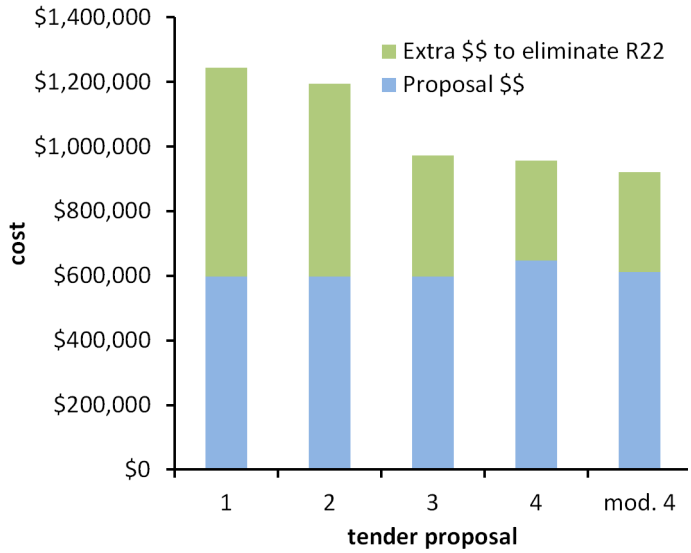

Figure 2. Proposal costs and the extra investment needed to eliminate R22 from the plant rooms in each proposal

A report was submitted to Council recommending the modified proposal four be installed and the recommendation was adopted by full Council at its meeting of the 1st of June 2010. Following some project refinement, additional funds to replace both roof top chillers and decommission the basement chillers were sought for the 2010/11 budget and this was approved by Council.

In January 2011 the chillers were ordered from an overseas supplier and installation was planned for the winter of 2011 when air conditioning demand was at its lowest and the existing chillers could be replaced in sequence. Unfortunately an error occurred during the manufacturing of the chillers which delayed delivery such that installation had to be postponed for one year.

Installation began in mid June 2012 following extensive stakeholder consultation within Council involving environment, administration and human resources staff as well as the Safety Committee. A staff engagement plan was also enacted. In each case stakeholders raised concerns and these were attended to no matter how small, in line with the culture of engagement and compromise in a public organisation where joint ownership and success is emphasised over speed and cost minimisation.

5. CONCLUSION

Public and private organisations differ intrinsically in the way they are owned, their concepts of performance and the way they are managed. Public organisations have broad ownership, are subject to a high degree of transparency, myriad stakeholders, adversarial political forces, vague performance measures and a culture of engagement. Private organisations are dedicated to the pursuit of profit for a limited number of motivated owners, have greater secrecy, fewer stakeholders and follow a more hierarchical culture where performance is more easily measured and rewarded.

Public organisations, particularly local government must address a very broad portfolio of concerns, while private companies have considerably fewer areas of focus. Climate change management in a public organisation is subject to heated political debate, limited resources, a very diverse range of concepts and a rapidly changing industrial landscape with many new players. Each issue presents a barrier to the adoption of new technologies.

On the other hand, public organisations use all approaches to finding solutions for decision making while private organizations tended to favour the 'existing solution' approach, no doubt because decisions can be made faster. 'Cyclical searches' produced the best results in the public arena. Despite a shaky start with a disreputable business, a semi-formal version of the cyclical approach was successfully used to source an innovative new chiller system for Logan City Council's administration building. While the need to progress a diverse range of other projects and satisfy numerous stakeholders slowed the process of contractual engagement and installation somewhat, Council is destined to become a leader in the pursuit of resilient, new generation air conditioning and looks forward to the opportunity to demonstrate the result to local industry.

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